Attachment 1

City of Edmonton
Valley Line-Stage 1
Light Rail Transit (LRT) Project
Environmental Impact Screening Assessment

Final Report

Prepared for:

LRT D and C
Transportation Services
City of Edmonton
Edmonton, Alberta

Prepared by:

Spencer Environmental
Management Services Ltd.
Edmonton, Alberta

Under Contract to:

AECOM
Connected Transit Partnership
Edmonton Alberta

Project Number EP - 522

July 2013

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26 July 2013
Our File: EP-522

Dear Ms. Buffalo,

Re: LRT Valley Line-Stage 1, Bylaw 7188 –EISA (Final Report)
Your file: Posse 131150741-003

On behalf of LRT D and C and as part of Connected Transit Partnership, we are pleased to submit the final Environmental Impact Screening Assessment (EISA) for the above-noted project. This final report reflects comments received from various City reviewers. We enclose five (5) hard copies and once electronic (pdf) copy.

Please contact the undersigned with any questions. Thank you for your assistance to date.

Spencer Environmental
Management Services Ltd.

ALBERTA SOCIETY of Professional Biologists
Lynn A. Maslen
545
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cc: Jeff Ward, City of Edmonton
Josh Jones, AECOM

EXECUTIVE SUMMARY

In keeping with the City of Edmonton Transportation Master Plan, Transportation Services, LRT Design and Construction is planning the City's next LRT extension, the Valley Line - Stage 1, connecting the city centre to communities in southeast Edmonton. The new line will comprise an urban style, low-floor LRT, and will cross the North Saskatchewan River Valley in the vicinity of Louise McKinney and Gallagher Parks. The project is nearing completion of preliminary design. In October 2012, City Council elected to pursue a P3 approach for project delivery and is now actively working toward procuring a P3 Contractor to design, build, finance, operate and maintain the new line. The P3 project will be governed by a detailed contract that is under development by the City. As of early April 2013, project design had been advanced to approximately 30%; this 30% design represents the Reference Design, upon which this impact assessment was based.

Within the river valley, the new LRT corridor will be approximately 1.6 km long and will follow an alignment that enters the valley via a tunnel and portal structure in the north valley wall, crosses the river on a bridge following the alignment of the Cloverdale pedestrian bridge, crosses 98th Avenue on an elevated guideway, and exits the valley on an at-grade track that parallels existing roads. The selected river valley corridor is in a centrally-located, highly-visible and highly-valued portion of the river valley that supports important viewscapes, events and facilities. The project therefore intersects with City parks, Natural Areas, and recreational facilities/infrastructure, creating potential for impacts to both physical and socio-cultural environments in the river valley.

The project falls within the boundaries of the City of Edmonton's *North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188)*, which governs all development within the river valley. The project is, therefore, subject to an environmental review. Several additional City bylaws and policies, including the *Parkland Bylaw*, *Natural Area Systems Policy* and *Corporate Tree Management Policy*, also apply. The project is likely to require various federal and provincial permits or approvals, including approval pursuant to the *Navigable Waters Protection Act*, a *Fisheries Act* Authorization, License of Occupation under Alberta's *Public Lands Act* and clearance under Alberta's *Historical Resources Act.* This report identifies legislation and policies that are currently applicable/relevant to the project; however, due to the relatively preliminary stage of design, specific permitting requirements will have to be revisited during detailed design.

Using the Reference Design and the probable project area required for construction and being cognizant of the as yet undeveloped construction methods and potential for change during detailed design by the P3 Contractor, this EISA identifies several *potential* environmental impacts that may occur as a result of this project. Major *potential* adverse impacts include slope instability concerns on the north and south valley walls, impacts to soil and water quality, release of contaminants to soils and water, loss of vegetation, impacts to wildlife habitat and movement, impacts to fish habitat and movement, temporary recreational trail closures, temporary effects on recreational user experience, changes to the visual and aesthetic environment in the project area, and construction-related impacts on nearby residential areas. Many of these can be fully mitigated using measures described in this impact assessment, resulting in few residual impacts. Some impacts cannot be fully mitigated owing to the size of the project area and the likely four-year duration of the construction period; however, these residual impacts are generally limited to the construction phase of the project.

Importantly, this EISA also predicts some positive impacts, such as greater transit access to the river valley and its amenities and aesthetic improvements to certain locales. To some Edmontonians, the new bridge amenities will be an added attraction to the river valley.

Several impacts remain unresolved at this time, largely as a result of two factors: the preliminary state of project design and the implications of the P3 process. Appropriate mitigation for unresolved impacts can be developed by the City during P3 procurement and by the successful contractor during the detailed design phase. In order to ensure that this occurs, this EISA recommends that LRT Design and Construction:

- require bidding contractors to develop plans that demonstrate adequate consideration for and mitigation of unresolved impacts;
- require the successful contractor to implement a small number of key mitigation measures that will effectively mitigate multiple identified adverse impacts and to undertake some monitoring
- require the successful contractor to submit any changes to the reference design for review and approval by the City (as would be necessary regardless);
- develop a process for reviewing and approving detailed design that includes consideration of specific environmental impact mitigation measures; and
- undertake several resource specific studies, such as additional rare plant surveys and transplants.

At the time of writing, some design aspects and mitigation measures remain incomplete or under investigation. Completion of design, mitigation measures and associated investigations, and implementation of related recommendations is expected to adequately mitigate some currently-unresolved impacts.

The P3 delivery model adopted for this project presents some new challenges with respect to construction, impact mitigation and environmental management in Edmonton's river valley. The mitigation measures specified in this EISA provide effective means of addressing these challenges during P3 procurement and design and construction.

Table of Contents

List of Figures

List of Tables

List of Plates

1.0 INTRODUCTION

1.1 Background

The City of Edmonton (the City) plans to construct a new urban style, low floor LRT line connecting the city centre to Mill Woods community. This SE LRT line, now known as the Valley Line-Stage 1, will cross the North Saskatchewan River Valley (NSRV) and thus requires an environmental review pursuant to the City of Edmonton's North Saskatchewan River Valley Area Redevelopment Plan (NSRV ARP)(Bylaw 7188). In 2011, discussion with Edmonton Sustainable Development, Urban Planning and Environment indicated that the nature of the project as a large-scale capital development project on public lands requires the review to take the form of an Environmental Impact Assessment. Thus, on behalf of the proponent, LRT Design and Construction (LRT D and C), this Environmental Impact Screening Assessment (EISA) document has been prepared in compliance with Bylaw 7188. While the EISA focuses on the section of the proposed line that will be situated in the NSRV, this chapter provides some necessary context for the entire Valley Line-Stage 1.

1.2 SE LRT Project Rationale

Edmonton has experienced recent rapid growth, with the population increasing by 30% within the past 20 years (City of Edmonton 2013a). This growth is projected to continue, with a 50% increase in population expected by 2040 (City of Edmonton 2010). The City recognizes that accommodating this growth in an ecologically, economically and socially sustainable manner will require a new model of urban design, one which is focused on increased urban density and a shift away from conventional, car-centered transportation systems. These goals are among the primary objectives laid out in the City's Municipal Development Plan, "The Way We Grow" (City of Edmonton 2010).

Planning in this direction has been ongoing for many years. In 2008, City of Edmonton Transportation Department undertook conceptual studies to determine appropriate alignments for an extension of the City's Light Rail Transportation (LRT) network. These extensions included a route linking downtown Edmonton to the community of Mill Woods (known then as the Southeast Extension). The Southeast Extension was included in the LRT Network Plan, approved by City Council in June 2009. Also in 2009, the City approved the current Transportation Master Plan ("The Way We Move", City of Edmonton 2009), which outlines strategic directions designed to meet the goals that have now been laid out in the Municipal Development Plan. In 2009, 77% of Edmontonians used personal vehicles for their everyday travel (City of Edmonton 2009). The Transportation Master Plan identifies public transit, including LRT, as a key component in shifting Edmonton's transportation system from a car-oriented system to one that emphasizes active and public modes of transportation. The City ultimately plans to construct five LRT lines, with the goal of connecting all sectors of the city (southwest, southeast, northwest, northeast, west and east) to the downtown by 2040. The City believes that a stronger, more efficient public transportation network will allow for the development of more compact communities throughout the city, thus lessening the pressure that continued population growth will exert on the region's land base and existing transportation infrastructure.

Following a lengthy decision-making process, the "Connors Road Corridor" (the one assessed here) was selected in January 2011 as the recommended SE alignment and endorsed by City Council. In 2011, the City approved the concept plan for the Southeast to West LRT (SE-W LRT). Development of the SE-W line was divided into two segments: Mill Woods to City Centre (southeast leg), and City Centre to Lewis Farms (west leg). In June 2011, City Council approved funding for preliminary engineering for the SE to W LRT and design began shortly thereafter. In December 2011, additional funding was approved for land acquisition associated with LRT extensions, some of which was allocated to the Southeast Extension. While preliminary design is now near completion for both SE and West legs, in 2012 Council identified detailed design and construction of the Valley Line-Stage 1 as a City priority and began exploring delivery models.

In short, the current Valley Line-Stage 1 project is the culmination of many years of careful planning, including much public consultation and numerous decisions endorsed by Council. It is consistent with City planning policy at the highest level and furthers the City's goals to strengthen public transit services and optimize growth within City lands.

1.3 Valley Line-Stage 1 Alignment

The Valley Line-Stage 1 will be largely situated in a highly developed urban context, including residential neighbourhoods, commercial centres and industrial parks. The alignment moves from downtown through the Boyle Street neighbourhood and into the river valley. It crosses the North Saskatchewan River (NSR) on the west margin of Cloverdale community, travels out of the valley along Connors Road, and then moves south along major arterial roadways (95th Avenue, 83rd, 75th and 66th Streets) to Mill Woods Town Centre. While the majority of the route will be at-grade, a short portion of the alignment downtown will be underground, and elevated crossings will be constructed within the NSRV, and in the area between Argyll Road and 75th Street.

As currently conceived, the Valley Line-Stage 1 triggers a Bylaw 7188 review at one location only: the NSRV. Further south, the alignment skirts the east border of the Mill Creek Ravine, near 83rd Street and Argyll Road, but does not enter the NSRV ARP. Further south yet, the alignment crosses Natural Area SE 402, an abandoned section of Mill Creek ravine in Wagner Park that is **not** part of the NSRV ARP. A separate Natural Site Assessment and Natural Area Management Plan are in development for the Wagner Park crossing. At the direction of City of Edmonton Sustainable Development, this EISA focuses only on elements of the SE LRT line to be developed within the Bylaw 7188 boundary. <u>Thus, for purposes of this EISA document, the project subject to this assessment, hereafter referred to as "the project", comprises those Valley Line-Stage 1 components that will occur within the NRSV in central Edmonton, and excludes all other SE LRT components. For a very few project components, lands outside the valley that are potentially affected by activities in the valley are also discussed.</u>

1.4 Location of the Project

The Project is located in the Central Area of the NSRV ARP, in SE 4-53-24-W4M, NE 33-52-24-W4M, and SE 33-52-24-W4M. River valley infrastructure will occupy a relatively narrow corridor (ranging from 10 m to 35 m) and will be approximately 1.6 km in length. The alignment begins at the north valley wall, just inside Louise McKinney Park, travels south across the river to 98th Avenue, curves southwest to the Muttart Conservatory, south to Connors Road, and then curves east and travels upslope to the top of valley, paralleling Connors Road (Figure 1.1). That portion of the project in the south valley floodplain is located at the western limits of the Cloverdale Neighbourhood. The portion along Connors Road is located downslope of Bonnie Doon Neighbourhood.

1.5 Project Delivery Model

In October 2012, the City elected to pursue a P3 (public-private-partnership) approach for project delivery and is now actively working toward procuring a P3 Contractor. Through a rigorous, competitive process, the City will select a qualified P3 Contractor, to design, build, finance, operate and maintain the Valley Line-Stage 1. The P3 model is intended to promote innovation, cost savings and timely delivery of an operational system. The P3 project will be governed by a detailed contract that is under development by the City.

For the entire Valley Line-Stage 1, including the project within the river valley, preliminary design (i.e., approximately 30% of final design) is complete. Design of some components is advanced further than others and most of the River Valley LRT components are among those that are furthest advanced. This design, referred to as the Reference Design, will be carried forward and provided to the P3 Contractor. The P3 contract will specify acceptable Reference Design variance tolerances and will set out spatial, temporal, structural and methodological standards and specifications. Those notwithstanding, the P3 Contractor may propose innovative designs or methods beyond variances or other specifications. Any proposal outside of those tolerances or not meeting prescribed standards will be subject to review and approval following current standard City approval processes, including City environmental review processes.

Nevertheless, the current project proponent, LRT D and C wished to ensure that the project, as currently defined, was subject to the Bylaw 7188 environmental review process at this crucial point in project planning. Further, they wanted the EISA to be approved by Council prior to entering into a contract with the P3 Contractor. Therefore, while this EISA assesses the Reference Design resulting from the preliminary engineering exercise, as described in the Design Detail Reports issued by Connected Transit Partnership (CTP), it also acknowledges that design changes are likely to occur during the P3 process. Moreover, as with many EISAs, because the environmental assessment, public involvement and preliminary design processes identified design issues that required addressing and adjustment, design refinement of some specific project components continued during preparation of this EISA document. Development of an EISA for a project as large in scale as this is a lengthy process and requires that the design be “frozen” at the beginning of the assessment. This EISA, drafted in April and

Figure 1.1 Project Setting

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created: 04 July 2013

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early May 2013, reflects design as it was in early April 2013. In other words, design as was presented in the detailed design reports finalized in February, March and early April 2013. Importantly, since that date, in parallel with the draft EISA preparation and review, design work has progressed on the track corridor alignment along Connors Road. While this new work incorporated environmental assessment analysis, it was not possible to integrate those design advances into this EISA. To acknowledge the recent design advances on that project component, the options analysis, the environmental factors considered in option evaluation and the final alignment recommendation are presented in Appendix A.

The P3 delivery model approach has influenced the content of this EISA in several ways. Firstly, for some elements, design information is less detailed than typical for Bylaw 7188 EISAs, and for most elements, little is specified about construction methods. For some project components, this has resulted in some uncertainty in impact determination. Most uncertainties regarding potential for impact or type of impact have been addressed in this EISA through assumption of worst case scenarios and development of proactive mitigation measures in the form of constraints, specifications and specific future planning requirements. Mitigation measures noted as commitments will be carried forward into contract documents. This includes commitments to require the P3 contractor to provide specific planning documents and for LRT D and C to develop performance measures. Numerous other mitigation measures identified as recommended in this EISA are not final commitments but are intended to assist the City in developing contracts and variance tolerances during the P3 procurement phase.

Secondly, the P3 Contractor's freedom to innovate, including modifying design of project components and proposing innovative construction methods and/or project scheduling means that the design and construction methods assumed as the basis for this EISA are subject to change as detailed design proceeds. As noted above, the City will protect against the potential for innovation to result in unintended outcomes by developing specific tolerances for variation; however, these tolerances are not yet determined and thus could not be included in this EISA. In response to this, on the basis of professional judgment and through consultation with local contractors possessing relevant construction experience, the project team defined a probable construction footprint, or project area for the Reference Design and this was used for EISA purposes (Figure 1.2). This project area represents reasonable construction site limits for the NSRV components of the Reference Design. To protect against unanticipated environmental impacts resulting from innovation, any proposed innovations or activities that do not conform to contract specifications or that would require modification of lands or facilities situated *outside of the project area delineated here and on Bylaw lands*, will be subject to the Bylaw 7188 environmental review process, at the expense of the P3 Contractor.

1.6 Environmental Assessment Objectives

A review of environmental assessment requirements at all three levels of government, as of early 2013, indicated that the City of Edmonton is the primary regulator with respect to environmental assessment of this project. Although environmental approvals will be required from municipal, provincial and federal governments (see Section 2.10), only the

Legend

- EISA Study Area
- Project Area
- Proposed LRT
- City of Edmonton River Valley Natural Areas (2010)
- Bylaw 7188 Boundary

0 50 100 200 Meters

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Figure 1.2 Project Area (Probable Construction Footprint)

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created: 04 July 2013

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City of Edmonton has specific environmental assessment/review requirements (see Section 2.10.3.1). The EISA undertaken for this project was, therefore, based on the following primary objectives:

- Meet the requirements for an environmental impact assessment pursuant to Bylaw 7188.
- Obtain sufficient information about the area's Valued Environmental Components (VECs) to enable identification of potential impacts.
- Achieve an environmentally-sound preliminary design and provide adequate protection for the City's highly valued river valley resources.
- Identify environmental permitting requirements.
- Include information that is likely to be required for environmental permits at the municipal, provincial and federal level.
- Prepare a report that documents all of the above.
- Obtain approval of the EISA from City Council.

1.7 Bylaw 7188 Environmental Review Process

This EISA has been prepared specifically to address the informational needs of Edmonton's municipal government. As the Valley Line-Stage 1 Right of Way is considered a new transportation corridor within the NSRV ARP, a Site Location Study (SLS) was also required. In May 2013, the draft EISA and the SLS were submitted together, as required, to Sustainable Development, Urban Planning and Environment for review. These documents were circulated to representatives of several Edmonton departments, branches and offices for review. All comments were submitted to Urban Planning and Environment and forwarded to the proponent for review and response. The EISA and SLS documents were then modified in response to the comments, finalized and resubmitted to Sustainable Development. Reviewers then had an opportunity to comment on the modifications. Following this review, the reports were finalized (as shown here) for submission to Sustainable Development, and will be sent to Transportation Committee and City Council, in August 2013.

In recent past, the City's EISA Bylaw 7188 review process has included circulation of EA documents by proponents to appropriate federal and provincial government departments for review and comment, to ensure a coordinated approach to resource protection and that all regulatory concerns have been addressed. This was not done in this case for two reasons: recent federal regulatory changes have reduced review of EAs by federal agencies and undetermined construction methods provide little for those agencies to comment on. Federal and provincial agencies have been made aware of the upcoming project and basic project components. While information contained in this EISA should contribute significantly to the permitting information needs of federal and provincial agencies, permitting applications will require additional environmental information, specific to design detail and construction methods and will, therefore, be the responsibility of the P3 Contractor. The contactor may decide to submit this EISA as a supporting document.

Recognizing that the P3 delivery model may mean that the EISA review process may leave some important considerations temporarily unresolved, LRT D and C commits to soliciting further input and agreement from those City departments, branches and divisions (City Stakeholders) that participated in the EISA review. While the City's P3 process remains in development at time of writing, the process framework has been established. The process will comprise at least four stages that will involve issue and review of key documents and more detailed information will be available at each stage. Items not addressed with sufficient depth or certainty in the EISA can be addressed through this process. These stages/documents include the following:

Request for Qualifications (RFQ): This document sets out the project scope and P3 proponent requirements. City Stakeholders can provide input into the RFQ to ensure that their specific concerns can be adequately addressed by the shortlisted bidders.

Request for Proposals (RFP): Among other things, this document sets out the functional design requirements for the project and the performance requirements for the technical submissions that will be developed by each of the shortlisted P3 contracting teams as they move through the bidding (pursuit) process, and, details a Concession Agreement. City Stakeholders can provide input into the RFP regarding select technical submission requirements. Examples of relevant technical plans are: traffic management plan (including pedestrians), environmental management system, drainage design report.

Technical Submissions: During the procurement phase each shortlisted team in pursuit of the contract will provide a number of technical submissions for evaluation with respect to ability to meet the Concession Agreement requirements. This process may generate additional questions for the bidders. The Valley Line project team review will include preparation of comments and questions to be further addressed by the P3 contracting teams. City Stakeholders can participate in the review of relevant technical submissions and the associated preceding and follow-up questions. Material issues identified in the reviews not previously addressed in the RFP or Concession Agreement can be dealt with by addendum. City Stakeholders may also be asked for input at this point. Extreme confidentiality protocols are in effect around all information shared by proponents during the design review process.

Technical Plans: Following award of the contract any detailed technical plan requirements that have been identified in the contract documents are to be submitted by the successful P3 proponent for a contract conformance evaluation. City Stakeholders will have opportunity to participate in that review.

Finally, as noted earlier, if the P3 Contractor proposes a design or activity that necessitates work outside of the project area defined for this assessment and, if those works require modification of Bylaw lands or existing facilities, or, if the proposal is not within the design tolerances or other constraints established in the P3 contract, the proposal will be subject to additional environmental review, pursuant to Bylaw 7188, at the expense of the P3 Contractor.

1.8 Report Organization

This report comprises 8 chapters. Chapter 1 provides context and background information related to the project and describes the report structure. Chapter 2 is the detailed project description, including project justification, key components, key activities, alternatives considered and relevant environmental regulations. Chapter 3 outlines the impact assessment methods and summarizes the public involvement program to date. Chapter 4 sets out the key issues associated with the project, incorporating public, professional and regulatory concerns. Chapter 5 describes the existing conditions for all valued environmental components (VEC) considered. Chapter 6 describes the impacts related to project implementation, recommended mitigation measures, and the residual impacts anticipated following mitigation application. Chapter 7 summarizes findings of the assessment, identifies monitoring requirements and recommended follow-up work, summarizes steps taken to resolve issues identified during the assessment and describes important considerations moving forward with the P3 process. Chapter 8 provides all references and personal communications cited in the report.

As a whole, the document is generally organized around the selected VECs. Individual EISA reviewers may consider restricting their review to the sections of the document most pertinent to their specific interests. We recommend that the entire document be read to fully understand the project impacts. Some mitigation measures are applicable to more than one VEC. Where significant overlap occurs, the first instance is referenced in later sections and the reader should refer back to that section.

This report has eight appendices. Appendices comprising supporting study reports are provided in a compact disc attached to the back report cover. The remaining appendices follow Chapter 8, in hard copy.

2.0 PROJECT DESCRIPTION

2.1 Declaration

The Project proponent is the City of Edmonton, Transportation Services, LRT Design and Construction (LRT D and C).

The primary project proponent contact is:

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The City's prime consultant for Preliminary Engineering of the Valley Line-Stage 1 (SE to W LRT) is Connected Transit Partnership (CTP), a team comprising a multidisciplinary suite of consulting firms, led by AECOM Ltd. Spencer Environmental Management Services Ltd. is CTP's environmental assessment specialist, responsible for preparation of this EISA.

The primary contact for the Environmental Assessment is:

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This final report represents the findings and conclusions of the environmental assessment consultant and CTP but also incorporates suggestions, comments and information from the project proponent, City reviewers, and members of the public.

In 2015, the City plans to award the project to one bidder, likely a consortium, hereafter referred to as the P3 Contractor, who will become responsible for the design, construction, operation and maintenance of the Valley Line-Stage 1. The P3 Contractor will assume the role of project proponent and will be responsible for obtaining many of the required environmental permits. The specific mitigative measures outlined in this document will inform the P3 procurement phase and the P3 Contractor regarding working in the river valley and many will be incorporated directly into contract documents.

2.2 Project Setting

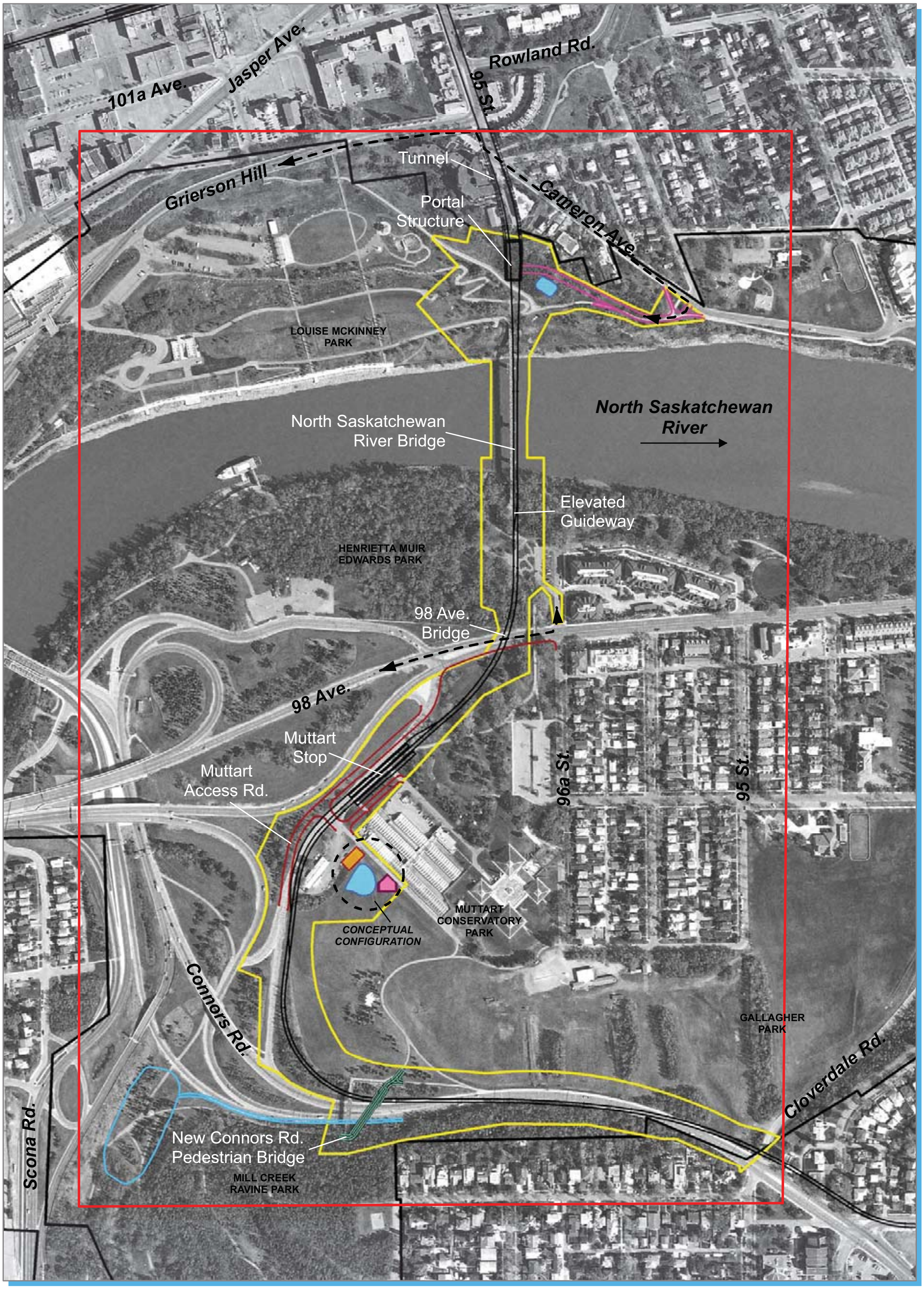
The Project is located in an area of the river valley that is wide, with a significant floodplain. This reach of Edmonton's river valley is highly developed and includes a number of important City parks, a high profile City conservatory, a number of transportation arteries, and a residential neighbourhood. The area also supports a few small recognized natural areas. The north bank and slope of the river valley is occupied by Louise McKinney Riverfront Park (Louise McKinney Park), which mainly comprises manicured parks and gardens and passive recreation infrastructure. The south bank of the NSR is occupied by Henrietta Muir Edwards Park (HME Park), a largely natural park that also has a few manicured elements. These parks are connected by the Cloverdale pedestrian bridge. HME Park is bounded on the south by 98th Avenue. To the south of 98th Avenue is the Muttart Conservatory, which comprises a number of glass houses as well as landscaped grounds. HME Park and the conservatory are located on a wide river terrace. The residential neighbourhood of Cloverdale is also located on the floodplain, just east of the proposed LRT alignment. The lower slopes of the south valley wall are occupied by Dove Hill and Gallagher Park, which are characterised by extensive lawns and steep slopes. This area also supports the Edmonton Ski Club, a downhill skiing facility. The upper slopes of the valley wall are part of Mill Creek Ravine Park and are characterised by steep, forested slopes. The upper and lower slopes of the south valley wall are separated by Connors Road, a significant arterial roadway linking eastern portions of the city to downtown.

2.3 Key Project Components

The proposed LRT line will consist of one continuous, relatively narrow structure through the river valley; however, the infrastructure can be described as having several distinct component parts. In addition, the introduction of LRT infrastructure necessitates adjustment or replacement of some existing infrastructure. These adjustments or replacements are also considered to be part of this project. The following section describes key project infrastructure. Descriptions are derived from a suite of reports and drawings prepared by CTP for the City, during preliminary engineering. The list of materials consulted in preparing these descriptions is provided in Appendix B. In the event of detail discrepancies, the information presented in those materials supercedes that presented here.

Key project components shown in Figure 2.1 are:

- a tunnel through the north river valley,
- a tunnel portal structure situated on the north wall of the NSRV,
- portal structure maintenance/emergency access road,
- North Saskatchewan River bridge, with separate LRT and pedestrian bridge decks spanning the river and HME Park and terminating north of 98th Avenue,
- 98th Avenue LRT bridge,
- Muttart LRT Stop and Traction Power Substation (TPSS),



Legend

- EISA Study Area
- Project Area
- Proposed LRT
- Construction Access
- Bylaw 7188 Boundary
- Proposed Dry Pond and Vegetated Swale (Conceptual)
- Proposed Rain Garden
- Traction Power Substation (TPSS)
- Muttart Storage Building
- Permanent Portal Access Road (Work-in-Progress/Not Yet Approved)

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0 50 100 200 Meters

1:4,250

Figure 2.1 Project Components

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created: 04 July 2013

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- existing roadway upgrades/realignments,
- new Connors Road pedestrian bridge,
- LRT track and trains, and
- stormwater management infrastructure.

The above list is limited to major structural elements and does not include temporary structures or construction activities. Information on key construction activities, including demolition of the existing Cloverdale Pedestrian Bridge is provided in Section 2.5.2. The following sections provide some additional project detail and include some information regarding possible construction methods. Descriptions are based on Preliminary Engineering drawings and a large body of reports prepared for the City in late February, March and early April 2013 by CTP. In general, information presented here is based on Reference Design information available as of early April 2013; however, because of the potential for change, dimensions and details provided here should be treated as approximate rather than fixed.

Beyond the key project components, the preliminary engineering phase has also included considerable effort toward developing measures to enhance certain project components in a manner that sensitively integrates the project into the surrounding environment and mitigates social impacts. These include enhancements to new infrastructure to improve river valley aesthetics, pathway adjustments, and landscaping enhancements. These measures are not included here as key components; rather they are described as mitigation measures in later sections of this document, as mitigation was the motivation behind these efforts.

2.3.1 *Tunnel Through North Valley Wall*

The Valley Line-Stage 1 begins at-grade in the city centre, transitions to an underground line at 102 Avenue and 96th Street, and travels through a twin tunnel into the river valley. A small section of the tunnel falls within the Bylaw 7188 boundary (Figure 2.1). The Contractor will be responsible for finalizing tunnel design, tunneling methods, sequencing and schedule. Some of the major tunneling construction activities may be located within the river valley, including material hauling on and off site.

2.3.2 *North Valley Wall Portal Structure*

The LRT will daylight at a tunnel portal structure to be situated on the upper slope of the NSRV north wall, at the extreme northeast corner of Louise McKinney Park (Figure 2.1). Bridge design, particularly elevation, slope stability considerations, and construction access considerations all influenced the selected portal structure location. Due to the long-standing instability issues in this portion of the north valley wall, the primary objective of portal structure design was to increase the factor of safety of those slopes. The slope stability issue is related to the presence of four horizontal bentonite seams in the bedrock on the north bank.

The portal structure will comprise a covered portion and an outer open top portion and will have one entrance that accommodates two tracks (Figure 2.2). It is thought that the covered portion of the portal structure will be constructed using cut and cover methods rather than sequential excavation or other tunneling methods.

In the vicinity of the portal structure, shear walls, or some other stabilizing structure, will be installed to protect slope stability. If shear walls are used, each wall would likely span approximately 40 m across the valley wall, centered on the alignment. Construction of slope stability structures would likely necessitate a large working area and involve significant earth works, large equipment and significant associated construction traffic. Construction access for the portal structure is designated as from the east, via Cameron Avenue but, as planning proceeds, the need for a secondary access from the west, through Louise McKinney Park, may also be identified. For this reason, this environmental assessment assumes an as yet unidentified secondary access from the west <u>but also assumes</u> that this access will be limited and will not require physical modification. Therefore, secondary access is not shown on figures, is considered to be outside of the study area and is only assessed qualitatively.

2.3.3 *Portal Structure Maintenance/Emergency Access Road*

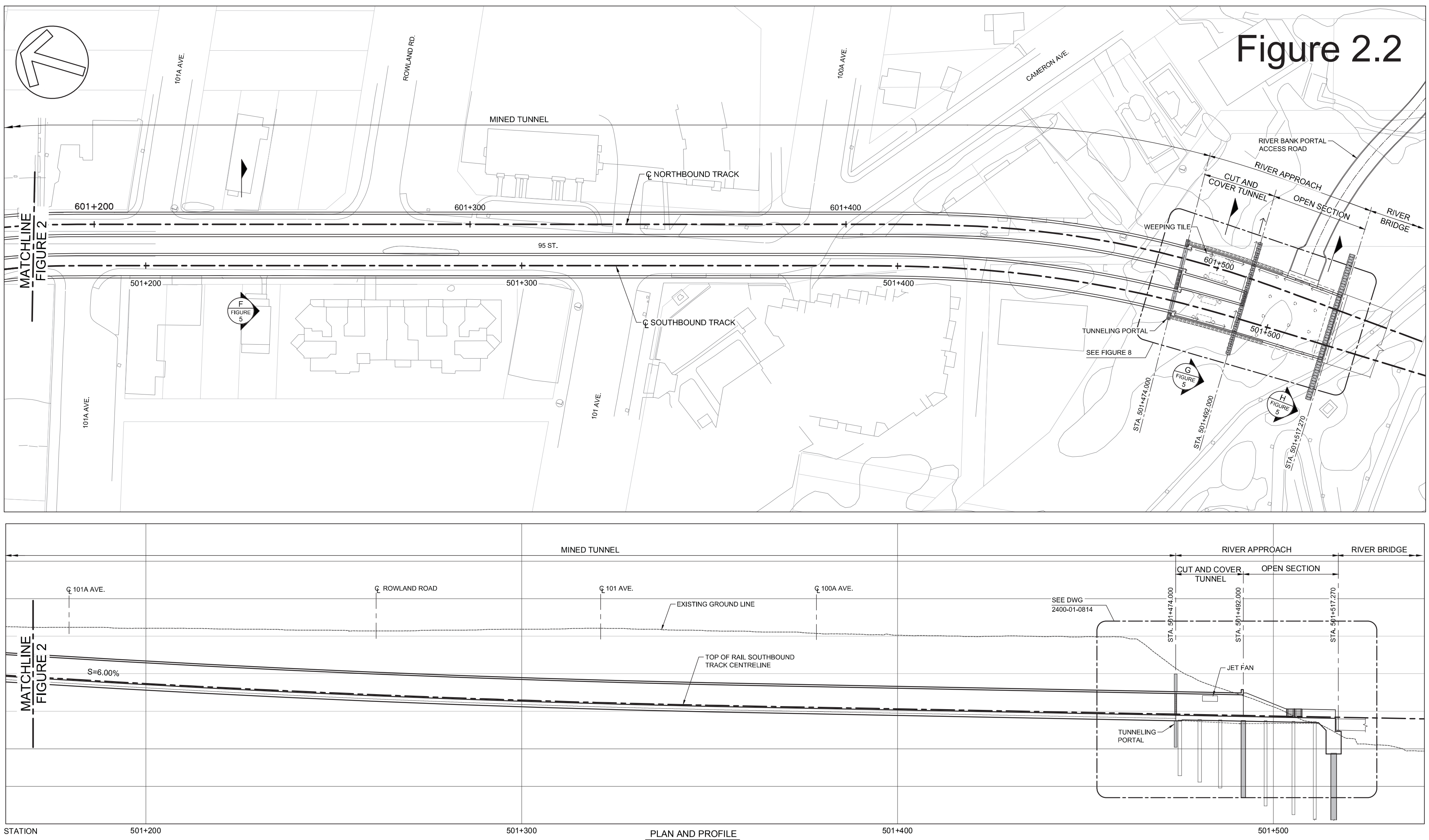
The required emergency and maintenance access for the north river valley LRT components will be provided through construction of a new access road that will connect the intersection of Cameron Avenue and 94th Street to the portal structure, upslope and to the west (Figure 2.1). This road will also provide north bank access to the bridge deck. Because of its position along the valley slope, retaining walls running parallel to the road may be required in some localities. These walls may be in the order of 2 to 4 m in retained height, depending on the slope topography and the final position of the road.

2.3.4 *North Saskatchewan River Bridge*

Considerations influencing the elevation of the NSR Bridge included the following: the need to maintain navigability on the NSR, the need to protect against slope instability at the north valley wall, and the need for the track to remain elevated to carry the LRT south over 98 Avenue. As a result, the proposed river bridge comprises two contiguous structures: a river bridge and an elevated guideway that continues south across the valley floodplain between the river bridge and 98 Avenue (Figure 2.1). Combined, these two structures span approximately 380 m. The river bridge begins at the north valley wall portal, spans the NSR and terminates on the south river bank. The elevated guideway begins where the bridge terminates, spans HME Park and terminates just north of 98 Avenue. Bridge and guideway lighting will be required. Lighting design will be developed as part of detailed design.

The new bridge over the river will be a single tower, extradosed bridge (Figures 2.3 and 2.4) with two decks: an upper deck that will support LRT infrastructure, and an underslung pedestrian/bicycle deck (walkway). The walkway will replace the Cloverdale pedestrian bridge and has been designed to provide for walking, cycling, and to have designated areas for reflection and river valley viewing. The walkway will be

Figure 2.2



PLAN AND PROFILE
1::500

ANANDA / March 12, 2013 / Y:\60222337\000-CADD\2400 - STRUCTURES\01 STAGE 1\REPORT\TUNNEL\FIGURE 3.DWG

Prime Consultant
AECOM
Hatch Mott MacDonald
ISL Engineering and Land Services
Associate Consultants
THE CITY OF Edmonton TRANSPORTATION SERVICES
DIALOG
gec architecture

SOUTHEAST TO WEST LRT

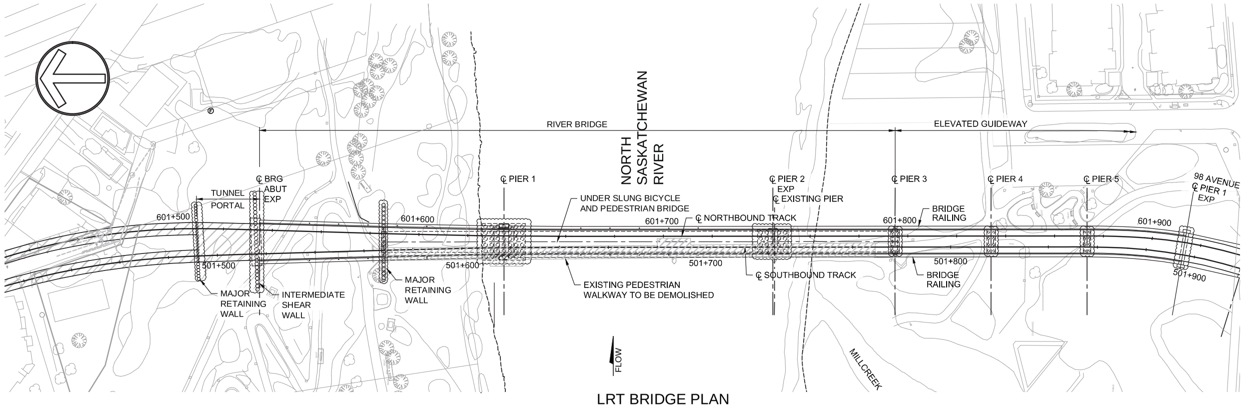
Drawn By: A.A.
Designed By: J.H.
Checked By: S.A.
Date Issued: 12-03-2013

QUARTERS TUNNEL AND PORTAL
GENERAL ARRANGEMENT
PLAN AND PROFILE - SHEET 2 OF 2

FIGURE 3

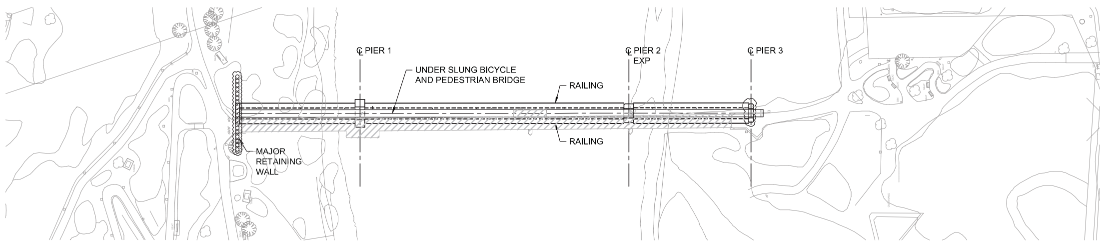
Figure 2.3
River Bridge Rendering

Figure 2.4



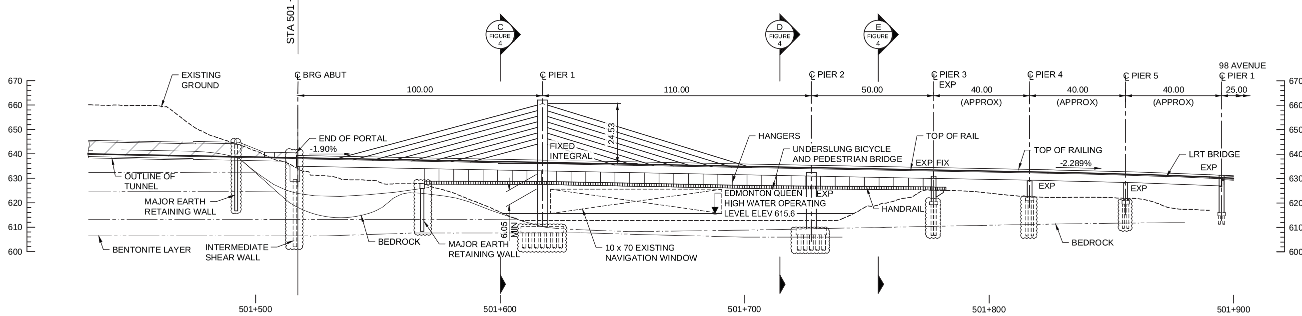
LRT BRIDGE PLAN

SCALE 1:1000



UNDERSLUNG BICYCLE AND PEDESTRIAN BRIDGE PLAN

SCALE 1:1000



ELEVATION

SCALE 1:1000

Prime Consultant

AECOM

THE CITY OF Edmonton TRANSPORTATION SERVICES

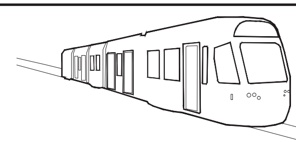
Hatch Mott MacDonald

ISL Engineering and Land Services

DIALOG

gec architecture

Associate Consultants



SOUTHEAST TO WEST LRT

NORTH SASKATCHEWAN RIVER BRIDGE
PLAN AND ELEVATION

Drawn By: A.A.
Designed By: R.M.
Checked By: B.R.
Date Issued: 28-02-2013

FIGURE 1

ANANDA / February 28, 2013 / Y:\60222337\000-CADD\2400 - STRUCTURES\01 STAGE 1\REPORT\RIVER BRIDGE\FIGURE 1.DWG approximately 210 m long, will connect Louise McKinney Park with HME Park, and at each end will terminate at existing grade and connect with the existing pathway. The walkway will have 3.6 m clearance, with a reduction to 3.0 m at pier locations. The deck has been designed to provide separation for various activities: a 3.0 m wide SUP will run along the centre of the deck to support higher speed traffic, such as bicycles. The alignment of trails feeding into either side of the bridge will take into consideration the desire lines for the bicycle traffic. It will be flanked on either side by approximately 2.0 m of additional space, providing room for viewing and/or resting along the length of the bridge. Benches will be provided in this space and benches and viewing areas will have unobstructed views of the surrounding area.

As currently conceived the river bridge has three spans and requires two piers in the river. The length of the north span avoids the need for pier construction on the most unstable portion of the north bank, by tying into the portal structure and subterranean shear walls (or equivalents) for stabilization. Current design shows the elevated guideway as having three spans through HME Park.

Navigational Clearance and Design Flood Levels

River bridge height was driven, among other considerations, by the need to provide adequate clearance below the pedestrian deck for watercraft navigation. The Edmonton Queen Riverboat, the largest watercraft that uses this stretch of the river, served as the design vessel. A 10 m high navigation window at the normal high water level of 615.60 m (equivalent to flow rates of 1000 m^3/s) was deemed to be sufficient for the Edmonton Queen Riverboat. This is slightly greater than the clearance provided by the existing bridge.

With 10 m clearance above normal high water level, the bridge is well buffered against flood events, and will be able to withstand water volumes well in excess of those associated with the 1:100 year flood event.

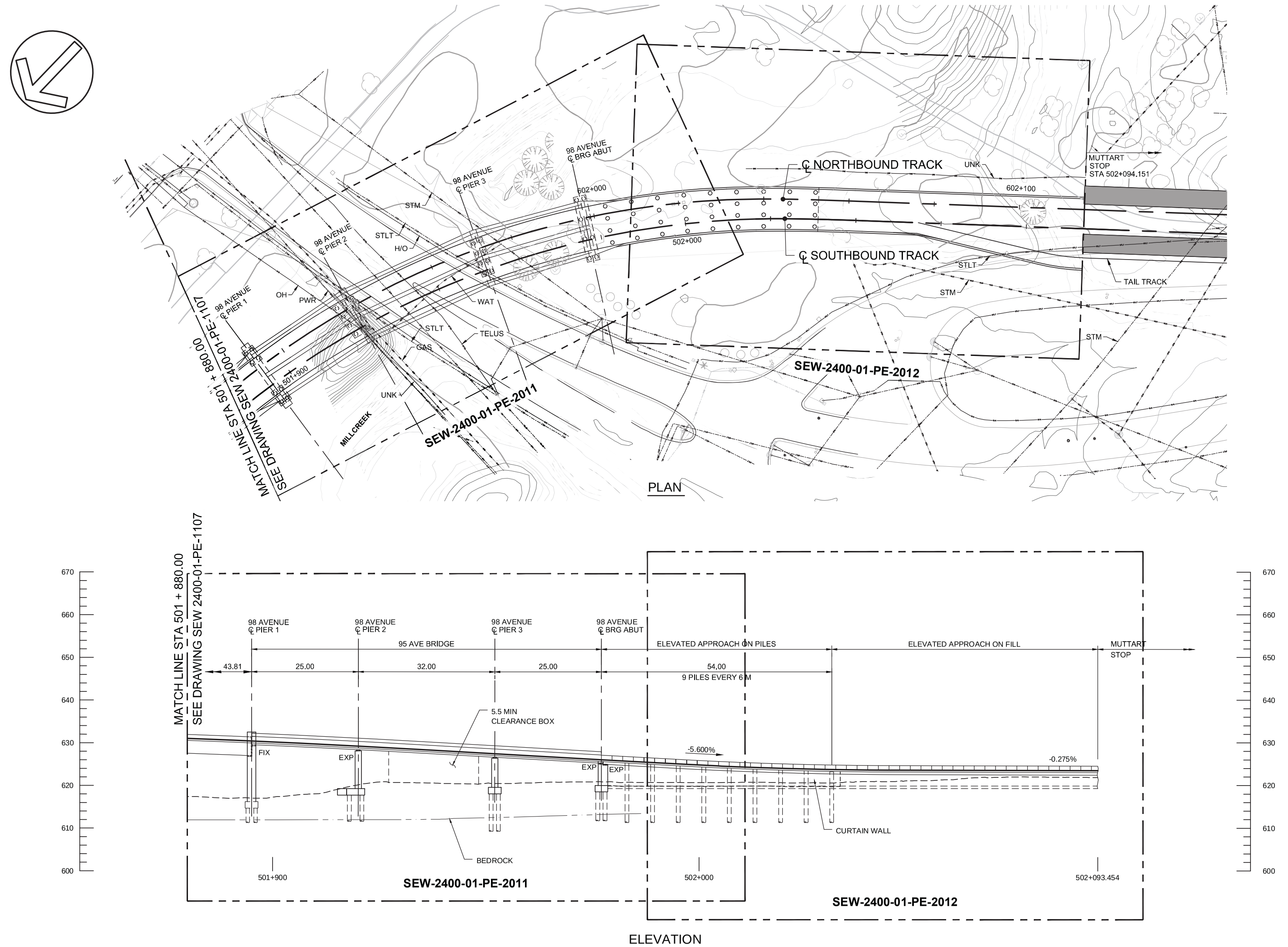
2.3.5 *98^th^ Avenue Bridge*

The 98th Avenue crossing structure (Figures 2.1), will be contiguous with the river bridge elevated guideway component and will provide a minimum 5.5 m clearance over 98th Avenue matching the existing clearance at the 98th Avenue pedestrian bridge located to the east. The bridge is currently shown as having three spans (Figure 2.5).

2.3.6 *Muttart Stop and TPSS*

Muttart Stop and the northern approach are located on a steep grade. From the 98th Avenue bridge the LRT line will descend to Muttart Stop on a pile-supported elevated approach, which will then descend to a fill-supported approach and then the stop (Figure 2.1). As currently conceived, the stop and approach require five retaining walls (RW-01 through RW-05), ranging in length from 230 to 120 m and in height from 6 to 2.5 m (Figure 2.6). Final wall length and height will be governed by final alignment/ROW design.

Figure 2.5



LEGEND:

PWR - POWER LINE
WAT - WATER LINE
STLT - STREET LIGHT CABLE
STM - STORM LINE
OH - OVERHEAD LINE
- POWER POLE
GAS - GAS LINE
TELUS - TELUS LINE
UNK - UNKNOWN LINE

NOTES:

PILE	ESTIMATED PILE LENGTHS
PIER 1	15 m
PIER 2	18 m
PIER 3	18 m
ABUTMENT	18 m
APPROACH	8 TO 12 m

no.	description	date	appd
C	FINAL PRELIMINARY ENGINEERING	28-03-13	R.M.
B	ISSUED FOR 90% REVIEW	07-12-12	R.M.
A	ISSUED FOR 60% REVIEW	22-06-12	R.M.

issue data

no.	description	date	checked

revisions

AECOM Consultant

A1 bar scale 1:750m 0 7.5 15.0 22.5m

drawn by A. ANAND
designed by R. MARZAN
checked by N. SAN PEDRO
date 28-03-2013

permit

seal

consultant job no 60222337
consultant reviewed by S. ALEXANDER

AECOM Prime Consultant

Edmonton Transportation Services

prime consultant job no 60222337

Hatch Mott MacDonald · ISL Engineering and Land Services · DIALOG · gec architecture

PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

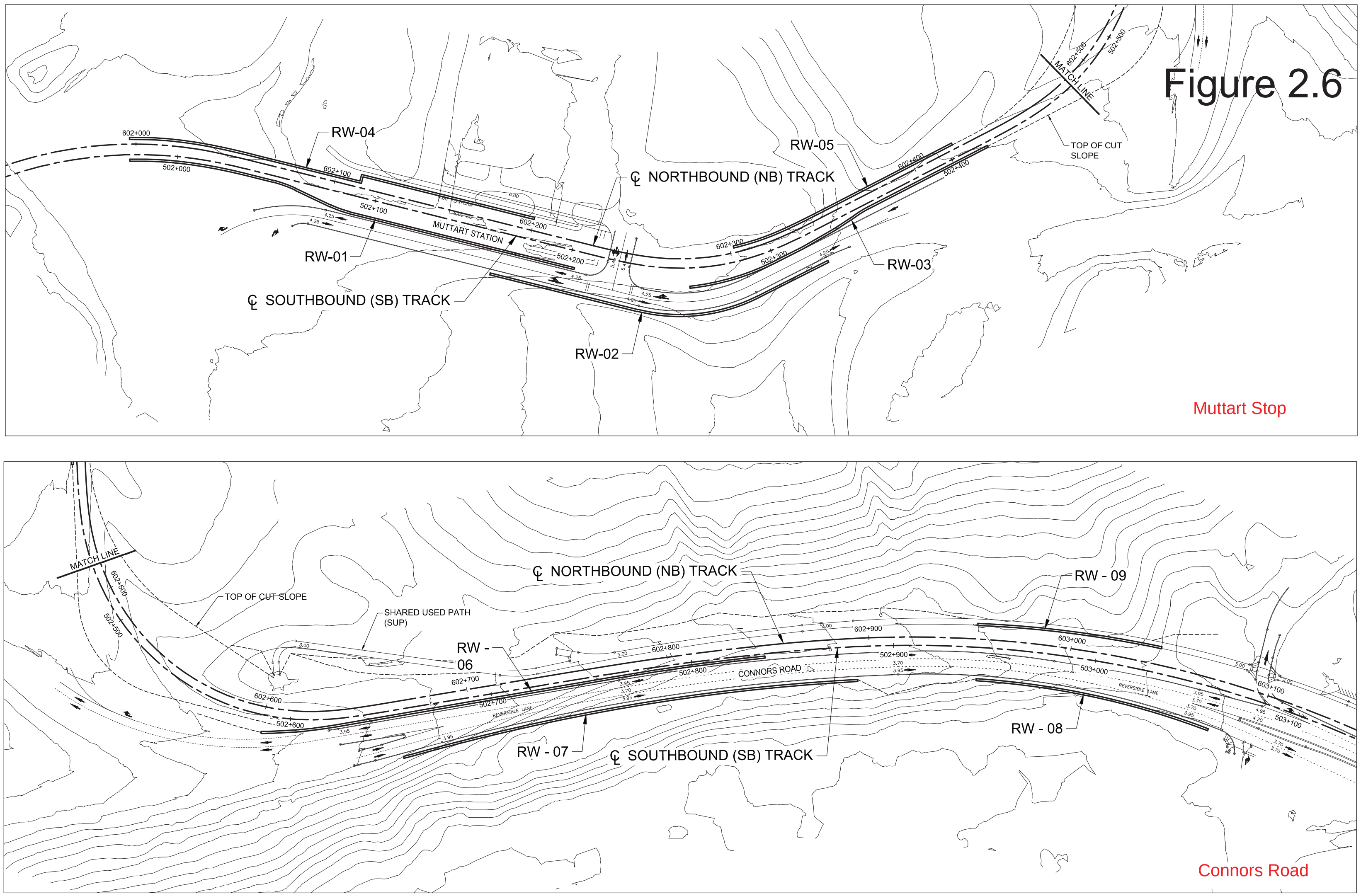
drawing title
98 AVENUE BIRDGE
GENERAL ARRANGEMENT

SE to W LRT
MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-2010
REV
SHT 052

ANANDA / March 28, 2013 / Y:\60222337\000-CADD\2400 - STRUCTURES\01 STAGE 1\98 AVENUE\SEW-2400-01-PE-2010.DWG

Figure 2.6



C	FINAL PRELIMINARY ENGINEERING	28-03-13	B.G.
B	ISSUED FOR 90% REVIEW	07-12-12	B.G
A	N/A	-	-
no.	description	date	appd
	issue data		

no.	description	date	checked
	revisions		

AECOM Consultant

A1 bar scale 1:1000m 0 10 30 50m

drawn by N. SELMA | designed by J. HONG

checked by B. GILLIS | date 28-03-2013

permit

seal

consultant job no 60222337

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AECOM Prime Consultant

THE CITY OF Edmonton TRANSPORTATION SERVICES

prime consultant job no 60222337

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PRELIMINARY ENGINEERING DRAWINGS
NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

drawing title
RIVER VALLEY RETAINING WALLS
RETAINING WALL
SITE PLAN

SE to W LRT
MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-1210 | REV | SHT 059

SELMAN / March 27, 2013 / Y:\60222337\000-CADD\2400 - STRUCTURES\01 STAGE 1\SHEETS\100% RIVER VALLEY RETAINING WALLS\SEW-2400-01-PE-1210.DWG

Muttart Stop was designed to be simple and visually unobtrusive, to reflect the character of the neighbourhood in which it is located and to be compatible in design with the remainder of the stops along Valley Line-Stage 1. Muttart Stop will have a standard side platform layout (Figure 2.7). The shelter will have a curved wood and metal canopy, a design that was selected to recall the river and surrounding natural setting. Sustainability design features include LED platform light fixtures, recycling containers located on platforms, and a bike rack near the platform to encourage bicycling. The project does not include Park 'n Ride facilities at Muttart Stop and there will no bus bays in the vicinity of the stop.

A railroad siding (storage track) will be built parallel to the northwest side of the Muttart Stop for the purpose of storing trains in the event of a breakdown in the valley. It will not be used for long-term storage, but may be used for staging for major events.

Traction power substations (TPSS) will serve to convert and distribute the energy needed to power LRT trains. Eleven substations will be required along the Valley Line-Stage 1, only one of which, the Muttart TPSS, is located in the study area. While a TPSS will also be constructed in association with the portal structure, it will be located outside of the Bylaw 7188 boundaries, and therefore is outside of the scope of this EISA.

The Muttart TPSS will be located to the southwest of the Muttart Stop, in the vicinity of an existing building currently used by the Muttart Conservatory for storage (Figure 2.1). The TPSS will be housed in a rectangular utility complex that will also contain three utility buildings that house electrical, communications and signals (Figure 2.8). The majority of substations along the Valley Line-Stage 1 will not be roofed, but because of its relatively prominent location, the Muttart TPSS will include a roof to reduce visual impacts. Construction of the utility complex requires demolition of the existing Muttart Conservatory storage building. A replacement storage building will be constructed to the southeast, closer to the non-public greenhouses.

2.3.7 *Existing Roadway Upgrades/Realignments*

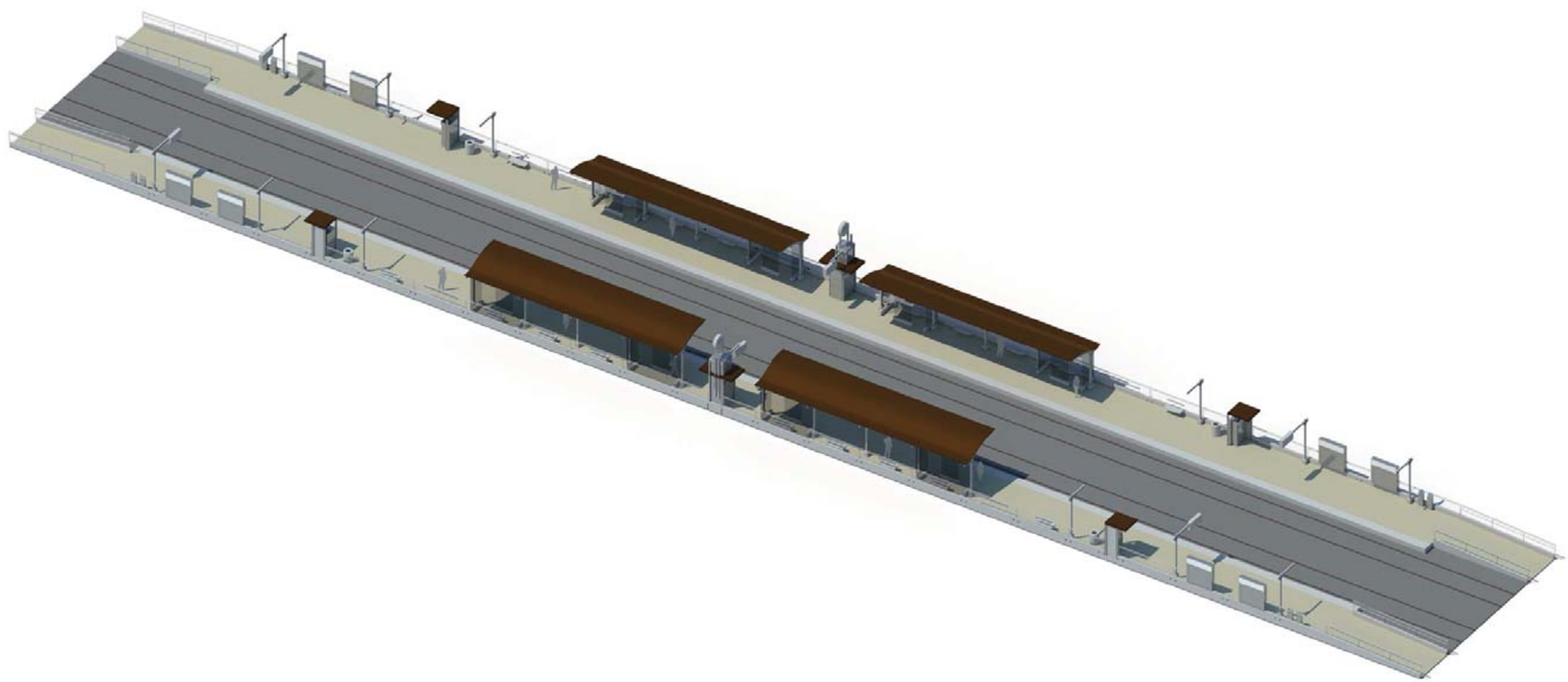
As currently conceived, the project will necessitate the realignment of the following roadways, and Shared Use Pathways (SUP):

- Connors Road, from top of the valley to Muttart Conservatory access road.
- Muttart Conservatory access road, between 98th Avenue and Connors Road.
- Existing SUP currently adjacent to the north side of Connors Road.

2.3.8 *Realignment of Connors Road*

The LRT track will climb out of the river valley on Connors Hill, parallel to Connors Road. Accommodating a new rail corridor parallel to that road requires additional right-of-way (ROW) width. Providing for extra ROW is a challenge considering the position of the existing ROW on the steep slopes of the south valley wall. At time of writing

Figure 2.7



SIDE PLATFORM OVERALL VIEW

Prime Consultant AECOM

Hatch Mott MacDonald

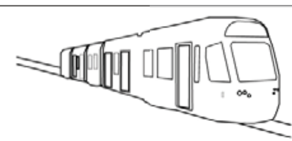
The City of Edmonton Transportation Services

ISL Engineering and Land Services

DIALOG

gec architecture

Associate Consultants

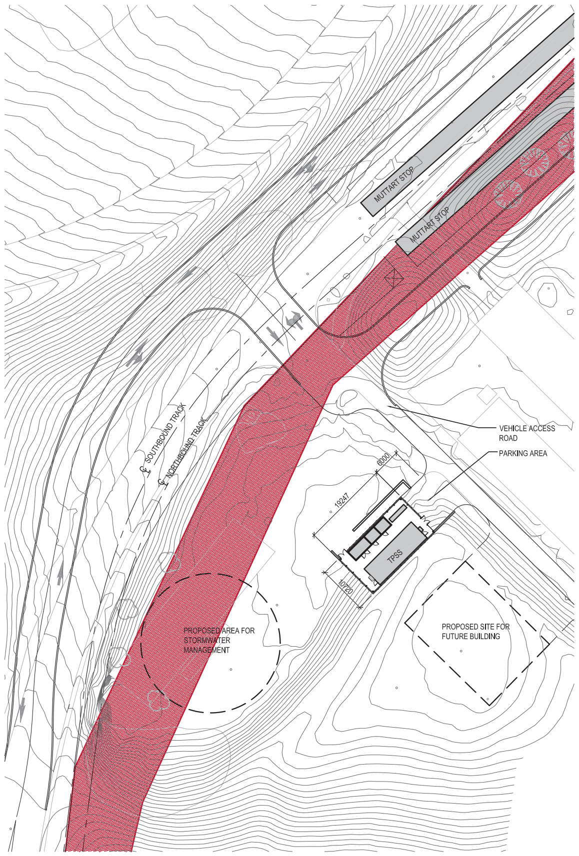


SOUTHEAST TO WEST LRT

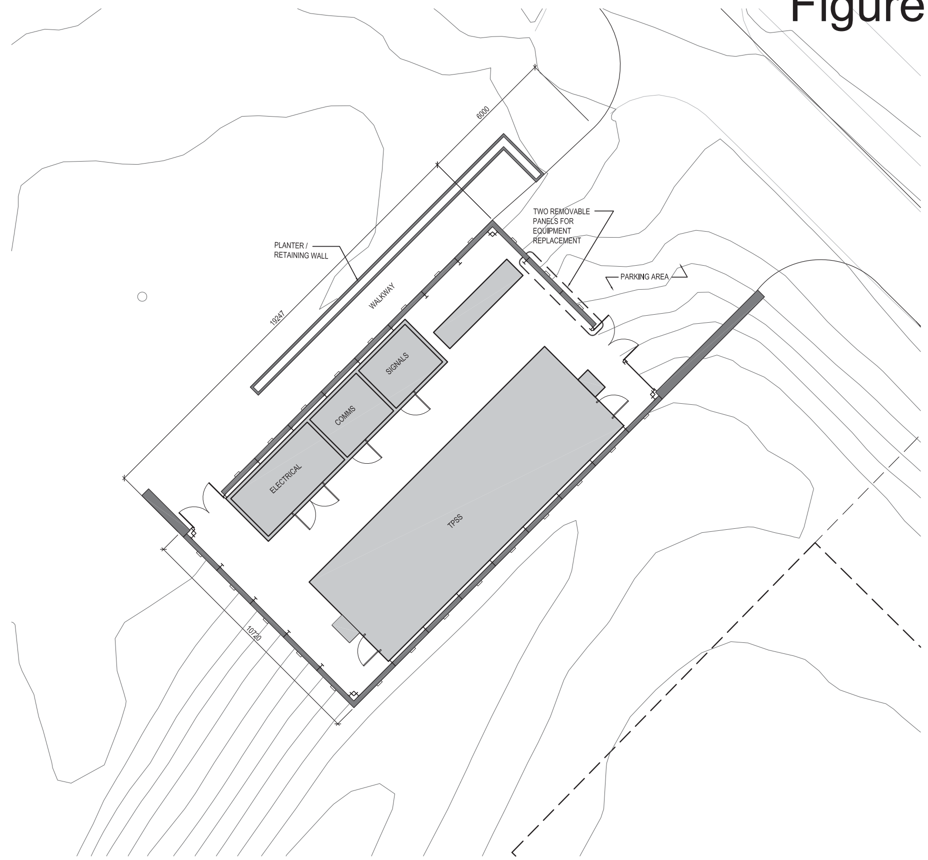
Drawn By: TB
Designed By: AECOM
Checked By: KW
Date Issued: 22-06-2012

FIGURE 1.1

Figure 2.8



1 SITE PLAN 1500-01 A103 1:500



2 PLAN 1500-01 A103 1:100

no.	description	date	appd
C	FINAL PRELIMINARY ENGINEERING	28-03-13	P.O.
B	ISSUED FOR 90% REVIEW	07-12-12	S.W./J.D

issue data

no.	description	date	checked
–	– –	–	–

revisions

gec architecture — Consultant

A1 bar scale 1:100mm 0 1000 3000 5000mm

drawn by M. LANDRY | designed by M. LANDRY | checked by P. OSBORNE | date 28-03-13

permit | seal

consultant job no 5205 | consultant reviewed by P. OSBORNE

AECOM Prime Consultant

The City of Edmonton TRANSPORTATION SERVICES

prime consultant job no 60222337

Hatch Mott MacDonald | ISL Engineering and Land Services | DIALOG | gec architecture

PRELIMINARY ENGINEERING DRAWINGS
NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

drawing title: ARCHITECTURE
MUTTART TPSS
SITE PLAN

SE to W LRT
MILL WOODS TO LEWIS FARMS

drawing no. SEW-1500-01-PE-A103 | REV – | SHT A103

MARIAL / March 22, 2013 / H:\5200 - 5249\5205 EDMONTON SE & W LRT\5205 TPSS\1.0 PROJECT ADMINISTRATION\1.9 PROJECT DESIGN\DESIGN DEVELOPMENT\DRAWINGS\SEW-1500-01-PE-A103.DWG (early April), several options were under development by the design team but regardless of the final option selected, the widened ROW would contain: Connors Road (possibly realigned but remaining as three lanes), the LRT track, and a new 3.0 m wide Shared Use Path (SUP) (Figure 2.6). The SUP will parallel the LRT track but may have variable separation, as required. One of the options under consideration (the one assessed here), involves shifting Connors Road to the south and cutting into the forested slope on the upper valley wall.

With this option, the total new ROW width is approximately 30m and, in certain locales, the SUP would require minor cutting into the existing slope north of Connors Road. Two other options under consideration are: 1) extend the ROW less to the south and one entirely to the north. All of these involve reduced cuts into the south hill and increased building out over the slope north of Connors Road. This EISA assesses the southernmost alignment but also considers in a less detailed way, the concept of the alignment furthest to the north. The project area shown in Figure 2.1 includes the approximate working area required for a shift either south or north and therefore represents an overestimation of the area of disturbance associated with any one final selection.

The option to create new ROW to the south requires installation of four retaining walls, two on each side of the widened ROW (RW-06 through RW-09 in Figure 2.6). The walls would begin in the vicinity of the existing pedestrian bridge and terminate near the top of the hill. As currently conceived, retaining wall length would range from 100m to 250 m and height would range from 2.5 m to 8 m. Final wall length and height will be governed by final alignment/ROW design.

Retaining wall type will be determined during detailed design. Pile walls have been identified during preliminary design as one suitable option. Regardless of type, all walls must be drained and are expected to comprise three layers: the structural wall (providing the slope retention), a thin drainage infrastructure layer and a veneer wall or façade (the aesthetic component). Veneer walls will also be selected by the P3 proponent, following specifications established during preliminary design by the City. The need for retaining walls increases the width of the required temporary working area, as lands behind (upslope of) the walls must be disturbed for wall construction. This probable working area is reflected in the project area shown in Figure 2.1. Retaining wall construction is expected to be a protracted process, owing to the size of the walls and the staged approach required for construction.

2.3.8.1 Realignment of Muttart Conservatory Access Road

To accommodate Muttart Stop and the south approach rail corridor, the existing Muttart access road must be relocated to the west of its current alignment, at a distance to be determined but to a maximum of approximately 20 m (Figure 2.1). As currently conceived, realignment will be required between 98th Avenue and Connors Road and the existing tie-ins would remain as they are.

2.3.8.2 *Sidewalk Additions*

The following roadways will have sidewalks added to them to improve pedestrian access in the area:

- Addition of sidewalks on each side of 98th Avenue west of 96A Street to the Muttart Conservatory access road.
- Addition of various sidewalks and shared use pathways around Muttart Stop, primarily north of 98th Avenue and west of 96A Street.

2.3.9 *Connors Road Pedestrian Bridge*

The additional ROW width required by the LRT track along Connors Road necessitates the removal and replacement of the existing pedestrian bridge situated near the bottom of Connors Road. The proposed superstructure is a shallow steel box girder (Figures 2.9 to 2.10). A 1400 mm picket-style railing is proposed. A 1500 mm canopy could be installed above the LRT alignment on either side of the bridge to protect the catenary system.

As currently conceived, rather than following the alignment of the existing bridge, the new bridge will be skewed to the east so that it crosses Connors Road on a north east diagonal. This is intended to provide for the required clearance while allowing the bridge to connect on the south to the existing recreational network in the same vicinity as the existing bridge connection, and reduce the disturbance area. Bridge construction is expected to be completed within one construction season and to be coordinated with other construction activities on Connors Hill. Grades on the bridge are 10% on the south and 3% on the north. The south bridge approach has grades up to 12% and the north approach up to 8%.

2.3.10 *LRT Track and Trains*

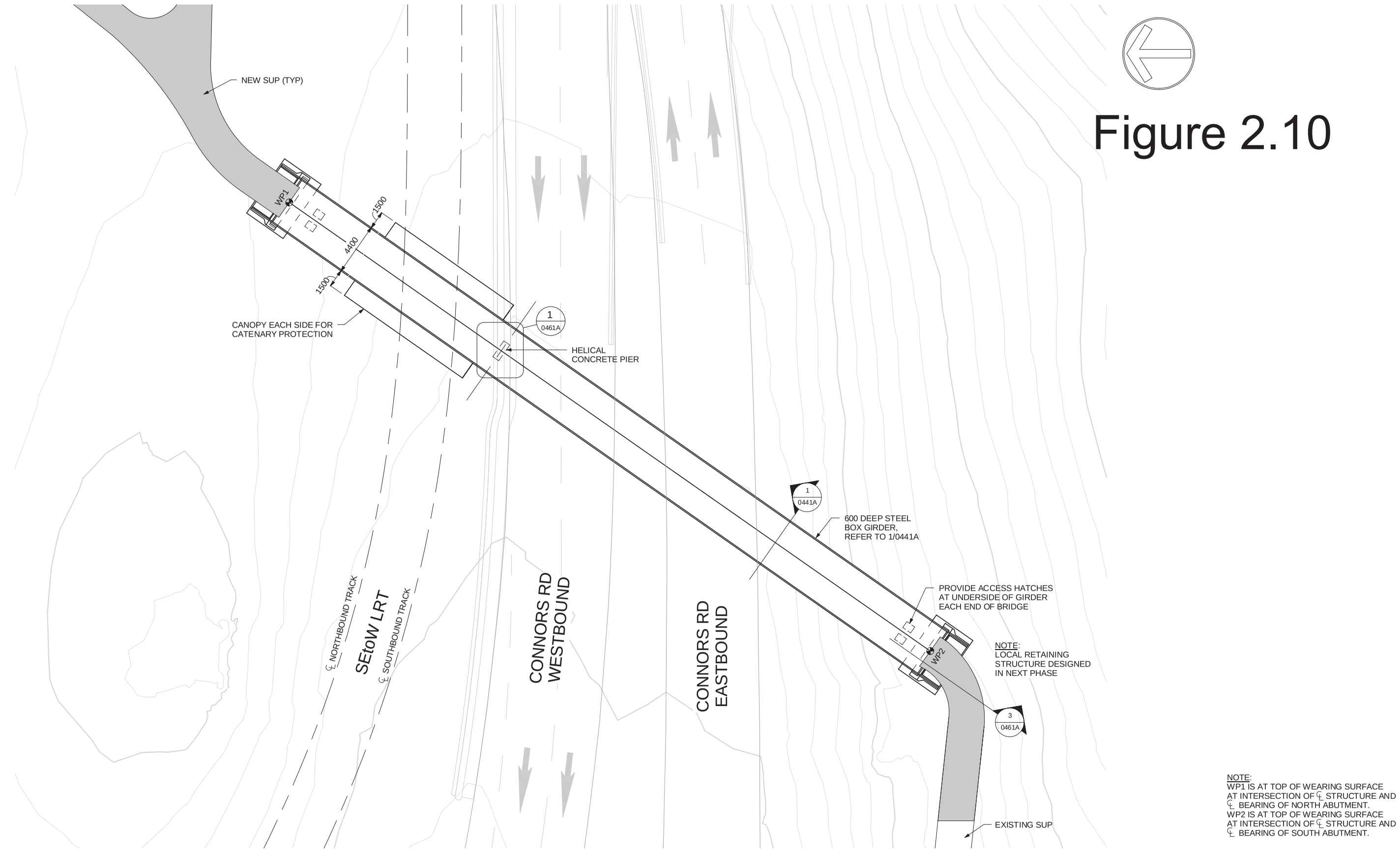
Track

As described above, within the river valley, the LRT corridor has both elevated and at-grade sections. The at-grade track corridor width will be no greater than 10 m. Direct fixation tracks will be used for the LRT within the river valley, rather than embedded tracks. Direct fixation tracks are appropriate where tracks will be supported on grade-separated structures, where there are vertical clearance requirements or where steep slopes are present. All of these conditions are found within the river valley alignment. An additional advantage of this track style, with respect to the park setting, is that it requires less maintenance than other track types.

Figure 2.9
Connors Pedestrian Bridge Rendering

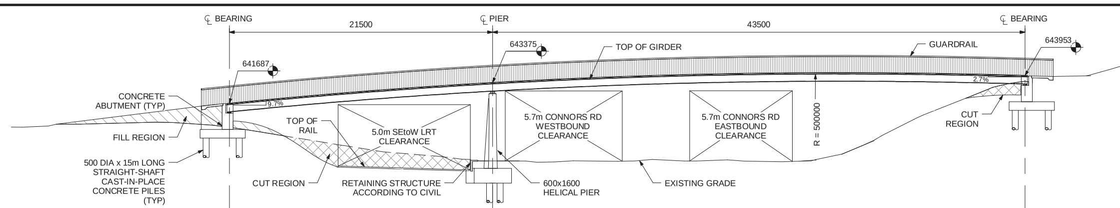
Figure 2.10

	NORTHING	EASTING	ELEVATION
WP1	5934616.771	34516.675	641.687
WP2	5934563.526	34479.392	643.953



1 2400-01 **OVERALL PLAN (STEEL OPTION)**

NOTE:
WP1 IS AT TOP OF WEARING SURFACE AT INTERSECTION OF ℄ STRUCTURE AND ℄ BEARING OF NORTH ABUTMENT.
WP2 IS AT TOP OF WEARING SURFACE AT INTERSECTION OF ℄ STRUCTURE AND ℄ BEARING OF SOUTH ABUTMENT.



2 2400-01 **ELEVATION (STEEL OPTION)**

no.	description	date	appd
C	FINAL PRELIMINARY ENGINEERING	28-03-13	S.A.
B	ISSUED FOR 90% REVIEW	07-12-12	S.A.
A	ISSUED FOR 60% REVIEW	22-06-12	S.A.

issue data

no.	description	date	checked

revisions

DIALOG Consultant

A1 bar scale 1:200 0 2000 4000 6000 8000 10000mm

drawn by N. KEMP | designed by S. PROZNIAK

checked by A. NEILSON | date 28-03-13

permit

seal

consultant job no 01255E0200

consultant reviewed by G. JOSI

AECOM Prime Consultant

The City of Edmonton TRANSPORTATION SERVICES

prime consultant job no 60222337

Hatch Mott MacDonald | ISL Engineering and Land Services | DIALOG | gec architecture

PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

drawing title
CONNORS HILL PEDESTRIAN BRIDGE OVERALL PLAN AND PROFILE - STEEL OPTION

SE to W LRT
MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-0403A | REV No | SHT 072

Trains

The Valley Line-Stage 1 LRT will differ in design and concept from Edmonton's existing LRT line. The existing line features relatively high speed trains and widely spaced stations. The high floor of the existing trains necessitates elevated platforms for access. The Valley Line, by contrast, will feature low-floor, relatively slow moving trains, and closely-spaced stops rather than stations. Because the cars of low-floor LRT trains are low to the ground, they can be accessed via simple stops, which can be as little as a raised sidewalk. This greatly reduces the amount of infrastructure needed to provide access to the trains, and reduces the capital costs of stops, thus facilitating the development of a larger number of relatively closely spaced stops. While the traditional high-floor LRT promotes so-called "suburban" style development, as it can transport people quickly across large distances, the low floor style LRT is intended to promote "urban" development: closely-spaced stops are intended to foster walkable neighbourhoods and densification within developed areas of the city. Additional advantages of the low-floor trains include easier access by riders with reduced mobility, and opportunity for better integration into mature neighbourhoods.

Trains will run through the river valley in intervals of approximately 5 minutes during peak hours and 10-15 minutes during off-peak (evening and weekend) periods, in each direction. Trains are expected to travel up to 60 km/h.

2.3.11 *Stormwater Management Infrastructure*

Stormwater management for the project has been developed to the predesign stage only, and must be reviewed and advanced in concert with detailed design of other project components. The stormwater management goal for the Valley Line-Stage 1 is to provide a high level of stormwater management servicing to the new LRT system such that potential impacts of stormwater runoff on LRT operation are minimized, and the level of service currently being provided by existing systems is maintained. Stormwater management predesigns recommended for the river valley LRT infrastructure, as described below, all seek to maximize use of existing infrastructure. All predesigns are compatible with the Edmonton Drainage Services operating principles, which include maximizing environmental protection. Stormwater predesigns have been developed for the following river valley components of the project: north valley wall portal structure, river bridge, Muttart Stop, Connors Hill and rail corridor. Some designs are LID and all components incorporate Best Management Practices such as vegetated swales with checkdams, or end of pipe treatment. At this point in design, individual footprints of the SWM detention facilities have not been identified, rather the design event is noted in the text and the features are shown conceptually sized and located on figures. On this basis, the design team expects that the features can be accommodated within the project area delineated on Figure 2.2. Design for all drainage components will be advanced in future, in tandem with alignment design.

North Valley Wall Portal

Drainage through the LRT portal on the north valley wall is expected to be minimal, but small quantities of snow melt from vehicles, groundwater seepage, and portal/tunnel wash water will collect in the portal and require draining. This water will be routed to a rain garden to be located on City property a short distance from the portal and bridge structural elements to ensure protection of those elements from possible saturated soils. Rain gardens, usually small, are landscaped detention facilities with engineered soils that are used to improve stormwater quality, reduce runoff volumes and generally facilitate infiltration of cleaned water. Rain gardens are sited ideally close to the source of the runoff and serve to slow the stormwater as it travels downhill, giving the stormwater more time to infiltrate and less opportunity to gain momentum and erosive power.

The Reference Design locates the rain garden as shown in Figure 2.1. Any water in excess of the capacity of the rain garden will flow down the valley slopes to the river, much as surface flow does now. Total volumes are expected to be minimal.

River Bridge

The LRT bridge deck will have deck drains to the river. Bridge deck runoff is likely to contain sediment and may contain small amounts of contaminants carried by trains. Recognizing that Fisheries and Oceans Canada and Alberta Environment have identified discharge of deleterious substances to the river as unacceptable, the deck drains will be fitted with grit traps to filter out sediments. This system can accommodate runoff up to the 1:5 year event. During major events, the bridge will shed excess runoff directly into the river. The pedestrian bridge will generate lower volumes of water owing to its position under the LRT deck and will not have deck drains.

Muttart Stop and TPSS

Muttart Stop is at a low point on the alignment, and all runoff on the approach of the elevated guideway and the lower part of Connor's Hill will drain to this area. In addition, the Muttart Stop introduces a larger impermeable area that will generate runoff. Drainage design for the Muttart Stop and approaches has thus been driven by the need to prevent ponding along the top of rail in this low area and on sloped track, where maintaining maximum traction is crucial for train operation. Design objectives included providing treatment for stormwater before it is released into the City's storm sewer system.

The Reference Design indicates that runoff in this catchment will be captured and conveyed along the alignment, into a swale located near the stop, and discharged into a new stormwater management facility (a rain garden) to be located in the vicinity of the Muttart Stop (Figure 2.1). The facility will be designed to accommodate flows from the 1:5 year event and will enable percolation into the subgrade. Runoff in excess of the 1:5 year event will be redirected via overland flow into adjacent parkland to the south and southwest of the alignment, mimicking existing flows. This system is expected to limit the top-of rail track ponding to a maximum of 100 mm, thus providing acceptable service.

LRT Track at Connors Hill

The rail corridor will increase the amount of impermeable surface on the hill. In addition, major drainage from the top of bank in the Strathearn Neighbourhood is currently directed down Cloverdale Road. Construction of tracks through the intersection of Cloverdale and Connors roads has potential to create a barrier to this flow route, and to redirect water along the tracks down Connors Road. This would represent a significant increase in the amount of runoff directed down Connors Road and would require management.

The proposed drainage system for this area will redirect drainage to the outer curbs of the track right-of-way. Drainage inlets designed to accommodate a 1:5 year storm event will prevent ponding and the track corridor will drain to underground pipe. Runoff from this section of the track and roadway will be directed into pipes and then into the stormwater management facility near the Muttart Stop. Assuming that the new road ROW will be sloped to drain to the south, the 1:100 year event in this area will be directed down Connors Hill, into a new swale located along the south edge of the road, on the lower hill only, and into a new stormwater management facility (likely a dry pond) currently conceptually located at the base of Connors Hill (Figure 2.1). The pond would drain to the existing City storm sewer system and would have check dams to provide retention (and some treatment) to avoid overwhelming the existing system and would release at a controlled rate. The pond would receive flows during all events and would thus be designed to have a low flow channel that would be permanently wet/moist. The design, location and size of the pond will be finalized in the next design phase. Pond size is dependent on final track design and whether or not that will result in diversion of water from Cloverdale Road, as described above. If that runoff is not diverted, the pond would be significantly smaller than the one shown in Figure 2.1. If the final ROW cross section dictates drainage across the ROW to the north, the new pond would be located adjacent to and merging with the Muttart Stop rain garden. Runoff would be directed there by way of a swale along the north side of Connors Road or an upgraded pipe installed underneath Connors Road.

2.3.12 *Utility Installation and Relocation*

Several utilities existing in the study area must remain in operation during and after construction and will, therefore, require protection in place or relocation. Wherever feasible, utility relocation will be undertaken by the owner/operator prior to the P3 contract coming into effect. Utility owners will be responsible for any Bylaw 7188 environmental review associated with these relocations.

The LRT project will require installation of the following new buried and above-ground utilities (excluding drainage).

- Communications
  - Phone lines
  - Fibre optic lines
  - Telephone/cable TV line

- Electrical
  - Power line
  - Street light cable
  - Power duct

  - Traffic light transit pole
  - Light standard/transit pole/traffic light

- Traffic signals
  - Underground traffic signal conduits
  - Signal fixtures
  - Above ground detector
  - Traffic signal
  - Traffic signal splice box

Design details are unavailable at this time.

2.3.13 *Built-In Mitigation Measures*

Adding LRT within the context of existing natural and developed parkland in the heart of the City will affect natural systems, and recreational and cultural facilities. Early planning recognized that these impacts will require mitigation, and several "built-in" mitigation works have been incorporated into project designs. These include:

- Relocation or restoration of the Rose Garden in Louise McKinney Park.
- Relocation of the Centennial Garden, a project initiated by the Edmonton Horticultural Society and located in HME Park.
- Plans to relocate the entrance sign to the Muttart Conservatory.
- Relocation or replacement of affected garden beds in the Muttart Conservatory grounds.
- Plans for a new entrance plaza and pedestrian access from the Muttart Stop to the Muttart Conservatory.
- Planned relocation of lift(s) at the Edmonton Ski Club, affected by the nearby LRT ROW. (To be undertaken by the ski club but funded by this Project).
- Recreational pathway realignments to ensure that the project does not result in any long-term losses to the river valley pathway network.
- Retaining wall treatment requirements.

Most of these measures are described in more detail in later sections of this report. Following is additional information currently available for pathway realignments.

The City recognizes that construction of the LRT will cause considerable disruption to the recreational pathway system (SUPs and other pathway types) in the project area. Temporary pathway closures and realignments will be necessary in some areas and LRT D and C is committed to ensuring that the project will not result in any permanent losses of pathway connectivity. For example:

- The pathway that runs northwest of the Muttart greenhouses and through the Muttart grounds conflicts with the LRT alignment and will require some shifting. Relocation details are in preparation and will be finalized during detailed design.

- While construction of the river bridge will disrupt the existing connection across the river, the new LRT river bridge will include a pedestrian/bicycle component that will provide the same services as the existing bridge. The existing pedestrian bridge over 98th Avenue will remain in place.

- Construction of the tunnel portal on the north valley wall will likely necessitate some temporary realignment of the pathways in Louise McKinney Park. Realignment planning is underway.

LRT D and C commits to ensuring that all existing pathways will be re-established or realigned such that the new system maintains or exceeds current service. Additional information on pathway enhancements planned as part of this project is provided in Section 6.2.3.11.

2.3.14 *Edmonton Design Committee Review Process*

Project designs have been subject to review by the Edmonton Design Committee (EDC), a Committee to Council that advises on projects within the river valley, major entrance corridors and all city funded projects, working towards the betterment of the design of these projects and City of Edmonton as a whole. The EDC is typically involved in the Development Permit review of design drawings for structures within a City owned project. The Committee considers three overarching urban design principles:

- **Principle A - Urbanism –** Strive to create and restore the existing urban fabric within the metropolitan region, create real communities and diverse districts, conserve the natural environment and respect Edmonton's built legacy.
- **Principle B - Design Excellence –** Exemplify design excellence by incorporating, translating and interpreting all three design principles to the greatest extent possible, consistent with best contemporary practices.
- **Principle C – Scale, Connections and Context –** Demonstrate appropriate scale, integration of design elements and fit within the context of the precinct.[1]

Projects presented to the Committee must demonstrate that they meet these design principles.

The design team has met with the EDC on two separate occasions (July 17, 2012 and January 15, 2013) for informal presentations (in camera) about the project. The first meeting introduced the vision and design principles as well as the ongoing public consultation process. The second meeting provided results of the public consultation process and how stakeholder input was being addressed in design of stops, stations and the North Saskatchewan river bridge. A third meeting is in preparation. At this meeting the SE to West LRT team anticipates presenting the current preliminary designs for the Valley Line-Stage 1 corridor, including Wagner Station, typical stops, typical corridor

[1] Edmonton Design Committee Principles of Urban Design
http://www.edmonton.ca/city_government/documents/Principles_of_Urban_Design.pdf

landscape and other structures. Information about the P3 procurement process will be provided as well as how this process may affect the role of the EDC. This may be followed by a fourth and final meeting.

2.4 Project Area

In support of preparation of this EISA, preliminary design included delineation of a project area that could reasonably accommodate the need for construction access points, staging, other temporary work areas, and final infrastructure as required by the Reference Design. This area is shown in Figure 2.1. This project area is considerably larger than the lands that will be permanently occupied by LRT surface infrastructure because certain construction activities, such as installation of shear walls on the north valley slope and retaining walls along Connors Road and at Muttart Stop, would require relatively large work areas. These additional work areas will be temporary and will be subject to reclamation as part of the project. The project area accounts for the current uncertainty surrounding the Connors Road alignment, and has been developed to capture predicted land impacts resulting from both the north and south options under consideration. Thus, the project area along Connors Road will decrease in size once a final alignment is chosen. Construction worker vehicle parking will be limited to pre-approved areas to be determined by the City during construction planning and contract negotiations.

The delineated project area does not include potential construction access routes *to the* project area. These routes remain undetermined and will be established by the P3 Contractor as part of their project planning, although probable routes through neighbourhoods are shown on Figures. Additional access routes must be approved by the LRT D and C in consultation with Community Services. South of the river it is a near certainty that access to the delineated work areas will involve 98th Avenue and Connors Road. North of the river, the contract documents will identify Cameron Avenue and Grierson Hill as the primary north valley access route. The portion of the construction access in Louise McKinney Park (between Cameron Avenue and the main project area) will require some modification to support the required loads and traffic volume. For this reason, and because it overlaps with the permanent maintenance access road, that portion of the construction access road is shown as within the project area. This assessment assumes the above-described construction accesses but also assumes use of existing access roads and/or one SUP within Louise McKinney Park, to be used as a secondary access route.

The delineated project area excludes the disjunct, conceptual location identified for the dry pond (and swale) that may be required at the base of Connors Hill (Figure 2.1); however, should final design require this pond, construction activity will also occur in this area. Impacts associated with construction in this area are assessed in later document chapters. Design of this feature, and drainage in general is less advanced, therefore, the location of this feature is less certain. The need for this facility must be verified during detailed design. The alternate location for the dry pond is near the LRT TPSS at the Muttart Stop. The project area shown on Figure 2.1 accounts for that alternate location.

Finally, most of the items identified as built-in mitigation measures, such as landscaping in the vicinity of Muttart Conservatory and potential temporary pathway relocations are not included in the delineated project area as they are smaller in spatial scale, very site-specific and described in more detail in the mitigation sections of this document.

The P3 Contractor will be encouraged to find ways to minimize the project footprint, temporally and spatially. Some possibilities are incorporated here in later chapters as select mitigation measures and the Contractor will be asked to consider this in their proposed project innovations.

2.5 Project Phases

Following are brief descriptions of the anticipated activities in the various project phases: site preparation, construction, landscaping/reclamation, and operation and maintenance.

2.5.1 *Site Preparation Phase*

In addition to pre-construction planning requirements, such as preparation of technical plans including trail detours and vehicle traffic accommodation plans, standard site preparation activities to be undertaken by the Contractor will include but may not be limited to:

- in field delineation of construction staging/laydown areas and construction access/haul routes,
- remaining utilities relocation and protection (if required),
- installation of temporary erosion and sediment control measures, and
- vegetation clearing.

Site preparation activities will be carried out beginning in 2015. Depending on how the work is scheduled with respect to geographic area (e.g. north valley wall, Connors Hill, etc.), site preparation could be undertaken in various locations within the project area throughout 2015 to 2018.

The City may undertake some more minor site preparation activities before 2015 to protect select park resources known to be affected. For example, rare plant translocations, if required will be undertaken prior to project turn over.

2.5.2 *Construction Phase*

Following are additional significant activities that will be part of the construction phase of this project and will be undertaken in support of the key components described above:

- Demolition - Cloverdale pedestrian bridge
- Demolition- Connors pedestrian bridge
- Demolition – Muttart storage building
- Vehicle traffic management/road closures
- Concrete pours
- Significant earthworks

The following sections provide more information on the nature of these activities.

2.5.2.1 Demolition - Cloverdale Pedestrian Bridge

The Cloverdale pedestrian bridge, constructed in the mid-1970s, is a three-span truss bridge with an open top and sides, a timber deck and metal and timber handrails. It provides for pedestrians and cyclists and has two dedicated viewing areas, with benches. Lighting is provided at both ends and at intervals along the bridge. The bridge has three instream concrete piers, one of which is situated near the middle of the river. A local drainage catchbasin and outfall is located on north bank west of the bridge and some surface and subsurface electrical utilities are in the vicinity of both bridge abutments. All of these will likely be removed during demolition. Abutment piles are expected to be removed to an acceptable depth, one that avoids future conflict and minimizes sub-surface disturbance.

Bridge demolition will likely be one of the first activities initiated at the river and will involve significant access through adjacent parks. The method of bridge demolition is not yet known. Development of demolition methods will be the responsibility of the P3 Contractor. Demolition planning is likely to be coordinated with bridge instream construction planning since synergies may exist for the instream work associated with each activity. The Contractor will be required to integrate any instream berms proposed for demolition into the ensuing bridge construction plans to minimize berm number, size and duration of berms in the river. Following is a description of a probable demolition scenario.

Demolition will likely begin with removing the mid-span bridge sections, followed by removal of the north and south end-spans. Containment will be required such that no debris will be allowed to enter the water or streambed. Containment and waste disposal will need to comply with all federal and provincial environmental regulations.

Pier removal will likely involve construction of temporary berms and one or more suspended platforms. Piers will be removed to the depth required by permitting authorities. The removal of the mid-stream pier will involve instream work in an area that will not be disturbed by new bridge construction.

The P3 Contractor will be required to develop a detailed demolition plan that demonstrates adequate protection of aquatic resources. The plan will be reviewed by the City and by provincial and federal regulators. Specific demolition protection measures are not covered in this EISA.

The Contractor will be asked to consider opportunities to reuse bridge component parts or materials and to consult with the City about this during demolition planning.

2.5.2.2 Demolition - Connors Road Pedestrian Bridge

The existing Connors Road pedestrian bridge is a two-span truss bridge built in the 1980s (Thurber Engineering 2012a) with a wooden deck and metal, picket-style railing. It provides a route across Connors Road for pedestrians and cyclists, and connects to SUPs on either side of the road. The single pier is located south of the road, near the south abutment of the bridge.

As with the existing river bridge, methods for bridge demolition are not known. Demolition and construction may be scheduled such that they coincide with the realignment of Connors Road, when the road will be closed to traffic. A hazardous materials assessment will be undertaken prior to bridge demolition. Bridge components will be recycled to the extent possible. Demolition may require some minor excavation to remove bridge abutments.

2.5.2.3 Demolition - Muttart Storage Building

The existing Muttart storage building, located south of the conservatory greenhouses, must be demolished to allow for the construction of the Muttart TPSS.

According to Muttart Conservatory Operations, the existing building is approximately 15 m x 50 m (+/-). At present, half of the building is used as a workshop for the Branch Fitness Team. The other is dedicated space for Muttart Conservatory Operations and used for storage of large items such as props used in the Feature pyramid, soil storage, etc.

This storage facility will be replaced by a similar building, of similar square footage, in the same general location, but with some shifting occurring to allow for the presence of the TPSS and utilities compound. The TPSS and storage buildings are expected to be of a similar style to provide for suitable aesthetics.

The Muttart Conservatory will be required to make alternate storage arrangements for the duration of building demolition and replacement. All demolished materials will be disposed of appropriately at approved facilities. Materials will be recycled to the extent possible.

2.5.2.4 Vehicle Traffic Management/Road Closures

North of the river, traffic management will be required along Grierson Hill and Cameron Avenue (and possibly feeder roads into these) to accommodate periods of significant construction traffic. South of the river, traffic management will be required along 98 Avenue, 96 A Street, and on the Muttart Conservatory Access Road and Connors Road. . Connors Road and the Muttart Conservatory access road will be fully closed for select periods of time to accommodate road realignment and other work. Work on the Muttart Stop and the Muttart access road will affect access to the rear entrance of Muttart and provision of an alternative and equally functional access arrangement will be a construction requirement. Details around traffic management will be developed during the next project phases.

2.5.2.5 *Concrete Pours*

Bridge piers, super structure, track corridors, and possibly other structures, such as retaining walls, and portal structures will require significant volumes of cast-in-place concrete. Large concrete pours involve high truck traffic volumes for select periods and will require access from both sides of the river.

2.5.2.6 *Significant Earthworks*

The following project components will require significant earthworks: installation of shear walls (or equivalents), installation of retaining walls near Muttart Stop and at Connors Road, and installation of temporary river berms to allow existing pier removal and new construction. Installation of shear walls and retaining walls are significant tasks that require relatively large areas of surface disturbance, sub-surface work and specialized equipment. Work will occur over many months, may create significant truck traffic and certain aspects will generate considerable noise. River berms are anticipated to be significant structures that will require importing large volumes of clean fill and riprap, if standard berms are employed. This work will generate significant truck traffic for a period of one to two months during installation and removal of each berm.

2.5.3 *Landscaping/Reclamation Phase*

Landscaping, reclamation and restoration of natural, semi-natural and manicured areas will be required following construction and will be initiated in a staged fashion as soon as construction of each component piece is complete. As part of preliminary engineering, preliminary landscaping plans were developed for some semi-natural and manicured areas within the study area; reclamation and restoration planning, required in certain areas, is less advanced at this point. More detailed reclamation and restoration plans will be developed by LRT D and C over the next year in accordance with principles established in the mitigation sections of this document and in the preliminary landscaping report. These plans will be reviewed by Community Services and Office of biodiversity and their impact reflected in the final plans/specifications provided by the P3 Contractor.

2.5.4 *Operation and Maintenance Phase*

Operation and maintenance of the new LRT line will be conducted by the P3 contractor for a period of 30 years following the completion of construction. The lifetime of structural components is expected to be approximately 100 years. During operations, trains will run through the study area in intervals of approximately 5 minutes during peak hours and 10-15 minutes during off-peak (evening and weekend) periods, in each direction. Trains are expected to travel at speeds up to 60 km/h.

Operational noise levels of trains are subject to the City's *Urban Traffic Noise Policy*. The policy limits noise levels in outdoor amenity areas to 65 dBA 5m from a property line. If feasible, maximum noise levels of 60 dBA will be targeted.

Regular track maintenance activities will include track corridor sweeping and snow clearing as needed. Train maintenance will be undertaken outside of the river valley at the Operations and Maintenance Facility, except in emergency circumstances.

2.6 Construction Protection Measures/Waste Management

Responsibility for construction protection measures will lie with the P3 Contractor. The Contractor will be expected to prepare a comprehensive Environmental Management System, compliant with ISO 14001. This will include an Erosion and Sedimentation Control Plan of the highest standard developed by a Certified Professional in Erosion and Sediment Control. As part of this, the Contractor will be responsible for handling of all waste material generated by construction and operation. Specifically, the Contractor will be required to meet or exceed waste management practices specified in Enviso, the City's Environmental Management System. The Enviso 'Contractor's Environmental Responsibilities Package' specifies several requirements with respect to waste management. Hazardous waste must be managed in accordance with applicable provincial legislation and best management practices. All waste must be disposed of at approved facilities. Contractors are also required to reduce waste and divert materials from landfills. Material recycling and litter control are required (City of Edmonton 2013). The Contractor must also follow any federal conditions regarding waste management practices that may be attached to receipt of federal funding and will be obliged to follow all federal and provincial waste management laws, policies and best management practices.

2.7 Project Schedule

2.7.1 Overall Schedule

At the time of writing, construction of the Valley Line-Stage 1 is scheduled to begin with contract award in 2015, and is anticipated to take four years. That schedule would have the Valley Line-Stage 1 operational in 2019. It is expected that construction in the river valley will be ongoing during this entire period and it may involve simultaneous construction of any of the above-noted components. The P3 Contractor will be expected to develop a detailed construction schedule for submission to the City for approval, prior to initiation of any work.

Timing of certain construction activities in the NSRV will be restricted by environmental policies and regulations. The NSR at the project area is classified as a Class C water body with a restricted activity period of 16 September to 31 July. This will dictate when the proponent can build isolation works in the river.

Because of this, bridge construction is on the critical path for project delivery. A possible bridge construction schedule, assuming use of conventional methods and following the Reference Design, is as follows:

- Year 1 (2015): construct lower pile wall (or equivalent) on north bank, place berms on north and south bank for pier removal and construction, and remove existing north and south piers, construct north and south river piers.
- Year 2 (2016): begin construction from north and south piers of concrete girders, cables (north pier only) and walkways. Construct piers between south bank and 98th Avenue.
- Year 3 (2017): complete construction of concrete girders, cables and walkways from river piers, construct girders between south bank and 98th Avenue, and construct girders over the north bank. Portal structure construction should be complete at this point. Remove berm from north bank; extend south berm in order to remove the centre pier of the Cloverdale pedestrian bridge. Remove south berm.
- Year 4 (2018): Construct safety barriers and lay track on main deck, construct SUP; landscaping.

Construction methods and schedule will, however, be determined in future project stages.

2.7.2 *Construction Working Hours*

In accordance with the City of Edmonton Community Standards Bylaw (14600), construction will be restricted to the hours between 7:00-22:00 from Monday to Saturday, and 9:00-21:00 on Sundays and holidays. Special permission may be granted by the City, upon request, to operate outside of these standard hours.

2.8 Alternatives Considered

The following is a brief summary of alternative project designs considered during the preliminary design phase, but rejected for various reasons, including unacceptable environmental implications. These examples are intended to demonstrate that environmental considerations informed preliminary design decisions.

2.8.1 *Portal Structure TPSS*

A TPSS is required in the vicinity of the portal structure. Various alternative locations were considered, including siting the substation within the river valley, near the portal structure mouth. Ultimately, a location near the top of bank, outside of Bylaw 7188 boundaries, was selected in the interest of reducing the visual impact and the number of structures situated in the river valley.

2.8.2 *New River Bridge*

Eight bridge design alternatives were originally developed. Based on public response, evaluations against the project's Sustainable Urban Integration (SUI) guidelines, engineer reviews, and assessment via a formal evaluation matrix (undertaken in September 2012),the original eight designs were narrowed down to three:

- A three-span single tower extradosed bridge,

- A two-span single tower cable-stayed bridge, and
- A three-span variable depth box girder.

The final evaluation matrix considered numerous engineering and sustainable urban integration criteria, among them geotechnical considerations; the extent and duration of required instream construction; river valley implications - such as visual impact and nature viewing opportunities; and user experience. Some of the evaluated options required more than two piers. This did not match a project objective of minimizing piers in the river.

The single tower extradosed design was selected by the governance board on 02 February 2013 and approved by City Council on 20 February 2013. An advantage of the single tower extradosed bridge is that it does not require a pier founded on the unstable north bank of the river, as would the girder bridge. While the cable-stayed design would have avoided the need to place any piers in the river, the single tower extradosed bridge was determined to be more cost-effective and less visually obtrusive than the cable-stayed design, while still providing a long main span with only two piers in the river.

2.8.3 *Connors Road Pedestrian Bridge*

A reduction of grades to a maximum of 5% for both bridge and approach slopes was deemed desirable to make the bridge conform to the City's recommendations for grades on shared use paths. Full accessibility of this bridge was also raised as a concern at public involvement (PI) sessions. However, the number of switchbacks and extent of tree clearing needed to accomplish this—particularly south of Connors Road—were deemed unacceptable, at the time of EISA preparation. Efforts continue to explore alternative options to reduce bridge and approach grades but these investigations were not complete at the time of EISA preparation.

During preliminary design, various alignments were also considered for the new bridge. The decision to tie in the south abutment at approximately the same location as the existing abutment will result in reduced disturbance to the slopes south of Connors Road.

2.8.4 *Drainage*

Standard options for drainage design were briefly considered, but ultimately, the use of low-impact development (LID) principles was adopted as a drainage design objective. Not all features in the river valley qualify as LID; however, all features incorporate Best Management Practices.

2.8.5 *Aesthetics*

Preliminary engineering included development of a process to identify suitable options, and eliminate unsuitable options, for aesthetic treatments of various LRT components, including benches, stop shelters, light standards, garbage receptacles, landscape plantings and finishes for retaining walls. This process led to identification of recommended options to be carried forward into the P3 procurement phase. For example, a selection of retaining wall and guideway wall facades with a natural stacked-stone aesthetic were identified as acceptable for integration into the river valley's natural environment.

2.9 Alternatives Currently Under Consideration

At the time of writing at least two alignments are currently under consideration by the design team for the Connors Road corridor. One of these is a realignment of Connors Road to the south, which will necessitate slope cuts and retaining walls on the south valley wall. The most extreme alternative north track alignment under consideration calls for Connors Road to remain in place and the LRT corridor to be located to the north of Connors Road. This requires less intrusion into the south valley wall, but impinges on slopes north of Connors Road. Wildlife passage and rare plant concerns in the Connors Road area have been communicated to the design team, and will be considered in final alignment evaluation and selection, as will the results of this EISA.

2.10 Environmental Permitting Requirements

LRT D and C have met periodically with regulators throughout preliminary design and have been tracking environmental permitting requirements. All relevant agencies are apprised of the upcoming project and thus far have not raised any insuperable concerns. Following is an account of relevant legislation and the potential permits required for this project.

2.10.1 *Federal Government*

2.10.1.1 Canadian Fisheries Act

The proposed project requires a new bridge crossing over the NSR, which is an important fish-bearing watercourse. The presence of fish habitat and the potential for adverse effects on a fish of economic, cultural or ecological value within the creek may trigger the need for an authorization pursuant to the *Fisheries Act* by the Department of Fisheries and Oceans Canada (DFO). Changes to the *Fisheries Act* are pending as a result of the federal government’s Bill C-38 and new application processes are expected in early 2013. This EISA will consider the potential for serious harm to fisheries during demolition of the existing bridge, construction of the proposed bridge and other associated works to the extent possible based on the Reference Design. Additional impact assessment and development of attendant mitigation measures for demolition and construction will be required during detailed design.

2.10.1.2 Navigable Waters Protection Act

The *Navigable Waters Protection Act* (*NWPA*), administered in Alberta by Transport Canada has recently undergone changes under Bill C-45 and a new act, the *Navigation Protection Act* (*NPA*) was created. The new Act is expected to come into effect in 2014. Under this *NPA*, a large number of watercourses that are currently considered navigable are expected to be deemed non-navigable; however, the NSR is expected to remain a navigable water body and the new bridge construction and existing bridge demolition is expected to require approval. Transport Canada should be consulted closer when final design is complete.

2.10.1.3 Federal Environmental Assessment

The City has secured partial Valley Line-Stage 1 funding from the federal P3 Canada Fund. Until recently, projects receiving federal funding were subject to the *Canadian Environmental Assessment Act* (CEAA) and the funding agency was required to complete an environmental assessment for the project prior to release of funds. Projects such as this one would typically have been subject to an Environmental Screening. In 2012, CEAA was replaced with the *Canadian Environmental Assessment Act* 2012 (CEAA 2012). The Act now applies only to projects described in the Regulations Designating Physical Activities or those designated by the Minister of the Environment. The Valley Line-Stage 1 does not meet the definition of a Designated Physical Activity and therefore does not require environmental assessment under CEAA 2012. However, we are currently in a transition period and additional CEAA 2012 regulations and protocols are still in development. Whether federal funding agencies will continue to assess environmental impacts of funded projects pursuant to other legislation or policy, remains uncertain at this time. Discussions during late 2012 with P3 Canada Fund staff highlighted uncertainty on this matter. Further, a 2012 application guideline document states that "where applicable, receipt of support through the P3 Canada Fund triggers certain requirements under federal legislation that must be addressed, including but not limited to environmental assessment requirements in accordance with the Canadian Environmental Assessment Act"[2]. The date of the document suggests that this point does not reflect the new Act. Therefore, the need for any kind of federal environmental assessment must be clarified with the P3 Canada Fund office through continued consultation. Under the former Act, this EISA would have provided much but not all of the information required to satisfy a federal review. Under a new protocol, there may be some deficiencies and, importantly, this document does not cover the full length of the funded project. Other studies undertaken as part of preliminary engineering for the larger Valley Line-Stage 1 project would provide some if not all of that additional information.

2.10.1.4 Other Applicable Federal Legislation

Environment Canada administers the *Migratory Birds Convention Act* (*MBCA*) and the *Species at Risk Act* (*SARA*). Those Acts provide guidelines for enforcement only; neither the *MBCA* nor the *SARA* requires permitting or approvals specific to the proposed project. Violation of these Acts may, nonetheless, result in penalties. This EISA provides information that facilitates the proponent's compliance with those Acts.

[2] PPP Canada. 2012. PPP Canada: Application Guide and Application Form. Round Four | April-June 2012. Government of Canada. Ottawa, Ontario.

2.10.2 *Provincial Government*

2.10.2.1 Alberta Water Act

The *Code of Practice for Watercourse Crossings* under Alberta's *Water Act* applies specifically to the replacement of the existing bridge. The *Code of Practice* outlines conditions and recommendations for environmentally-sound construction, placement, installation, maintenance, replacement or removal of all or part of a watercourse crossing structure, or any activity associated with those works. Specific conditions of the *Code of Practice* are dependent upon the classification of the water body. According to the *Code of Practice for Watercourse Crossings* St. Paul Management Area Map, the NSR is mapped as a Class C waterbody in the project area (Alberta Environment 2006). The river is subject to a restricted activity period extending from 16 September to 31 July to protect critical periods for spring and fall spawning fish species known to inhabit the NSR.

Provided mitigative conditions applicable to the type of watercourse crossing are met, only notification to Alberta Environment and Sustainable Resource Development is required for the river crossing work. However, the appropriate mitigation and design measures must be incorporated into the project design, including an ESC plan. Some of the information in this document will support the *Code of Practice* notification but additional information that can only be generated during or following detailed design will be required.

For construction activities on the river banks (e.g., bank recontouring and armouring) that extend beyond the width of the new bridge (i.e., beyond the bridge crossing footprint), *Water Act* approval may be required.

2.10.2.2 Alberta Environmental Protection and Enhancement Act

Stormwater drainage and management facilities are regulated by Alberta's *Environmental Protection and Enhancement Act* (*EPEA*). Construction of facilities such as storm ponds may require approvals under *EPEA* but, depending on design and connections to the existing system, they may be absorbed into the City's existing approvals.

2.10.2.3 Alberta Public Lands Act

The bed and shore of permanent and naturally-occurring bodies of water are owned by the province pursuant to the *Public Lands Act*. The bed and shore of the NSR and the now-abandoned former channel of Mill Creek are both Crown-owned. Elements of the proposed project (e.g. bridge piers and bank armouring) will occupy Public Lands, which will require approval or amendment of existing approvals. The project will also require temporary works (e.g., instream berms) in the riverbed and on the shores and could potentially require temporary works in the former Mill Creek channel. Both activities would require Temporary Field Authorizations pursuant to the *Public Lands Act*.

2.10.2.4 *Alberta Wildlife Act*

The Alberta *Wildlife Act* prohibits disturbance to a nest or den of prescribed wildlife species. Although permitting is not required under that *Act*, violations may result in fines. The potential to impact nests or dens is addressed in this EISA to enable this issue to be tracked through project planning. Additional investigations, such as searches for nests and dens, may be required closer to construction initiation. Results of all nest searches will be submitted to City of Edmonton Urban and Environmental Planning.

2.10.2.5 *Alberta Historic Resources Act*

Any development with potential to disturb historical and paleontological resources requires clearance by Alberta Culture, Historic Resources Management Branch, pursuant to the *Historical Resources Act*. For this project, the Province requested an Historic Resources Impact Assessment (HRIA) and a paleo-HRIA in select localities. These were completed and submitted to the Province for review. Results are reported later in this document. The Province's decision is pending.

2.10.3 *Municipal Regulatory and Permitting/Review Processes*

2.10.3.1 *North Saskatchewan River Valley Area Redevelopment Plan (City of Edmonton Bylaw 7188)*

The North Saskatchewan River Valley Area Redevelopment Plan (NSRV ARP) governs development within a defined plan area. Any City project proposed for lands within that area must undergo an environmental review. The review process is administered by City of Edmonton Sustainable Development, Urban Planning and Environment, who determine which of the three levels of review will apply. In this case, Urban Planning and Development has determined that the proposed river valley project components are considered to be a "major new development" and thus the appropriate level of environmental review is an Environmental Impact Assessment (EISA). The river valley crossing is the only section of Valley Line-Stage 1 that intersects in any way with NSRV ARP lands. Terms of Reference for this EISA were developed in consultation with Sustainable Development and Parks.

2.10.3.2 *The Way We Green*

The Way We Green is the City of Edmonton's updated, long-term environmental strategic plan, pursuant to the City's overarching strategic plan *The Way Ahead*. *The Way We Green* sets out principles, goals, objectives, policies, and approaches for the City of Edmonton to preserve and sustain its environment. The plan outlines 12 goals that describe what ultimately must be achieved for the City to be sustainable and resilient with respect to its environment. *The Way We Green* includes a particular emphasis on the natural environment and sustaining healthy ecosystems but also emphasizes increased use of public transit and transit supportive planning.

2.10.3.3 Parkland Bylaw 2202

Project activities will occur within NSRV parkland. The City of Edmonton's *Parkland Bylaw 2202* regulates the conduct and activities of people on parkland and protection of the environment in all City parks, including the NSRV. Pursuant to Bylaw 2202, disturbance to natural areas, utilization of construction laydown areas, interference with other park users and motor vehicle access are restricted. It is anticipated that upon approval of the proposed project, LRT D and C or the City Manager, will develop a process for granting the selected P3 Contractor an exemption to Parkland Bylaw 2202, conditional upon development of an approved detailed Staging Area Agreement prior to construction onset. The agreement would cover such aspects as hazardous materials storage, staging area size, access, security, utilities hoarding, tree hoarding, public safety measures and construction staff parking. The scope of agreement would be based on contract procurement documents and discussions with Parks.

2.10.3.4 Community Standards Bylaw (14600)

Part III of the City of Edmonton's *Community Standards Bylaw 14600* establishes construction working periods (0700-2200 hours Monday to Saturday; 0900-2100 Sundays and holidays) and acceptable noise levels (not to exceed 65 dBA). Exemptions are, at times, granted.

2.10.3.5 Corporate Tree Management Policy (C456)

All ornamental trees and natural treed areas on City-owned property are the responsibility of Edmonton Parks Branch (including procurement, maintenance, protection and preservation) pursuant to the City of Edmonton's *Corporate Tree Management Policy C456*. That policy states that where damage to, or loss of City trees occurs, equitable compensation for that loss will be recovered from the entity causing the damage or loss and applied to future tree replacements. All costs associated with tree removal, replacement or relocation must be covered by the P3 Proponent. Compensation amounts are dependent on the type of plant species lost or damaged and are calculated using set formulae or, in some cases, negotiations between City departments. This project will require tree clearing on City-owned lands, thus compensation pursuant to *Policy C456* will be required. As dictated by the Policy, all vegetation clearing and clearing methods/tree protection must be pre-approved by a City forester.

2.10.3.6 Natural Area Systems Policy (C531)

In 2007, City of Edmonton adopted *Policy C531* and a new approach to natural area management. The policy commits the City to conserving, protecting, and restoring the natural uplands, wetlands, water bodies, and riparian areas, as integrated and connected natural systems throughout the City. To that end, the Natural Areas inventory has now been updated (to 2010) and includes both tablelands and river valley Natural Areas. The City is committed to balancing the ecological and environmental considerations of a project with economic and social considerations in its decision-making and will demonstrate that it has done so. This goal requires the procurement of appropriately detailed ecological information about any project that has the potential to affect a City

Natural Area. While many river valley lands intersected by the proposed project have been converted to developed parkland or other land uses, some lands still support native vegetation and are mapped as delineated Natural Areas. These lands are subject to *Policy C531*. The Bylaw 7188 EISA will satisfy that Policy's information requirements for affected Natural Areas within the river valley.

2.10.3.7 City of Edmonton Wildlife Passage Engineering Design Guidelines

In June 2010, the City of Edmonton introduced its *Wildlife Passage Engineering Design Guidelines*. The purpose of those guidelines is to provide transportation designers and decision makers with recommendations that allow the needs of wildlife to be incorporated into transportation projects. Guideline objectives will be met through restoring previously removed habitat connections and ensuring that existing connections remain. The guidelines are also meant to reduce the effects of anthropogenic habitat fragmentation and human-wildlife conflict, including wildlife-vehicle collisions. Although the guidelines present ideal designs for wildlife passage structures, the City recognizes that not all transportation projects will be capable of meeting that standard and will consider alternative structures on a project-specific basis. The wildlife passage guidelines have been considered during design and construction of each river valley LRT project component and attempts made to reduce project impacts on wildlife passage. This EISA will further assess this issue and develop mitigation measures, as required.

2.10.3.8 City of Edmonton Enviso

In 2004, Edmonton City Council approved City Policy *C505* (Edmonton's Environmental Management System) committing the City to establishing an environmental management system (now known as Enviso) based on the international standard ISO 14001 ENVISO provides the city with a systematic method of managing and improving its environmental performance and provides a framework for a strong environmental management system, aimed at legal/regulatory compliance. Edmonton has achieved ISO certification in 10 branches deemed to have the highest environmental risk. The P3 Contractor will be expected to develop an EMS that meets or exceeds Enviso. According to performance specifications set out in P3 contract documents.

2.10.3.9 Sewers Use Bylaw C9675

The release of material, including contaminated runoff, from the construction site into the NSR is regulated by the Sewers Use Bylaw. Part III of this Bylaw prohibits the release of hazardous materials and materials that produce a colour value greater than or equal to 50 true colour units. Turbidity restrictions are also in effect. The release of any material other than that permitted in this Bylaw may result in penalties. Compliance will be achieved through spill prevention measures, erosion and sedimentation control measures and adherence to the City of Edmonton's "Contractor's Environmental Responsibilities Package: Construction and Maintenance" (City of Edmonton 2008). Discharges of groundwater or stormwater into either the sanitary or storm system are only permitted through application to Drainage Regulatory Services.

3.0 METHODS

3.1 General Methods

Following is a summary of the main steps and activities employed in the preparation of this EISA. These were not necessarily sequential steps; many were iterative.

- We participated in Connected Transit Partnership (CTP) design meetings, workshops and presentation held during the period October 2011 to March 2013, to enhance understanding of the project.
- Discussions were held with City of Edmonton LRT D and C personnel regarding project implementation and stakeholder group consultations.
- Discussions were held with City of Edmonton Sustainable Development to identify the appropriate level of environmental assessment, scope of work and issues to be addressed in the EA pursuant to Bylaw 7188 and P3 project implementation, project issues.
- Discussions were held with City of Edmonton Community Services and Office of Biodiversity to identify issues, site-specific information and select potential mitigation measures.
- In October 2011, we convened a round table meeting of municipal, provincial and federal regulators with potential jurisdiction regarding environmental review and approvals to ascertain environmental review scope and permitting.
- We reviewed all public information and group stakeholder materials to the end of March 2013, and incorporated relevant public concerns into the EISA.
- We identified Valued Environmental Components (VECs) for purposes of environmental assessments by referring to City of Edmonton guidelines for the environmental assessment process for river valley projects. Further, we identified VECs by examining the study area and aerial photographs.
- Necessary field investigations, as identified in the concept planning phase of the project, for historical resources, amphibians, breeding birds and rare plants were conducted in autumn 2011, and spring/summer 2012. Detailed information review and field inspections, including mapping of VECs, were undertaken at this time
- We reviewed all pertinent reports on existing biophysical conditions.
- We reviewed all Design Detail Reports and other drawings and memos available to 04 April 2012.
- Based on the descriptions of existing conditions and available design information, the potential impacts were identified, analyzed and rated according to direction, magnitude, duration and predictability.
- Appropriate mitigation measures to minimize potential adverse effects and enhance positive effects were developed.
- We assessed synergies among residual impacts, in order to identify particular measures, practices, approaches or objectives that could effectively mitigate multiple identified impacts.

3.2 Detailed Methods

The following sections provide more detail for select methods used in preparing this EISA.

3.2.1 *Scoping the Assessment*

Following determination by City of Edmonton Urban Planning and Environment that the appropriate level of Bylaw 7188 environmental review was Environmental Impact Assessment, we held discussions with several branch representatives to identify issues, key stakeholders and essential Valued Environmental Components.

As a result of the repealing of *CEAAct* and the promulgation of *CEAAct* in 2012, a federal environmental assessment became unnecessary for a project of this nature. Specific CEAA assessment requirements, not required for Bylaw 7188 assessments, were dropped from the project scope.

Some additional environmental information will be necessary to support permit applications that will occur as part of detail design, therefore consultations with two federal departments remained ongoing: Transport Canada and Fisheries and Oceans Canada.

3.2.2 *Issue Identification*

Key project issues were identified through consultation with the public, with the project team members, with federal, provincial and municipal representatives and based on experience with other projects of similar nature.

Key issues are tracked throughout this document to illustrate the process of examining issues, to determine which are associated with potential impacts and can or cannot be mitigated, which can be resolved with more project information and which were not resolved.

3.2.3 *Selection of Valued Environmental Components*

No environmental assessment can be so broad in scope that it investigates potential impacts on all components of the natural, social and heritage environments. To be effective, investigations must focus on selected environmental features that are considered most important within the context of the proposed development. Three types of Valued Environmental Components (VECs) were identified:

- **Valued Ecosystem Components:** species or features of the natural environment.
- **Valued Socio-Environmental Components:** features of human settlement / development or cultural values.
- **Valued Heritage Components:** sites, paleontological and historic artifacts or structures of our natural and human history.

VECs were selected based on five criteria:

- relative abundance or status,
- public concern,
- professional concern,
- economic importance, or
- regulatory concern.

Relative abundance or species status refers to those resources within the study area that are considered rare, threatened or endangered at a provincial or national level. It can also include those that have a limited distribution or abundance within the local or regional study area.

Resources of public concern include attributes or features that were raised as issues by the public during public involvement sessions or from precedent studies. Professional concerns are related to those features of the environment known to be critical for sustaining the ecosystem, or maintaining social or heritage values within the affected site. In the case of the City of Edmonton's River Valley system, professional concerns might include any resources or features considered an integral component of the river valley as a "Ribbon of Green" and the main corridor in Edmonton Ecological Network, or, an attribute important for maintaining the current quality of life in the river valley system or the adjoining communities.

Lastly, features of regulatory concern apply to resources that have been identified as of special concern by provincial or federal regulatory agencies. These could include parkland and associated tree cover and/or rare or migratory species depending on the project type and location. Selected VECs and the jurisdiction used for their selection for this project are listed in Table 3.1.

3.2.4 *Assessment Spatial and Temporal Boundaries*

The spatial boundaries, or study area, for this assessment are shown in Figure 2.1. Study area boundaries were developed by considering, at a high level, the potential for the project to exert direct and indirect effects on the selected Valued Environmental Components. The assessment recognizes that project access routes will extend beyond these boundaries along established City roads. For some VECS, the study area was contracted or expanded to suit the subject matter. These adjustments are noted in VEC-specific sections of Existing Conditions. Within the study area, for many VECS, the project area (Figure 2.1) comprised the most intensively studied lands, as this is the area expected to be directly physically affected.

Temporal assessment boundaries were set as the anticipated construction period, 2015 to 2018, as this is the phase of the project that is expected to have the greatest environmental impacts. That said, anticipated impacts during the operations phase were also considered.

Table 3.1. Justification for the selection of VECs

Valued Environmental Components	Relative Abundance or Status	Public Concern	Professional Concern	Economic Importance	Regulatory Concern	Trigger
Valued Ecosystem Components						
Geology/Geomorphology		√	√		√	• Bylaw 7188
Soils		√	√		√	• Bylaw 7188
Hydrology Surface Water/ Groundwater		√	√		√	• Bylaw 7188 • Alberta *Water Act*
Fish and Fish Habitat	√	√	√		√	• Bylaw 7188
Vegetation	√	√	√		√	• Bylaw 7188 • Federal *Species at Risk Act* • Alberta *Weed Control Act*
Wildlife	√	√	√		√	• Bylaw 7188 • Federal *Species at Risk Act* • Federal *Migratory Birds Convention Act* • Alberta *Wildlife Act*
Habitat Connectivity	√	√	√		√	• Bylaw 7188
Valued Socio-economic Components						
Land Disposition and Land Use Zoning		√	√		√	• Bylaw 7188
Residential Land Use		√	√		√	• Bylaw 7188
Recreational Land Use		√	√		√	• Bylaw 7188
Utilities		√	√	√	√	•
Worker and Public Safety		√	√		√	• Bylaw 7188
Visual Resources		√	√		√	• Bylaw 7188
Valued Historic Components						
Historical Resources		√	√		√	• Bylaw 7188 • Alberta *Historic Resources Act*

3.3 Description of Existing Conditions

The description of existing conditions provides a current snapshot of the project area, over which the proposed project area and project components can be overlaid to identify potential interactions. For the Edmonton NSRV and associated ravines, environmental conditions are well-documented. A biophysical assessment conducted in 1981 provides a comprehensive overview of the river valley that has since been regularly used in environmental assessments of numerous small and large-scale projects proposed for the river valley (EPEC Consulting Western Ltd 1981). That document formed the basis of many of our descriptions. This information was supplemented and updated with site-specific field studies undertaken within the study area in 2012 and 2013. Specific field methods used for these studies are detailed in VEC-specific sections of Chapter 5. Several other CTP members undertook discipline specific studies such as noise and vibration, geotechnical and contaminant investigations to support design. CTP landscape architects also supported us by providing the foundation for the recreation and visual resources sections. We reviewed these studies and the information was used as required to develop descriptions of study area existing conditions. Finally, City maps, zoning information and other data held by City branches were consulted as required.

Characterization of existing visual resources consisted of observing and photographing the project area from a variety of key, near and distant vantage points, and characterizing the visual quality of the views. This involved consideration of views in summer and winter conditions.

3.4 Impact Analysis

3.4.1 *Potential Impacts*

Potential impacts were identified through the following sequential steps. We developed a matrix with project activities along one axis and VECs along the other (see Section 6) and considered potential interactions between the elements of each axis. Each identified interaction was then analysed with regard to the potential to effect change on the VEC.

Bylaw 7188 recognizes the NSRV as containing lands that will be preserved and enhanced for recreation, scenic and ecological purposes. However, the bylaw also specifically allows for transportation development, setting out a specific transportation objective: to support a transportation system which serves the needs of the City and the Plan area, yet is compatible with the parkland development and the environmental protection of the River Valley and its Ravine System. This guiding piece of legislation and its goals and objectives are foundational to the impact assessment process employed. Thus, this assessment assumes that the existing natural and recreational assets of the river valley are important resources and that change that diminishes those resources is of concern to the City. All identified impacts were described and classified as to their direction (positive, adverse or neutral), magnitude (negligible, minor, or major), and duration (short-term, long-term, or permanent) and the confidence in impact prediction (predictable or uncertain effect) noted. These descriptors were defined as follows:

Direction:

Positive Impact: An interaction that enhances the quality or abundance of natural or historical resources, or social pursuits or opportunities.

Adverse Impact: An interaction that diminishes the abundance or quality of natural or historical resources, or social pursuits or opportunities.

Neutral Impact: An interaction that changes, but neither enhances nor diminishes the quality of natural or historical resources, or social pursuits and opportunities.

Magnitude:

Negligible Impact: An interaction that is determined to have essentially no appreciable effect on the resource. Such impacts are not characterized with respect to direction, duration or confidence.

Minor Impact: An interaction that has an appreciable effect but does not affect local or regional populations, natural or historical resources beyond a defined critical threshold (where that exists) or beyond normal limits of natural perturbation; or, an interaction that slightly alters existing or future recreational pursuits at established facilities or well-used areas.

Major Impact: An interaction that affects local or regional populations, natural or historical resources beyond a defined critical threshold (where that exists) or beyond the normal limits of natural perturbation; or, an interaction that changes the character or precludes existing or future social pursuits at established facilities or well-used areas.

Duration:

Short-term Impact: An interaction resulting in measurable change that does not persist for longer than two years.

Long-term Impact: An interaction resulting in measurable change that persists longer than two years, but at some point dissipates completely.

Permanent Impact: An interaction resulting in measurable change that persists indefinitely.

Confidence:

Predictable Impact: Effects on VEC are well understood through experience in projects of a similar nature.

Uncertain Impact: Effects on VEC are not well understood owing to lack of knowledge of the VEC and/or its response to disturbance.

Project interactions presenting a risk to worker and public safety were not characterized using the above definitions. They were instead assessed in terms of the degree of perceived risk (i.e., likely vs. unlikely to occur). Moreover, the assessment relating to this VEC was limited to those risks directly related to natural resources or proximity to people.

Potential impacts were addressed based on the information presented in the project description. Sound project planning involves building best management practices and mitigation measures into early planning, and this was done in this case. This initial assessment assumes that built-in mitigation measures noted in the project description, such as provision of trail detours, have been applied, but that additional mitigation measures have not.

3.4.2 *Potential vs. Residual Impacts*

In the next step of the assessment, mitigation measures were developed to address the impacts assessed as having an undesirable impact on a VEC. Residual impacts are impacts predicted to remain *after* application of mitigation measures. Residual impacts were classified according to the above impact characteristic definitions, with one exception:

Predictable Residual Impact: Efficacy of proposed mitigation measures is well understood through application in similar projects or circumstances.

Uncertain Residual Impact: Efficacy of mitigation measure is not well understood because of lack of previous experience in similar circumstances or lack of knowledge about the VEC.

3.5 Public Involvement Process

Pursuant to the City's *Public Involvement Policy* (C513), a five stage Public Involvement Process (PIP) has been used to solicit feedback about plans for the (then) SE-W LRT line as design develop. A summary of the process is provided below. The full process is provided in Appendix C.

The alignment has been subdivided into six different areas, and Public Involvement activities have been specifically developed for each area. The project area under consideration in this EISA falls into Area 4: Strathearn to City Centre West. Consultations are being conducted over a two year period, which began in 2011, and is scheduled to conclude in 2013.

PIP design was based on City standards and BMPs for public involvement. Key objectives of the process include the following:

- Inform and consult the public, and provide opportunities for active participation in decision making, where deemed appropriate.
- Build awareness, knowledge and understanding among stakeholders and the public about low-floor LRT.
- Solicit input and feedback from stakeholders.
- Understand stakeholder and public concerns and mitigate issues to the extent possible.
- Build and maintain trusting, respectful relationships among stakeholders, the public, and the City.

The five stages of the process are:

- **Stage 1 – Pre-consultation:** This stage focused on developing the Public Consultation Plan that provides the framework for opportunities for Public Involvement. The plan was based on input and information from the Concept Planning Phase, as well as stakeholder interviews and an online survey. The PIP was also introduced to participants during Stage 1.
- **Stage 2 – Initiation:** This stage consisted of Area Meetings. Objectives of the Area Meetings are to provide background information from conceptual plans to the public, solicit feedback on certain elements of project design, provide information regarding project and PIP scheduling, present information on low-floor LRT, introduce architectural concepts, discuss issues of safety and securing, and examine property requirements and land re-development.
- **Stage 3 – Consultation:** This stage involved a second round of Area Meetings focused on presenting concept designs for each area, including changes to roadway and pedestrian/cyclist access routes, plans for noise attenuation, plans for mitigating safety and security concerns, and to provide overall project updates. Input was sought regarding designs for landscaping, structures, tunnels and changes to transportation networks.
- **Stage 4 – Refinement (ongoing):** Area Meetings during Stage 4 provide opportunities for review and input into proposed designs and key issues identified in Stages 2 and 3. Information was/is presented and input sought for refined concept designs, including changes to transportation networks and plans for noise attenuation.
- **Stage 5 – Conclusion:** This stage is focused on sharing final designs in a public information/open house format. Participants will have the opportunity to review and comment on final designs, and comments received will be posted on the project website.

Opportunities for online participation have been provided in Stages 2-5. In an effort to maximize the accessibility of PI sessions, translation and interpretation services were provided, and physical accessibility was considered when choosing meeting locations.

Stages 2 to 5 presentations included boards informing the public of environmental requirements associated with the project, including the need to undertake a Bylaw 7188 environmental review. Stages 4 and 5 also included three open houses (Table 3.2) at which the consulting team presented project-specific information generated as part of the Bylaw 7188 environmental assessment process. Appendix C includes all environmental assessment boards displayed at PIP sessions.

Table 3.2. Public Involvement Sessions that presented EISA information.

PI Session	Date	Location
Stage 4, Areas 5 and 6	May 14, 2013	Westend Christian Reformed Church
Stage 5, Areas 1 and 2	June 5, 2013	South Edmonton Alliance Church
Stage 5, Areas 3 and 4	June 19, 2012	Old Timer's Cabin

Although the river valley is situated in Area 4, it is considered to be a City-wide resource. Thus, river valley EA information was presented at sessions that targeted all six PIP areas. Public feedback specific to the EA process was solicited by including a specific request to do so on the session comment sheet (see Appendix C), allowing for input to be attached to display boards and encouraging people to provide input on line at the City's LRT website. Feedback collected from stakeholders at public meetings, through online surveys, and email/mail/telephone correspondence has informed this EISA and the final recommended preliminary design of the Valley Line.

Until May 2013, only a few comments relevant to biophysical river valley resources were received during the preceding PIP. Most of those comments were related to wildlife movement or preserving trees and green spaces in the river valley; many more comments were received about the appearance of the proposed LRT components and potential increases in noise. All of these comments have been well documented and summarized in the formal LRT project public consultation reports that are posted on the City's website as completed. All relevant concerns raised in PIP Stages 2 and 3 were integrated into the key issues analysis undertaken for this EISA.

With the additional focus on the EISA process that was included in the May and June 2013 sessions, numerous comments were submitted to the City related to potential environmental impacts associated with the project. Feedback collected from stakeholders at public meetings, through online surveys, and email/mail/telephone correspondence is tabulated in Appendix C grouped according to the following topics: alignment/river crossing; bridge design; Muttart Stop; wildlife; Edmonton Folk Music Festival; ski club; slope stability on Connors Hill; and general. All of the issues/comments provided had already been addressed in varying ways by the draft environmental assessment that was, by that time complete. No other action specific to those comments will be taken. The final EISA will be posted to the City's website in early August.

4.0 KEY ENVIRONMENTAL AND SOCIO-ECONOMIC ISSUES

The following are the key project issues identified for consideration in this EISA, based on professional knowledge, regulatory requirements, and concerns expressed by the City and members of the public. This EISA seeks to clarify these issues and determine if they have potential to be project impacts. In that sense, these issues are foundational to impact analysis. Key project issues are organized by subject area. Brief contextual notes are presented, followed by specific issues, in bold type and in the form of questions. Chapter 7 revisits these issues, presents conclusions about which ones represent actual impacts, and summarizes the steps taken toward issue resolution.

4.1 Valued Ecosystem Components

4.1.1 *Geology/Geomorphology*

The project area is known to include steep unstable or potentially unstable slopes. For example, slopes proposed for works in Louise McKinney Park have a history of instability. Realignment of Connors Road requires cutting into a steep slope; installation of retaining walls; and installation of subsurface support structures for a new pedestrian bridge.

- **Will construction activities on the north bank and north valley wall, including demolition of the existing Cloverdale bridge impact slope stability?**
- **Does slope instability have the potential to affect the structural integrity of LRT infrastructure?**
- **Can the upper south valley wall (Connors Hill) remain stable following construction?**
- **Is there potential for slope stability issues to cause unexpected delays in construction?**

4.1.2 *Soils*

The history of development in the study area suggests that the area supports a combination of fills and native soils. Construction will occur in both and on steep slopes, raising concerns around erosion potential and soil quality. Concerns associated with native soils include the potential for high-quality topsoils, necessary for reclamation, to become unsuitable for revegetation activities. The presence of historical landfills also introduces the potential for the project to intersect with contaminated fill/soils that require isolation and careful handling.

- **Will project activities trigger surface erosion?**
- **Will project activities cause soil compaction, degradation or loss?**
- **Do contaminated soils occur within the project site? Could the project result in mobilization of contaminants or contaminated soils?**
  Will use of staging areas for fuel, lubricants and other supplies pose a risk for soil contamination during construction?

4.1.3 *Hydrology (Surface Water/Groundwater)*

Several aspects of the project have potential to affect river water quality. Construction (isolation works) in the river, in support of bridge demolition and new bridge construction, could have implications for river hydraulics. The new arrangement of bridge piers could result in temporary or permanent alteration of downstream hydrology. A historic landfill is located in the vicinity of the existing and new bridges, creating potential for impact to the river water quality. As with any project, work on valley slopes and instream work creates potential for effects on river sedimentation. Introduction of new infrastructure requires management of increased surface runoff. Specific key issues are as follows:

- **Will the existing river bed, and therefore hydraulics, be permanently altered by placement of fill material for temporary berm construction or by the new pier arrangement?**
- **Will work on slopes in the valley and in the river (for demolition and construction activities) result in release of deleterious substances into the North Saskatchewan River?**
- **Could bridge piers or supporting subsurface structures in the vicinity of the abandoned landfill create preferential pathways for leachate migration?**
- **Will the addition of impermeable surfaces lead to increased runoff and have an adverse effect on existing stormwater infrastructure or river water quality?**
- **Will (new) bridge deck runoff be released into the North Saskatchewan River, resulting in introduction of deleterious substances?**
- **Will LRT maintenance activities adversely affect river water quality?**

4.1.4 *Fish*

The need for demolition and construction work in the river, introduces the potential for alteration to, and possibly degradation or loss of, fish habitat.

- **Will pedestrian bridge demolition temporarily alter river flows and consequently, downstream fish habitat?**
- **Will it be possible to restore fish habitat after demolition and removal of the existing bridge piers?**
- **Will new bridge construction or operation activities introduce deleterious substances into the North Saskatchewan River, either directly or through the stormwater management system, thereby affecting fish habitat?**
- **Will any rare or sensitive fish species be affected by the project footprint?**
- **Will any permanent habitat loss or alteration result from new permanent structures associated with the project?**

4.1.5 *Vegetation*

Clearing of native vegetation and stripping of landscaped areas will be required to accommodate construction work areas, staging and access. Some of that area will permanently support infrastructure but the remainder will be reclaimed to various states.

- **Will the project result in significant disturbance to, or loss of, natural, semi-natural and manicured plant communities?**
- **Will naturally-occurring or ornamental trees on City lands be removed or damaged during construction?**
- **Does the project have the potential to affect rare, threatened or endangered plants or plant communities?**
- **Will vegetation in recognized Natural Areas be affected?**
- **Will the project result in the introduction of or increase in weeds within the river valley?**

4.1.6 *Wildlife*

The downtown river valley supports significant wildlife habitat and, more specifically, many species of wildlife. Construction of the LRT requires removal of some natural habitat.

- **Will critical wildlife habitat be lost?**
- **Will any special status wildlife species be affected by project construction?**
- **Will the project result in wildlife mortality?**
- **Does the project have potential to temporarily or permanently alienate wildlife from available habitat?**

4.1.7 *Habitat Connectivity*

The NSRV is known to be the main spine of Edmonton's Ecological Network and an important regional wildlife movement corridor. LRT infrastructure may involve temporary or permanent reduction in habitat connectivity or blocking of that corridor. Landscaping associated with the project may form new habitat connections. As such, the project has the potential to influence the movement of wildlife through the river valley.

- **Will wildlife movement or habitat connectivity be compromised by construction or operation of the new LRT line?**

4.2 Valued Socio-Economic Components

4.2.1 *Land Disposition and Land Use Zoning*

Within the NSRV, most but not all lands are owned by the City. City holdings can be specific to a City department. Land requirements and land use zoning must be settled prior to project initiation.

- **Will any additional land acquisition be needed to construct the project?**

- **Will land use zoning changes be required?**
- **Will the project cross any other land jurisdictions, requiring right-of-way?**
- **Will any City lessees be affected?**

4.2.2 *Residential Land Use*

In the river valley, the project area and operational LRT will be located very close to some homes within the Quarters, Riverdale, Bonnie Doon and Cloverdale neighbourhoods. Some neighbourhood access roads may be directly affected. Following are the key issues relevant to residential land use.

- **Will construction of the proposed project affect traffic along 98th Avenue or Connors Road?**
- **Will construction of the proposed project affect access to the Muttart Conservatory?**
- **Will construction adversely affect local traffic or local road conditions?**
- **Will any construction activities generate high levels of particulate matter, including dust or airborne contaminants?**
- **Will construction or operation noise adversely affect residents within or at the crest of the river valley?**
- **Will vibrations associated with construction and LRT operation adversely affect local homes or associated infrastructure?**
- **Will the LRT positively contribute to improved air quality in the river valley through a reduction in motor vehicle volumes?**
- **Will the operating LRT and Muttart Stop adversely affect local traffic or parking?**

4.2.3 *Recreational Land Use*

The new LRT line in the NSRV will intersect with several parks, and with the NSR itself, and will take place in the heart of the City's recreational corridor. The area supports local and regional pathway connections both within and outside of the river valley. Many highly-valued recreational activities and programmed events occur in the area, including water-based activities. Key recreational issues are:

- **Will local pathway disruptions during the construction period be suitably mitigated for all users, including those availing themselves of wheelchair accessibility?**
- **Will access to the river, valley parks, the Muttart Conservatory or the Edmonton Ski Club be disrupted during construction and/or operations?**
- **Will the Trans-Canada Pathway kiosk, wishing tree or donor trees or benches require temporary or permanent relocation?**
- **Will gardens be disturbed by construction, and how will this be mitigated?**
- **Will LRT train operations disrupt recreational use in the study area?**
- **Will any long-term losses or alterations to recreational infrastructure occur as a result of the project?**

- **Will construction or operations interfere with special events such as the Edmonton Folk Music Festival and Dragon Boat Festival?**
- **Will bicycle parking be provided at the Muttart Stop?**
- **Will the project result in a loss of green space?**

4.2.4 *Visual Resources*

The river valley provides views from the top-of-bank that are considered locally important, possibly iconic. The introduction of construction and new infrastructure to this part of the NSRV has the potential to temporarily and/or permanently alter these views. The river valley natural areas and landscaping provides pleasing within valley views to park users and nearby residents. The Muttart Conservatory holds special events and attracts many visitors. Views from within the valley and from certain residential areas may also be altered.

- **Will construction activities adversely affect the visual resources of the North Saskatchewan River Valley?**
- **Will the new LRT components affect the quality of views from within the valley or from the top-of-bank?**
- **Will utilitarian infrastructure be screened, and will screening be natural in character?**
- **Will the new LRT components affect the quality of views from residential areas within and outside of the NSRV?**

4.2.5 *Utilities*

Several buried and overhead utilities exist in the project area and the LRT will require installation of new utilities.

- **Will relocation or installation of underground utilities increase the area of disturbance?**

4.2.6 *Worker and Public Safety*

Construction will introduce many incompatible activities in the river valley, including deep excavation, bridge work, in-stream work, above-stream work and work near former landfills. This introduces the potential for hazards to workers. Further, these construction areas will be established within public parks and near established neighbourhoods where public safety must be maintained.

- **Are there any potential interactions between project activities, the project area, and/or identified environmental impacts specific to this project and environment that could create a risk to worker and/or public health?**

4.3 Valued Historic Components

4.3.1 *Historical Resources*

Archaeological and paleontological resources are valued non-renewable resources protected by legislation. Surface and subsurface historical resources must be assessed prior to disturbance and approval to proceed with construction must be issued by the Province. Key issues are:

- **Are historical resources vulnerable to disturbance by the project or has the Province provided historical resources clearance that indicates that resources are not at risk and clears the project for construction?**
- **Do project activities have the potential to adversely impact any undocumented historic (including paleontological) resource sites or artifacts? Will the Province require monitoring of any subsurface construction activities?**

5.0 EXISTING CONDITIONS

The EISA study area comprises a mixture of parkland, residential neighbourhoods, low intensity recreational amenities, high-profile recreational facilities and transportation arteries. Being located adjacent to the city centre, the study area falls within a highly-visible and highly-valued section of the NSRV. The study area also contains natural plant communities, provides wildlife and fish habitat, and provides wildlife connections through a highly-developed urban environment. As such, the study area has considerable value from both socio-cultural and ecological standpoints.

5.1 Valued Ecosystem Components

5.1.1 *Geology/Geomorphology*

5.1.1.1 Methods

Geological and geomorphological characteristics of the Edmonton region have been well-documented (e.g., Kathol & McPherson 1975, Edmonton Geological Society 1993, EPEC Consulting 1981). These documents provide general information regarding the geology and geomorphology of both the local and regional study areas, and were used to inform descriptions of baseline conditions.

Site-specific investigations associated with other developments in the vicinity have provided more site-specific information. Boreholes were drilled prior to the construction of the existing Cloverdale pedestrian bridge (T. Lamb, McManus & Associates 1976), and in support of the development of the Louise McKinney Park riverfront plaza and promenade (Spencer Environmental 2005). Finally, Thurber Engineering undertook geotechnical investigations specifically in support of the SE-W LRT. These comprised both desktop analyses and field investigations. Desktop analyses involved examination of various data sources, including:

- aerial photographs of the study area, covering a period from 1920 to 2008,
- previous test hole information,
- two coal mine atlases,
- various studies of the Grierson Hill landslide,
- LIDAR data of the project area.

Field investigations included the drilling of 22 irregularly spaced boreholes along the alignment between the Quarters neighbourhood and the top of Connors Road, 16 of which were in the NSRV within Bylaw 7188 boundaries. The alignment for the portal access road had not been developed when geotechnical investigations were conducted; thus, geotechnical information is not available for this area. Standard penetration tests were performed on soils collected. Standpipe piezometers were installed in most of the testholes for groundwater monitoring. Soils and bedrock collected in boreholes were subject to laboratory investigations to assess physical, chemical and mechanical properties such as moisture content, strength, and grain size. The full suite of parameters examined, along with results for individual samples, is presented in Thurber Engineering 2012a).

As part of the preliminary design exercise, slope stability was assessed on the north and south valley walls. From November 2011 to January 2012, Thurber Engineering monitored one slope inclinometer installed on the north valley wall in 2011 and three others installed by the City for antecedent studies. Several reconnaissance surveys were also carried out on the north slopes, with an emphasis on using surface characteristics to evaluate slope stability.

For the south valley wall, Thurber examined data from five inclinometers installed along the alignment (some current, some antecedent), directly north of Connors Road. Inclinometers were generally monitored monthly, with some months being missed due to frozen ground and wintertime access constraints. In addition, slope stability assessments were carried out on two cross sections of the south valley wall using the software SLOPE/W. Composition of bedrock and depositional layers, shear strength of material and groundwater conditions were all incorporated into assessments of slope stability. Further details are provided in Thurber Engineering 2012b.

5.1.1.2 Description

Bedrock and Surficial Geology

Bedrock in the local study area is of the Upper Cretaceous Edmonton Formation, which is dominated by clay shale, with lesser amounts of sandstone or siltstone, and occasional coal seams and bentonite layers (Thurber Engineering 2012a). Bedrock in the Edmonton area is flat-lying and dissected by numerous pre-glacial valleys. The closest pre-glacial valley is Beverly Valley, located approximately 3.5 km north of the study area. Four bentonite seams underlie the north bank of the river within the study area, two of which are believed to have been associated with the Grierson Hill landslide (see "Slope Stability", below).

Surficial geology comprises primarily depositional materials, including glacial till and glaciolacustrine sediments (Thurber Engineering 2012a). Glacial till is an unsorted mixture of sand, silt, clay, pebbles and rocks deposited by glaciers; in our area, deposition occurred during the Pleistocene epoch. Glaciolacustrine deposits are a remnant of glacial Lake Edmonton, a large lake formed when melting glacial water was impounded by ice dams (Edmonton Geological Society 1993). They comprise a combination of silts, clays and fine sands (Thurber Engineering 2012a).

Alluvial and colluvial deposits are both present within the NSRV (Thurber Engineering 2012a). Alluvium, which consists of deposited fluvial sediment, is present throughout the valley on the floodplain (lowermost valley terrace) (EPEC Consulting 1981). Colluvium is unconsolidated surface material that has been mobilized downslope by gravitational or erosional forces. Due to the steep slopes and large quantities of loose materials present in the NSRV, colluvium is assumed to be common in the valley.

Studies specific to the area of the portal structure access road have not yet been undertaken.

Regional Geomorphological Features

Topography in the Edmonton area is generally rolling to flat, with minimal relief; however, the NSRV system is an important exception to this and the river valley is the dominant geomorphological feature in the region. In our study area, the Mill Creek Ravine, which is tributary to the NSR, is a second significant feature. The NSRV was incised by water from rapidly-melting glaciers, resulting in a deep, steep-sided valley cut into the surrounding tablelands. Two fluvial processes - downcutting and lateral meandering - have been instrumental in the formation of the valley. While downcutting by meltwaters was historically the dominant process shaping the geomorphology of the drainage, lateral meandering now plays a larger role (EPEC Consulting 1981).

The NSRV in Edmonton contains four terraces, representing historic and current floodplains (EPEC Consulting 1981). The floodplain on the south side of the river in the study area, between the south bank and the south valley wall, represents the lowest and youngest of these terraces (Thurber Engineering 2012a). The presence and width of the terrace are believed to protect the south wall of the valley from erosion (Thurber Engineering 2012a). No terraces are present on the north side of the river in the study area.

Local Geomorphological Features

The study area contains a mixture of steep slopes, rolling hills and a relatively flat floodplain. The north and south valley walls are both characterised by steep slopes; on the north side of the river, the slopes continue down to the river bank (Plate 5.1). The south river bank is characterised by a wide, low-lying, relatively flat terrace (Plate 5.2). The dominant geomorphological feature on the river terrace is the Mill Creek channel; however, a large portion of the channel has been backfilled, and only the northernmost portion of the channel remains on the landscape (Plate 5.3). Today, the channel winds from the 98 Avenue north backslope, through Henrietta Muir Edwards Park, to the NSR. Portions of that remnant ravine may have been filled during construction of the 98 Avenue pedestrian bridge and closer to the river, to accommodate construction of the Cloverdale pedestrian bridge. Rolling terrain is present at the base of Connors Hill; some of this might be the result of fill applied for landscaping purposes (Plate 5.4). Filling and grading have occurred on the slopes below Connors Road, at the site of the Edmonton Ski Club (Thurber Engineering 2012b).

Plate 5.1. Steep slopes above the north river bank

Plate 5.2. The flat, low-lying river terrace, as seen from the north valley

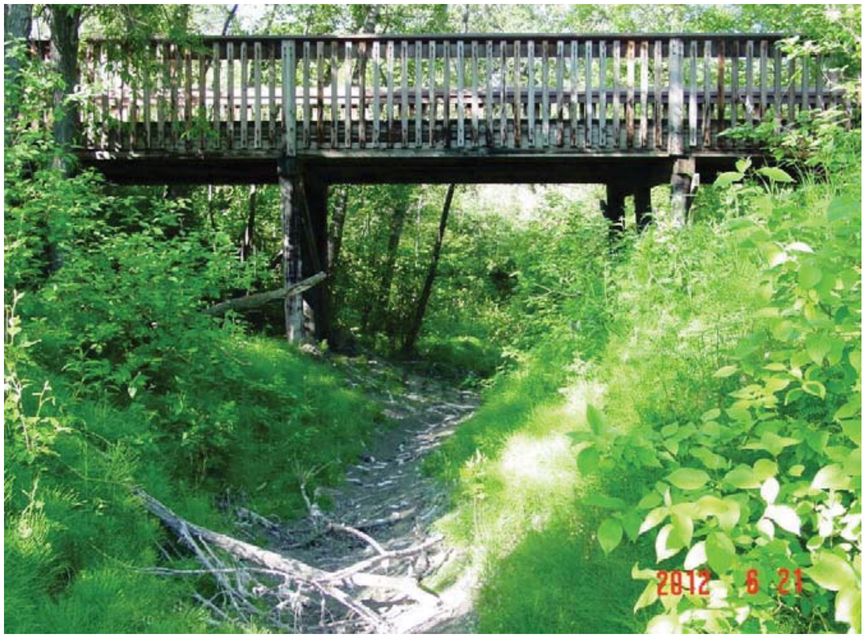


Plate 5.3. View to north along Mill Creek channel, near the junction with the NSR

Plate 5.4. Graded slopes near the base of Connors Hill

Slope Stability

Two localities in our study area are potentially of concern with respect to slope stability: the north bank, and the south valley wall, along Connors Road.

The following summary is taken from Thurber Engineering (2012a). Slope stability on the stretch of the north bank that intersects with the LRT alignment is considered marginal as a result of several intrinsic factors, including steep slopes horizontal stresses caused by overconsolidation of bedrock, and exposed bentonite layers. Four bentonite seams have been identified in the bedrock on the north slope. The intrinsic instability of the north bank was exacerbated by coal mining activities that occurred in the area from the late-19th century to the mid-20th century; during this period ten coal mines operated in the Louise McKinney-Grierson Hill area. Mine shafts formed areas of weakness that often collapsed and caused surface subsidence. Instability caused by mining, along with fluvial erosion of the riverbank and unusually high precipitation, are all believed to be factors underlying the 1901 Grierson Hill landslide. Translational movement along the deepest two bentonite seams led to slumping of surface material on the north bank, moving the bank of the river south by approximately 50 m, narrowing the river channel at this location. Since that time, additional slumping and filling have pushed the toe of the slope another 50 m further into the river. The landslide remains active, with movements of approximately 11-25 mm per year near the centre of the slide, located just east of the Shaw Conference Centre and approximately 500 m west of the LRT alignment. In 1986, summer flooding resulted in toe erosion significant enough to remove 8 m of material along the riverbank in Louise McKinney Park. Following this, a berm was constructed and riprap placed along the river's edge.

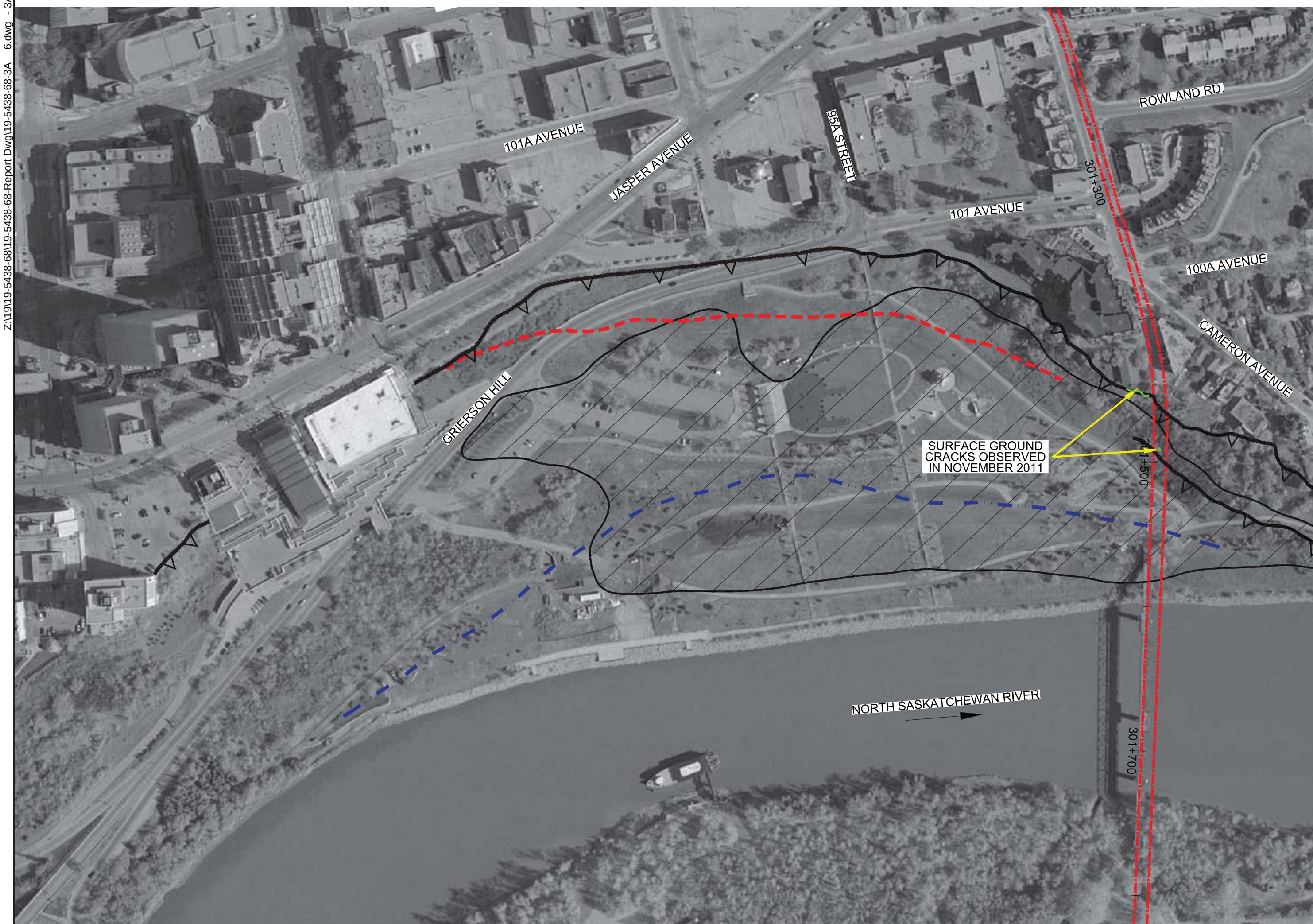
By contrast, the slopes of south valley walls have no known history of instability. Investigations of the south valley wall indicated that bedrock in the area was "weak to extremely weak" (Thurber Engineering 2012b), and that bentonite layers are present. In spite of these potentially destabilizing factors, models suggest that the slopes in this area are stable. Thurber Engineering notes that the wide terrace that separates the slopes from the river likely protects slopes against river action, resulting in greater stability on the south valley wall than in the north valley.

The steep slopes of the Edmonton Ski Club, north of Connors Road, contain fills that are believed to vary with respect to thickness and consistency, and to be of relatively poor quality. Thurber Engineering (2012b) speculates that some of the fills may have been placed in an uncontrolled manner. Upper layers of boreholes drilled in this area were found to comprise clay.

Landfills

The site of the Grierson Hill landslide was used as a landfill (Grierson Nuisance Grounds) for several decades in the early 20th century. Since then, the landfill has been covered with soil fills and landscaped, but the waste materials remain present in subsurface layers. The approximate boundaries of the landfill were delineated by Thurber Engineering on the basis of aerial photograph interpretations, historical review of developments between 1911 and 1940, and test hole data (X. Wang and H. El-Ramly, *pers. comm.*). The eastern end of the landfill intersects with the project area (Figure 5.1). The Phase I ESA undertaken for this project recommended further investigation of the implications of the landfill and the need for mitigation in relation to this project (Connected Transit Partnership 2013a). These investigations were undertaken in early 2013 and included a Phase II ESA (Connected Transit Partnership 2013b). Two testholes at this former landfill location yielded significant metals exceedances (e.g., elevated arsenic, lead, copper nickel, tin, zinc, and boron levels).

Figure 5.1



LE EN

GRIERSON HILL USED AS A WASTE DUMP FOR EDMONTON BETWEEN 1911 AND 1940

PRESENT DAY SLOPE CREST / SCARP

SLOPE CREST IN 1887 (BEFORE FAILURE)

TOE OF RIVERBANK IN 1987 (BEFORE FAILURE)

PROPOSED LRT ALIGNMENT

0 25 50 75 100 150 200 m

SCALE 1:3000

AIR PHOTO PROVIDED BY CH2M HILL CANADA LTD.

AECOM

E MONTON SO T EAST LRT E TENSION
PRELIMINAR EOTEC NICAL INVESTI ATION

RIERSON ILL SLI E - PLAN VIEW

W N 1 - 4 - - A

DRAWN BY	KLW
DESIGNED BY	MB
APPROVED BY	HER
SCALE	1:3000
DATE	MARCH 2012
FILE No.	19-5438-68

THURBER ENGINEERING LTD.

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Geotechnical test hole data suggested that a second landfill was located on the river terrace on the south bank at the former Cloverdale Incinerator location (now Muttart Conservatory and Edmonton Ski Club). That incinerator was active from the 1930s to 1971. As recommended by the Phase I ESA, additional drilling was conducted adjacent to the Muttart Conservatory and on the north and east sides of Connors Road to provide additional delineation of the former incinerator footprint. Drilling observations included the presence of buried waste material in all holes with ash, traces of coal and wet coal seams observed in some locations (Connected Transit Partnership 2013b).

5.1.2 *Soils*

5.1.2.1 Methods

The soils study area is limited to the project area shown in Figure 2.1. Agronomic soil surveys were not undertaken for the project; however, soil conditions in the NSRV have been generally described by Western Soil and Environmental Services (1980; in EPEC Consulting 1981), and within the project area, the 16 boreholes drilled in the NSRV by Thurber Environmental (see Section 5.1.1.1 for detailed methods) provided some information on soil depth and additional information on sub-surface conditions along the alignment. Phase I and II Environmental Site Assessments (ESA's) have been completed for the full Valley Line-Stage 1 alignment.

5.1.2.2 Description

Regional Context

Edmonton is located near the northwest boundary of the Central Parkland Natural Subregion of Alberta. Soils in the Central Parkland are generally of four orders: Chernozem, Luvisol, Gleysol and Solonetz. Chernozems are rich, dark organic soils typically found in association with grasslands and open woodlands. Luvisols generally underlie aspen forests. Gleysols are present throughout the region, and are associated with wetlands. Solonetzic soils, which are characterised by a saline hardpan layer, are found throughout the region, but are most concentrated in a band in east-central Alberta. (Natural Regions Committee 2006, Agriculture and Agri-Food Canada 1998).

Soils of the North Saskatchewan River Valley

Geomorphological and fluvial processes within the NSRV have resulted in soil conditions that differ from those of the surrounding uplands. Luvisols, Chernozems, Gleysols and Regosols are present in the NSRV (Western Soil and Environmental Services 1980; in EPEC 1981). Western Soil and Environmental Services (1980; in EPEC 1981) identified two other major groups: Colluvial Bank soils, associated with steep slopes, and Windermere soils, associated with floodplains and terraces. These soils generally have poorly developed horizons and are sometimes associated with alluvial and colluvial deposits (Agriculture and Agri-Foods Canada 1998).

Soil/Subsoil Conditions in the Study Area

The majority of lands along the NSRV alignment have a long history of disturbance, including the Grierson landslide and landfill, industrial works and landfills on the south bank river terrace, various road-building activities and associated grading and back-filling, and park landscaping. Most, if not all of the project areas topsoils have been disturbed by various developments at some point in recent history. Upper layers of test hole samples were generally found to comprise fills consisting of a variety of materials, including silty clay, gravel, sand, waste material (associated with landfills on both the north and south sides of the river), alluvial sediments and organic matter (Thurber Engineering 2012a). This reflects the extensive history of disturbance throughout much of the study area, and the associated grading and filling that likely took place. Thus, testhole data may not be reflective of natural soil conditions within the project area, where they occur.

Two natural, forested areas are found within the study area: the first on the south bank at HME Park, and the second along some of the upper slopes of the south valley wall, south of Connors Road. Soil conditions in these areas might differ from the above description, as the presence of mature native forest suggests that these areas do not have the same history of ground disturbance, filling and grading as the rest of the study area. One testhole (TH11-16) was drilled within HME Park, and was characterised by clay and clay till. However, this testhole was drilled very close to an existing paved SUP, and it is difficult to tell whether the composition of soil found here represents fills applied during pathway construction, or native forest soils. Sampling of the (forested) upper slopes of the south valley wall was not feasible due to the steep terrain, but Thurber speculates that soils in this area likely comprise a thin layer of colluvium overlying bedrock (Thurber Engineering 2012b).

Contaminated soils are present in the north valley, resulting from the abandoned Grierson Nuisance Grounds, and, on the south river terrace, at the former Cloverdale Incinerator site (now Muttart Conservatory/Edmonton Ski Clue) and associated upslope areas. The Phase I ESA recommended confirmation of the status and extent of the incinerator site. A Phase II ESA confirmed the presence of elevated levels of several metals and PAH's at all tested locations at the former incinerator site and the presence of buried waste materials, ash, traces of coal and wet coal seams. Various metals exceeded criteria at soil depths ranging from 15 feet (4.5 m) to 42 feet (12.8 m). In general, metals exceedances were identified at relatively shallow depths near the bottom of the hill (adjacent to the Muttart Conservatory), where soils may not have been significantly disturbed since the operation of the incinerator. At testhole locations extending up Connor's Road, the deeper contamination is likely indicative of the significant surface disturbance that was observed. The presence of PAHs in soil samples may be associated with the presence of buried ash material, although the potential also exists for naturally occurring PAHs to result from coal seams, which have been identified in the drill area.

5.1.3 *Hydrology - Surface Water/Groundwater*

5.1.3.1 Methods

Surface Water

Regional and local hydrological descriptions were developed by consulting available existing literature and databases, reports generated by CTP during preliminary design, a bathymetric survey commissioned by the City in support of conceptual phase LRT planning, and field observations. Water quality was not investigated.

Groundwater

Geotechnical studies conducted by Thurber Engineering (2012) for the LRT included investigation of groundwater levels. Standpipe piezometers were installed in 15 river valley bylaw test holes that were drilled along the proposed alignment for geotechnical investigations (TH11-02 to TH11-16) and one hole at the top of valley near Cloverdale Road (TH11-01). Groundwater levels were assessed when piezometers were installed, and then reassessed a number of times over the next six weeks.

5.1.3.2 Description

Surface Water

Regional Resources

The study area is situated within the North Saskatchewan River (NSR) Basin. The NSR originates at the Saskatchewan Glacier, 500 km upstream from Edmonton and within the continental divide of the Rocky Mountains between British Columbia and Alberta (Genivar 2008). From there, the river flows in a northeasterly direction near Nordegg and through Rocky Mountain House before flowing past Drayton Valley. The river continues northeast through Edmonton and then flows east into Saskatchewan. The river length within Edmonton is approximately 48 km.

Upstream of Edmonton, water use along the North Saskatchewan River system includes potable water, waste assimilation, hydroelectric power generation, thermal power plant cooling, oil and gas extraction, mining, and agriculture (Aquality 2005). Major dams in the watershed include the Brazeau on the Brazeau River and the Bighorn on the NSR, which forms Abraham Lake. Releases from these upstream dams can manifest as rapidly increasing water levels downstream, affecting river banks and instream construction projects. The largest urban area on the river is the Edmonton Capital Region, where the NSR supports approximately one million people, serving as their potable water supply and providing water for a large segment of Alberta's resource processing industry (Tetra Tech 2009). Edmonton's drinking water intakes are located at the Rossdale and E. L Smith water treatment plants, located upstream of the project area, approximately 2.4 and 19 km respectively.

Within Edmonton, Mill Creek originates at the City's eastern limits near 34 Avenue and flows northwest towards the city centre. One short section, near 75 Street is piped. In 1972, as part of bridge and interchange construction, a short reach in lower Mill Creek was backfilled to accommodate a major road interchange involving 98 Avenue and all upstream flows were permanently diverted west by pipe to a new outfall on the NSR, upstream of the James MacDonald Bridge (Thurber Engineering 2012). The forested ravine remains intact upstream and for a short distance downstream of the diversion to the point where the ravine joins the main river valley and meets the interchange road complex.

The City of Edmonton affects water quality of the NSR through discharges from the Goldbar Wastewater Treatment Plant (GBWWTP), downstream of the project area, and 242 stormwater outfalls spread throughout the NSR and ravine system (City of Edmonton 2013). Water quality was not characterized for this study.

Study Area

Two watercourses are present within the study area: the NSR and a short, abandoned reach of Mill Creek. The NSR (Plate 5.5) is obviously a focal and influential watercourse, influencing project construction and design. At the proposed crossing site the wetted river is approximately 130 m wide. Southward movement of the north bank due to historical landslides has resulted in a constriction of the channel in the vicinity of the study area. According to the NSR floodplain overlay shown on City zoning maps (City of Edmonton 2013e), in the study area, the north floodplain is limited to the vicinity of the near river bank. The north river bank is armoured through the study area (Plate 5.6). On the south bank, the floodplain is wider, with the farthest point extending south to the northeast corner of the site of the future LRT Muttart Stop. The river bank is naturally vegetated (Plate 5.7). There are two stormwater outfalls in the vicinity of the project area, one on each river bank.

Plate 5.5. Upstream view of the NSR north bank from the Cloverdale pedestrian bridge

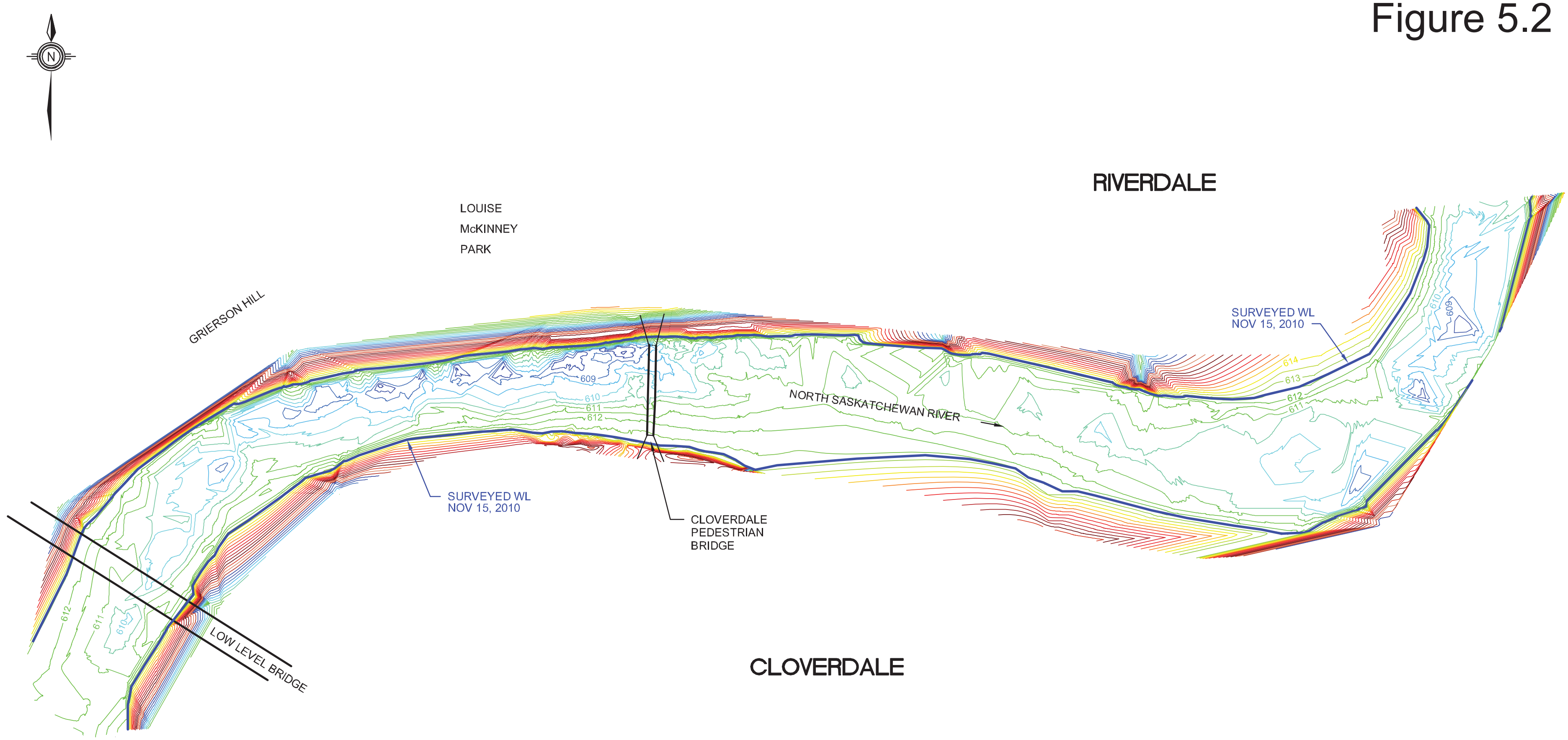
Plate 5.6. View of the armoured north bank from the Cloverdale pedestrian bridge

Plate 5.7. View of the naturally vegetated NSR south bank from the Cloverdale pedestrian bridge

Limited bathymetric studies undertaken by Northwest Hydraulics Consultants Ltd (2010) (Appendix D), produced a 0.5 m contour plan of the river bottom for a reach extending approximately 1.1 km downstream and 1.0 km upstream of the proposed LRT crossing, and a 0.25 m contour plan for a shorter reach centered on the crossing (Figures 5.2 and 5.3). As the figures show, the northern channel is generally the deepest channel area but there is a local deeper pool upstream of the bridge. Cross-sectional transect data collected by Pisces (2010) in this reach confirm both deeper water in the northern part of the channel and the localized pool.

Filling of Mill Creek for the 98 Avenue/bridges interchange, as described above, occurred on the lands situated in the southeastern corner of our study area; but the lowest reaches of Mill Creek, further east, were left intact. As a result, north of 98 Avenue, within HME Park, the abandoned creek reach and former creek/NSR confluence remain present. Under certain conditions this reach continues to convey water, as evidenced by flowing water present and discharging to the river during the spring freshet of April of 2013 (Plate 5.8). Ponding and local channel contours observed this spring suggest that localized rainwater ponding occurs regularly during the warmer seasons (Plate 5.9). The creek appears to continue to provide some stormwater storage/management function. The lowest reaches of the creek may also be occasionally backflooded from the NSR during flood conditions; but this has not been investigated. Drainage throughout HME Park appears to remain relatively natural and would be to the creek or directly to the river.

Figure 5.2



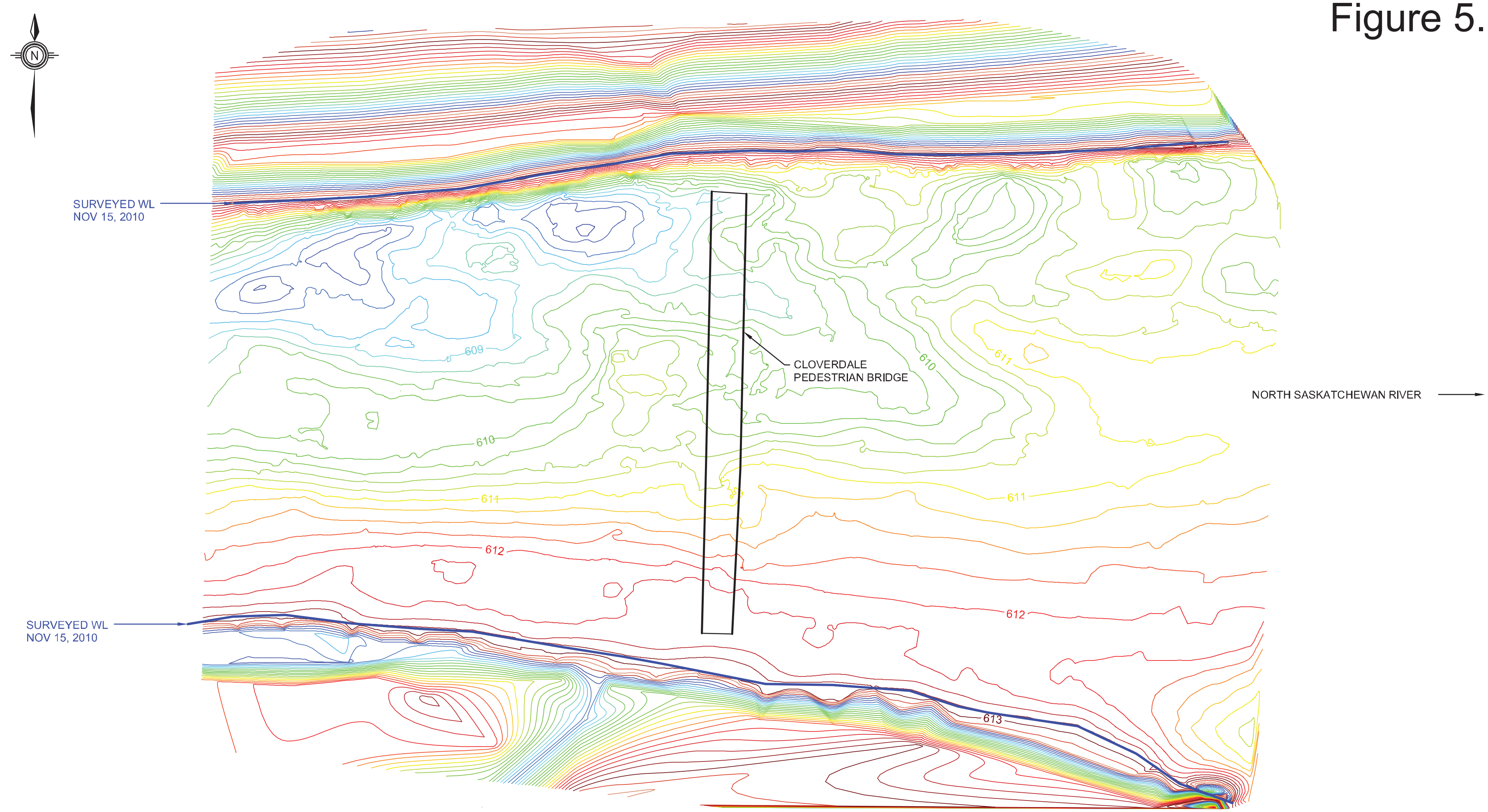
DESIGN NOTES

1. ALL DIMENSION IN METERS UNLESS OTHERWISE INDICATED
2. GRID DATUM: UTM ZONE12, NAD 83
3. SURVEY CONDUCTED BY NHC NOVEMBER 15, 2010
4. CONTOUR INTERVAL 0.5 m

nhc northwest hydraulic consultants

SPENCER ENVIRONMENTAL MANAGEMENT		
LRT BRIDGE DESIGN NORTH SASKATCHEWAN RIVER **RIVER BATHYMETRY**		
Dwg. 7575-002	20 DEC 2010	**Figure 1**
northwest hydraulic consultants ltd.		

Figure 5.3



DESIGN NOTES

1. ALL DIMENSION IN METERS UNLESS OTHERWISE INDICATED
2. GRID DATUM: UTM ZONE12, NAD 83
3. SURVEY CONDUCTED BY NHC NOVEMBER 15, 2010
4. CONTOUR INTERVAL 0.25 m

20 0 20 40 60 m

SCALE 1:1,000

nhc northwest hydraulic consultants

SPENCER ENVIRONMENTAL MANAGEMENT		
LRT BRIDGE DESIGN NORTH SASKATCHEWAN RIVER		
CONTOUR PLAN		
Dwg. 7575-001	20 DEC 2010	**Figure 2**
northwest hydraulic consultants ltd.		

Plate 5.8. Abandoned reach of Mill Creek continues to convey water to the NSR, April 2013

Plate 5.9. Water pooling in a former reach of Mill Creek ravine located in HME Park, April 2013

Local surface drainage patterns elsewhere in the study area appear to be well managed. Surface drainage on the unmanicured upper north valley wall appears to follow natural patterns, flowing downslope and eventually into the river. In the manicured park, stormwater is assumed to be managed and problems have not, to our knowledge, been identified in drainage reports. The local vicinity west of the north abutment of the Cloverdale pedestrian bridge, drains to a catchbasin and outfall that discharges on to the river bank, (E. Raszko *pers. comm.*), presumably untreated. The wooden plank deck of the existing Cloverdale Pedestrian Bridge allows precipitation to flow through and into the NSR, untreated. Flows in the Muttart area are managed as overland flow and through existing pipes. Connors and Cloverdale Hill roads both receive major drainage from a sizeable portion (31.2 ha) of the Strathearn Neighbourhood, which is handled by pipes. Once drainage has entered the City storm sewers, it is discharged into the NSR without treatment (Connected Transit Partnership 2013c). During large storm events stormwaters can result in pooling problems in two sump areas at the base of Connors Hill.

Groundwater

Project Area

Only one standpipe was located within the study area on the north side of the river, and no groundwater data were collected from it. Thus, there are no available groundwater measurements for the north bank or north valley wall within the bylaw lands. On the south river terrace, two groundwater regimes were identified by Thurber Engineering (2012): a perched water table was observed in some localities, and a deeper water table in others, in bedrock.

At final reading, the perched groundwater table depth at the river bank and river terrace ranged between 6.4 and 9.8 m below existing grade (elevations 612.8 to 615.9 m) and the bedrock groundwater table ranged between 9.1 and 13.9 m below ground level (approximate elevations 608.1 to 613 m). Thurber indicated that river terrace groundwater is likely connected to the water level in the river, and will fluctuate throughout the year. On the slopes of Connors Hill, groundwater levels ranged from 3.9 to 14.4 m below ground level (in bedrock), at final reading. Groundwater at the one hole situated outside of the valley (Th11-01) was encountered 6.7 m below ground surface, at elevation 653.4 m, and in overburden.

Landfills

The presence of an abandoned landfill on the north side of the river (former Grierson Nuisance Grounds now Louise McKinney Park) raises concerns regarding the presence of contaminated groundwater, and concerns about down-gradient water quality (N. Oke., *pers. comm.*). As a result of the Phase I ESA in support of preliminary engineering, further investigations into the presence and constituents of contaminated groundwater were recommended. A Phase II ESA was completed including two groundwater samples from this site. Both samples exceeded guidelines for chloride, TDS, boron, nickel, and sodium.

Only one piezometer was located within the north side landfill; thus, no data are available regarding the direction of groundwater flow from the landfill. That said, the NSR is a major collector of water and flow patterns in the project area are believed to be towards the river (X. Wang and H. El-Ramly, *pers. comm.*). Groundwater flow rates are believed to be low as a result 1) of limited recharge from valley uplands, where water is largely drained by the municipal storm sewer system, and 2) the presence of low permeability subsurface soils in the area (X. Wang and H. El-Ramly, *pers. comm*.).

Similar concerns regarding contaminated groundwater exist for the south side of the river at the former Cloverdale Incinerator site (now Muttart Conservatory/Edmonton Ski Club). Seven groundwater monitoring wells were sampled as part of the Phase II ESA and all wells had exceedances with respect to metals and PAH's. The groundwater issues ran the length of the tested area in the vicinity of the former incinerator activities.

Groundwater elevations were recorded during the sampling program at the incinerator site. Based on those elevations, groundwater flow is likely northeast, towards the North Saskatchewan River.

5.1.4 *Fish and Fish Habitat*

5.1.4.1 Methods

Pisces Environmental Consulting Services Ltd. (Pisces) undertook a fish and fish habitat assessment of the NSR in early November 2010 (Figure 5.4). The fisheries study area encompassed approximately 2.5 km of the NSR, extending 0.5 km upstream and 2.0 km downstream of the existing Cloverdale Bridge. The objectives of the fish and fish habitat assessment were to:

- review existing information and consult with regional fisheries managers regarding the fish community of the NSR;
- conduct fall season electrofishing surveys in the vicinity of the project;
- conduct a fisheries habitat inventory at and adjacent to the proposed bridge crossing;
- identify potential lake sturgeon (*Acipenser fulvescens*) habitat in the vicinity of the project;
- assess the stream bank conditions at, and adjacent to, the proposed disturbance area; and
- identify potential impacts to fisheries resources and suggest mitigation measures based on conceptual information.

The habitat of the North Saskatchewan River was inventoried using the Large River Classification System developed by R.L. & L. Environmental Services Ltd. (O'Neil and Hildebrand 1986). Inventory data were detailed on air photos (approximately 1:8000) in the field. A Lowrance X-16 depth sounder was used to determine water depth throughout the study section and to identify deep water that would be suitable sturgeon holding habitat. Two transects, established parallel with the stream flow were situated at approximately one-third and two-thirds of channel width. Substrate composition at the existing Cloverdale bridge crossing site was assessed using an Aquaview underwater camera at transect locations.

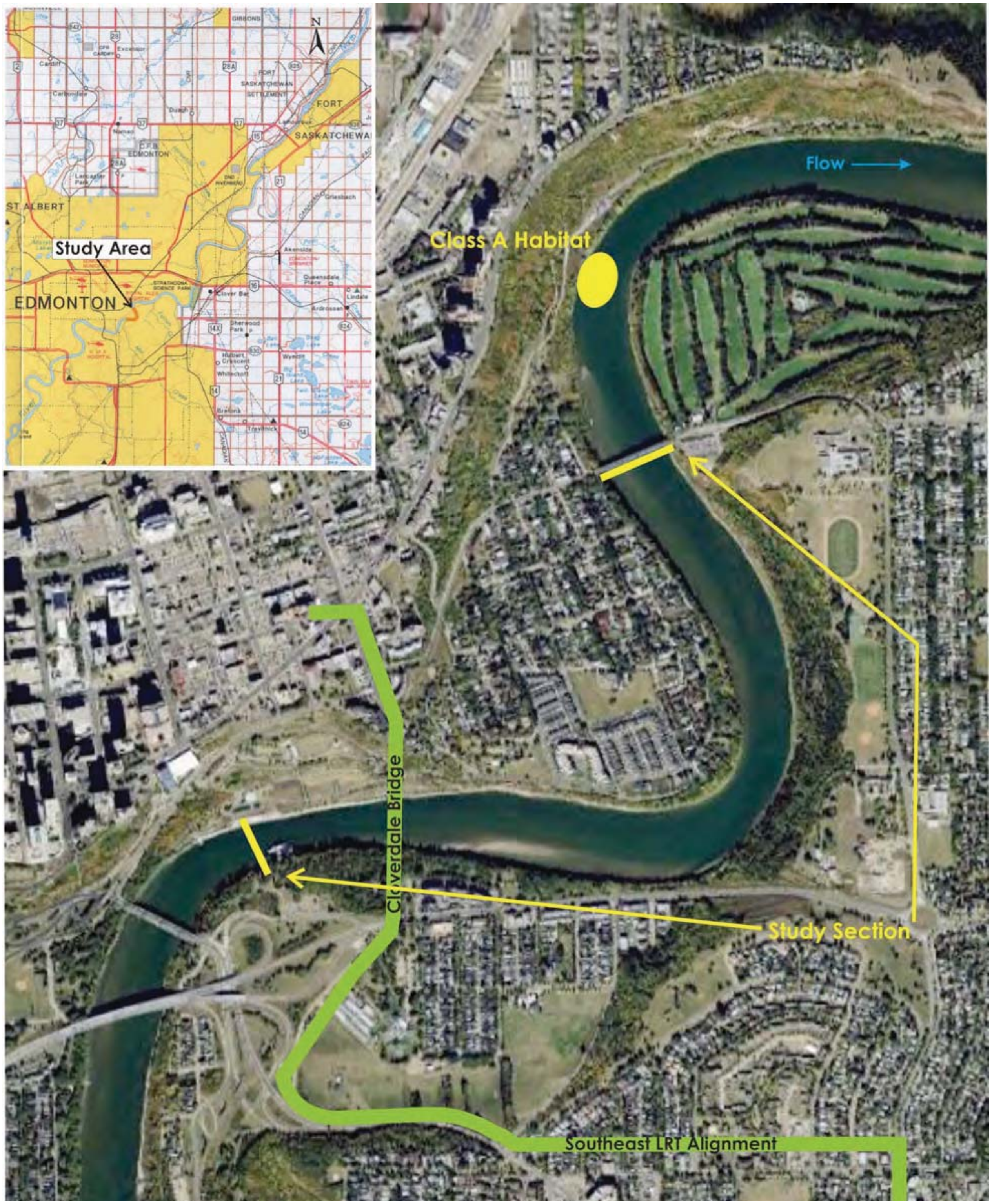


Figure 2.1. Study area location for Cloverdale LRT bridge crossing

Project: City of Edmonton Cloverdale Bridge Replacement
Prepared For: Spencer Environmental Management Services Ltd.

Pisces Environmental Consulting Services Ltd.

Electrofishing surveys were undertaken in the project area on 01 November 2010 (Figure 5.4). Between the Low Level and Dawson Bridge, 18 transects were conducted at intervals of approximately 150 m, with Transect 1 established furthest upstream. A channel cross-section was established at each transect.

Historical records, including the FWMIS database, were reviewed for records of fish species previously recorded in the study area.

Upon completion of the Reference Design, in April 2013, Pisces prepared a preliminary fish and fish habitat impact assessment, based on that design, and developed some preliminary mitigation measures. That report is found in Appendix E.

5.1.4.2 Description

A summary of Pisces' 2010 and 2013 reports follows, and copies of the full reports are found in Appendix E. The following account is taken from Pisces (2010).

Fish Habitat

The NSR in the study area consists of one main unobstructed channel (Type U). The habitat within the study section consists primarily of moderate depth, slow, run habitat, interspersed with discrete areas of deep-water habitat and shallow shoals. Substrate was a mixture of fine materials and cobble, with increasing percentages of fines in areas where water velocities are lower and increasing percentages of course substrate (gravel, cobble, and boulder) in higher velocity areas. Cover was relatively scarce within the study section; boulders (from riprap) and water depths were the primary refuge. The streambank assessment indicates that the river banks are steep, relatively well vegetated with grass, shrubs and trees, and composed of fine materials. Streambank armouring with riprap is quite common within the study section, particularly along the north river bank.

The average wetted width of the channel was approximately 160 metres. Water depths were generally less than two metres with the exception of the area immediately upstream of the existing bridge where depths exceeded four metres.

According to the *Code of Practice for Watercourse Crossings* St. Paul Management Area Map, the majority of the river in the vicinity of the proposed project is classified as Class C habitat, which is considered moderately sensitive and broadly distributed within the province (Alberta Environment 2006). There is, however, a section of Class A habitat, defined as highly sensitive habitat that is critical for lake sturgeon, located approximately 2.5 km downstream of the existing bridge.

Fish Populations

The NSR in the Edmonton area supports a wide variety of sport, non-sport and forage fish species. According to Allan (1984), northern pike, walleye and goldeye were common or seasonally abundant; sauger, mooneye and yellow perch occurred occasionally, and lake sturgeon, mountain whitefish and bull trout were rare. Historically, 17 species of fish have been found within the City limits in the NSR; however, main populations included only nine sport and non-sport species (Kippen Gibbs

1993). Mountain whitefish and goldeye were the most common sport fish captured during that time (Kippen Gibbs 1993). Seasonal abundance was relatively constant for most species, although mountain whitefish, goldeye and shorthead redhorse exhibited some variation (Kippen Gibbs 1993). Goldeye were the most common spring and summer sport fish but were virtually absent in fall; shorthead redhorse also decreased in abundance in fall (Kippen Gibbs 1993).

In 2010, the most common species captured while sampling were emerald shiner, mountain whitefish and mooneye (Table 5.1). Longnose sucker, northern pike, spottail shiner, trout-perch, walleye and white sucker were less common species. The majority of fish were found along the shoreline or at the edge of deep water habitat.

Table 5.1. Fish species recorded around the Cloverdale Pedestrian Bridge in 2010 and previously recorded upstream of the project area.

Species*	Number Recorded in 2010[a]	Previously Recorded Upstream of Project Area[b]
Burbot		√
Emerald Shiner	4	√
Goldeye		√
Longnose Dace		√
Longnose Sucker	1	√
Mooneye	3	√
Mountain Whitefish	5	√
Northern Pike	1	√
Shorthead Redhorse		√
Spoonhead Sculpin		√
Spottail Shiner	1	√
Trout-Perch	1	√
Walleye	2	√
White Sucker	1	√
Yellow Perch		√
Total # of Species	9	16

*Scientific names are provided in Pisces 2010 (Appendix E)
[a]Pisces (2010)
[b]Pisces (2011) and Sentar (1996)

At present, none of the species historically reported from the reach of the NSR within the study area are listed on Schedule 1 of the Species at Risk Act (SARA); however, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has assessed lake sturgeon as Endangered. As of October 2012, lake sturgeon are still being considered for listing pursuant to SARA (Alberta Lake Sturgeon Recovery Team 2012). As of May 2013, the federal government has not made a decision on whether or not the NSR lake sturgeon population should be listed under the Species At Risk Act (Pisces 2013).

Lake sturgeon have a limited presence in Alberta and the North Saskatchewan River population is one of only two sub-populations in Alberta. An assessment of lake sturgeon populations in the NSR in 1992 focused on a 240 km section of the river extending from approximately 100 km upstream of Edmonton to approximately 130 km downstream of the city (Watters 1993). Abundance was low and individuals appeared to have a grouped distribution with fish concentrated in a few specific locations (Watters 1993). Preferential sturgeon habitat characteristics included a back eddy below a gravel bar or island, with deep water (>3.8 m) adjacent to the river bank (Watters 1993). Investigations in 2010 found one site within the Cloverdale Bridge project area that met those criteria located immediately upstream of the existing Cloverdale Bridge. There is, however, no historical record of lake sturgeon occupying this habitat (FWMIS 2010, D. Watters *pers.comm.* 2010). Anglers have reported catching sturgeon upstream and downstream of the Cloverdale Bridge.

Habitat Utilization

Much of the habitat in the Edmonton area consists of moderate depth placid run habitat that is neither unique nor in short supply within the NSR (Kippen Gibbs 1993, Stemo 2006). As such, habitat utilization of the area is varied as some species may frequent the area on a seasonal basis while others may occupy this section of the river during all life cycle phases on a year-round basis. Following are some examples.

Mountain whitefish utilize a range of habitat for spawning including riffle, run or deep pool habitat (Thompson and Davies 1976, McAfee 1966) and have demonstrated an adaptability in utilizing varying substrates and water depths (Pisces 2010) including areas of moderate to high water velocities with clean cobble/pebble/gravel substrates (Sentar 1996). Considering these wide-ranging characteristics, it appears suitable spawning habitat is relatively common within the study area and likely the entire reach of the NSR near the City of Edmonton. In addition, suitable rearing, feeding, and overwintering habitat did not appear to be limited within the study section.

The margins of the river likely provide rearing habitat for walleye and the capture of juvenile walleye in fall 2010 suggest that the study section is utilized for this life cycle phase. Walleye typically spawn on clean gravel or rubble substrate 2.5-15 cm in diameter (McMahon et al. 1984) in areas of slow to moderate velocities. While this type of habitat is relatively common within the study area, the relatively low densities of historical walleye captures suggest that spawning activity may be limited in this part of the NSR.

The role of aquatic vegetation in the life cycle of northern pike is of considerable importance, specifically in reproduction and rearing (Craig 1996). It is widely agreed that meeting spawning habitat requirements (including the presence of adequate vegetation) is the most critical condition for establishing a durable pike population (Inskip 1982, Raat 1988). Suitable vegetation for northern pike reproduction was not present within the study section and it seems more likely that pike spawn in tributary streams such as Whitemud Creek. River margins and backwater areas within the study section are probably used by northern pike for rearing and the deeper runs may provide overwintering habitat.

Larger bodied coarse fish species and forage fish species are relatively abundant in the NSR near Edmonton (Kippen Gibbs 1993) and are likely present in the study area year-round, as suitable spawning, rearing, feeding and overwintering habitat is common. Ripe fish have been captured in the Edmonton reach of the NSR (Kippen Gibbs 1993), suggesting that spawning has been attempted and it seems likely that deeper habitat could be used during the winter.

5.1.5 *Vegetation*

5.1.5.1 Methods

Two types of plant surveys were conducted in support of this assessment: a general plant survey to delineate and characterise plant communities within the study area, and a rare plant survey. The study area comprised both natural (native) plant communities and manicured areas. The focus of plant surveys was to map and characterise natural areas; however, manicured areas were coarsely assessed as well.

The local study area for plant surveys, generally speaking, was an approximately 60 m wide swath through the river valley centered on the alignment. This assumed a disturbance footprint of 30 m on either side of the alignment. The corridor was widened where design information suggested that additional disturbance would be necessary (i.e., for access routes or staging areas). The NSRV in the greater Edmonton region was considered to be the regional study area; this was not formally incorporated into surveys but was considered when assessing impacts.

Surveys were carried out over a number of days in summer 2012. Mill Creek Ravine Park was surveyed on 22 June. Tree stands north of Connors Road were surveyed on 03 July. The north bank, Muttart grounds, and manicured parkland in Gallagher Park were surveyed on 20 July 2013. Additional surveys were conducted on the north bank on 07 September 2012. Rare plant surveys were conducted on 03 July, 2012, and targeted all unmanicured areas in the study area. The proposed project dry pond site was a late addition to the project area and was not included in 2012 surveys; however, a reconnaissance survey of the area was conducted in April 2013 to coarsely characterise the plant community.

To characterise natural plant communities present within the study area, a botanist familiar with aspen parkland ecosystems walked a series of meandering transects through each community, recording all species observed and their relative abundance within that community was ranked (D=dominant, A=abundant, F=frequent, O=occasional, R=rare [locally uncommon]). Plants that could not be identified in the field were sampled and keyed out using various keys and botanical manuals. Following field surveys, species were classified as native or exotic, based on data from the Alberta Conservation Information Management System (ACIMS), which provides a comprehensive database of species known to occur in the province (Alberta Parks, Tourism and Recreation 2012). Species scientific nomenclature also follows ACIMS.

Communities were delineated on aerial photographs during field surveys, and later classified according to the system developed by Westworth and Associates (1980) for the classification of plant communities in the NSRV in Edmonton. Where community boundaries were not clearly visible on the aerial photographs (e.g., where one type of deciduous forest graded into another, but the transition between the two communities was too subtle to be visible on aerial imagery), they were approximated based on nearby landmarks.

The classification system developed by Westworth and Associates focuses largely on different forest types, as the majority of natural communities found in the valley are treed, and classification is primarily based on canopy composition. Shrub, grassland and manicured community types are also recognized. Though not part of the classification, Spencer Environmental has found it necessary in the past to include separate classifications for caragana and Manitoba maple dominated communities, as these communities do not fit within the scheme developed by Westworth and Associates.

Manicured areas were classified as lawns, gardens, and planted beds. Lawns are defined for the purpose of this assessment as areas dominated by grass and regularly mowed. Gardens are discrete beds dominated by ornamental flowers and shrub species. Planted beds are characterised by planted, native or exotic shrubs and trees. Gardens and planted beds were coarsely surveyed, gathering only the data necessary to characterise them broadly. Lawns were mapped but not surveyed. All manicured areas were typically dominated by ornamental cultivars and non-native plants.

Rare Plants

Prior to conducting rare plant surveys, the ACIMS database was consulted to identify any existing records of rare plants within or near the study area. Rare plant surveys were conducted in conjunction with an experienced rare plant specialist, and were carried out via meandering transects in all natural plant communities. This included the forests on the south bank and south valley wall, as well as the unmanicured areas on the north bank. Rarity was defined by subnational ranks (S-ranks) based on up-to-date data from ACIMS. For the purposes of this report, S1, S2 and S3 species are considered rare. Generally speaking, S1 species are those that are known from five or fewer locations in the province, while S2 species are known from 6-20 locations. All S1 or S2 species observed in the study area were marked with a GPS, and data were collected regarding demographics (number of plants, life stage), habitat (slope, aspect, light, moisture) and plant community (other species in vicinity) for each observation. Data will be submitted to ACIMS for addition to their database. S3 species, which are generally known to occur in 21-100 locations in the province, were also inventoried but not located by GPS, and site-specific data were not collected. However, based on expressions of interest in these species from the City, S3 species observed in community surveys are flagged in this report, and included as rare plants in the following description, as well as impact analyses.

5.1.5.2 Description

Regional Context

Edmonton is located within the Central Parkland natural subregion of Alberta. This subregion, which forms a broad band across central and west-central parts of the province, forms a transitional area between the boreal forest to the north and the grasslands to the south. In its natural state, the Central Parkland is characterised by a mosaic of aspen- or poplar-dominated forests and rough fescue-dominated grasslands. Closed forests become more prominent towards the northern and western boundaries of the subregion, as well as in cooler, wetter areas such as valleys and north-facing slopes. Expansive grasslands dominate in the south, and in drier, warmer areas, such as south-facing slopes. Wetlands are common throughout the subregion. Edmonton is located near the northwestern boundary of the subregion, and the relatively sheltered environment of the NSRV largely supports aspen and poplar forest, with conifer-dominated forests occasionally occurring on some north-facing slopes, and patches of grassland and shrubland on well-drained, south-facing slopes. The Central Parkland is the most densely populated subregion in the province, and has been heavily altered by human activities such as urbanization, agriculture and industrial development. Little remains in a natural state (Natural Regions Committee 2006).

Eight plant communities were found in the study area (Figure 5.5), along with one S2 species, six S3 species, ten noxious weeds and two prohibited noxious weeds. The following sections provide detailed descriptions of these elements. Communities are divided into natural plant communities and manicured areas, and are discussed by geographic area, beginning with the north valley wall and moving southward to Connors Road. A full list of species found in each community is provided in Appendix F.

Natural Communities

<u>North Valley</u>

Louise McKinney Riverfront Park, located directly adjacent to the downtown core, is a highly urbanized park compared to many of the river valley parks, and is characterised by landscaped parkland, including manicured lawns, formal gardens and paved pathways.

Unmanicured areas in the north valley consist mainly of grassland, with a patch of caragana shrubland present on upper valley slopes (Table 5.2). Grassland (G) communities and grass/shrub communities (G/S) were found on the north valley wall near the top of the valley and along the riverbank. Grasslands were generally among the weediest communities observed in the study area, and were commonly dominated by exotic grass species, including crested wheatgrass (*Agropyron pectiniforme*), quackgrass (*Elytrigia repens*) and smooth brome (*Bromus inermis*). Reed canarygrass (*Phalaris arundinacea*), a native grass, was also dominant in some areas. Other common species included wooly burdock (*Arctium tomentosum*), pasture sage (*Artemisia frigida*), and buckbrush (*Symphoricarpos occidentalis*). Seven species that are considered noxious under the *Alberta Weed Control Act* were found in this community: Canada thistle (*Cirsium arvense*), dame's rocket (*Hesperis matronalis*), black henbane (*Hyoscyamus niger*), common tansy (*Tanacetum vulgare*), white cockle (*Silene pratensis*), wooly

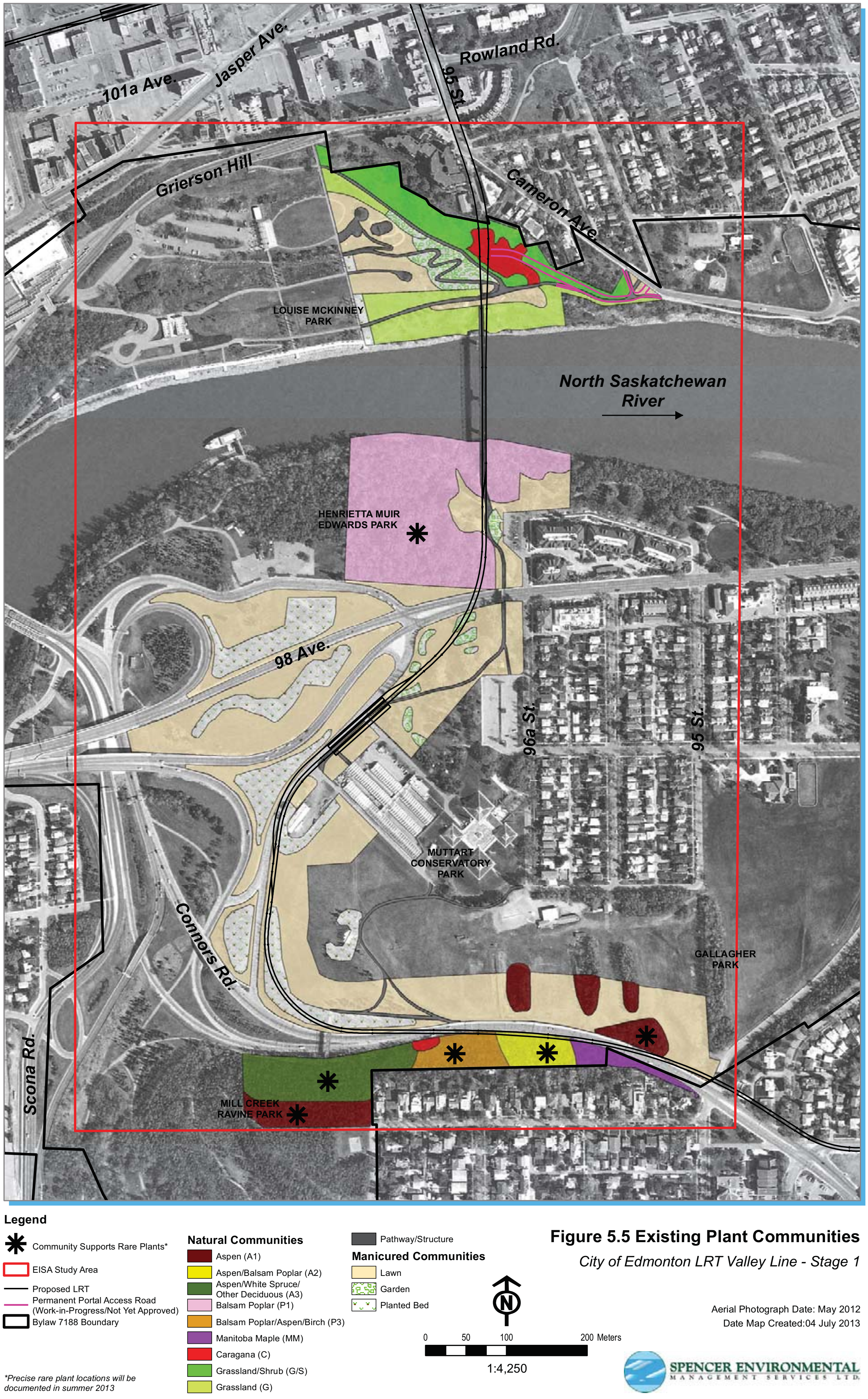


Figure 5.5 Existing Plant Communities

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created: 04 July 2013

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

burdock and yellow toadflax (*Linaria vulgaris*). Exotic species accounted for 68% of species found in this community, the second highest proportion of all communities surveyed.

Table 5.2. North valley plant communities

Community	Richness (% native)	No. of rare species
Grassland (G)	56 (30%)	0
Tall Shrub (S2)	5 (20%)	0

The other non-manicured community surveyed on the north valley was a small area in the north valley wall, where common caragana (*Caragana arborescens*), an exotic species, was dominant. This community, which was classified as a Caragana (C) community, was extremely species-poor, with little growing below the dense cover of caragana shrubs. Other species found in this community were chokecherry (*Prunus virginiana*), smooth brome, dame's rocket, and wooly burdock. Chokecherry was the only native species observed, and was a minor component of the community.

The weedy plant communities found on the north bank are likely a product of the area's extensive history of disturbance, including landslides, landfills and other fills, slumping, and slope erosion. Disturbed soils, particularly in urban areas, are highly susceptible to colonization by exotic species. If left to re-vegetate naturally following disturbance, a community dominated by weedy species can be expected. In light of this, we consider these communities to be semi-natural rather than natural or native.

South Bank: HME Park

HME Park is located north of 98th Avenue, on the floodplain of the NSR. It comprises mostly mature balsam poplar forest, with some manicured area. Manicured areas include lawns as well as the Centennial Garden, a flowerbed established and maintained by the Edmonton Horticultural Society, in partnership with the City.

Only one natural plant community was found in the park: a mature balsam poplar (*Populus balsamifera*) forest (P1) (Table 5.3). Areas along the former Mill Creek channel and along the river bank tended to support species that require moist soil, however, dominant species were relatively consistent throughout the area, and the presence of some moisture-loving species in some areas did not, in our opinion, warrant mapping and characterization of two separate communities. The bed of the creek channel was only sparsely vegetated; it is possible that abundant standing and flowing water during spring runoff precludes plant establishment. This was confirmed in spring 2013.

Table 5.3. HME Park plant communities

Community	Richness (% native)	No. of rare species
Balsam poplar (P1)	56 (30%)	6

Balsam poplar was the single dominant canopy tree in this community, with the exception of the areas along the banks of the Mill Creek channel, which supported abundant Manitoba maple, and forest edges, where ornamental trees such as Manitoba maple and American elm were present. The edge of the community along 98th Avenue was quite weedy, and supported species such as quackgrass, crested wheatgrass, kochia (*Kochia scoparia*), smooth brome and Canada thistle. The understorey consisted of common aspen woodland species such as Canada lily-of-the-valley (*Maianthemum canadense*), Canada anemone (*Anemone canadensis*), and wild sarsaparilla (*Aralia nudicaulis*). There was also a well-developed shrub layer comprising red osier dogwood (*Cornus stolonifera*), European mountain ash (*Sorbus acuparia*), chokecherry, and snowberry (*Symphoricarpos albus*). The forest interior was not overly weedy, though exotics such as dandelion (*Taraxacum officinale*), burdock (*Arctium* sp.) and smooth brome were locally common in some areas. One S2 species and five S3 species were found in this community. These are discussed in "Rare Plants", below.

Mill Creek Ravine Park and Gallagher Park

Five distinct communities were found along the steep slopes to the north and south of Connors Road: an aspen community (A1), an aspen/birch/spruce community (A3), a balsam poplar/aspen community (A2), a balsam poplar/birch community (P3), a small caragana community (C) and a Manitoba maple dominated community (MM) (Table 5.4). All communities appeared to comprise mature forest, with large canopy trees up to 20 m in height.

Table 5.4. Mill Creek Ravine and Gallagher Park plant communities

Community	Richness (% native)	No. of rare spp.
Aspen (A1)	64 (72%)	2
Aspen/Balsam poplar (A2)	12 (75%)	1
Aspen/White spruce/Other deciduous (A3)	30 (70%)	1
Balsam poplar/Aspen/Birch (P3)	22 (59%)	1
Manitoba maple (MM)	11 (64%)	0

Aspen (A1) communities were found along the upper slopes and top of bank in the western portion of the study area, on flat to moderately sloped terrain with west, northwest and north aspects; and in the tree stands on the north side of Connors Road. Aspen communities were characterized by a mature aspen canopy, relatively high light levels in the understorey, and an understorey community that supported a number of forb and shrub species. Trembling aspen (*Populus tremuloides*) was the dominant tree species, with occasional green ash, jack pine, white spruce, balsam poplar and Manitoba maple. The shrub layer was well-developed but was not sufficiently dense to choke out the herb layer. Common shrubs in this community were buffaloberry (*Shepherdia canadensis*), beaked hazelnut (*Corylus cornuta*), western blue clematis (*Clematis occidentalis*), high bush cranberry (*Viburnum opulus*), twining honeysuckle (*Lonicera dioica*), chokecherry and prickly rose (*Rosa acicularis*). Weeds, including smooth brome and quackgrass, were abundant along the southern boundary of this community, but were not otherwise a significant component of the community. Common forbs included wild vetch (*Vicia americana*) and wild sarsaparilla.

The four surveyed tree stands north of Connors Road also supported aspen communities. The easternmost tree stand had a depressional centre and appeared to be somewhat moister than the others, and supported moisture-loving plants such as yellow lady's slipper (*Cypripedium parviflorum*), yellow avens (*Geum aleppicum*) and fringed loosestrife (*Lysimachia ciliata*). The other tree stands were similar in composition to the ridgetop community in Mill Creek Ravine Park. This community was dominated by native species, which accounted for 73% of species observed, the second highest of all communities surveyed. Two S3 species, yellow lady's slipper and high bush cranberry, were found in this community.

The aspen/white spruce/birch (A3) community was found along lower to mid slopes above the western portion of Connors Road. The canopy was co-dominated by trembling aspen, balsam poplar and white birch, with a small number of white spruce (*Picea glauca*) also present. The understorey was similar to that found in A1, with a well-developed shrub layer dominated by twining honeysuckle, beaked hazelnut and pin cherry (*Prunus pennsylvanica*). Common forbs were wild sarsaparilla and wild vetch. Native species dominated, comprising 70% of the community's flora. One S3 species, tall anemone, was found in this community.

The balsam poplar/birch/Manitoba maple community (P3) was found on moderate to steep north-facing slopes between Connors Road and the top of bank. It was dominated by large balsam poplar and birch trees, but Manitoba maple and caragana formed a significant portion of the understorey. The well-developed shrub layer was dominated by red osier dogwood, beaked hazelnut, and caragana. The forb layer was relatively sparse and was dominated mainly by wild sarsaparilla. 60% of species observed in this community are native. One S3 species, high bush cranberry, was observed in this community.

The aspen/poplar community (A2), found just east of the P3 community, was characterized by a mature canopy co-dominated by trembling aspen and balsam poplar, and by an extremely dense shrub layer comprising red osier dogwood, Manitoba maple saplings, beaked hazelnut, with a minor component of gooseberry/currant and chokecherry. The forb layer in this community was relatively species-poor, possible as a result of heavy shading and competition by the shrubs. This community had the highest representation of native species in the study area, with 75% of species observed being native. One S3 species, high bush cranberry, was observed in this community.

The easternmost portion of Connors Hill was occupied by a Manitoba maple (MM) community. This community occupied a small strip of forest between arterial roads and residential development. Both the canopy and understorey were dominated by Manitoba maple, and the understorey was particularly poorly-developed, supporting only one forb (fireweed – *Epilobium angustifolium*) and no grasses. This community was relatively depauperate, with only 11 species, the second lowest in the study area. The majority (64%) of species observed were native.

Manicured Areas

Louise McKinney Park

Manicured gardens, planted beds and lawns formed a large proportion of the park. Planted beds in the park supported ornamental perennials such as oleaster (*Elaeagnus* sp.), poplar, crabapple, pine, and larch (*Larix* sp.). A rose garden ("the World Walk") is present in the eastern portion of the park. A Chinese garden is located northwest of the World Walk. Planted beds comprising trees and shrubs, including oleaster, pine and columnar poplar trees, were present along the staircases on the western edge of the study area.

South bank

A small manicured area was present near the SUP in HME Park. This comprised lawns, as well as the Centennial Garden, a garden established and maintained by the Edmonton Horticultural Society in partnership with the City.

Areas between 98th Avenue and Connors Road consist of manicured lawns, planted beds and gardens (in the case of the Muttart grounds). The Muttart grounds feature a park-like setting, with manicured lawns and scattered trees. A number of native and exotic tree species were present, including ash (*Fraxinus* sp.), mountain ash (*Sorbus* sp.), chokecherry, elm (*Ulmus* sp.), cedar (*Tsuga* sp.), buckthorn (*Rhamnus* sp.), Jack pine (*Pinus banksiana*) and blue spruce (*Picea* sp.). Several planted beds are present throughout the grounds and were mapped at the time of vegetation surveys. Each bed has a distinctive character and showcases a particular type of plant, such as prairie natives, perennials, or vegetables. Some are associated with specific Edmonton-based community groups, including the Edmonton Food Bank, the Edmonton Horticultural Society and the Edmonton Naturalization Group.

Six planted beds are located within the study area between HME Park and Connors Road, mostly along arterial roads. They are characterised by a mixture of native tree species (aspen, Jack pine, balsam poplar and white spruce) and exotic tree species (Colorado blue spruce, Manitoba maple). Trees ranged in size from less than 5 m tall to over 20 m tall, and generally appeared to be in good health. Understories in the planted beds consisted mostly of exotic grasses, including smooth brome and quackgrass.

Mill Creek Ravine: Dry Pond Site

The dry pond will be sited at the bottom of Mill Creek Ravine, at the toe of the valley slopes, between the northbound lane of Scona Road and the southbound lane of Connors Road. The majority of this area consists of manicured lawns and unmanicured grassland, with scattered trees throughout. Areas to the west of the north-south SUP are unmanicured, while areas to the east of the pathway are manicured. The majority of the trees present are spruce, with occasional pine, larch, birch and aspen.

Rare Plants

One S2 species and seven S3 were found in the study area. The sole S2 species observed was smooth sweet cicely (*Osmorhiza longistylis*). The S3 species were tall anemone (*Anemone riparia*), Herriot's sagewort (*Artemisia tilesii*), spotted coralroot (*Corallorhiza maculata*), yellow lady's slipper (*Cypripedium parviflorum*), purple peavine (*Lathyrus venosus*), turned sedge (*Carex retrorsa*), and high bush cranberry (*Viburnum opulus*). The following is a description of these species, their preferred habitat and where they were found in the study area.

Osmorhiza longistylis (Smooth sweet cicely) (S2)

Smooth sweet cicely (Plate 5.10.) is a perennial forb found in moist forests in the Parkland and Grassland natural regions of Alberta (Kershaw *et al.* 2001). It is a member of the carrot family (Apiaceae), and is distinguished by a sweet, liquorice-like smell, the presence of persistent, reflexed bracts at the base of the flower clusters, and long styles (>2mm) on the fruits (Plate 5.11). Smooth sweet cicely was found in two locations in the study area, both in HME Park. The first location supported a population of approximately 50 plants, and was found along the edge of the forest adjacent to the paved pathway that runs between the riverbank and 98A Avenue, approximately 30 m to the east of the pedestrian bridge. The plants were growing under a dense canopy of Manitoba maple, though light levels were relatively high due to the location at the edge of the woods. The majority of the plants were found to be flowering in mid-June. The second location was in the forest interior, near the western boundary of the study area in HME Park. A single vegetative plant was found here. Smooth sweet cicely is ranked S2 in Alberta, suggesting that 6-20 populations are known to occur in the province.

Plate 5.10. Smooth sweet cicely plants

Plate 5.11. Fruits, showing long styles and reflexed bractlets

Anemone riparia (Tall anemone) (S3)

Tall anemone is a perennial forb from the buttercup family (Ranunculaceae). It is found in thickets and woods in the Central and Peace River Parkland subregions of Alberta (Moss 1983). Plants of this species are distinguished from other anemones by the presence of two separate whorls of leaves (involucres) subtending the flowering heads (Plate 5.12). Tall anemone was found in two of the communities found on Connors Hill (A1 and A3), where it was an uncommon component of the understorey community, observed growing in a handful of scattered locations.

Plate 5.12. The double involucre that is characteristic of tall anemone

Artemesia tilesii (Herriot's sagewort) (S3)

Herriot's sagewort is an aromatic perennial herb that is a member of the composite family (Asteraceae). It is distinguished from other sagewort species by the presence of coarsely toothed leaves that are nearly hairless on the top, but densely covered in wooly hairs below. Though uncommon in Alberta, it has a wide range in the province, with known populations in the Central and Peace River Parkland subregions, as well as the boreal forest, as far north as the border with the Northwest Territories (Kershaw *et al.*, 2001). Herriot's sagewort is found on river flats and in open woodlands. In the study area, a single individual of this species was found growing on a slope in the Mill Creek channel close to the confluence with the NSR.

Corallorhiza maculata (Spotted coralroot) (S3)

Spotted coralroot is a member of the orchid family (Orchidaceae) that is distinguished by its purplish-red colour, its conspicuously spurred, white-and-purple spotted flower, and by leaves that are reduced to tiny, inconspicuous scales along the stem (Moss 1983). A woodland species, it is found in the Boreal Forest, Parkland and Montane natural regions of Alberta. Coralroots do not have photosynthetic leaves; instead, they obtain nutrients from dead organic matter on the forest floor, which they obtain via symbiotic relationships with soil fungi (Johnson *et al*. 1995). One individual of this species was found growing in HME Park.

Cypripedium parviflorum (Yellow lady's slipper) (S3)

Yellow lady's slipper is another member of the orchid family that is found throughout the Boreal Forest and Rocky Mountain natural regions in Alberta (Plate 5.13). Yellow lady's slipper is distinguished by its single, large yellow flower, large and sparsely hairy stem, and leaves that form a sheath around the stem at the base (Moss 1983). It is found growing in moist woodlands and banks, often on limy soils (Johnson et al. 1995). This species was found growing in the easternmost tree stand on the north side of Connors Road, where a handful of individual plants were found in a concentration and growing in association with other moisture-loving plants such as fringed loosestrife, bunchberry (*Cornus canadensis*) and Canada anemone (*Anemone canadensis*).

Plate 5.13. Yellow lady's slipper, showing the large yellow flower, hairy stem and sheathing leaves

Lathyrus venosus (Purple peavine) (S3)

Purple peavine is a member of the pea family (Leguminosae), and one of two peavine species found in Alberta. It is characterized by the presence of tendrils, large, dense clusters of pinky-purple flowers, and narrow stipules where the leaves join the main stem. Purple peavine has a limited distribution in Alberta, where is it found only in the Central Parkland subregion, around Edmonton and east of Edmonton towards the Saskatchewan border. It is found in moist woodlands in this region. A few plants of this species were found in the P1 community in HME Park.

Carex retrorsa (Turned sedge) (S3)

Turned sedge is a perennial graminoid, and a member of the sedge family (Cyperaceae). Although uncommon, it is widely distributed in the province, occurring in the Boreal, Foothill, Parkland and Grassland natural regions of Alberta. Turned sedge is found in wet, forested or open environments, including swamps and wet meadows. It is distinguished by bracts that are several times longer than the flowering spikes they subtend, and seeds that are reflexed (downward pointing) at maturity. Within the study area it was found in a moist area in the Mill Creek channel in HME Park.

High bush cranberry (Viburnum opulus) (S3)

High bush cranberry is a tall shrub from the honeysuckle family (Caprifoliaceae). Though the species has a wide range in Alberta, from the southern limit of the central parkland in the south to the lower Peace and Athabasca valleys in the north, it is only known from a very limited number of locations. High bush cranberry is found in moist woods river valleys in Alberta. It is characterised by opposite, lobed leaves and by inflorescences comprising a ring of sterile but showy flowers surrounding an inner cluster of smaller, fertile flowers. Within the study area it was found in several communities, including the poplar (P1), the aspen (A1), the aspen/balsam poplar (A2) and the balsam poplar/aspen/birch (P3) forests.

Noxious and prohibited noxious weeds

Noxious weeds are generally those that are currently widespread in the province, and are considered difficult to eradicate. However, provincial legislation requires that these species be controlled. Prohibited noxious weeds are those that are currently uncommon or absent in the province, but which 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. Two prohibited noxious species and numerous noxious species were found in the study area. The *Alberta Weed Control Act* defines two categories of weeds: noxious and prohibited noxious.

Prohibited noxious species

Prohibited noxious species found within the study area were limited to common buckthorn (*Rhamnus catharticus*) and orange hawkweed (*Hieraceum aurantiacum*).

Common buckthorn was present throughout HME Park, with at least some individuals occurring within the project area. Numerous individual plants were observed, but no dense concentrations. A buckthorn tree was observed on the grounds of the Muttart Conservatory, which is close to the park, but it is not known whether it is of the same species or not. Common buckthorn can be controlled using herbicides, burning, hand pulling and flooding (Alberta Invasive Plant Council 2012), though, as with many invasive species, control is difficult and may require a multi-year effort. Seeds of common buckthorn germinate readily in disturbed soils.

A single patch of orange hawkweed was found on Connors Hill, in the A1 community, outside of the project area. This patch consisted of approximately one dozen plants growing together in a clump. Hand pulling and herbicides can be used to control this species.

Noxious weeds

Noxious weeds found in the study area include wooly burdock (*Arctium tomentosum*), creeping harebell (*Campanula rapunculoides*), ox-eye daisy (*Chrysanthemum leucanthemum*), Canada thistle (*Cirsium arvense*), dame's rocket (*Hesperis matronalis*), black henbane (*Hyoscyamus niger*), yellow toadflax (*Linaria vulgaris*), scentless chamomile (*Matricaria perforata*), white cockle (*Silene pratensis*), and tansy (*Tanecetum* *vulgare*). With the possible exception of black henbane, all these species are relatively common in disturbed and waste areas in the Edmonton region. Their presence in the study area is likely reflective of its location within a densely populated city. Provincial legislation does, however, require control of these species. Surface disturbance associated with LRT construction could create ideal conditions for the spread of these and other noxious species.

5.1.6 *Wildlife*

5.1.6.1 Methods

Study Area

Wildlife resources were considered at two scales: locally and regionally (Figure 5.6). The EISA study area was selected as the local wildlife study area. A regional wildlife study area was delineated to account for the fact that the local project area comprises only a small portion of the home range for some species in that area and to facilitate the discussion of the NSR system as a wildlife movement corridor. The regional study area was established based largely on ecological boundaries relevant to potentially occurring wildlife species with large home range requirements, and the topographic NSRV features in the vicinity of the local study area.

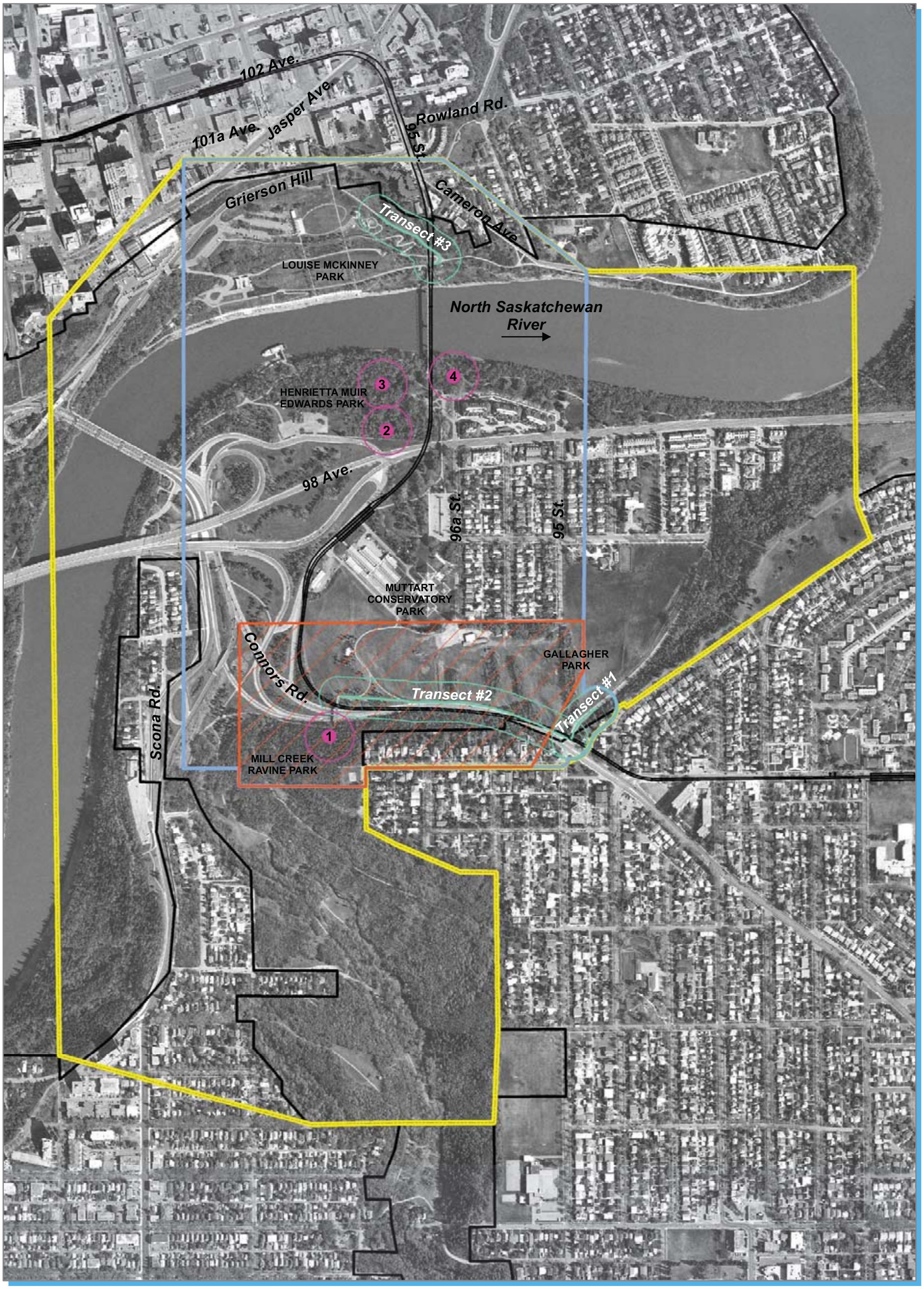
Habitat Characterization

The habitat within the local study area was described using vegetation mapping developed for this environmental assessment and field observations with respect to vegetation structure, topography, and habitat patch location and condition. Habitat types were not mapped beyond vegetation mapping.

Wildlife Communities

Wildlife communities in the study area were described using a combination of literature search and field investigations. To determine wildlife species potentially present in the area, information was compiled through a review of previous studies conducted within the NSRV. Westworth & Associates (1980) provided preliminary information. Recent environmental assessments for Scona Road (Spencer Environmental 2011), Louise McKinney Park (Spencer Environmental 2005) and the new Walterdale Bridge (Spencer Environmental 2012) provided more recent and more local supplemental information. The Fisheries and Wildlife Management Information System (FWMIS) (Alberta Environment and Sustainable Resource Development 2012) was searched on 23 November 2012 for information regarding special status species recorded in the area. In addition, a number of scientific papers and field guides were consulted to determine species ranges and behaviour.

Wildlife field investigations consisted of breeding bird surveys, and reconnaissance-level winter tracking. In spring 2011, the local study area was analyzed, through air photo interpretation and a site reconnaissance, for the presence of potential amphibian breeding habitat (e.g., wetlands, streams). No suitable habitat was identified in the local study area; therefore, no amphibian surveys were conducted.



Legend

- Bird Point Count Survey Location (with 50m radius plot)
- Bird Survey Transect (with 40m buffer)
- Regional Wildlife Study Area
- Local Wildlife Study Area
- Reconnaissance Track Survey Study Area
- Proposed LRT
- Bylaw 7188 Boundary

N

0 50 100 200 Meters

1:7,500

Figure 5.6 Wildlife Study Areas and Sampling Locations

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012

Date Map Created: 01 May 2013

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Breeding Bird Survey

A breeding bird survey was conducted in the local study area on 22 June 2012 to characterize breeding bird richness and abundance, using point counts and transects. Bird survey locations were chosen based on the desire to survey representative habitat within the local study area and in the near vicinity of the LRT alignment (Figure 5.6). Larger habitat blocks were suited to point count surveys, while narrower habitat patches were suited to transect surveys (Figure 5.6).

One 8-minute survey was conducted at each of four point count stations. All birds detected (seen and heard) within a 50 m radius were recorded. Three fixed-width transects ranging in length from 150-220 m were walked and all birds detected (seen and heard) within 40 m of either side of a transect were recorded. All other animal observations or signs were documented and described in terms of presence and habitat use.

Reconnaissance Winter Tracking

A winter tracking reconnaissance survey was conducted on 29 November 2012. The purpose of the survey was to document wildlife movement patterns in the local study area, particularly in the vicinity of Connors Road. The area investigated is shown in Figure 5.6.

5.1.6.2 Description

Wildlife Habitat

Habitat types in the study area include: small patches of vertically complex, mature deciduous forest; larger patches of mature, deciduous and mixedwood forest; mature, degraded riparian forest; shrubland and grassland; small planted tree beds and extensive manicured areas. In addition, this reach of the NSR has some areas of slower moving waters and shoals. Wildlife habitat in the local study area can be generally described as disturbed, either physically or indirectly as a result of noise and human activity. For example, many of these forested patches are slightly compromised by human use and support weeds. The local study area is bisected by 98 Avenue and Connors Road, both major arterial roads converging downtown commuter traffic volumes.

The disturbed character and the area's location in the center of the city, make the habitat most suitable for urban-adapted species (e.g., coyotes, small mammals, commonly occurring bird species), although some less tolerant species may be present on an irregular basis. Of the habitat present, there are several small patches of natural, higher quality habitat in Mill Creek Ravine Park, Gallagher Park, and HME Park and eastern extremities of Louise McKinney Park that are not manicured and experience lower levels of human use. These are likely the best habitats. The southeast corner of the study area catches the lower reach of Mill Creek Ravine, which extends south to form a much longer, continuous riparian habitat patch. The NSR also comprises aquatic habitat suitable for foraging, loafing and breeding for a number of bird species. Birds, such as swallows, may nest on the pedestrian bridge substructures. One citizen described Canada geese nesting on the Cloverdale river bridge. The river may also be frequented by beavers and muskrats.

Wildlife - General

Approximately 200 wildlife species (bird, mammals, reptiles and amphibians) have been observed within the city limits, most of which were observed in the NSRV (Pattie and Fisher 1999, Fisher and Acorn 1998, Russell and Bauer 2000, Westworth and Associates 1980). Of those 200 species, the most common are generalist species tolerant of human activity and fragmented habitats. Potentially occurring species include migrants, breeding individuals, and resident species. Species migrating through the area would not remain long, instead they rest or forage for a short time before continuing their migration. Nonetheless, migratory habitat does provide an important function to species travelling long distances.

Avifauna

A total of 10 bird species (comprising 33 individuals) was observed (Table 5.5) at the point count stations. The most common species observed was yellow warbler, which was the most abundant species and was observed at all survey stations. Cedar waxwing and black-billed magpie were observed at two of the four stations. All of the species observed are common, urban-adapted species that typically occupy deciduous woodland habitat, which is the most common natural habitat type in the study area. No special status species were observed.

Table 5.5. Bird species recorded at four point count stations during surveys conducted in summer 2012.

Species Name	Total Count	# of sites where present	% of sites where present
American crow (*Corvus brachyrhynchos*)	3	2	50
American robin (*Turdus migratorious*)	2	2	50
Black-billed magpie (*Pica pica*)	2	1	25
Cedar waxwing (*Bombycilla cedrorum*)	5	2	50
Downy woodpecker (*Picoides pubescens*)	2	1	25
Hairy woodpecker (*Picoides villosus*)	1	1	25
Least flycatcher (*Empidonax minimus*)	1	1	25
Red-eyed vireo (*Vireo olivaceus*)	2	2	50
White-breasted nuthatch (*Sitta carolinensis*)	4	1	25
Yellow warbler (*Dendroica petechial*)	11	4	100
Total # Species	10		

Bird abundance was greatest at point count stations 2 and 3 (16 and 10 individuals, respectively), two of the stations situate in HME park. Stations 1 (Mill Creek Ravine) and 4 (east HME Park) had the lowest bird abundance (1 and 6, respectively). Stations 2, 3 and 4 had similar species richness, likely because they are all located in an area of riparian habitat adjacent to the NSR. At the time of the breeding bird survey there was a severe caterpillar outbreak at Stations 2 and 3 which may have provided an abundant food source for a variety of bird species. Species richness and abundance were low at point count Station 1, for no obvious reason. This station was located at the bottom of Mill Creek Ravine, south of Connors Road. There appeared to be appropriate forested habitat to accommodate a variety of bird species, but only one species (yellow warbler) was observed at that station.

In total, 8 bird species comprising 11 individuals were observed (Table 5.6) along survey transects. Relatively low numbers of individuals were observed within each transect. The most common species observed were the black-billed magpie, clay-colored sparrow and yellow warbler. Similar to the point count stations, all of the species observed were commonly-occurring and urban-adapted. No special status species were observed.

Table 5.6. Bird species recorded during three fixed-width transect surveys conducted in summer 2012.

Species Name	Total Count	# of sites where present	% of sites where present
American robin (*Corvus brachyrhynchos*)	1	1	33
Black-billed magpie (*Pica pica*)	2	1	33
Clay-colored sparrow (*Spizella pallida*)	2	1	33
Gray catbird (*Dumetella carolinensis*)	1	1	33
House wren (*Troglodytes aedon*)	1	1	33
Red-eyed vireo (*Vireo olivaceus*)	1	1	33
Song sparrow (*Melospiza melodia*)	1	1	33
Yellow warbler (*Dendroica petechial*)	2	1	33
Total # Species	8		

Transect 3 (on the north river valley slope) had the highest bird abundance (7) and species richness (5) compared to Transects 1 (1, 1, respectively) and 2 (3, 2, respectively). Transect 3 was located at the interface between natural shrubby habitat and landscaped habitat, providing a diversity of habitat features suitable for a wider range of species. There were no roads/traffic in the survey area. Three of the species observed along Transect 3 - song sparrow, house wren and gray catbird – were not recorded anywhere else in the study area. Transects 1 and 2 were situated adjacent to Connors Road, a busy arterial road, and although the habitat surveyed included some deciduous forest, much of the surveyed area covered manicured park and road, and, as expected, results (four birds in total) suggest lower quality habitat. Each transect supported a different bird community, suggesting that a diversity of habitat patches contributes to increased total species richness in the study area.

Over all surveys conducted, a total of 13 bird species was observed and most species were present in relatively low numbers, with the exception of yellow warblers. These results support our contention that wildlife habitat in the study area is somewhat disturbed and adversely influenced by the surrounding urban environment and high human use. However, results also indicate that the avian community present was related to habitat type, supporting the theory that habitat diversity plays a role in increased avian diversity, even at the local level where native habitat patches are small and fragmented by development.

Mammals

Urban-adapted mammals are the most likely to occur in the local study area. Specific mammal surveys were not undertaken. Small mammals such as snowshoe hare and red squirrels are commonly observed within the NSRV. Other small mammals, such as chipmunks, ground squirrels, voles, mice and weasels may use the mix of park lands and forested areas, especially where taller grasses and adequate ground cover are present in the local study area. The little brown bat is the most commonly-occurring bat species in Edmonton and is most often seen foraging around waterbodies. The little brown bat may forage around the NSR and may use the forested riparian areas for brooding.

Medium sized mammals such as skunks, porcupines and beavers all occur in the NSRV and may find suitable habitat in the local study area. Medium sized carnivores in the river valley are limited to the more urban-adapted species such as coyote and fox (Westworth and Associates 1980). Residents in the local study area have reported seeing coyotes and snow tracking conducted in November 2012 documented coyote use in the area surrounding Connors Road. Coyote movement in this area is monitored as part of the University of Alberta urban coyote project, suggesting that coyotes have potential to be in the area. Study data were not available at time of EISA preparation.

Both white-tailed and mule deer have been observed in the NSRV (primarily outside the downtown core) and in tributary ravine systems (Folinsbee 1993, Westworth and Associates 1980). Deer tracks were found in abundance at the north end of Mill Creek Ravine, south of Connors Road, during the November 2012 snow tracking survey. While deer are not anticipated to be common in this area, the connection to Mill Creek Ravine may bring them to the area.) Moose are occasionally observed in the NSRV, but most sightings occur in areas of the NSRV more peripheral to the developed center of the City. The limited forest cover and concentration of human activity throughout this section of the river valley likely prevents the establishment of resident deer and moose populations.

Large carnivores such as cougars and black bears have been observed in Edmonton’s river valley and are known to exist in areas surrounding the City. They occur in Edmonton very rarely, and likely only use the river valley and associated ravines as travel corridors during regional-scale movements. The potential for these species to be present in the local study area is considered negligible; therefore, they are not considered further in this assessment.

Amphibians and Reptiles

Available amphibian breeding habitat within the regional study area is limited. All of the amphibian species that have the potential to occur in the study area based on species distributions require shallow, ponded water habitats for breeding. With the exception of the potential for such habitat along Mill Creek, in some years, the local study area was found not to have any suitable amphibian breeding habitat. The naturally vegetated areas of the study area may provide suitable habitat for terrestrial post-breeding stages of wood frogs and boreal chorus frogs; however, considering the lack of nearby breeding habitat, the potential for the occurrence of frogs/toads is considered low.

The red-sided garter snake is, by far, the most commonly-occurring reptile species in the Edmonton area. Plains garter snakes also occur, particularly to the southeast of Edmonton, but are considerably less common within Edmonton's City limits. Both species have broad foraging habitat preferences, frequenting ponds, marshes and dugouts, as well as habitat with ample ground cover (Russell and Bauer 2000). All terrestrial reptiles in Alberta, including snakes, congregate in winter dens or hibernacula. Hibernacula may be naturally occurring pits or crevices in rocky outcrops, burrows co-opted from small to medium-sized mammals, or excavated by the snakes themselves (Russell and Bauer 2000). No known hibernacula are located in the local study area. Despite the lack of known records, suitable habitat for garter snakes (including hibernacula) does exist in the local study area. The north slope of the river valley likely represents the most suitable garter snake habitat in the study area. All wooded habitat in the study area would, however, provide suitable foraging habitat should garter snakes occur in the study area.

Special Status Species

Based on habitat requirements, habitat availability and provincial distributions, we identified 37 special status species with the *potential* to occur in the regional study area (Appendix G). Of the 37 special status species, four species were considered in more detail here because they are ranked by the Province as *May Be At Risk* (Canadian toad, northern bat, long-tailed weasel) or *At Risk* (peregrine falcon) and were considered to have a moderate probability of occurring in the regional study area, although a low probability of occurring in the local study area (Table 5.7). Of the remaining 33 species, one is ranked as *May Be At Risk* but has a low probability of occurring here and 32 are Provincially ranked as *Sensitive*. Some of these species have also been granted special status by the federal government.

This section of the report is important for the identification of key biophysical resources as required by the City's Bylaw 7188 process, but is also important to ensure compliance with provincial and federal conservation legislation. When discussing listed species, the likelihood of such species occurring in the area in question and the likely duration of their stay are critical considerations for assessments related to development, as this will influence the possibility that a particular species could be affected by a project. For many of these species, the presence of available habitat does not necessarily indicate that a species will be present. For example, many special status species are listed as such because of limited distribution; therefore, for those, not all suitable habitats will be occupied. To account for this, Appendix G also includes a qualitative assessment of the likelihood of a species occurring in the regional study area (noted as low, moderate or high), based on professional opinion arrived at by considering habitat availability at the site and on adjacent lands, and specific potential habitat use by each species (e.g., potentially breeding at the site, or passing through the area on migration and stopping to forage). The following section discusses all Provincially-ranked *At Risk* and *May Be At*

Risk species with a moderate likelihood of occurrence (Table 5.7). There are a total of four such species, one bird, two mammals and one amphibian.

Table 5.7. Select special status species that may occur in the regional study area

Common Name	Provincial Status*	Wildlife Act Designation and New Species Assessed by ESCC[1]	COSEWIC Designation[2]	SARA Designation[3]	Recorded in Study Area	Potential Habitat Use	Likelihood of Occurrence
Peregrine Falcon (*Falco peregrinus anatum*)	At Risk	Threatened	Special Concern	Schedule 1 (Threatened)	No	Foraging	Moderate
Long-tailed Weasel (*Mustela frenata*)	May Be At Risk		Not at Risk		No	Foraging	Moderate
Northern Bat (*Myotis septentrionalis*)	May Be At Risk		Endangered		No	Breeding / Foraging	Moderate
Canadian Toad (*Anaxyrus hemiophrys*)	May Be At Risk		Not at Risk		FWMIS[4] (2007)	Breeding / Foraging	Moderate

***According to General Status of AB Wild Species (date)**
[1] ESCC- Alberta's Endangered Species Conservation Committee
[2] COSEWIC -
[3] SARA – Committee on the Status of Endangered Wildlife in Canada
[4] Fish and Wildlife Information Management System

Peregrine Falcon

The only *At Risk* species with a moderate likelihood of occurrence in the study area is the peregrine falcon. Peregrine falcons prefer rocky cliffs, or tall buildings in cities, for nesting (Fisher and Acorn 1998). Peregrine falcons are known to nest on office buildings in Edmonton's downtown core, approximately 1km northeast of the Cloverdale Pedestrian Bridge. Peregrine falcons are also known to have nested in recent years on the High Level Bridge approximately 4 km upstream from the study area. Their likelihood of occurring in the regional and local study area is, therefore, considered moderate, as they are often observed hunting in the river valley and could forage in the area. They are not, however, expected to nest in the local study area.

Mammals

Two special status mammal species could potentially occur in the regional study area: long-tailed weasel (*May Be At Risk*) and northern bat (*May Be At Risk*) (Appendix G). The long-tailed weasel prefers open agricultural areas, but can be found on grassy slopes or foraging in aspen parklands where it preys on small mammals such as voles and mice (Pattie and Fisher 1999). Although long-tailed weasel habitat is available in the regional study area, this is a wide-ranging species and, if present, the regional area may comprise only part of its territory. Habitat within the local study area is highly disturbed and may only be used by long-tailed weasels when dispersing. Considering the above, we have rated their likelihood of occurrence in the regional study area as moderate and the local study area as low.

Northern bats prefer forested areas, usually those close to waterbodies (Pattie and Fisher 1999). Considering the forested areas within the regional study area and the proximity of the NSR, this species has been identified as having a moderate likelihood of occurring in our regional study area. Since less disturbed treed habitat occurs in Mill Creek Ravine and further along the NSRV, the likelihood of the northern bat occurring in the local study area is rated as low.

Amphibians and Reptiles

One special status species of amphibian – the Canadian toad (Provincially-ranked *May Be At Risk*) - has been previously recorded in the regional study area. Canadian toads have been recorded within the regional study area on the north side of the river by the low level bridge in 1914, 1950 and 1957, as well as more recently in 2007 in the lower part of the Mill Creek Ravine. The 2007 sighting by the Alberta Amphibian Monitoring Program was identified as a reproductively mature adult.

Canadian toads typically breed along the margins of lakes and rivers, which are preferred habitat over small streams and temporary ponds (Hamilton et al. 1998). They are most often found using waterbodies with stable water levels, mudflats and cattail margins (Hamilton et al. 1998). Outside of the breeding season, Canadian toads can occur in areas of boreal forest and aspen parkland, and along river valleys, but may also be found far from water (Russell and Bauer 2000). The 2007 record from lower Mill Creek ravine suggests that suitable breeding habitat may be present in that area of the regional study area. Accordingly, the likelihood of the Canadian toad occurring in the regional study area is considered high, but potential occurrence in the local study area is considered low, owing to lack of suitable watercourse margin habitat.

5.1.7 *Habitat Connectivity*

5.1.7.1 Methods

Habitat connectivity was assessed based on the quality and distribution of habitat in the local and regional study areas; consideration of local topography; a review of an existing report on landscape linkages and connectivity in the City of Edmonton (Spencer Environmental 2006; results of a reconnaissance winter tracking survey conducted in support of this EISA; and examination of local vehicle wildlife collision records. The primary purpose of the reconnaissance tracking survey was to document evidence of obvious wildlife movement patterns in the Connors Road vicinity. The 2006 landscape connectivity analysis modeled landscape permeability/connectivity at a coarse level, using desktop analyses, throughout the city, including in the river valley.

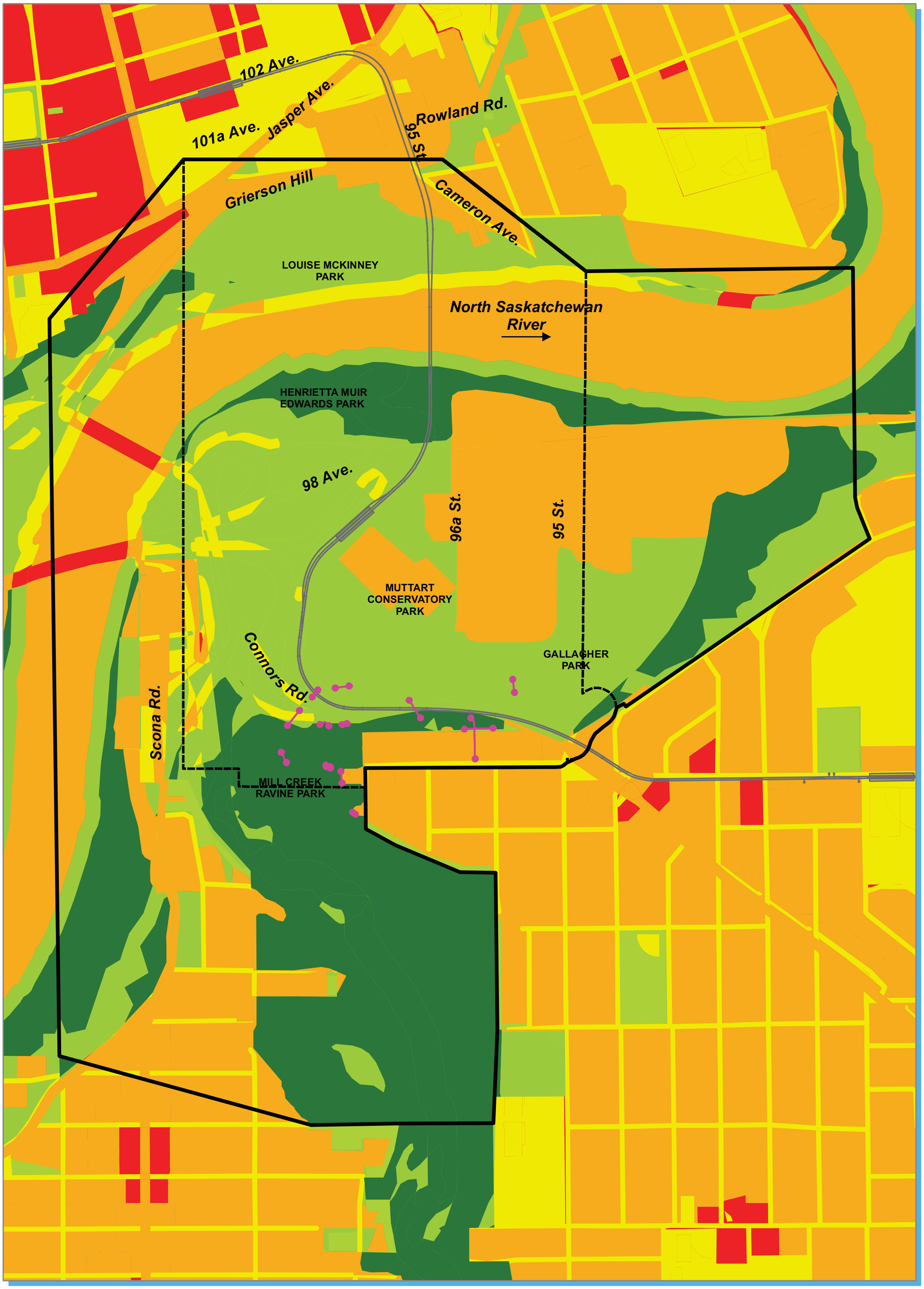
5.1.7.2 Description

Highly developed areas such as residential, commercial and recreational regions pose barriers to wildlife movement and dispersal, when suitable habitat is present nearby. In such cases, wildlife corridors play a key role in wildlife dispersal because they serve as lineal natural or constructed links between larger habitat areas, accommodating daily, seasonal or dispersal movements that enable genetic exchange and access to other resources (Paquet et al. 2004). The viability of an area as a wildlife corridor is a function of the continuity in its vegetation structure, its width, the amount and type of surrounding disturbance and the quality of the habitat it connects. Major wildlife corridors provide cover and resources, connecting large areas of habitat at a regional scale. River valleys and their associated riparian strips in particular are widely recognized as important wildlife corridors (Vermont Agency of Natural Resources 2005).

The Edmonton North Saskatchewan River Valley Ravine system is the longest continuous urban green space in North America and is viewed as an important regional wildlife corridor (Spencer Environmental 2006). For those reasons, the NSRV provides the foundation for Edmonton's ecological network. The NSRV consists of a mosaic of different land uses: forested patches, manicured parkland and urban development are just some of the many land uses present. The regional and local study areas are no exception: natural woodland habitat, open manicured parkland, landscaped/naturalized areas and urban development are all present. These habitat types provide varying degrees of habitat permeability and connectivity (Figure 5.7). The local and regional study areas include vegetated riparian areas on either side of the river and numerous parks that provide a relatively permeable area for wildlife to move through but also include features that may restrict wildlife movement. Restricting features include: an extensive road network, residential development and steep riverbank slopes. The following sections describe in more detail specific areas within the local study area that are key to wildlife movement and habitat connectivity and may be affected by components of the Valley Line-Stage 1 project.

Louise McKinney

Louise McKinney Park (north side of the valley), provides a mix of natural grassland/shrub habitat on the upper steep slopes of the valley, and landscaped and manicured habitat on the lower, less steeply sloped areas of the park. The habitat available to terrestrial wildlife moving through the valley north of the river narrows to a gap approximately 60m wide between residential property boundaries and the shores of the river at a point about 100m east of the Cloverdale Pedestrian Bridge. The majority of that available habitat occurs below the paved SUP. To the east, this habitat connects to other, albeit very narrow, steeply sloped areas of natural riverbank habitat. Further east yet, a short length of very steep slopes prohibits wildlife movement. The slopes then become shallower further downstream. To the west, this natural habitat extends under the footbridge, but terminates where the Louise McKinney Park riverside promenade begins. The existing habitat connectivity along the riverbank may facilitate the movement of smaller wildlife species, but does not provide the protective cover preferred by larger species such as deer. Coyotes, which tend to be less wary and more willing to travel through open areas, may travel along the north side of the river underneath the bridge, but may also travel across the SUPs and landscaped areas above the bridge. Overall, the significance of the north valley wall in the local study area as a wildlife movement corridor is considered low to moderate because of the presence of a narrow pinch point, a lack of protective cover and the area's capacity to functionally support the movement of only relatively small mammals. This conclusion is consistent with the permeability



Legend

- Documented Wildlife Movement Trails
- Regional Wildlife Study Area
- Local Wildlife Study Area
- Proposed LRT

Landscape Permeability Model Output*

- Low
- Moderately Low
- Moderate
- Moderately High
- High

0 50 100 200 Meters

1:7,500

*Measured by the degree to which landscape elements facilitate wildlife movement;
Source: Spencer Environmental (2006)

Figure 5.7 Landscape Permeability

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created: 01 May 2013

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modeling undertaken in 2006 for the City of Edmonton, which mapped this lower riparian corridor as being moderately permeable to wildlife and the higher slopes as having moderately high permeability (Spencer Environmental 2006).

Henrietta Muir Edwards Park

HME Park, occupying the south river bank and some of the wide river terrace, is the largest and most continuous wildlife corridor within the local study area, one that extends beyond the local study area. The wooded riparian park measures approximately 200 m at its widest, although the width of the available habitat narrows to approximately 60m at the west edge of the local study area. The habitat in HME Park generally consists of mature deciduous woodland, with variable topographic relief, which provides suitable protective cover for the full range of potentially occurring wildlife species from small (mice, squirrels) to large (coyotes, deer). Two SUPs wind through the park, however, they are situated close together, which allows a clear separation between human and wildlife movements. East of the local study area, the wooded habitat along the south side of the river extends un-fragmented for approximately 2kms to the bridge crossing at Rowland Road. West of the local study area, the natural riparian habitat narrows to approximately 25m beneath the Low Level Bridge but then widens again. The road network south of this location is very concentrated and likely presents a significant barrier to most terrestrial species. Much of the wildlife travelling along the south valley is, therefore, likely funneled to the area under the Low Level Bridge. Although wildlife movement through this reach of the NSRV may be reduced compared to less urbanized areas of the river valley, it is the most permeable area within the central portion of the river valley (Figure 5.7) and remains a critical component in the City's ecological network. Contrary to the north river bank, the relatively shallow slope and natural vegetation along the south riverbank were mapped as having moderately high permeability for wildlife movement. The significance of HME Park as a wildlife movement corridor is rated as high.

Mill Creek Ravine and Gallagher Park

The other potentially significant wildlife movement corridor present in the local study area is on the south side of the river through Mill Creek Ravine, across Connors Road, into Gallagher Park to the Cloverdale Road Ravine and back to the main river valley (Figure 5.7). Mill Creek Ravine provides a large patch of natural habitat suitable to support a high diversity of native wildlife species. The City has recognized the value of Mill Creek Ravine through its designation as a Biodiversity Core Area within the City's ecological network (City of Edmonton 2008). Mill Creek Ravine also functions as a wildlife movement corridor, extending in a linear fashion for approximately 3kms to the south. The natural habitat of Mill Creek Ravine effectively terminates at Connors Road. As a result, wildlife moving beyond the ravine (or approaching the ravine) must either cross over Connors Road and enter Gallagher Park, or traverse Scona Road to access other natural areas of the NSRV near the Old Timers Cabin. Snow tracking observations made in November 2012 provided evidence that some wildlife do cross over Connors Road into Gallagher Park. Deer tracks, in particular, were observed in abundance just south of Connors Road. Two sets of tracks were seen to cross over Connors Road; one set of tracks approached the road before turning back. Some tracks were also noted moving through a forested slope parallel to Connors Road, particularly along the back edge of the residential lots south of the road. The number of animals and frequency of use cannot be determined from this one survey event. Existing records of animal-vehicle collisions on Connors Road are patchy and not site specific, but do not suggest one concentrated corridor or a chronic collision problem. Nonetheless, despite the presence of Connors Road, a three-lane arterial roadway, the connection between Mill Creek Ravine and Gallagher Park appears to be functional for larger bodied wildlife species such as deer and coyotes. The width of Connors Road and traffic volumes may provide a more significant barrier to smaller wildlife species such as porcupines, skunks or squirrels; however, even individuals of those species are still expected to cross occasionally. From Gallagher Park, highly permeable, natural habitat connections exist to the northeast along the wooded valley slopes above Cloverdale Road (Figure 5.7). Several small round and linear woodland patches in Gallagher Park are expected to act as stepping stones between Connors Road and Cloverdale Ravine, providing protective cover for animals moving through the manicured park. Cloverdale Ravine, in turn, connects to the wooded riparian area along the river north of 98th Avenue, looping into the corridor available in HME Park, although 98 Avenue separate the two features.

All of the above suggests that the connection between Mill Creek Ravine, a biodiversity core area, Gallagher Park, the Cloverdale Ravine and the rest of the NSRV represents a significant confluence of components in Edmonton's ecological network. Accordingly, the value of this connection is considered high.

5.2 Valued Socio-Economic Components

5.2.1 Land Disposition and Land Use Zoning

5.2.1.1 Methods

Land disposition was determined through consultation with Connected Partnership personnel responsible for LRT land acquisition investigations. Land use zoning was determined by referencing the City of Edmonton Zoning Bylaw No. 12800 and its accompanying map (City of Edmonton 2013e).

5.2.1.2 Description

Land Disposition

Park lands are currently owned by City of Edmonton Community Services. One parcel of land within the project area (10021-95th Street) is privately owned; however, it is being acquired by the City. Lands on the north and south side of the NSR are owned by the City of Edmonton Community Services. The bed and shore of the river and Mill Creek (i.e., the abandoned channel) are owned by the Province of Alberta.

The Edmonton Ski Club which began operation in its present location in 1911, leases a substantial portion of Gallagher Park from the City of Edmonton. The Muttart Conservatory is owned by the City of Edmonton and is situated on City property.

Land Use Zoning

All lands within the study area are zoned either Metropolitan Recreation Areas (A) or River Valley Activity Node (AN) (Figure 5.8).

The NSRV and immediately adjacent uplands, as well as the lower section of Mill Creek Ravine are primarily zoned as Metropolitan Recreation Areas (A) (Figure 5.8). The purpose of these zones is to preserve natural areas and parkland along the river, creeks, ravines and other designated areas for active and passive recreational uses and environmental protection in conformance with Plan Edmonton and the North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188). The River Valley Activities Nodes (AN) are present in sections along the north wall of the valley and lands between Connors Road and 98th Avenue. The purpose of these zones is to allow for limited commercial development within activity nodes in designated areas of parkland along the river, creeks and ravines, for active and passive recreational uses, tourism uses, and environmental protection in conformance with Plan Edmonton, the Ribbon of Green Master Plan, and the North Saskatchewan River Valley Area Redevelopment Plan.

5.2.1 *Residential Land Use*

5.2.1.1 Methods

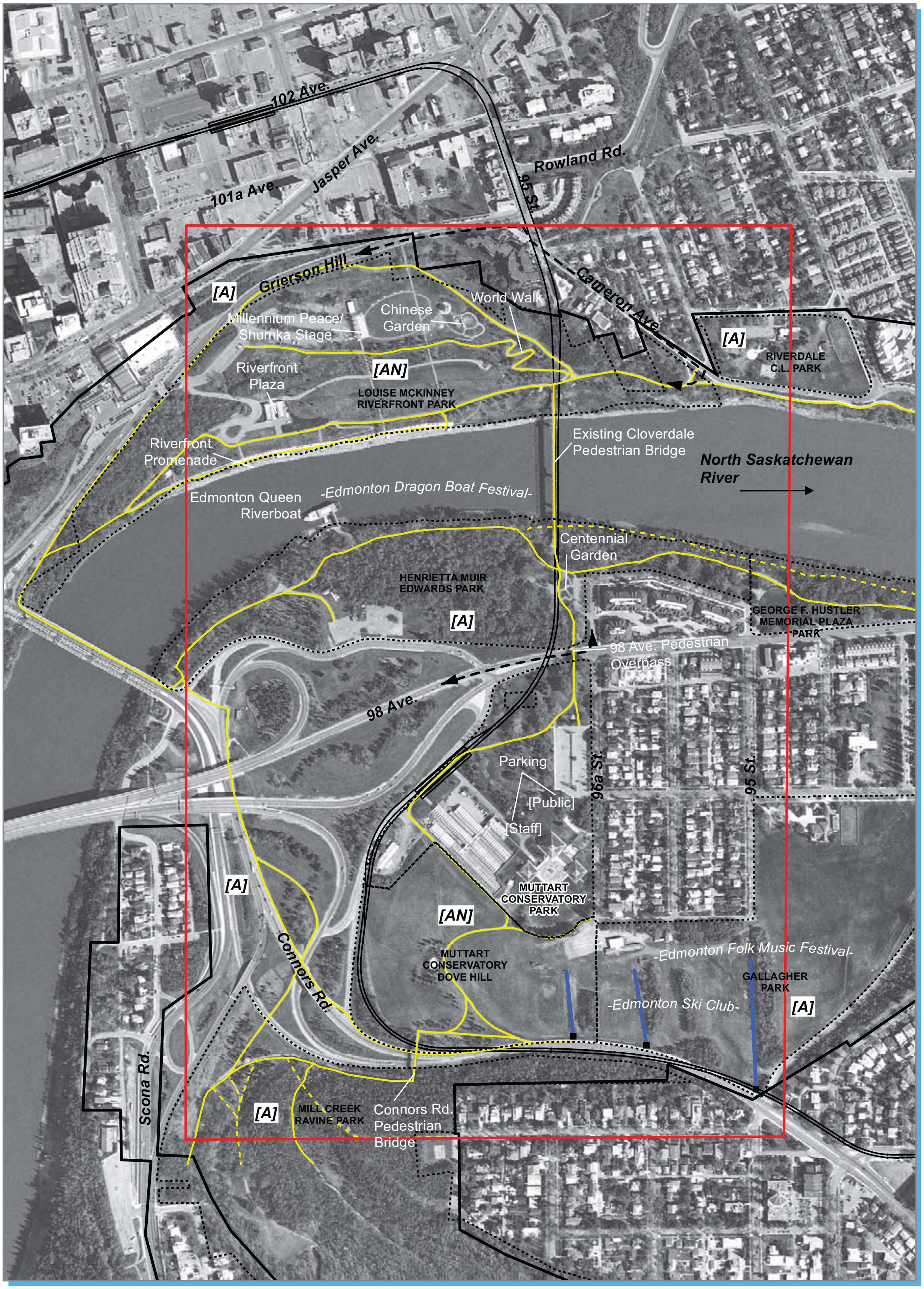
Several residential areas are within or border the EISA study area, necessitating a description of residential land use from the perspective of potential project interactions. Key project issues prompted investigation of four fundamental aspects of residential areas: identification of neighbourhood areas nearest to the project area; neighbourhood acoustic environments; local traffic routes and road conditions in relation to project area construction access; and ambient dust/mud. (Concerns regarding visual impacts are discussed in section 5.2.3).

Relevant residential information (Figure 5.9) was compiled using information collected from City of Edmonton Neighbourhoods Map (City of Edmonton 2013c), Google Maps, a Socio-Economic Baseline Condition Report for the Valley Line LRT (named in Appendix B) and observations made during site reconnaissance inspections.

The existing acoustic environment in the river valley and bordering areas was described by referring to a reported summary of a noise assessment conducted in the LRT conceptual stage, (for the full length of the Valley Line-Stage 1) and qualitative field observations.

5.2.1.1 Description

There are three main residential areas in the local study area: Riverdale, Cloverdale and Bonnie Doon. The Riverdale Neighbourhood is located directly north of the existing Cloverdale Bridge on the north side of the river, bounded to the north by Grierson Hill and Rowland Road, the east and south by the NSRV and the west by McDougall Hill. The neighbourhood was founded in 1883 and is one of the oldest neighbourhoods in the city. The houses, which are predominantly large, old, detached character homes, are located east of 95th Street. Three roadways are located within the study area on the



Legend

EISA Study Area

Proposed LRT

Construction Access

Bylaw 7188 Boundary

Park Boundaries

Ski Lift

Zoning

[A] Metropolitan Recreation Area

[AN] River Valley Activity Node

Pathway

Shared Use Pathway

Granular Pathway

0 50 100 200 Meters

1:5,000

Figure 5.8 Existing Recreational Amenities

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created:04 July 2013

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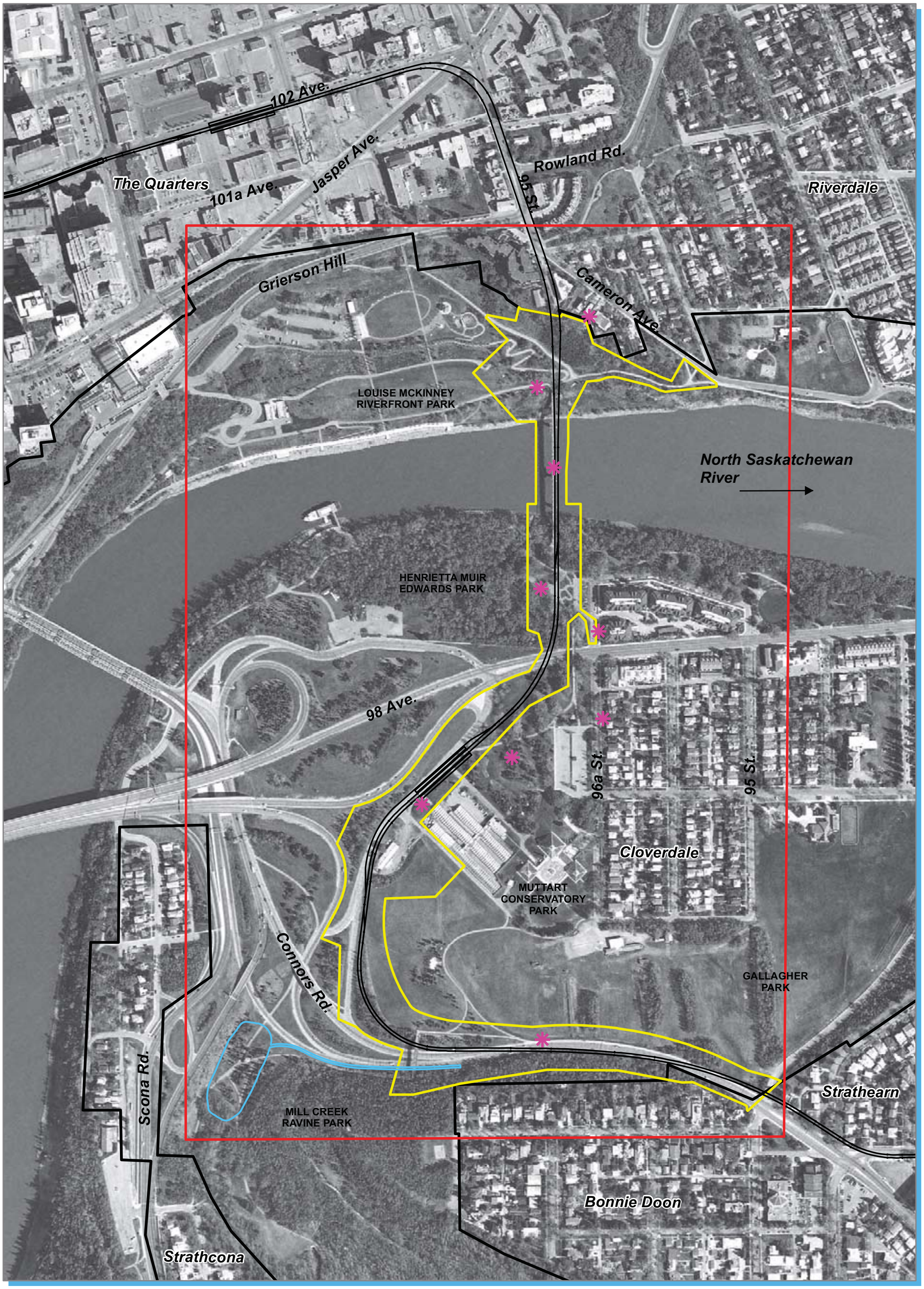
**Muttart garden beds not shown*
***Land use zoning source: City of Edmonton Planning and Development (2013)*



Legend

- Key Short-Distance Viewpoints
- EISA Study Area
- Project Area
- Proposed LRT
- Proposed Dry Pond and Vegetated Swale (Conceptual)
- Bylaw 7188 Boundary

N

0 50 100 200 Meters

1:5,000

Figure 5.9 Neighborhoods and Key Short-Distance Viewpoints

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created: 04 July 2013

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north side of the river: Grierson Hill Road, Cameron Avenue and 95th Street NW. Grierson Hill Road and Cameron Avenue are proposed as project area access routes. Grierson Hill is a two-way, three-lane roadway which is mainly used to access Louise McKinney Park, the south entrance of the Shaw Conference Centre and east downtown Edmonton. Cameron Avenue is two-lane, local roadway that descends to the valley bottom and then turns left sharply to parallel the riverbank. The road primarily services local residents and is assumed to currently support relatively low traffic volumes at all times. Houses line both sides of Cameron Avenue and approximately five houses back onto the eastern part of Louise McKinney Park and the SUP (TransCanada Trail) into the park (Plate 5.14) that will be upgraded to form the portal structure access road.

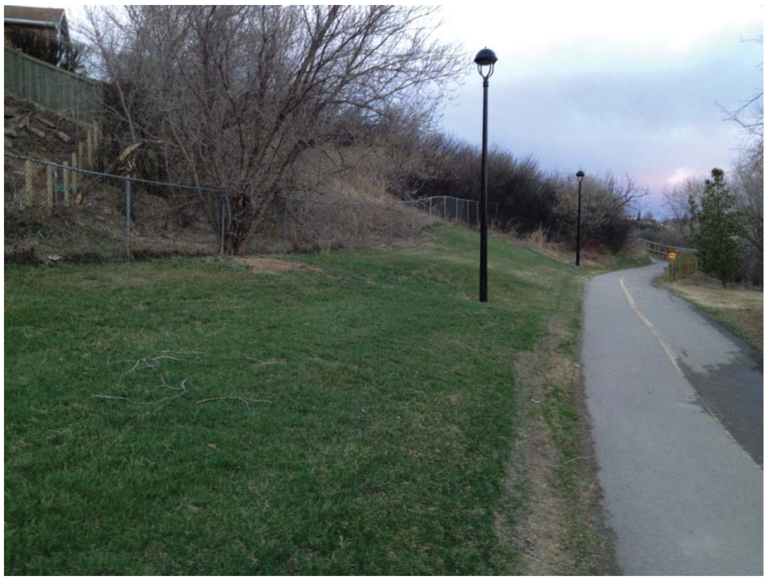

Plate 5.14. Houses located along Cameron Avenue backing onto Louise McKinney.

The Cloverdale Neighbourhood, founded in 1907, is located largely on the south river terrace and the western portion is situated within the river flood plain and in the project area. Extending from the river to Connors Road in the west and south, and 84th Street in the east, the neighbourhood includes a number of community parks, including Gallagher Park. Most of the homes along 91 Street, 96 Avenue, and 96a Street are also bordered by parkland areas, including the Muttart Conservatory grounds. During the Edmonton Folk Music Festival, the Cloverdale neighbourhood acts as a staging area and experiences heavy pedestrian traffic, logistic traffic and restricted parking. Condominium and townhouse complexes are situated along both sides of 98th Avenue (Plate 5.15). The Landing, situated between 98th Avenue and the NSR, and adjacent to HME Park, is a relatively recently developed condominium complex. No homes in the Cloverdale neighbourhood back directly onto the LRT alignment but several are located within 40-60 m of the proposed tracks and the westernmost units of The Landing are directly adjacent to the project area and proposed truck entrance (Plate 5.15).

Within Cloverdale, 98th Avenue is a four-lane roadway that begins at the Low Level Bridge and travels east/west. The road carries downtown commuter traffic but also services Cloverdale Neighbourhood. Traffic on local roads within the neighbourhood is assumed to be relatively low and primarily residential. The Muttart Conservatory parking lot is accessed from 96 A Street serves and may experience slightly higher traffic than other local roads in the neighbourhood. During the Edmonton Folk Music Festival, traffic and parking in Cloverdale is limited to residents and Folk Festival workers only; however, this represents increased traffic and noise and may limit visitor parking and is, therefore, likely experienced as an inconvenience to Cloverdale residents.

Plate 5.15. View from HME Park of condominiums and townhouses lining 98th Avenue

Although situated outside of the Bylaw 7188 boundaries, margins of the Bonnie Doon and Strathcona neighbourhoods are also considered here since proximity of select homes to the project creates potential for them to be indirectly affected. Homes along 95th Avenue in the Bonnie Doon Neighbourhood are situated in the southeast corner of the study area and the lots are bounded by Connors Road to the north, and Mill Creek Ravine North to the west. Houses in this locality are generally large, two-story, character houses, many with views of the downtown. At Connors Hill, Connors Road is a three lane roadway which includes a reversible middle lane to aid heavy traffic flow during the morning and evening rush hour periods. In this area and further south, Connors Road services traffics from much of the Bonnie Doon Neighbourhood and beyond.

The narrow, northern tip of the Strathcona neighbourhood is located at the westernmost part of the study area, between Connors Road on the east and Nellie McClung Park on the west. This isolated area of Strathcona Neighbourhood comprises small two-storey and bungalow homes, and approximately 12 of them back onto Scona Road and the EISA study area. They were not included in the baseline noise assessment.

None of the three above neighbourhoods in the study area appeared to have obvious existing sources of concentrated dust or road mud, over and above what a typical Edmonton neighbourhood experiences in response to seasonal conditions.

5.2.2 *Recreational Land Use*

5.2.2.1 Methods

Descriptions of existing recreational resources were developed through the following means and in collaboration with CTP members:

- Pedestrian reconnaissance of the project area, during which the presence and location of all park features and amenities were noted.
- Observations of activities taking place during the pedestrian survey.
- Information searches regarding recreational facilities and programs.
- Consultation with City staff regarding valued park amenities and programs.
- Review of previous park planning documents.
- Reliance on in-house knowledge held by landscape architects at ISL Engineering and AECOM.

The study area for recreational land use was selected to capture potential direct and indirect project impacts on recreation. It is our assumption that lands within the project area will be subject to direct impacts associated with LRT construction and that a smaller internal area will be permanently and directly affected by the presence of operating LRT infrastructure. However, it is also recognized that effects of the both construction and operation can extend beyond the project area in the form of indirect impacts such as noise, dust, and disruptions to recreational networks. For this reason, the full area of each park that intersects with portions of the project area was considered in our assessment (Figure 5.8). These include:

- Louise McKinney Riverfront Park (Louise McKinney Park),
- Henrietta Muir Edwards Park (HME Park),
- Muttart Conservatory,
- Dove Hill,
- Gallagher Park, and
- the northernmost portion of Mill Creek Ravine Park, north of 95th Avenue.

The study area in Mill Creek Ravine Park was truncated south of 95th Avenue because the remainder of the park, which extends several kilometres to the south, is believed to be too far from the project area to be substantially affected. We recognize that some potential impacts, such as trail closures, may extend beyond the boundaries of the study area, and although these extended areas of impact are not captured within our study area, they will be considered in the impact assessment where appropriate.

5.2.2.2 Description

North River Bank and Louise McKinney Park

Louise McKinney Riverfront Park is a prominent urban park space that connects downtown Edmonton to the river valley (Plate 5.16, Figure 5.8). The park is among Edmonton's highest profile urban parks and several of its design features have won urban design and landscape architecture awards. The 12.9 ha park site provides space and

Plate 5.16. Louise McKinney Park, as seen from the north, looking southeast (downstream).

amenities for active and passive recreational activities and is an important community festival and event location, with 10-20 smaller festivals/events occurring in the park each year.

The park has numerous SUPs that are used for running, walking, cycling, rollerblading and other similar activities, and some of these trails are component parts of well-used larger trail loops. Benches are available for passive activities such as reading or river viewing. The Park features many prominent and well-used festival amenities, including a stage that can be used for concerts and similar events and a riverfront promenade offering open river views.

Important park features and amenities include:

- Chinese Garden (Plate 5.17);
- Oval Lawn (recreation and event space);
- Shumka Stage / Millennium Plaza;
- World Walk rose garden (Plate 5.18);
- Trans Canada Trail and pavilion (donor recognition);
- Riverfront Plaza and Promenade;
- custom-designed pedestrian furnishings, including benches and light standards;
- public art that has been incorporated into the urban design through features like light standard poetry wrap details;
- donor trees, benches, and features;
- various pathways and connections throughout the park and to areas outside of the park, including connections to downtown and across the river;

- a wheelchair accessible switchback pathway that descends into the valley. The pathway runs through the World Walk;
- a “wishing tree”, to which people attach notes containing wishes; and
- trailhead to Cloverdale pedestrian bridge.

Unlike many of Edmonton’s river valley parks, at Louise McKinney Park, the river is a highly integrated park feature, with respect to landscaping and recreational use. The Edmonton Dragon Boat Festival, held annually in mid-August and lasting four days, takes place in the NSR below Louise McKinney Park, with participants gathering in the park and at the Cloverdale pedestrian bridge. The central event of the Dragon Boat Festival is a Dragon Boat race, which begins at the Cloverdale pedestrian bridge and ends 250-500 m upstream. The race can be viewed from the Riverfront Promenade and the Cloverdale pedestrian bridge. Dragon boat teams practice and train throughout the summer, making use of Henrietta Muir Edwards Park and Rafters Landing boat launch. Parking for training programs and the festival is available in a public lot in the northwest portion of the park.

Plate 5.17. Stone bridge in the Chinese Garden (Louise McKinney Park).

Plate 5.18. The World Walk (Louise McKinney Park).

Future Park Plans

Community Services has indicated that several capital projects are in development for Louise McKinney Park and anticipated to commence in the next three year period, including: new plaza and grand staircase, immediately east of the west parking lot; new buildings and urban beach (beach not yet approved by Council) on the lower slopes, near the riverfront plaza; and, additions to the Chinese Garden, with approximately 7 features. All of these are situated outside of the project area shown in Figure 2.4, although some of the Chinese Garden features are very close to the project area margin.

Community Services has also indicated that as a Corporation, City of Edmonton is in negotiation to host a new biannual, high profile event at Louise McKinney Park.

North Saskatchewan River

The NSR is one of the major attractions for recreational enjoyment in the river valley. The river supports individual and group activities and hosts multiple community events. Individual or group pursuits include rowing, canoeing, kayaking, rafting, paddle-boarding, motor boating and fishing. Organized community events include the Dragon Boat Festival. Commercial recreational uses include the Edmonton Queen Riverboat, which offers short tours of the NSR. The Edmonton Queen Riverboat docks instream, slightly west (upstream) of the project area, at Rafter's Landing (Plate 5.19). The ship is operated by Riverboat Inc.

Rafter's Landing is the only boat launch within the study area. It is licensed to the Edmonton Queen Riverboat, and not available for public use; however, the City has an agreement with Riverboat Inc. to allow access to the launch for certain special events, including hand launching for the dragon boats. A public floating dock is available on the north side of the river. This dock is not a launching point for boaters, but can be used to access Louise McKinney Park from the river.

Plate 5.19. The Edmonton Queen Riverboat, docked at Rafter's Landing, with the Riverfront Promenade on the opposite bank, viewed from downstream

The Cloverdale pedestrian bridge provides a pedestrian-friendly river crossing, and links to pathway networks on the north and south sides of the river (Plate 5.20, Figure 5.8). The bridge, built in the 1970s, is approximately 5 m wide. Seating and viewing areas are available at the two northernmost piers, where the bridge deck widens, as well as near the south abutment. The bridge is often used to view activities and events on the river, and provides a pathway connection across the river for casual and commuter pedestrians and cyclists. The bridge is one of four dedicated pedestrian bridges across the NSR in Edmonton.

Plate 5.20. Cloverdale pedestrian bridge

South River Bank and Henrietta Muir Edwards Park

HME Park comprises a mixture of forest and open space areas along the south bank of the river. It provides a trailhead for pedestrian pathways extending both east and west along the riverbank, and connects to Muttart Conservatory, Rafter's Landing and the Cloverdale pedestrian bridge. The site also supports a picnic site and shelter (Plate 5.21), with a paving stone plaza and moveable picnic tables; however it is in disrepair, has no heritage value and is not a bookable space (S. Buchanan, *pers. comm.*) . East of the picnic area, the Centennial Garden, planted by Edmonton Horticultural Society to commemorate Edmonton centennial anniversary (2009) and its horticultural heritage, serves as a park entrance amenity. The garden project was conducted as part of the City's Partners in Parks program and features 13 ornamental trees, 62 shrubs and 226 perennials, in addition to gravel pathways and benches (Plate 5.22). A small parking lot is situated adjacent to the Centennial Garden, making the park an access point to the greater river valley parks system. Because of the parking lot, HME Park acts as an entrance point to the larger parks system for users from various parts of the City. A blue emergency phone is located in the park near the trailhead, and is intended for use by park and pathway users.

Plate 5.21. Picnic shelter at HME Park

Plate 5.22. Centennial Garden

HME Park supports a number of low-impact activities, including:

- group picnic activities;
- running, jogging, walking, rollerblading;
- cycling (both recreation and commuter);
- horticultural enjoyment (Centennial Garden);
- nature, bird and wildlife watching;

- orienteering;
- passive activities, such as sitting, reading, etc.; and
- pedestrian river crossing and viewing from Cloverdale Footbridge.

The Muttart Conservatory/Dove Hill

The Muttart Conservatory, a public conservatory and botanic garden, is an important recreation destination and Parks commercial enterprise, and the pyramids are a significant architectural icon (Plate 5.23). The facility, which opened in 1976, focuses on horticultural displays and programming throughout the year. The pyramids are most easily accessed by private automobile. Two bus routes (routes 85 and 86) stop in the vicinity of the Conservatory, but both run on relatively infrequent schedules, particularly on weekends, which is likely a peak period for Conservatory visitorship.

Plate 5.23. The Muttart Conservatory

Indoors, the facility features:

- four public greenhouse pyramids that house horticultural displays;
- horticultural, cultural, and artistic programs and courses;
- event rental spaces (i.e. weddings, parties);
- youth programming, including day-camps;
- café and gift shop; and
- art exhibition areas.

A non-public greenhouse complex that supports the conservatory's horticultural activities is located west of the pyramids (Plate 5.24). A storage building and maintenance yard support volunteer gardening activities and provide storage for Muttart's display props (Plate 5.25). Staff parking is located in this area. Vehicular access to this area is provided by the Muttart access road, a narrow road that connects with 98th Avenue and Connors Road.

Plate 5.24. Staff parking and working greenhouses at the Muttart Conservatory

Plate 5.25. Muttart storage facility

The Muttart Conservatory grounds, located to the north of the greenhouse pyramids, provide multiple recreational activities and support the Muttart's horticultural programming, including important community partnering programs. Outdoor amenities and activities include:

- pathway connections, including SUP connections that are used for running; jogging, walking, cycling (both recreational and commuter) and rollerblading;
- pedestrian amenities, such as benches and movable picnic tables;
- a gazebo;
- a decorative pedestrian foot bridge;
- public art (sculpture);
- passive activities, such as reading, sitting, picnicking, and sunbathing; and
- horticultural enjoyment and learning.

The grounds are landscaped, and comprise a mixture of lawns, formal thematic gardens and ornamental trees. Numerous garden beds are present, some of which are associated with particular community groups, including:

- a native prairie garden established by the Edmonton Naturalization Group;
- a vegetable plot established in support of the Edmonton Food Bank "Plant-a-Row, Grow-a-Row" program (Plate 5.26). Produce from the bed is distributed to people in need through the Edmonton Food Bank. The bed is maintained by the Yellowhead Youth Centre., and
- a perennial flowerbed established by the Edmonton Horticultural Society;

Plate 5.26. The Edmonton Food Bank "Plant-a-Row, Grow-a-Row" vegetable plot

The open park space situated southwest of the Muttart site is known as Dove Hill, and is mainly unprogrammed. A piece of public artwork, "Dove of Peace", is located on a high point in this area adjacent to an SUP. The "Dove of Peace" is a white steel sculpture designed to commemorate Pope John Paul II's visit to Edmonton in the 1980s, and is visible from various viewpoints within the river valley. The pathway that passes by the sculpture connects the Muttart Conservatory and HME Park to Connors Road, the Connors Road pedestrian bridge and neighbouring communities (Figure 5.8).

Gallagher Park

Gallagher Park, located on the lower slopes of Connors Hill and Cloverdale Hill, contains the Edmonton Ski Club site, and the Cloverdale Community League area. Gallagher Park is also the site of the Edmonton Folk Music Festival (EFMF). The Ski Club is located in the western and west-central portions of the park, while the Cloverdale Community League is located in the southeast.

The Edmonton Ski Club (Plate 5.27) has used Gallagher Park since 1911 and offers downhill and freestyle ski programming and courses throughout the winter. The Ski Club operates out of a lodge located at the bottom of the hill, in the western portion of the park. The ski club provides downhill runs, a beginners' hill, and a terrain park. Access to the runs is provided via five lifts, including tow ropes, T-bars, and ski-lifts. Parking is available south and west of the lodge.

Plate 5.27. Edmonton Ski Club slopes and lodge

Gallagher Park is the permanent home of the EFMF, which has been held annually in early August for over three decades, and which attracts over 50 000 attendees. The Festival takes place over four days, with a period of up to two weeks required before and after the festival for site set-up and tear-down. The EFMF site occupies a substantial portion of Gallagher Park, including the Edmonton Ski Club slopes. Festival parking is not available onsite or in Cloverdale; rather, public transportation to the site is provided via a Park 'n' Ride system, which drops off users at the base of Cloverdale Road. The site can also be accessed using the SUP network.

Mill Creek Ravine

Mill Creek Ravine Park is an extensive park paralleling the Mill Creek system. Only the southernmost portion of the park will be considered in this EISA, as the majority of the park is not expected to experience impacts related to the project. Areas of interest with respect to the proposed LRT include the upper valley slopes above Connors Road, and the junction between Mill Creek Ravine and the NSRV in the valley lowlands. The upper slopes support a granular pathway extending from 95th Avenue west to the top-of-bank. Wooden staircases descend the steep ravine slopes and connect to the ravine trail network. The valley bottom supports a number of pathways, including an SUP that connects to the Connors Road pedestrian bridge. Mill Creek Ravine Park supports a number of low-impact recreational activities, including:

- running, jogging, cycling (both recreational and commuter) and rollerblading,
- wildlife watching and nature enjoyment, and
- passive activities, such as reading and viewing.

Valley Pathway Network

Numerous pathways are present within the study area (Figure 5.8). SUPs within the study area include:

- East-west SUP that parallels the north bank (Trans Canada Trail), connecting Louise McKinney Park with Riverdale to the east and Rossdale to the west.
- SUP that connects Grierson Hill to the Cloverdale pedestrian bridge,
- Cloverdale pedestrian bridge,
- SUP that parallels the south riverbank, connecting HME Park with Forest Heights Park to the east and Nellie McClung Park to the west,
- SUP that runs south from Cloverdale pedestrian bridge (Plate 5.28), crosses 98th Avenue via a pedestrian overpass, and crosses Muttart grounds,
- SUP the runs through the Dove Hill area and to the Connors Road pedestrian bridge,
- Connors Road pedestrian bridge, a truss style bridge with a wooden plank deck,
- SUP linking the Connors Road pedestrian bridge to the Mill Creek Ravine pathway network.

Other trails in the study area include:

- a granular pathway that crosses beneath the south end of the Cloverdale pedestrian bridge, heading east only
- a granular pathway that runs through Mill Creek Ravine, and connects with the SUP crossing Connors Road, and
- a shared-use sidewalk, which permits cycling, up to the top of Connors Road.

The main trails found within Louise McKinney Park and Henrietta Muir Edwards Park and the connecting Cloverdale Pedestrian bridge is part of much larger, well used trail network that currently forms a recognized jogging route that connects to the Royal

Glenore Club and the Kinsmen Sports Centre and is used by several running clubs and programs.

Plate 5.28. Connors Road pedestrian bridge

Summary – Recreational Amenities

Table 5.8 summarizes facilities and amenities located within the full study area and highlights those that are located partially or fully within the project area.

Table 5.8. Amenities and facilities located fully or partially within the project area

Park	Amenity/Facility	In Project Area?
Louise McKinney Park	Chinese Garden	Yes
	Oval Lawn	No
	Shumka Stage/Millennium Plaza	No
	World Walk rose garden	Yes
	Trans Canada Trail and pavilion	Yes
	Riverfront Plaza and Promenade	No
	Public dock	No
	Pedestrian furnishings	Some
	Public art	Undetermined
	Donor trees & benches	Undetermined
	Pathways	Yes
	Wishing tree	Undetermined
	Cloverdale pedestrian bridge	Yes
HME Park	Rafter's Landing/Edmonton Queen Riverboat/ EDBF Association	No but Yes for river activities
	Pathways	Yes
	Picnic area and shelter	Yes
	Centennial garden	Yes
Muttart Conservatory/Dove Hill	Public greenhouse pyramid complex	No
	Pathways	Yes
	Benches and picnic tables	Undetermined
	Gazebo	No
	Footbridge	No
	Public art	Undetermined
	Volunteer beds	Some
	"Dove of Peace" sculpture	No
Gallagher Park	EFMF site	Yes
	Edmonton Ski Club	Yes
	Cloverdale Community League	No
	Connors Road pedestrian bridge	Yes
Mill Creek Ravine	Pathways	Yes

5.2.3 *Visual Resources*

5.2.3.1 Methods

The following description of visual resources was based on observations and photographs collected during a pedestrian survey of the project area in fall 2012 and supplemented by additional surveys in winter and early spring 2013. Existing viewscapes were assessed with an emphasis on views of prominent areas, views with particular social significance, and other viewscapes identified as stakeholder concerns, including views from residential areas adjacent to or overlooking the project area. Seasonal variations in viewscapes were also considered, with winter views emphasized so as to assess the worst case scenario for near views of the project area. While winter/early spring views may not offer the most attractive qualities, consideration of winter views, when deciduous tree foliage is absent, allows assessment of conditions when vegetation screening is least effective.

5.2.4 Description

North River Bank and Louise McKinney Park

Louise McKinney Park is an important visual resource in Edmonton, and has been designed, among other objectives, to aesthetically link the downtown urban environment with the natural environment of the river valley. Views from the north, along the top-of-bank from the Downtown and Quarters neighbourhoods look across Louise McKinney Park, and include the river, Cloverdale pedestrian bridge, and south river bank in the background (Plate 5.29). The park enjoys a central Edmonton location and is highly visible from several in-valley and top-of-bank vantage points, including several major roadways into downtown.

The residential properties at the top of the river valley along Cameron Avenue and at the south end of 95th Street have views of the river valley and Cloverdale pedestrian bridge, as well as views across Louise McKinney Park towards the downtown core.

Views from Louise McKinney Park include the existing footbridge (Plate 5.30), World Walk (rose garden), the river, park landscaping, and shrubland/grassland surroundings near the east end of Louise McKinney Park. Currently, the steep slopes of the north valley wall at the east end of the park acts as a backdrop to the park, framing park views and providing a natural look and feel to the east areas of the park (Plates 5.31 and 5.32).

Plate 5.29. Louise McKinney Park, looking south from Grierson Hill

Plate 5.30. The Cloverdale Bridge from the north valley slope, looking west from Louise McKinney Park (upstream)

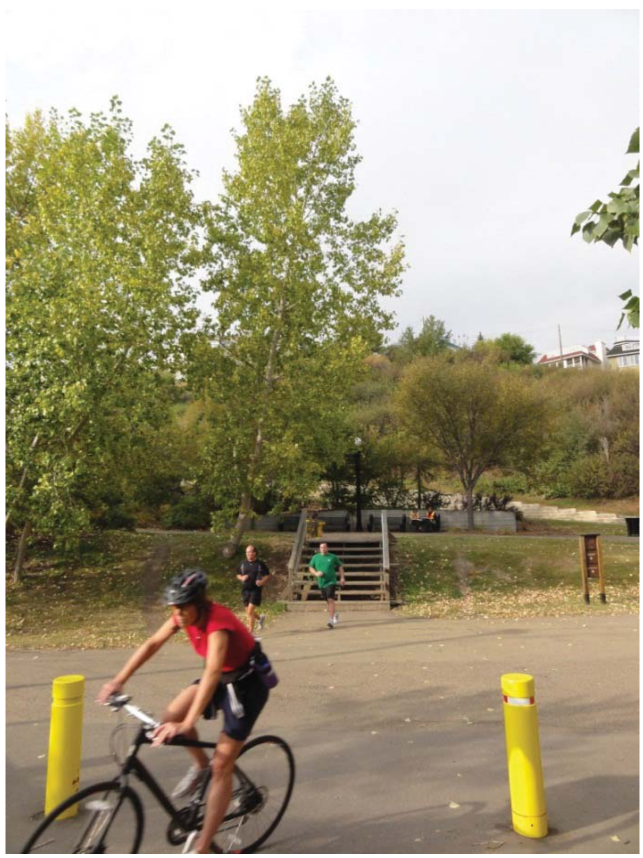

Plate 5.31. View north from the north end of Cloverdale pedestrian bridge, (Louise McKinney Park)

Plate 5.32. View of north valley slope from the north end of Cloverdale pedestrian bridge

North Saskatchewan River

The existing open trestle footbridge provides pedestrian 360º views of the river valley. Views include the river, adjacent park sites, forest areas, and the downtown skyline (Plate 5.33). Recreationists using the river for boating and other activities have views of the adjacent park sites, downtown skyline, and the Cloverdale footbridge.

South River Bank and Henrietta Muir Edwards Park

Residents of The Landing condominium complex in Cloverdale have minimal views of the river and the north bank, as their views come from a lower angle and are largely screened by forest vegetation, even in winter (Plate 5.34). Residents in north-facing suites in the upper stories of this complex may have partial views of the north side of the river. Residents at the west end of the complex with eastern exposures look out into the park area and picnic shelter (Plate 5.35).

Plate 5.33. The view of Louise McKinney Park and the city skyline looking northwest from the Cloverdale pedestrian bridge

Plate 5.34. View north from north of The Landing condominium complex

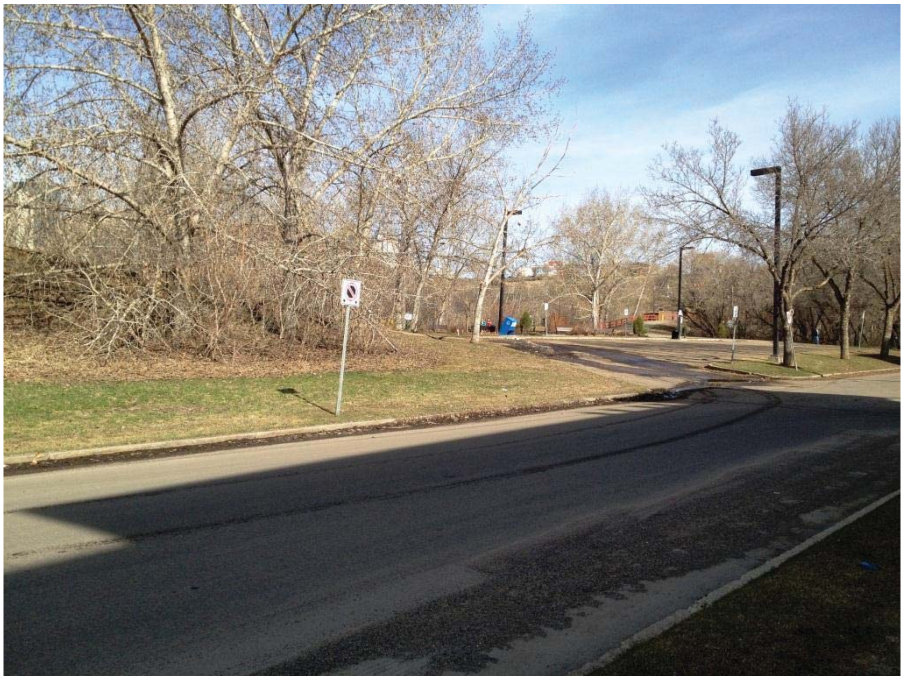

Plate 5.35. View northwest into HME Park from the corner of 98th Avenue and 96A Street

From within the east side of HME Park, where the LRT will be constructed, park users currently do not have significant views outward as the site is mostly enclosed by forest vegetation. Rather, the site presents as an intimate recreational space, covered by a mature forest canopy.

98th Avenue Views

The river, Cloverdale pedestrian bridge, and Louise McKinney Park are all visible from 98th Avenue, as the avenue descends into the NSRV from the east. Similar vantage points are available along the top-of-bank parkland in Strathearn (Plate 5.36).

Muttart Conservatory

The park space directly north of Muttart Conservatory pyramids showcases horticultural activities and serves as an attractive entrance feature to the conservatory. The grounds provide a visual resource highlighted by volunteer garden beds, mature trees, rolling lawn areas, a gazebo, public art, and a decorative footbridge, all set against the backdrop of the pyramidal public greenhouses. This area is visible to motorists along 98th Avenue. Residents of 96A Street in Cloverdale overlook the Muttart conservatory, public parking lot and landscaped grounds. Plate 5.37 shows the view looking west from the Muttart Conservatory parking lot; residents' views would be similar, although the parking lot would be visible in the foreground.

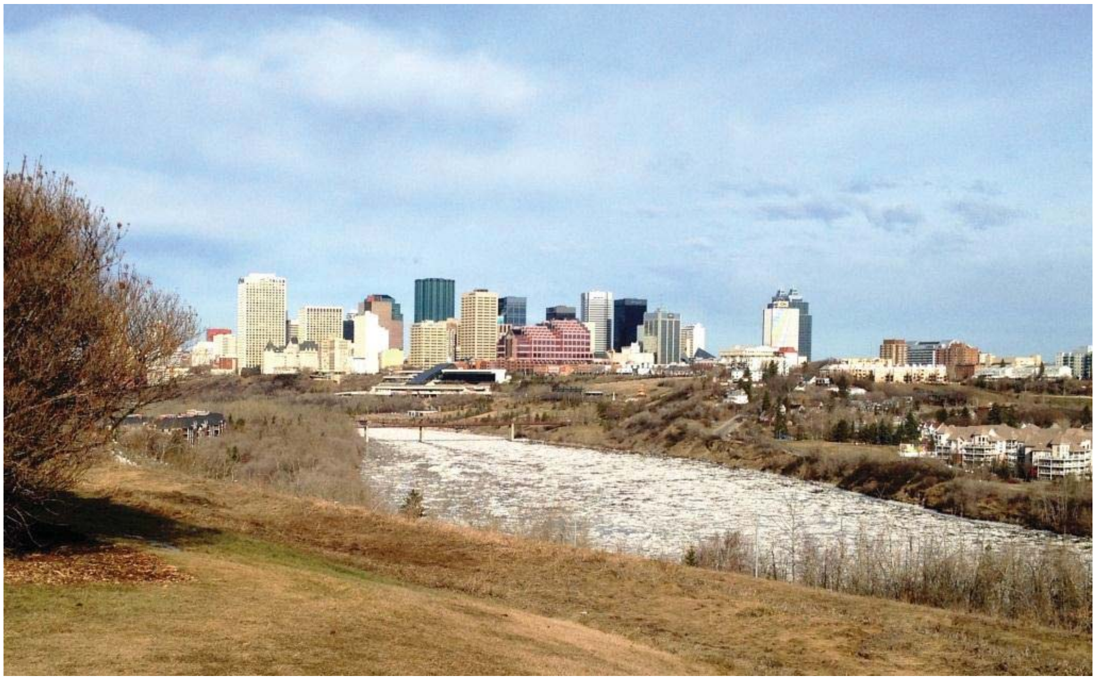

Plate 5.36. View from the top-of-bank at Strathearn

Plate 5.37. Looking west from the Muttart public parking lot.

A brick storage building and maintenance yard is located directly southwest of the Muttart greenhouse complex, adjacent to the access road off of Connors Road. Trees and landscape contours serve to screen the facility relatively effectively from north and east vantage points; however, it is quite visible from the south and southwest. Because of the condition and utilitarian uses, this area is relatively unattractive and negatively impacts the image of the Muttart area.

Connors Road Viewshed

The views along Connors Road are some of Edmonton's most iconic "postcard images" (Plate 5.38). This location provides sweeping views of Gallagher Park, Muttart Conservatory, "The Dove of Peace" sculpture, the river valley, and the downtown skyline.

Views to the south (uphill) from Connors Road comprise steep, forested slopes. Some of the properties at the top-of-bank in Bonnie Doon are assumed to have partial views over Connors Road and into the river valley. Views would be resident specific and influenced by the amount of vegetation that separates the property from Connors Road; however, we have assumed that views from upper-story windows are more expansive and less obstructed by the trees. Owing to steep slopes, residents would not likely be able to see the Connors Road corridor. The existing Connors Road pedestrian bridge offers views of the downtown skyline to the west (Plate 5.39). Views to the east are largely limited to the upper portions of Connors Road (Plate 5.40).

Plate 5.38. View north from near the top of Connors Road

Plate 5.39. View west from Connors Road pedestrian bridge

Plate 5.40. View to the east from the Connors Road pedestrian bridge

5.2.5 *Utilities*

Existing utilities have been inventoried by the project team, in support of preliminary and detailed design. Not all utilities have been located and some additional investigation will be required in future stages. Detailed maps of the best available information have been provided to LRT D and C. Multiple utilities lines are present in the SE LRT project area. An EPCOR water main and an EPCOR Power underground pressurized 72 kV oil filled transmission cable are situated on the north side of 98 Avenue. A 762 mm steel transmission water main also crosses the Connors Road alignment. Two ATCO gas lines are located within the project area: a 406 IP5 ST line beneath the Muttart Stop and a 406 IP ST located at the top of Connors Road. Some of the required utility relocation is already underway.

5.2.6 *Worker and Public Safety*

Analysis of this VEC consists of identification of conditions particular to this project and setting that might pose a risk to worker and public safety. Salient study area resources were identified as:

- proximity to parks and residences;
- steep, forested valley slopes;
- vegetation (as fuel for wildfires);
- North Saskatchewan River;
- abandoned landfills; and
- wildlife.

5.3 Valued Historic Components

5.3.1 *Historical Resources*

Historical resources comprise two types: archaeological resources, such as aboriginal artifacts or settlement sites, and, paleontological resources, such as fossils or bones of prehistoric species. Surveys for each of these were conducted separately.

5.3.1.1 Methods

Upon review of a Historical Resources Statement of Justification (SOJ) prepared for this project by The Archaeology Group, a Historical Resources Requirement (HRR) letter was issued on 06 December, 2010 by the Historical Resources Management Branch of Alberta Culture and Community Spirit. The HRR indicated that a Historical Resources Impact Assessment (HRIA) was necessary for the project but at only one location in the project area: an area measuring approximately 100 m x 25 m, encompassing a small gully that formed part of the abandoned Mill Creek channel in HME Park. Further, the Royal Tyrrell Museum of Paleontology indicated that an HRIA for paleontological resources was also required. Resulting reports are provided in full in Appendix H.

Archaeological Resources

The Archaeology Group conducted database searches (Historical Sites Resources Files, the Paleontological Resources Sensitivity Zones Map, and the Archaeological Site Inventory Data Files) to identify any previously-known archaeological sites within the study area. Database searches were followed by a foot survey and shovel tests in the area. Consultation with Alberta One-Call indicated that buried utilities were present in the lawn area north of the gully. Due to the risk of disturbing utilities and the lack of archaeological potential of the lawn area (resulting from previous ground disturbance associated with the installation of these utilities), the area north of the gully was not subject to shovel tests. No tests were carried out in the narrow strip of land between the south bank of the gully and the 98th Avenue sidewalk. Thus, all shovel tests in the study area were done within the gully. Seventeen tests were conducted, with digs ranging in size from 30 x 30 cm to 50 x 50 cm wide, and from 30-75 cm deep.

In addition to formal surveys carried out on the south bank of the river, at the request of Thurber Engineering, who were undertaking investigations in the NSRV, The Archaeology Group examined a number of objects that were discovered in the course of geotechnical investigations conducted on the north bank. These comprised objects excavated from the Grierson landfill. The Archaeology Group assessed the approximate age and historical significance of the objects.

Paleontological Resources

Paleontological assessment of the NSRV comprised desktop analysis of maps, particularly the Paleontological Resources Sensitivity Zones Map, geotechnical borehole logs, and proposed design and construction plans. Information reviewed in desktop analyses included:

- topography and relief;
- bedrock geology;
- surficial geology;
- sediment thickness; and
- areas with HRV 5p designation (indicating that historic resources are believed to be present within the area).

Based on the paleontological sensitivity of the North Saskatchewan River Valley, recent fossil resources recovered from projects along the NSR Valley, and the survey area permitted in the paleontological permit, the permit holder also assessed lands outside the area specified in the HRR to more accurately assess the proposed project's potential to impact paleontological resources. Pedestrian paleontological surveys were conducted in October 2011 at three areas in the NSRV: the tunnel location, the north valley wall in the proposed portal vicinity, and the south wall along Connors Road. Surveys consisted of recording observations of topography, visible deposits and outcrops.

5.3.1.2 Description

Archaeological Resources

The Archaeology Group found a number of modern cultural items in the gully, including a pair of metal toboggan rails, a small backpack, a pillow, some aluminum drink cans and some candy wrappers. Shovel tests conducted on the north bank revealed a lack of cultural materials, buried soils or stratified layers, and surveyors concluded that the site does not warrant further investigation or concern.

Objects encountered during geotechnical investigations on the north bank included an ink bottle, cow bones, a rib from an unidentified animal, a brick, a fragment of a bowl, a milk bottle and a medicine bottle. The origin of the items was traced to the landfill. None of the items were believed to be pre-20th century in origin, however, the authors did not discount the potential for older artifacts to be present below the landfill. They also noted, though, that the proportion of the landfill that would be disturbed by LRT construction is very small, and potential disturbance to the landfill is too minor to be considered significant. They concluded that the area warranted no further investigations or concern.

Paleontological Resources

The full project area within the NSRV is designated as HRV 5p, indicating that historic resources are believed to be present. Thus, the authors of the paleontological HRIA concluded that there is a high potential for impacts to paleontological resources any time the project has the potential to interact with Horseshoe Canyon bedrock layers.

Three areas of shallow bedrock were observed: on the north bank, in the riverbed, and on the mid-slopes of Connors Road. On the north side of the river, bedrock layers are close to the surface near the toe of the slope (close to the river bank), as well as near the top of the slope, in the vicinity of the portal structure location.

As the surveys were conducted in the fall, when water levels in the river are low, the riverbed was visible. Numerous coal and bedrock fragments were observed in the riverbed, indicating again that the bedrock is close to the surface – authors estimate that it is within 0.5-2 m of the riverbed surface. The upper 0.5 m of this is assumed to have poor paleontological potential due to weathering.

The river terrace on the south bank contains alluvial deposits approximately 5-10 m thick overtop of the bedrock, with thinner deposits (5 m) associated with the dry Mill Creek channel. As the alignment moves up Connors Road, it intersects with an area where surficial deposits thin and bedrock is once again within 0.5-2 m from the surface. This area begins approximately 100 m east of the Connors Road pedestrian bridge and extends approximately 200 m eastward up the slope.

6.0 IMPACT AND MITIGATION MEASURES

Anticipated interactions of specific project activities with VECs are summarized in Table 6.1, organized by site preparation, construction, reclamation and operation/maintenance phases of the project. Not all interactions have potential to manifest as a project impact. The interaction matrix, which, for most project components was completed based on information presented in the project description, was then examined and potential impacts selectively identified. At this stage, the potential for several impacts to occur was noted as having been eliminated during project planning. The following section presents the potential impacts that were assessed in depth, organized by VEC and the specific mitigation measures developed for each. Some mitigation measures are applicable to more than one VEC. Where significant overlap occurs, the first instance is referenced in later sections and the reader should refer back to that first section.

As noted earlier, mitigation measures are of two types: Mitigation measures noted as commitments will be carried forward into contract documents. This includes commitments to require the P3 contractor to provide specific planning documents. Several other mitigation measures are identified as recommendations to LRT D and C and should not be viewed as final commitments. Recommended measures are intended to assist the City in developing contracts, and variance tolerances during the P3 procurement phase.

Table 6.1 VEC/Impact Interaction Matrix

			Site Preparation						Demolition			Bridges and LRT Component Construction											Reclamation			Operation		
			Establishment of staging/laydown areas and access routes	Clear vegetation, hoard and otherwise protect trees/shrubs in construction areas	Utility relocations, decommissioning and protection	Establish road, bridge and SUP closures and detours	Install erosion & sediment controls	Install isolation devices in river	River bridge and pier adjustment/removal	Connors Road Bridge	Muttart storage building	Site recontouring	Excavation and earthworks	Tunneling	Portal and access road construction	NSR Bridge construction	Muttart Stop and TPSS construction	Connors Road pedestrian bridge construction	LRT line construction- South of River	Drainage systems construction	Utility installation	Road and SUP realignment and construction	Removal of NSR isolation	River bank armouring, and revegetation (landscaping)	Restoration of Mill Creek channel	Revegetation along LRT line and Connors Road	LRT line and bridge operation	LRT Maintenance
Valued Environmental Components	Valued Ecosystem Components	Geology – slope stability	✓		✓		✓		✓	✓		✓	✓	✓	✓	✓		✓	✓					✓			✓	
		Geology - geomorphology	✓					✓	✓			✓	✓			✓							✓		✓			
		Soils	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓				✓	✓		
		Hydrology (Surface Water/Groundwater)	✓	✓				✓	✓			✓	✓			✓			✓	✓			✓	✓	✓			✓
		Fish and Fish Habitat		✓				✓	✓			✓	✓			✓							✓	✓	✓			
		Vegetation – natural		✓						✓											✓				✓	✓		
		Vegetation – manicured		✓						✓											✓			✓		✓		
		Wildlife – habitat		✓												✓		✓						✓		✓		
		Wildlife – mortality		✓																								
		Habitat Connectivity		✓		✓	✓			✓								✓	✓	✓				✓	✓	✓	✓	
	Valued Social Components	Land Disposition and Land Use Zoning	✓					✓								✓								✓	✓			
		Residential Land Use – noise/vibration		✓		✓		✓	✓			✓	✓		✓	✓		✓	✓		✓		✓	✓			✓	
		Residential Land Use – traffic	✓					✓						✓	✓	✓			✓			✓	✓	✓				
		Recreational Land Use	✓			✓		✓	✓	✓					✓	✓	✓	✓		✓		✓	✓	✓			✓	
		Visual Resources	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓		✓	✓	
		Utilities			✓								✓	✓			✓				✓							
		Worker and Public Safety		✓				✓	✓				✓	✓	✓	✓		✓					✓	✓				
	Valued Historical Components	Historic Resources											✓	✓		✓			✓			✓						

6.1 Environmental Resources

6.1.1 Geology/Geomorphology

6.1.1.1 Overview

Two localities within the study area were identified in early preliminary engineering as having observed or potential slope stability issues. On that basis, we examined the following potential impacts to geology and geomorphological resources:

- Slope instability, or increased instability, leading to slope failure at:
    - the north valley wall
    - the south valley wall at Connors Road.
- Structural instability or structure failure resulting from minor slope movements on the north valley wall and river bank, during LRT operation phase.
- Structural or slope instability, or other geotechnical concerns, associated with the portal structure access road.

In addition, south of the river, the project area as currently shown has potential to result in disturbance to the abandoned reach of Mill Creek. We therefore examined the following potential impact:

- Alteration to the abandoned channel of Mill Creek.

The fills associated with the abandoned Grierson Nuisance Grounds have not been identified by geotechnical engineers as a potential concern with respect to slope stability and thus were not further examined.

6.1.1.2 Slope Failure on the North Valley Wall

Impact

Thurber Engineering (2012a) identified two particular types of slope failure as a concern at the north valley wall: failure of overburden above the tunnel crown, and deep failure associated with the bedrock bentonite seams. Thurber Engineering (2012a) indicated that increased strain on the bentonite seams, for example from additional loading or disruption of drainage patterns, can result in decreased shear strength in the seams, and, that during construction, activities such as drilling, excavation and the installation of new structures on steep slopes in an active landslide zone could cause increased instability and introduce greater risk of slope failure. In addition, Thurber noted that removal of the existing armouring along the north river bank during construction could leave the bank more vulnerable to erosion and undercutting. We add our concern that this risk on the north bank could potentially be exacerbated if a berm is coincidentally present on the south river bank, restricting channel width and causing localized increases in flow velocity against the north bank. In general, slope failure occurring during the LRT construction or operation phases must be avoided as this could result in damage to nearby recreational infrastructure, park landscaping, and LRT infrastructure, and, of course, represents a risk to human safety.

Geotechnical concerns and recommendations by geotechnical engineers have all been communicated to the design team in a series of reports. The marginal stability of the slope, the need to carefully plan construction and the potentially severe consequences of slope failure have all been accounted for by CTP in development of the Reference Design Critical design components include suitably located stabilization structures. Geotechnical engineers have reviewed the designs and concluded that geotechnical concerns have been sufficiently mitigated by the specifications of the Reference Design (Connected Transit Partnership 2013d). In the absence of the design work to date, the potential impacts of slope instability would have been rated as adverse, permanent, major and predictable. Because all geotechnical information, ensuing specific recommendations and a suitable Reference Design will be carried forward into the P3 Procurement phase and all information provided to bidders, we consider the potential impact at present to be resolved to negligible

Mitigation Measures and Residual Impact

Moving into detailed design and construction, the existing north valley wall and riverbank conditions and potential for slope instability are issues requiring continued attention and mitigation targeting short-term and long-term slope stability. Achieving these objectives into the long term will require:

- a construction plan that adequately mitigates construction-related slope stability issues; and
- stabilization structure design adequate to maintain stability during the construction and operations period.

Therefore, the overarching mitigation measures to address potential geotechnical concerns at the north valley wall are as follows:

- The P3 contractor will adhere to all recommendations and specifications included in the Reference Design and supporting studies, and the ensuing P3 Contract.
- Should the P3 contractor choose to deviate from the Reference Design, studies to assess the geotechnical feasibility of new designs must be submitted to LRT D and C for review.
- In association with this, LRT D and C will require the P3 contractor to develop a construction plan that demonstrates adequate mitigation of any construction-related slope stability concerns. The plan will include consideration of the potential of altered river hydraulics during instream construction to erode the toe of the north river bank.

Carrying this approach forward will continue to eliminate the potential for slope failure, and should result in negligible residual impacts. The need for future study of any design deviating from the Reference Design will protect against increased risk during the P3 phase and beyond.

6.1.1.3 Slope Failure on the South Valley Wall

Impact

Two project activities could potentially trigger slope instabilities on the south valley wall:

- Bank cuts associated with the realignment of Connors Road,
- Excavations associated with the demolition and replacement of the Connors Road pedestrian bridge.

The current LRT alignment would require a realignment of Connors Road to the south of its current location, necessitating wall cuts of up to approximately 7 m height into the south valley wall. Thurber Engineering (2012b) noted that while the south valley wall is stable in its current state, unsupported wall cuts would severely destabilize it. Upper slopes of the ski hill may comprise low quality fills placed in an uncontrolled manner (Thurber Engineering 2012a) and, therefore, may also require stabilizing measures. The Reference Design includes plans for four retaining walls, which have been designed to promote long-term slope stability on the south valley wall. With these measures in place, impacts are expected to be negligible.

Excavations associated with the demolition and replacement of the Connors Road pedestrian bridge could potentially impact the stability of the south valley wall. The degree to which this is a concern is not clear at this time, as the size and depth of excavations required are not known (X. Wang and H. El-Ramly, *pers. comm.*). Considering the presence of private residences at the top-of-bank, and the presence of a major roadway and parkland below the south valley wall, these impacts are rated adverse, major, short-term, but uncertain since the extent of excavations required is unknown.

Mitigation Measures and Residual Impact

Adequate measures have been proposed to ensure continued slope stability along Connors Road during Connors Road realignment and after installation of the track corridor. Therefore, the Reference Design provides the required mitigation. Additional measures will be required during the construction of the Connors Road pedestrian bridge. Once bridge construction methods are known, adequate stabilization measures and appropriate construction procedures can be implemented to minimize the risk of slope instability (X. Wang and H. El-Ramly, *pers. comm.*). Overall, for all work along Connors Road, to ensure that the contractor has adequately controlled for slope stability issues on the south valley wall, LRT D and C will require the P3 contractor to develop a plan that demonstrates effective mitigation of slope stability concerns. Such a plan would reduce residual impacts to negligible. Should any design deviations be proposed or should an alternate track alignment to the north be ultimately adopted, additional geotechnical analysis will be required of the P3 Contractor and all proposed design aspects and construction methodology must demonstrate adequate risk reduction.

6.1.1.4 Structural Instability or Failure Resulting from Slope Movement

Impact

Structures on the north river valley will necessarily be founded within an active landslide zone. As such, minor, natural slope movements can be expected to occur. If LRT structures are not designed to accommodate some degree of slope movement, structural failures could result. Structural instability could result in a disruption to LRT service; could result in damage to LRT infrastructure, park landscaping or recreational infrastructure; and would endanger human health and safety.

Extensive geotechnical work has been conducted in support of the proposed project, and the continued active landslide on the north side of the river has been identified as an issue that requires mitigation from a structural design perspective. A stress-deformation analysis was conducted for the north valley slope to assess the degree of movement that can be expected (Thurber Engineering 2013). That report, recommends that structures be designed to accommodate up to 70 mm of movement; this recommendation has been incorporated into the Reference Design (B. Ramsey, *pers. comm.*) and is deemed sufficient to mitigate risks to structures associated with slope movements. This potential impact has, therefore, been resolved with the Reference Design and is rated as negligible.

Mitigation Measures and Residual Impact

Mitigation will target maintaining long-term stability of structures on the north bank, an objective that has been achieved by the Reference Design. Thus, the overarching mitigation measure to ensuring structural stability for north valley components is:

- The P3 contractor will adhere to all recommendations and specifications included in the Reference Design and supporting studies, and the ensuing P3 Contract.

- Should the P3 contractor choose to deviate from the reference design, studies demonstrating structural stability of new designs must be submitted to the City for review.

Considering the amount of geotechnical information that has been incorporated into preliminary project designs, this approach will eliminate the potential for structural instability, which will reduce potential for residual impacts to negligible.

6.1.1.5 Concerns Associated with the Portal Structure Access Road

Impact

The portal structure access road design is less advanced than other project components and geotechnical work has not yet been done at the site of the access road. This road will become the permanent maintenance access road but will first serve as the construction access road. Geotechnical work will be carried out to: 1) determine the feasibility of the road alignment, and 2) inform detailed design of the road. However, considering the current lack of available information, potential impacts at this stage of the project have been assessed as follows:

- Construction access through this area, with attendant frequent and heavy loading, could be determined to be infeasible in the absence of targeted geotechnical measures. Without supporting technical information and appropriate design recommendations, the portal access road, as currently located, is assessed as having potential to adversely affect geology/geomorphology; thus this impact is currently rated as major to minor, long-term and uncertain.

Mitigation

LRT D and C will require the P3 contractor to undertake geotechnical studies along the proposed access road alignment and proceed with route selection and road design according to results. With that done, the residual impact to geology/geomorphology at this location should be negligible. It may be, however, that measures such as installation of retaining walls to ensure slope stability, and/or route adjustment have attendant effects on other VECs, such as wildlife movement. The potential for impacts to other VECs is captured in other report sections. Of note, however, is that the project area defined here is wide enough to allow for some route shifting and for installation of retaining walls to the south of the road (Figure 2.1), and thus these actions may not involve vegetation impacts additional to what is calculated in this EISA.

6.1.1.6 Alteration of the Mill Creek Channel

Impact

The abandoned Mill Creek channel in HME Park is among the more significant geomorphological features in the study area. Two parts of the channel intersect with the project area as currently delineated: the mouth of the channel, at the confluence of the NSR, and an upstream portion of the channel, directly north of 98th Avenue and west of the 98th Avenue pedestrian overpass. Construction may require temporary backfilling in these two areas, as they are very close to the alignment and those lands may be required may be required for work areas and/or access to the riverbank work site.

The bed and shore of the channel are owned by the Crown, and disturbance to the channel will require authorization from Alberta Public Lands. That agency has indicated that it would consider granting approval; however, following construction the contractor would be required to reclaim the channel to existing condition, and to ensure its long-term viability. Because this channel continues to convey stormwater, effective, long-term erosion and sedimentation control would be an important part of any restoration effort. Long-term monitoring would be required.

Conservation of this channel is also a City of Edmonton corporate priority. The City of Edmonton and Alberta Environment and Sustainable Resource Development (AESRD) have committed to evaluating the potential to reestablish connectivity of the Mill Creek system, including the reach located within the study area. Based on this strong desire to retain the channel in its current condition, and the long-term restoration efforts required if disturbed, disturbance and backfilling of parts of the channel is rated as an adverse, minor, long-term and predictable impact. It is minor not because of its importance but because of the small reaches included in the project area.

Mitigation Measures and Residual Impact

Avoidance of the channel is the preferred approach to mitigation. LRT D and C will encourage the P3 contractor to explore the possibility of avoiding or minimizing disturbance to the channel through careful planning of access routes and staging locations, or a slight clipping of the project area. Reducing the project area may add to project costs; however, costing of this strategy should consider the costs and risks associated with channel disturbance,, the need for permitting (which may also involve Department of Fisheries and Oceans), the cost of compensating for removal of mature trees under the City's Corporate Tree Policy, the need to achieve successful restoration to the satisfaction of the City and the Province and the long-term responsibility and attendant costs of remediation until full restoration has been achieved. If the channel could be completely avoided, residual impacts to Mill Creek would be negligible. If not, because of the risk associated with successful restoration, they remain as adverse, minor, long-term and predictable.

6.1.2 *Soils*

6.1.2.1 Overview

River valley native topsoils are in short supply in the project area, but are a critical resource for successful revegetation. Protection against loss or degradation of topsoils and subsoils is, therefore, an important consideration. Examined potential impacts related to native soils resources include the following:

- soil erosion during demolition and construction activities;
- loss and mixing of topsoil during demolition and construction activities;
- compaction of soils by heavy equipment;
- disturbance of contaminated soils; accidental spills of hazardous materials near, or on, unpaved surfaces resulting in soil contamination; and
- damage to soil physical, biological and chemical properties, resulting from stripping and stockpiling.

The majority of the project area is underlain by fills; the following discussion does not pertain to such areas.

6.1.2.2 Soil Erosion During Construction and Reclamation

Impact

Exposed soils in areas cleared of vegetation are vulnerable to erosion. Erosion potential is greater on slopes, where the downward movement of soil particles is facilitated, and particularly when soils are finely-textured. Construction of the piers (excluding instream piers), wall cuts and the establishment of construction, laydown areas and staging areas will all require the removal of native vegetative cover for extended periods in the project area. For some project components this will involve steep slopes. Considering the above, there is high potential for erosion in the project area. Erosion could also occur at unprotected native soil stockpiles. Eroded material can be transported off site and permanently lost, through fluvial or aeolian erosion. Erosive loss of native topsoils is detrimental to reclamation efforts, as topsoils contain nutrients and organic matter vital to the development of plant communities. Impact associated with soil loss are rated as adverse, major, long-term and predictable.

Mitigation Measures and Residual Impact

The overarching mitigation measure to limit erosion of native soils will be the development and implementation of a comprehensive and proactive erosion and sedimentation control system. Because these measures will also protect NSR water quality, they are recommended for the project as a whole, not just for native soils.

- LRT D and C will require the P3 Contractor to provide the following technical submissions for City approval:
    - An Environmental Management System (EMS), developed to the standard of ISO 14001.
    - An Environmental Construction Operations (ECO) Plan that includes a comprehensive Temporary Erosion and Sedimentation Control Plan (TESCP).
- The TESCP will meet or exceed the standards of ESC guidelines developed by the City of Edmonton, and Alberta Transportation, respectively, and must be approved by the contractor's Certified Professional in Erosion and Sediment Control (CPESC).
- LRT D and C may develop additional performance measures for the TESCP, as this project requires.

The EMS and ECO Plan will be among the technical plans required in bid proposal packages, and will be subject to approval and review by the City prior to project commencement.

The TESCP should outline measures that will be taken to control erosion and sedimentation, based on site-specific environmental conditions along with specifics of construction requirements. Examples of the types of detail that could be included in the plan, or included as performance measures, are as follows:

- Mandate a staged approach to construction, whereby construction activities are concentrated along one part of the project area at any given time, rather than occurring concurrently throughout much or all of the project area.
- Mandate progressive reclamation of the project area, in which re-vegetation efforts are initiated in portions of the project area that are no longer undergoing active construction, regardless of whether construction is ongoing elsewhere in the project area.
- Require the contractor to specify measures to protect the north bank against erosion. These may include:
    - not removing existing riprap earlier than necessary during construction, and/or
    - incorporating river hydraulic considerations into the TESCP plan.

A comprehensive erosion and sediment control system developed with consideration of site-specific conditions (e.g., steep slopes) and concerns will reduce impacts to native soils to negligible.

6.1.2.3 Mixing of Topsoils and Subsoils

Impact

During stripping in areas of natural vegetation, topsoils and subsoils can be mixed, thus diluting the characteristics (organic matter, nutrients, etc.) that contribute to topsoil fertility. Mixed top and subsoils would be less conducive to plant growth in the reclamation/landscaping phase of the project, thus delaying the required re-vegetation. Considering the high value attached to successful re-vegetation, this impact is rated as adverse, major, long-term and predictable.

Mitigation Measures and Residual Impact

If the P3 contractor wishes to reuse native, in-situ soils, they will be required to treat native topsoils and subsoils separately during soil stripping, stockpiling, and reapplication. The following specific practices are recommended:

- Native topsoils and subsoils should be stripped separately, and stripping will be carried out under the supervision of a qualified professional trained in the identification of soil horizons (e.g., a soil/environmental scientist or reclamation specialist).
- Topsoils and subsoils should be stockpiled separately, adequately identified, and reapplied separately during reclamation.

The above measures will prevent the mixing of topsoils and subsoils, and reduce residual impacts to negligible.

6.1.2.4 Topsoil and Subsoil Compaction During Construction and Reclamation

Impact

Soil compaction can result where soils are subjected to the weight of heavy construction machinery. This can occur on topsoils and subsoils when they are stripped and stockpiled, on subsoils remaining in-situ during the construction period, and on subsoils and topsoils following reapplication for reclamation. Compaction can damage soil structure, reduce porosity and water infiltration capacity, resulting in reductions in soil moisture, reduce aeration, impede plant root growth and hinder uptake of soil nutrients by plants. By reducing infiltration capacity, soil compaction can also trigger increased surface runoff, exacerbating potential soil erosion problems. If runoff is released into the NSR, sedimentation of the river could also result from soil compaction. Considering that soil compaction can result in secondary effects such as erosion and sedimentation, and could potentially delay the re-establishment of vegetation in cleared areas, soil compaction is rated as an adverse, long-term, and predictable impact. The magnitude of the impact is, strictly speaking, major, but ecological/environmental implications of the impact are minor.

Mitigation Measures and Residual Impact

The primary mitigation measure is for LRT D and C to require/encourage the P3 contractor to adequately protect against topsoil and subsoil compaction during construction.

Following is an account of proactive measures that could be employed. Construction will be suspended during wet and/or partially frozen conditions in order to prevent compaction of soils remaining in-situ in the project area during construction. Indicators of excessively wet conditions include rutting, wheel-slip, puddle formation, build-up of mud on tires, and tracking of mud throughout the construction area. These indicate that conditions are sufficiently wet to cause significant physical damage to soil, and that construction activities should be halted until the substrate is dry enough to support construction machinery. Minimizing the depth of soil stockpiles and planting stockpiles with a deep-rooted cover crop will help alleviate compaction of stockpiled soils. Following reapplication, subsoils will be ripped and topsoils disked to decrease bulk density and increase aeration. Vehicle use on reapplied soils will be minimized.

Application of these or equivalent measures is not expected to eliminate soil compaction issues, but will improve re-vegetation success. Considering the unspecified nature of the mitigation measure, this residual import is left as uncharacterized.

6.1.2.5 Degradation of Soil Physical, Chemical and Biological Properties

Impact

Stripping and stockpiling soil inevitably results in a deterioration of soil physical, chemical and biological properties, diminishing soil quality. Specifically, stripping and stockpiling soil can result in increased bulk density, decreased infiltration capacity, reductions in soil microbes (including symbiotic fungi), reduction in soil invertebrates, reduced nutrient cycling, loss and/or reduction of the viability of the soil seed bank, development of anaerobic conditions, and loss of organic and inorganic carbon (Strohmayer 1999). This is particularly of concern when dealing with stockpiled native soils, which have considerably greater ecological value than fills. The duration of stockpiling and depth of stockpiles can significantly affect the severity of these effects. Diminished condition of stockpiled soils could delay successful reclamation, resulting in the need for remedial reclamation efforts and increasing the risk of erosion and sedimentation problems in the post-reclamation period. This could result in additional costs and liabilities to the P3 contractor; for example, the contractor could incur fines for damage to the bed and shore of Mill Creek or the NSR resulting from inadequate ground stabilization. For these reasons, impacts to native soil quality are considered to be adverse, long-term and predictable. While the magnitude of the impact is, strictly speaking, major, implications to the greater ecosystem are expected to be minor.

Mitigation Measures and Residual Impact

Application of best management practices can mitigate many of the issues listed above. LRT D and C will require the P3 contractor to develop a set of soil stockpiling practices that will maximize the conservation of soil quality during storage. Recommended practices include the following:

- Minimization of storage time by adopting a staged construction approach.
- Implementation of a progressive reclamation.
- Planting of stockpiles with a non-weedy cover crop to maintain aeration, infiltration capacity and a viable soil biota.
- Minimization of stockpile depth. Ideally stockpile depth would be no greater than the rooting depth of the cover crop (Tate & Klem 1985; in Strohmayer 1999). If this is deemed unfeasible, a maximum depth of 1 m should be used.

The following caveats should be applied to reclamation efforts: fills stripped from manicured or landscaped areas should not be applied in natural areas; native soils should not be applied in manicured areas, as this would be at the expense of use in restoration areas.

While the above-noted measures will reduce the effects of stripping and stockpiling, they are not expected to eliminate them. Preserving soil quality will improve the efficacy of reclamation efforts, potentially resulting in cost savings to the contractor. Assuming high quality soils, reclamation performance should be strong. Considering the unspecified mitigation measures, this residual impact is left uncharacterized.

6.1.2.6 Disturbance of Contaminated Soils During Construction

Impact

A Phase II ESA confirmed the presence of contaminated soils in the project area at former landfill and incinerator sites on the north and south sides of the North Saskatchewan River, respectively. On the north side, the former Grierson Nuisance Grounds appear to have contributed to heavy metals contamination in soils upgradient of the river. On the south side, buried material has been identified along Connors Road (in the vicinity of the former Cloverdale Incinerator) that is associated with heavy metals and PAH contamination in soil . Coal seams, however, have also been identified in the same area, which could potentially be contributing natural occurrences of PAHs and metals. Disturbance, stockpiling and reuse of contaminated soils could result in the spread of contaminants, uptake of toxic substances by plants during reclamation, and contamination of groundwater. Based on this information, the potential impacts of construction to result in contaminant spread are rated as adverse, major, long-term and predictable.

Mitigation Measures and Residual Impact

As recommended by the Phase II ESA, LRT D and C contacted AESRD for feedback regarding mitigation of the contaminated soils in the project area. As a result of those discussions, and because the footprint of the LRT represents a very small proportion of the larger landfill issues, LRT D and C has determined that the project will take a risk

management approach in addressing contamination. The scope, responsible party, and specific requirements will be defined at a later time but a risk management/monitoring plan will be designed to minimize impact to the natural environment.
This will likely consist of ensuring that the Contractor does as follows:

- Excavation as required to facilitate construction;
- Backfilling with clean material;
- Classification of excavated materials and excavation water as clean, contaminated or hazardous, and disposal accordingly;
- Implementation of health & safety protocols for the protection of workers and the public during construction; and
- Monitoring to assess downgradient mobilization of contamination resulting from construction activities. This may be a very long-term initiative (e.g., greater than the 30 year P3 period). It will require development of a detailed monitoring plan initiated by the contractor.

Specific requirements for risk management of contaminated soils will be defined in the P3 procurement documents and the Contractor will implement them.

Based on the proposed risk management approach, removal of identified contaminated soils and replacement with clean fill would be considered a positive, major to minor, permanent and predictable residual impact and the potential for contamination to spread would be avoided.

6.1.2.7 Hazardous Materials Spills During Construction

Impact

Spills of fuels and lubricants, associated with onsite storage areas, or maintenance and/or refueling of construction equipment, could cause localized soil contamination. Where slopes are present there is the potential for smaller spills to spread over large areas. Considering the large scale of construction that will occur, the potential for a spill resulting from, for example, refueling or a broken hydraulic hose, is considered to be high. The result would be unusable, contaminated materials. The severity of impacts would be dependent on the nature of the spill, and the severity is not characterised.

Mitigation Measures and Residual Impact

Mitigation objectives are to reduce potential for spills and maximize potential for effective, rapid clean-up, should a spill occur. The following plans required for other purposes should provide this mitigation:

- An EMS prepared to the standards of ISO 14001,
- An ECO Plan.

In addition, the following specific mitigation measure is recommended:

- Fuels and other hazardous chemicals must be stored in an approved location out of the floodplain, and in a protected, flat location with secondary containment, to reduce spread potential, and prevent release to the NSR.

With the conscientious application of best management practices, potential for soil impacts from spills will be low.

6.1.3 *Hydrology - Surface Water/Groundwater*

6.1.3.1 Overview

The project has the potential to interact with both surface and groundwater in several ways. We examined the following potential impacts to hydrology:

- Changes to surface drainage patterns/volumes.
- Flooding due to temporary disruption of Mill Creek.
- Indirect impacts to natural resources as a result of changes to the hydrological regime.
- Increased runoff leading to erosion or flooding concerns.
- Introduction of contaminants to the NSR as a result of founding structures in the former landfill in the north valley.
- Migration of contaminated groundwater.
- During construction, introduction of sediments, contaminants from groundwater, or other deleterious substances into the river.
- Altered or disrupted groundwater flow.
- Altered river hydraulics resulting from pier removal.
- Risk of infrastructure flooding.

6.1.3.2 Changes to Surface Drainage Patterns/Volumes

Impact

The establishment of LRT infrastructure in the study area is expected to result in changes to surface drainage patterns as a result of re-grading, and the introduction of new infrastructure. The project therefore requires new stormwater infrastructure. Drainage designs are not well-advanced, but on the basis of the concepts presented in reference design, current analysis suggests potential for the following impacts to occur.

Surface drainage patterns will alter as a result of new infrastructure that will increase impermeable surfaces in the study area. These changes are not expected to substantially impact the biophysical environment in the study area for the following reasons. Much of the drainage that will be redirected is currently drained via the municipal storm sewer system and does not have a significant interaction with VECs such as plant communities or natural drainage systems. Additionally, as both current and expected future drainage patterns are largely directed across paved surfaces, altered drainage patterns should not trigger erosion issues, nor will there be a redirection of drainage from permeable surfaces, where it could infiltrate, to impermeable surfaces, where it will drain as runoff. Essentially, water that currently drains to the municipal storm sewer system will continue to do so, only the pathway will change.

During the operations phase of the project, the increase in impermeable surfaces in the study area is expected to result in increased surface runoff, creating the potential to overwhelm existing drainage infrastructure, if not managed adequately. Drainage systems have therefore been designed not to overwhelm existing drainage infrastructure, via the use of LID elements such as swales and rain gardens, which will slow the discharge of stormwater to the municipal storm sewer system. The planned stormwater management facility at the base of Connors Road might positively impact the study area, as ponding can be an issue at the base of Connors Hill; new drainage infrastructure might improve this situation. Overall, changes to surface drainage patterns and volumes are thus expected to be a positive, minor, permanent, and predictable impact.

Mitigation Measures and Residual Impact

Changes to surface drainage patterns are considered to be a positive impact, and thus do not require mitigation; residual impacts are not expected.

6.1.3.3 Flooding Due to Temporary Disruption to Mill Creek

Impact

The abandoned reach of Mill Creek at HME Park intersects with the project area in two locations: at the mouth of the channel, where the creek joins the NSR, and directly north of 98th Avenue, near the 98th Avenue pedestrian overpass. Construction in this area may require backfilling of the channel at these two locations to facilitate construction access and/or staging. Currently, the channel does not support a permanent stream; however, it does collect and discharge water during periods of high runoff (i.e., spring runoff, large storm events), in amounts significant enough to provide a valuable stormwater management service and to require management during construction. This hydrological function must be considered if the channel is backfilled for construction (see also Section 6.1.1.5 for details). The channel was observed to support abundant standing water in the spring of 2012, and both standing and flowing water in the spring of 2013. This suggests that it plays a role in local drainage patterns. Backfilling of the channel, especially at the mouth of the creek, would disrupt drainage flows and, if no alternative is provided, could result in flooding in upstream portions of the catchment and of the project area. Considering the role the channel plays in local surface drainage, there is potential to alter the flow inadvertently, particularly at the junction with the NSR. This would be considered adverse, minor, short- to long-term and predictable. Any redirection of surface flow in this creek would likely require a *Water Act* approval from Alberta Environment and Sustainable Resource Development. Conditions may be applied.

Mitigation Measures and Residual Impact

Avoidance of the Mill Creek channel would be the preferred approach to surface water management. The P3 contractor should explore the possibility of avoiding disturbance to the channel though careful planning of access routes and staging locations, or a slight clipping of the project area. For a fuller discussion see Section 6.1.1.5 (Alteration of the Mill Creek Channel). If the channel could be avoided, the residual impacts to Mill Creek hydrology, and associated risk of flooding would be negligible.

If disturbance to the channel cannot be avoided, provisions (i.e., a culvert installation, or diversion through pipes) must be made to ensure effective and appropriate water management. The Crown has confirmed they remain the owner of the abandoned channel, thus, disturbance would require authorization from Alberta Public Lands, and the province would require that the channel be reclaimed following construction. Therefore, this residual impact would be temporary and adverse, minor and predictable. With channel restoration, residual impacts would be reduced to negligible.

6.1.3.4 Introduction of Contaminants (Other than Sediment) to River

Impact

According to the final engineering drawings, the existing Cloverdale pedestrian bridge north abutment pier is located within the former landfill. Further, the Reference Bridge Design shows an abutment and stabilization wall founded in that vicinity. The existing pier bridge must be removed and a new structure installed. The existing pier will be left in place and cut off at approximately 1 m below existing ground level (X. Wang and H. El-Ramly, *pers. comm.*). The new pier or other structure could be installed by drilling or boring, through the landfill into the bedrock. Depending on the method used, these activities could result in introduction of contaminated soils and/or water to the surface of the working area, creating potential for contaminants to enter the river.

Bridge demolition has potential to introduce deleterious substances into the river, if not done correctly. The age of the bridge suggests the creosote may be present. In addition, demolition creates potential for debris to enter the river.

Introduction of contaminates into the river would be an adverse, major, long-term, predictable impact as it would contravene prohibitions of the Alberta *Water Act* and federal *Fisheries Act* and *Migratory Birds Convention Act*.

Mitigation Measures and Residual Impact

The potential for work in this area to result in an impact is partly related to landfill groundwater contamination. LRT D and C will take a risk management approach in addressing contamination as part of the LRT construction project. This would likely consist of:

- Excavation as required to facilitate construction;
- Backfilling with clean material;
- Classification of excavated materials and excavation water as clean, contaminated or hazardous and disposal accordingly;
- Implementation of health & safety protocols for the protection of workers and the public during construction; and
- Monitoring to assess down gradient mobilization of contamination resulting from construction activities. This may be a very long-term initiative (e.g., greater than the 30 year P3 period). It will require development of a detailed monitoring plan initiated by the contractor.

Specific requirements for risk management of contaminated soils and groundwater will be defined in the P3 procurement documents and the Contractor will implement them.

In addition, the P3 Contractor will be required to prepare a detailed Cloverdale Pedestrian Bridge demolition plan, to be reviewed by the City, according to specific performance measures, and by relevant provincial and federal agencies. This will include a hazardous materials assessment.

Based on this information, the residual impacts of introduction of contaminants into the river would be reduced to negligible.

6.1.3.5 Migration of Contaminated Groundwater

Impact

Installing subsurface structures such as retaining structures, bridge abutments and piers in a landfill can lead to the creation of preferential pathways, facilitating the movement of contaminated groundwater towards the river during the operations phase of the project. Since groundwater in the former Grierson Nuisance Grounds (now Louise McKinney Park) landfill site is contaminated (i.e., it exceeded guidelines for chloride, TDS, boron, nickel and sodium), and if down-gradient flow is to the river, as is expected, then preferential pathways could facilitate the movement of contaminants into the river during the operations phase of the project.

A second landfill is suspected to have been located on the south river terrace in association with the Cloverdale Incinerator site (now Muttart Conservatory/Edmonton Ski Club) based on the presence of buried waste materials in the Phase II ESA test holes. In addition ash, traces of coal and wet coal seams were observed. All wells had exceedances with respect to metals and PAH's and these groundwater issues ran the length of the tested area in the vicinity of the former incinerator activities.

Additionally, it is not known whether, in the final design, any subsurface structures will be founded deep enough to intersect with groundwater at either site. As currently conceived, the potential for preferential pathways is low for the following reasons:

- Subsurface concrete structures are expected to be in direct contact with soil, which will substantially limit the potential for such preferential pathways to form,
- Soil permeability is low,
- Water supply is limited, as upslope parts of the catchment are largely drained by the municipal storm sewer system (X. Wang and H. El-Ramly, *pers. comm.*).

If this impact were to occur, it would be rated as adverse, major, and permanent.

Mitigation Measures and Residual Impact

LRT D and C will take a risk management approach in addressing contamination, including migration, as part of the LRT construction project. This would likely consist of:

- Excavation as required to facilitate construction;
- Backfilling with clean material;
- Classification of excavated materials and excavation water as clean, contaminated or hazardous and disposal accordingly;
- Implementation of health & safety protocols for the protection of workers and the public during construction; and
- Monitoring to assess down gradient mobilization of contamination resulting from construction activities. This may be a very long-term initiative (e.g., greater than the 30 year P3 period). It will require development of a detailed monitoring plan initiated by the Contractor.

Specific requirements for risk management of contaminated groundwater will be defined in the P3 procurement documents and the Contractor will implement them.

6.1.3.6 Introduction of Sediments or Spilled Deleterious Substances to the River, During Construction

Impact

Introduction of Sediments to the River

During site preparation and construction, the combination of vegetation clearing and compaction of soils by construction equipment is expected to result in a localized increase in runoff. Increased runoff in itself does not necessarily constitute an adverse impact; however, runoff over compacted, bare soils, or through stockpiled soils will likely promote soil erosion, which could result in sediment releases into Mill Creek or the NSR, particularly in work areas that are close to the river or where topography promotes drainage towards the river. An additional concern is bank erosion associated with sudden rises in water levels resulting from spring freshet or dam releases. Obviously, placement and removal of instream isolation measures in the river hold high potential for river sedimentation if not done carefully and using best management practices.   Sedimentation of the NSR resulting from construction is not permitted under Alberta's *Water Act* or the federal *Fisheries Act*. In the absence of mitigation measures, potential for impact during the site preparation and construction phases of the project is thus rated as adverse, major, short-term and predictable.

During the operations phase of the project, the planned drainage system will direct most of the runoff from project infrastructure into one of three new stormwater management facilities. These facilities will promote settling of suspended sediments, thus reducing the amount of sediment that enters the downstream stormwater system, and, ultimately, the river. Drainage from some areas (i.e., LRT and pedestrian bridge decks) will not be directed to stormwater management facilities; however, runoff from these areas is expected to be minimal and grit separators will treat the LRT bridge deck runoff during minor events. As currently conceived, the pedestrian bridge deck will drain directly to the river. Depending on deck maintenance practices, this could result in introduction of minor amounts of sediment to the river. Use of winter maintenance material is expected to be low considering the covered nature of the pedestrian deck. As currently designed, the drainage infrastructure associated with the LRT will maintain or improve the quality of water discharging into downstream systems and directly into the river from this area. Impacts during the operations phase are thus considered negligible.

Deleterious Substances (Hazardous Materials Spills)

During the construction phase of the project, fuels, oils and lubricants used in construction equipment could be harmful to aquatic environments if released into the river. Additionally, introduction of such substances into the river could have a deleterious impact on the quality of drinking water for downstream communities. The federal *Fisheries Act* prohibits the introduction of deleterious substances to fish-bearing waters, including the NSR, and the *Migratory Birds Convention Act* prohibits release of deleterious substances into waters frequented by migratory birds. Introduction of such substances to the river would constitute an adverse, major, short-term and predictable impact.

Mitigation Measures and Residual Impact

Sediment control measures should be used when working in or near the river, or in areas where topography would facilitate drainage to the river. All sediment-laden water collecting or encountered on site must be treated on site before discharge to a watercourse or stormwater system. The mitigation measures outlined earlier to require the contractor to prepare an EMS, ECO Plan and TESCP, and to meet or exceed City ESC guidelines will address this potential impact. In addition DFO may issue special consideration for works in the river.

At a minimum, LRT D and C will require the following specific performance measures to be included in those plans:

- postponing clearing activities until immediately before construction or demolition activities are scheduled to begin; or, if not feasible, clearing vegetation but leaving root networks intact, and hand-clearing bank slopes,
- hoarding of catch basins that link to the City's storm sewer system,
- closely monitoring disturbed areas, especially those immediately adjacent to the NSR, to ensure that sufficient vegetation cover becomes established to provide permanent erosion and sediment control protection, and
- locating soil stockpiles away from drainage lines.

Implementing the measures recommended in Section 6.1.2.7 (Hazardous Materials Spills, soils) will greatly reduce the risk of surface water contamination. If these, or other equivalent practices, are conscientiously and consistently applied during site preparation and construction, the residual impacts will be negligible.

6.1.3.7 Alteration or Disruption of Groundwater Flow

Impact

Subsurface stabilization structures will be required to ensure slope stability on the north valley wall during and following the construction of LRT infrastructure. If these structures are sufficiently deep to intersect with groundwater, they may block the flow of water towards the river. Conversely, it is possible that new subsurface structures could create preferential pathways for groundwater, thus facilitating downgradient flow.

This may not be a significant concern because groundwater flows on the north bank and north valley wall are expected to be minimal, as the majority of potential inputs are captured by the municipal storm sewer system, and because of low soil permeability (X. Wang and H. El-Ramly, *pers. comm.*). Additionally, the footprint of any structures installed on the north bank is expected to be relatively small, extending only approximately 40 m. Any disruptions to groundwater flow would be expected to be limited to the same small area. The Reference Design indicates that retaining walls to be installed along Connors Road also have potential to intersect with groundwater. These walls will be fitted with drainage systems to manage the interaction with groundwater and will drain down Connors Road in a controlled manner Potential impacts to groundwater are thus rated as negligible.

Mitigation Measures and Residual Impact

No mitigation is needed, and no residual impacts are expected.

6.1.3.8 Altered River Hydraulics Resulting from Pier Removal

Impact

Construction of the new NSR bridge will result in the removal of three instream piers from the existing Cloverdale pedestrian bridge and their replacement with two instream piers. The removal of existing piers should re-establish natural riverbed morphology in those localized areas. The net reduction in river piers and associated net gain in natural river bed is therefore rated as positive, minor, permanent, and predictable.

Mitigation Measures and Residual Impact

No mitigation measures are required; residual impacts will remain positive, minor, permanent, and predictable.

6.1.3.9 Risk of Infrastructure Flooding

Impact

Some LRT components will be situated in the south river terrace floodplain (elevated guideway, 98th Avenue bridge, and elevated approach to Muttart Stop). The elevated nature of those structures removes them from risk of flooding and the fortified character of the piers, to the satisfaction of the City and provincial and federal agencies, assures no risk of flood damage. The Muttart Stop and TPSS will be located outside of the river floodplain. Thus, potential impacts associated with flooding are rated as negligible.

Mitigation Measures and Residual Impact

No mitigation is needed, and no residual impacts are expected.

6.1.4 *Fish and Fish Habitat*

6.1.4.1 Overview

The proposed demolition and construction work required in the NSR, has potential to affect fish habitat. All instream work will very likely require authorization from DFO, which will impose conditions on procedures and will, to some degree, dictate construction methods. The examined potential impacts on fish include the following:

- Interruption of critical fish movements.
- Temporary or permanent loss or alteration of fish habitat.
- Fish entrapment within isolation works.
- Increased river suspended sediment levels.
- Introduction of deleterious substances.
- Mortality and/or disturbance of special status species.
- Potential fisheries in Lower Mill Creek.

6.1.4.2 Interruption of Critical Fish Movements

Impact

Construction and Demolition

Fish move between habitats for a variety of reasons. Individuals migrate for spawning, to search for food, to escape predators, or to leave undesirable habitat. Interference with fish passage becomes most critical when instream activities (e.g., berm construction) are scheduled to coincide with spawning times. According to the Code of Practice for Watercourse Crossing St. Paul Management Area Map (Alberta Environment 2006), the NSR in the study area is a mapped Class C waterbody and, subject to a restricted activity period (RAP) from 16 September to 31 July. This RAP is in place to protect both spring and fall spawning species.

During bridge demolition and construction phases of the proposed project, instream works will need to be isolated from flowing waters. Isolation works typically result in channel constriction and increased water velocities. Depending on the extent of the channel constriction and the subsequent impact on water velocities, it is possible that upstream fish movements would be temporarily impeded (Pisces 2013). Based on this information and the potential instream construction duration of four years, in the absence of mitigation, bridge demolition and construction has the potential to be an adverse, major, long-term, and predictable impact on critical fish movements.

Operation

Once constructed, the instream bridge piers are not expected to affect fish movements since they will not pose a physical barrier to fish (Pisces 2013). As currently conceived, the piers are also not expected to adversely impact water velocities (Pisces 2013). Based on this information, impacts related to the interruption of critical fish movements during operation are rated as negligible.

Mitigation measures and residual impact

Demolition and Construction

To minimize impacts to critical fish movements during instream activities, LRT D and C will require the P3 contractor to prepare a construction schedule, staging plan isolation works and demolition plan that demonstrate suitable and effective provision for critical fish movements during the course of the construction period, for review by the City, Fisheries and Oceans Canada (DFO) and AESRD.

- At a minimum, the plan will address the following items:
    - Design isolation works so that constriction of the NSR is minimized.
    - Implement a construction schedule that minimizes duration of constriction the NSR (e.g., sequential process whereby only one side of the river is isolated at a time).
    - Develop a hydraulic model to assess the effect of potential river constriction on water velocities to provide confidence that there will be zones where velocities are low enough to allow for upstream fish movements.
    - Monitoring provisions to assess fish movements through the construction area during the project.

- LRT D and C will require that provisions for critical fish movement be prepared by a Qualified Aquatic Environmental Specialist (QAES).

- Respecting the approval authority of DFO and AESRD, LRT D and C will develop performance measures for evaluating the critical fish movement components of the technical submission.

Assuming that all DFO and AESRD permitting requirements are fulfilled, residual impacts to interruption of critical fish movements during bridge demolition and construction can be reduced to negligible. Final design and permitting will likely require additional environmental impact assessment and development of specific mitigation measures by a QAES.

Operation

No mitigation required; residual impacts to critical fish movements during bridge operation are expected to remain negligible.

6.1.4.3 Temporary or Permanent Loss or Alteration of Fish Habitat

Impact

The harmful alteration, disruption or destruction of fish habitat (i.e., HADD) can occur during instream works associated with construction and/or demolition of watercourse crossing structures and a result of permanent structures in the river. The extent that habitat alteration is considered harmful depends on the quality and sensitivity of fish habitat that is impacted.

Temporary impacts to fish habitat as a result of isolation works to facilitate bridge demolition and/or construction will depend on the isolation method and the size of the isolation areas. While regulators often prefer that non-earthen cofferdams be installed, the installation of armoured berms constructed of high plastic clay is the most commonly used isolation method when the isolation works will be in place for long periods and need to withstand winter conditions and large fluctuations in flow. The use of temporary instream isolation works over the period of four years has the potential to be an adverse, major, long-term, and predictable impact on fish habitat.

The magnitude of permanent HADD depends on the type and size of the installed crossing structure, is typically directly related to the instream footprint (e.g., instream piers and streambank armouring) of the crossing structure, and can be influenced by associated gains through demolition. Reference Design plans indicate that the new bridge will have two instream piers compared to the three instream piers that currently exist. The north abutment and the land-based piers of the elevated guideway on the south side of the river will not be located within the active channel and are not expected to adversely impact fish habitat. It is assumed that some riprap armouring will be necessary to protect the streambanks and bridge structure. Armouring placed on the north bank is not expected to impact fish habitat since that bank already has extensive riprap. The introduction of permanent armouring on the south bank has the potential to be an adverse, major to minor, long-term and predictable impact on fish habitat, with the severity dependent on the spatial extent of proposed bank protection works. This will be determined during detailed design.

Mitigation measures and residual impact

The overarching mitigation measure for HADD is that LRT D and C will require the P3 contractor to develop a construction schedule that takes into account the Restricted Activity Period (RAP) (16 September to 31 July) and ensures that construction phases with the most potential to impact critical life cycle phases for fish (e.g., installation and removal of isolation works) are not completed during sensitive periods. More specifically, construction and removal of isolation works will be scheduled to avoid the spring portion of the restricted activity period (01 April to 31 July) to avoid potential effects on important spring spawning species such as lake sturgeon. Any deviations from the RAP must be proposed to DFO and AESRD for review and approval.

- At a minimum, the LRT D and C will require that the plan demonstrates the following efforts:

    - Ensure disturbances to fish habitat are minimized during the construction period and any impacted channel or bank will be rebuilt to replicate natural conditions.
    - Minimize the area affected by the isolation works.
      Minimize natural bank disturbance and the attendant need for riprap
    - Ensure all materials associated with isolation work are completely removed from the river.
    - Ensure use of bioengineering techniques to stabilize streambanks.

LRT D and C will develop performance measures aimed at minimizing bank disturbance and naturalizing disturbed banks.

Pisces (2013) provided the following notes regarding fall works in the river: Considering habitat attributes found within the study area, mountain whitefish is likely the only fall spawning species that would use the habitat in the immediate vicinity of the project for spawning. They are quite adaptable and will utilize a wide range of habitat conditions for spawning. The habitat in the vicinity of the proposed project is neither unique nor in short supply in the NSR and is, therefore, not considered critical to mountain whitefish. As such, while it would be optimal to avoid completing the installation and/or removal of isolation works during the fall, it may be possible to conduct these works in the fall if deemed essential to the overall construction schedule. Additional field investigations (e.g., kick net surveys for whitefish eggs) and/or mitigation strategies (e.g. restricted compliance limits during sediment monitoring) may be required if instream work within the RAP is permitted.

Residual Impacts – DFO Risk Assessment Matrix (taken from Pisces 2013)

To assist with assessment of the potential of a project resulting in HADD after mitigation measures are applied, DFO provides a risk management based framework. HADD can depend on the potential magnitude of effect on fish and fish habitat (i.e., the Scale of Negative Effect) and the sensitivity of the habitat potentially affected (i.e., the Sensitivity of Fish and Fish Habitat).

The Scale of Negative Effect depends on the extent of the project, the duration of the effect, and the intensity of the change. The proposed bridge will be a permanent structure (potential for long-term impact) but is not expected to have a major footprint since 1) there will be fewer piers than currently exist and 2) impacts to riparian areas will be limited since bank armouring is already prevalent in the area. Isolation works will be temporary and as such the footprint is expected to be short-term. Considering these factors and based on current project information Pisces (2013) rated the Scale of Negative Effect for the project as low.

The sensitivity of the habitat depends on what species may utilize the habitat, the potential of the habitat to provide for critical life cycle phases, the rarity of the habitat, and the resiliency of the habitat. The habitat potentially impacted by the proposed project is utilized by a wide variety of fish species for a number of life cycle phases. The habitat within the study section was not rare within the NSR; however, there is critical lake sturgeon habitat located downstream of the project. Overall, the habitat is considered to be moderately resilient. Given these factors, Pisces (2013) rated the sensitivity of the habitat potentially affected by the project as moderate/high.

Considering available project information and assuming that recommended mitigation measures will be properly implemented, Pisces (2013) concluded the potential for HADD (of fish habitat), based on application of the DFO Risk Assessment Matrix, is expected to be low. Final determination of HADD will, however, depend on final design and construction plans and review of the project by DFO.

Assuming the P3 Contractor can deliver a construction plan and final design that is acceptable to DFO and AESRD, and results in all required permitting, residual loss or alteration of fish habitat as a result of bridge demolition, construction and operation is expected to be negligible. Final design and permitting will require additional environmental impact assessment and development of specific mitigation measures, to be undertaken by the P3 Contractor.

6.1.4.4 Fish Entrapment within Isolation Works

Impact

It is likely that temporary isolation works will be used to isolate instream bridge demolition and construction activities in the NSR. The ponded area within the isolation works will be dewatered to create dry working conditions to support pier construction. Fish trapped in the ponded areas could be stranded during this process, posing a source of mortality for fish. The impact would likely vary depending on the species of fish and timing of isolation works construction, but generally, entrapment would result in an adverse, minor to major, short-term and predictable impact on fish populations.

Mitigation Measures and Residual Impact

The P3 contractor will be responsible for implementing the following measures: Any fish entrapped within the isolation works will be salvaged. Fish salvage operations will be conducted in all isolated work areas with the intent of removing and transferring fish trapped in the isolated areas to a suitable release location in the NSR. The appropriate fish collection permits will be obtained prior to the commencement of the fish salvage program. All fish captured in the isolation works will be identified and enumerated. If a pump is used to dewater fish-bearing waters, the pump intake will be screened in accordance with Fisheries and Oceans Freshwater End-of-Pipe Fish Screen Guideline (DFO 1995). With these measures effectively in place, the residual impact of increased fish mortality related to entrapment in isolation works would be reduced to negligible.

6.1.4.5 Increased Sedimentation

Impact

Construction and Demolition

Sedimentation generally occurs at stream crossing sites during instream construction and may also result from surface runoff over disturbed ground around the site. In the absence of any appropriate erosion and sediment control measures, there is the potential for unacceptable levels of sediment to enter the NSR and affect downstream habitat.

The generation of sediment during new bridge construction and existing bridge demolition could have adverse effects on fish health and instream habitat. During construction, there is potential for particulate sediment to become suspended in the water column. Increased levels of TSS (total suspended solids) in the water column may lead fish to exhibit an avoidance response (Watters 1995); however, fish may use elevated TSS for cover (Gregory et al. 1993). Further increases in TSS can cause physiological stress which may result in respiratory difficulty and, in extreme cases, mortality. While sensitivity to suspended sediment varies by species, the effects are dependent on two variables: the concentration of TSS to which fish are exposed and the length of exposure (Newcombe and Jenson 1996). Furthermore, sediment deposition during fish egg incubation periods can smother eggs, often increasing incubation mortality.

Increased sediment loads can impact fish habitat quantity and quality. Sediment loads that exceed the transport capacity of the receiving stream may result in deposition, reduce pool depth, and fill the interstitial spaces in coarse substrates (gravels and cobbles) that serve as spawning habitat for fish and shelter for invertebrates eaten by certain fish species (Waters 1995). Additionally, sedimentation can have indirect effects on fish populations through its impacts to water quality, aquatic invertebrate health, vegetative growth and other factors that may support the fish community.

The impacts from construction and demolition generated sediments are expected to be adverse, minor to major, short-term, and predictable.

Operation

Based on the Reference Design, it appears there is low potential for sedimentation associated with the operational phase of the project. As currently conceived, appreciable levels of sediment are not expected to fall into the river from the LRT bridge deck because decks drains will be fitted with grit traps designed to capture up to the 1:5 year event. While the pedestrian bridge deck will be somewhat protected from the elements because of its location below the LRT deck, there is potential for grit generation if the deck is maintained during winter and subsequent release to the river. Regardless of practices, the quantities of grit and/or de-icer applied are expected to be small. Based on this information, bridge operation has the potential to have an adverse, minor, long-term, but uncertain impact on fish habitat.

Mitigation measures and residual impact

Demolition and Construction

Measures set out for soils and hydrology, to mitigate sedimentation, will also prevent adverse impacts to fish and fish habitat resulting from sedimentation. To ensure mitigated impacts to fish, the P3 Contractor TESC Plan must also comply with the *Code of Practice for Watercourse Crossings* (Alberta Environment 2005). If earthen cofferdams are used in the river, they will be constructed using non-dispersive clay materials in order to reduce any potential sedimentation.

Further, LRT D and C will require the P3 contractor to implement a sediment-monitoring program during instream construction. The extent of such a program will depend on site logistics and construction scheduling. The monitoring program should identify specific monitoring procedures, compliance criteria, and reporting protocols to ensure minimal introduction of sediments during instream construction.

Based on these considerations and the effectiveness of implementing mitigation measures, residual impacts related to increased sedimentation during construction and demolition activities are expected to be reduced to negligible.

Operation

Residual impacts to sedimentation during bridge operation remain uncharacterised in the absence of detailed bridge drainage design and established bridge maintenance practices. For fisheries (DFO) permitting purposes, the proponent may be required to develop additional specific mitigation measures, although recent indications suggest otherwise.

6.1.4.6 Introduction of Deleterious Substances

Impact

Construction and Demolition

The potential impact to fish and fish habitat resulting from an incident whereby hazardous materials were introduced into the NSR would depend on the type and quantity of material spilled. With construction activity near water, activities such as installing and isolation works, potential exists for accidental spills of fuel, oil and other materials that may be toxic to fish or other aquatic organisms. As stated in other sections, refueling or maintenance of construction equipment will be permitted only in appropriate locations within the NSR and spill kits will be accessible to all equipment and workers will be trained in their use. Thus, the potential for large spills with these standard operating procedures in place is low; however, should one occur, it could have significant effects and must be contained and disposed of following provincial guidelines. In addition, during bridge demolition, in the absence of an assessment of bridge materials, potential exists for debris and contaminants to enter the river. Overall, the impact associated with hazardous materials spills during construction and demolition could be adverse, major, short-term and predictable.

Operation

No deleterious substances are expected to be used or introduced into the NSR during LRT operation, under ordinary circumstances. The impacts related to the introduction of deleterious substances during operation are therefore rated as negligible.

Mitigation measures and residual impact

Demolition and Construction

The commitment for LRT D & C to require the P3 contractor to submit the plans noted in previous sections will address this potential impact, with one addition: the plans must include an assessment of the existing Cloverdale bridge to contain hazardous materials such as lead-based paint and creosote and demolishing plans must be prepared accordingly to ensure proper containment of hazardous materials. With these measures in place, impacts associated with demolition and the use of hazardous materials are expected to be negligible.

Operation
No mitigation required; impacts are expected to remain negligible.

6.1.4.7 Mortality/Disturbance of Special Status Species

Impact

Currently, none of the species historically or recently captured in this reach of the NSR are listed in Schedule 1 under the *Federal Species at Risk Act* (*SARA*); however, lake sturgeon occur in the river. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has assessed lake sturgeon as Endangered. As of October 2012, lake sturgeon are still being considered for listing pursuant to SARA (Alberta Lake Sturgeon Recovery Team 2012). As of April 2013, the federal government has not made a decision on whether or not the NSR lake sturgeon population should be listed under the *Species At Risk Act* (Pisces 2013).

Lake sturgeon are known in some localized areas of the NSR that exhibit preferential sturgeon habitat characteristics including a back eddy below a gravel bar or island, with deep water (>3.8 m). Investigations in 2010 found one site within the Cloverdale Bridge project area that met those habitat criteria located immediately upstream of the existing Cloverdale Bridge. There is, however, no historical record of lake sturgeon occupying this habitat (FWMIS 2010, Watters *pers.comm*. 2010). Anglers have reported catching sturgeon upstream and downstream of the Cloverdale Bridge.

Without mitigation, adverse impacts to special status fish species from bridge demolition and construction activities, particularly instream isolation works, would be adverse and major as regional populations could be adversely affected if construction occurs during sturgeon spawning or migration periods. Since suitable habitat is located nearby and the presence of lake sturgeon in the study area is possible, in the absence of mitigation and detailed scheduling, potential impacts to special status fish species are rated as adverse, major, long-term but uncertain.

Mitigation Measures and Residual Impact

LRT D and C will require the P3 contractor to develop a construction schedule that takes into account the Restricted Activity Period (RAP) (16 September to 31 July) and ensures that construction phases with the most potential to impact critical life cycle phases for fish (e.g., installation and removal of isolation works) are not completed during sensitive periods. At a minimum, construction and removal of isolation works will be scheduled to avoid the spring portion of the Restricted Activity Period (01 April to 31 July) to avoid potential effects on important spring spawning species such as lake sturgeon. In addition, those mitigation measures outlined above in Interruption of Critical Fish Movements (Section 6.1.5.2) will be implemented.

With effective mitigation as above, and in compliance with the DFO Authorization, residual impacts to special status fish species during demolition and construction should be negligible. In support of final design and permitting, additional environmental impact assessment may be required, including development of specific mitigation measures.

Operation

No mortality or disturbance of special status fish species is expected to occur during operation (Pisces 2013); impacts are expected to be negligible.

6.1.4.8 Potential Fisheries in Lower Mill Creek

Impact

The potential for the NSR to backflood into the abandoned Mill Creek channel during high water events was not specifically addressed as part of this EISA. If backflooding occurs, it is possible that DFO will consider lower Mill Creek to comprise fish habitat and require protection and consideration of the creek as part of permitting for instream works. At this point, in the absence of sufficient information, the potential for adverse impact to fish habitat in this area is rated as adverse, minor, short-term but uncertain. It is short-term because any alteration of Mill Creek would be temporary only.

Mitigation Measures and Residual Impact

LRT D and C will consult a fisheries specialist, to ensure that relevant supporting information is collected as required to support future permitting and/or LRT D and C will ensure that the P3 procurement documents cover this issue as part of fisheries permitting, as required. The residual impact will be negligible.

6.1.5 Vegetation

6.1.5.1 Overview

Examined potential impacts related to vegetation include the following:

- Loss of vegetation, including both natural plant communities and manicured areas,
- Introduction of weedy or invasive species,
- Loss of rare plants due to clearing activities,
- Disturbance to recognized City Natural Areas.

6.1.5.2 Loss of Vegetation

Impact

Both natural and manicured plant communities, the latter including lawns, planted beds, and gardens, are found within the project area (Figure 6.1). In this section, the significance of plant communities and of impacts to these communities are evaluated from a strictly ecological perspective, in which the salient factors for assessing and rating impacts are biodiversity and the representation of native species, particularly those that

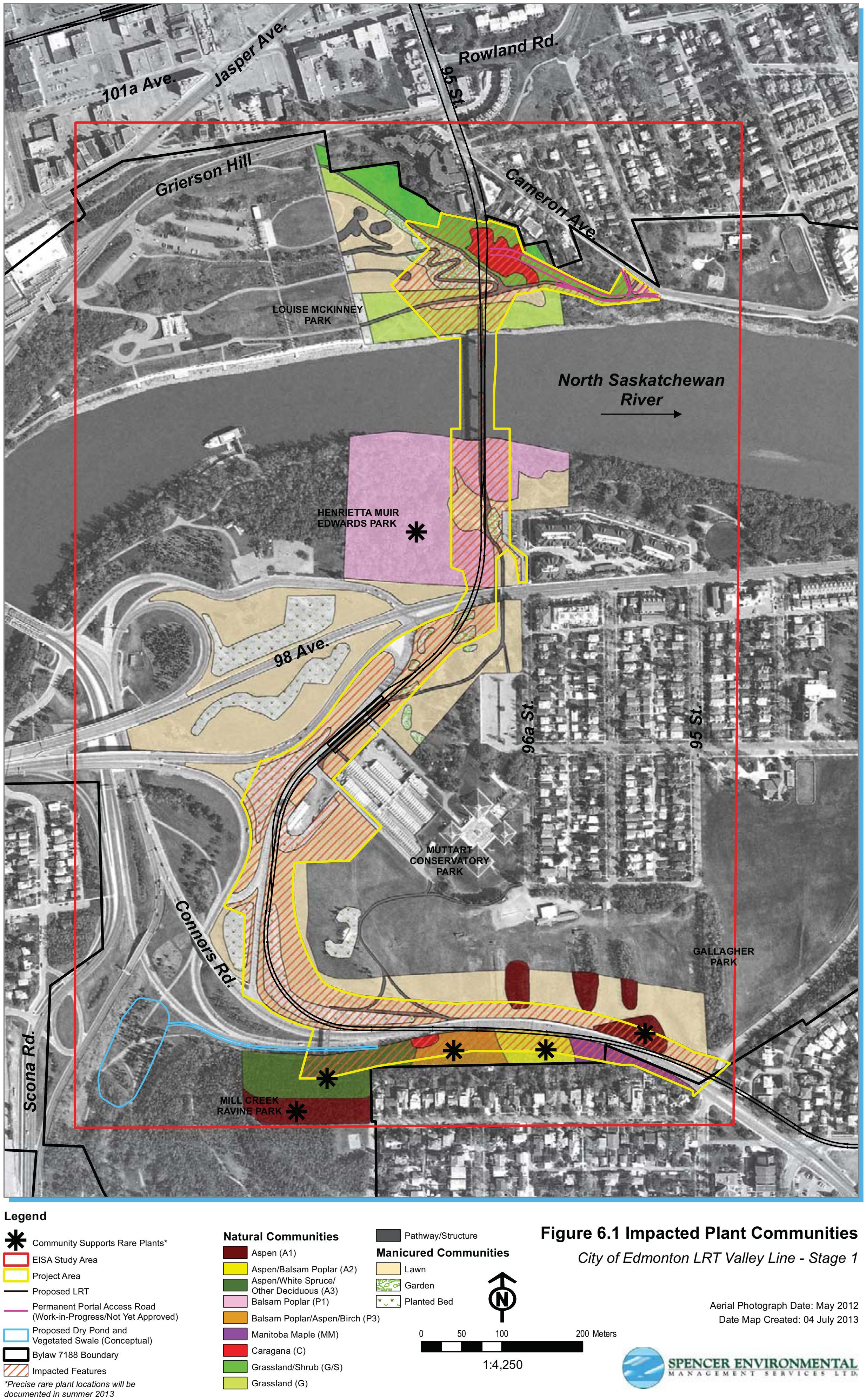

Figure 6.1 Impacted Plant Communities

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created: 04 July 2013

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are uncommon and rare. That said, lawns and planted beds may be valued from a recreational or aesthetic perspective, as “green space”. The value of manicured areas from a *social* perspective is assessed in Section 6.2.3.6 (Relocation of Socially-Valued Amenities) and Section 6.2.3.10 (Loss of Green Space).

Natural and Semi-Natural Plant Communities

Construction of LRT infrastructure in the NSRV will necessitate the removal of some natural plant communities, including the semi-natural grassland/shrubland on the north bank and natural forest on the south bank and on the upper slopes of the south valley wall. Table 6.2 shows the area of each community type that is expected to be cleared, based on the project area. The largest area affected is the riparian forest in HME Park. Some losses will be associated with clearing needed for construction staging and access (see Table 6.2), because these areas will be re-vegetated following construction, losses will be temporary. Some permanent loss of vegetation will also occur in areas that will be permanently occupied by LRT structures, or that must remain clear for access, maintenance or safety purposes. These losses are expected to be very small and are a subset of the temporary losses, and have not been quantified. The importance of conserving native biodiversity is recognized in City policies and programs, such as the *Natural Area Systems Policy* (C531) and the Local Action for Biodiversity (LAB) project. For this reason, and because areas of mature forest that take years to recover will be affected, the impacts to natural plant communities is rated as adverse, major, long-term and predictable.

Table 6.2. Loss of natural plant communities associated with LRT development

Location	Community	Impacted (ha)
North valley wall	G	0.51
	G/S	0.54
	C*	0.33
South bank/terrace	P1	0.77
South valley wall	A1	0.19
	A2	0.23
	A3	0.35
	P3	0.24
	MM*	0.22
	C*	0.33
Total		**3.39**

*Dominant species are non-native

Manicured Areas

The project area contains many landscaped areas, including the World Walk rose garden and manicured lawns at Louise McKinney Park, the Centennial Garden at HME Park, lawns, ornamental trees and flowerbeds at the Muttart Conservatory, and lawns and planted beds in the vicinity of Connors Road. Impacted area for manicured communities is shown in Table 6.3. Due to the importance placed on trees under the City’s *Corporate*

Tree Management Policy, impacts to planted beds (which are tree-dominated) are rated as adverse, minor, long-term (if trees are replanted in situ) to permanent (if compensation occurs off-site) and predictable. Impacts to lawns and gardens, from an ecological perspective, are considered negligible.

Table 6.3. Loss of manicured plant communities associated with LRT development

Community	Impacted (ha)
Lawns	4.10
Gardens	0.48
Planted beds	1.11
Total	**5.69**

*Plus planted trees in dry pond area.

Landscaping Trees

The site proposed for the dry pond supports scattered planted trees that would be need to be removed during construction. The loss of trees would constitute an adverse, minor and permanent. At this point, the impact is uncertain because of the conceptual nature of that facility location.

Mitigation Measures and Residual Impact

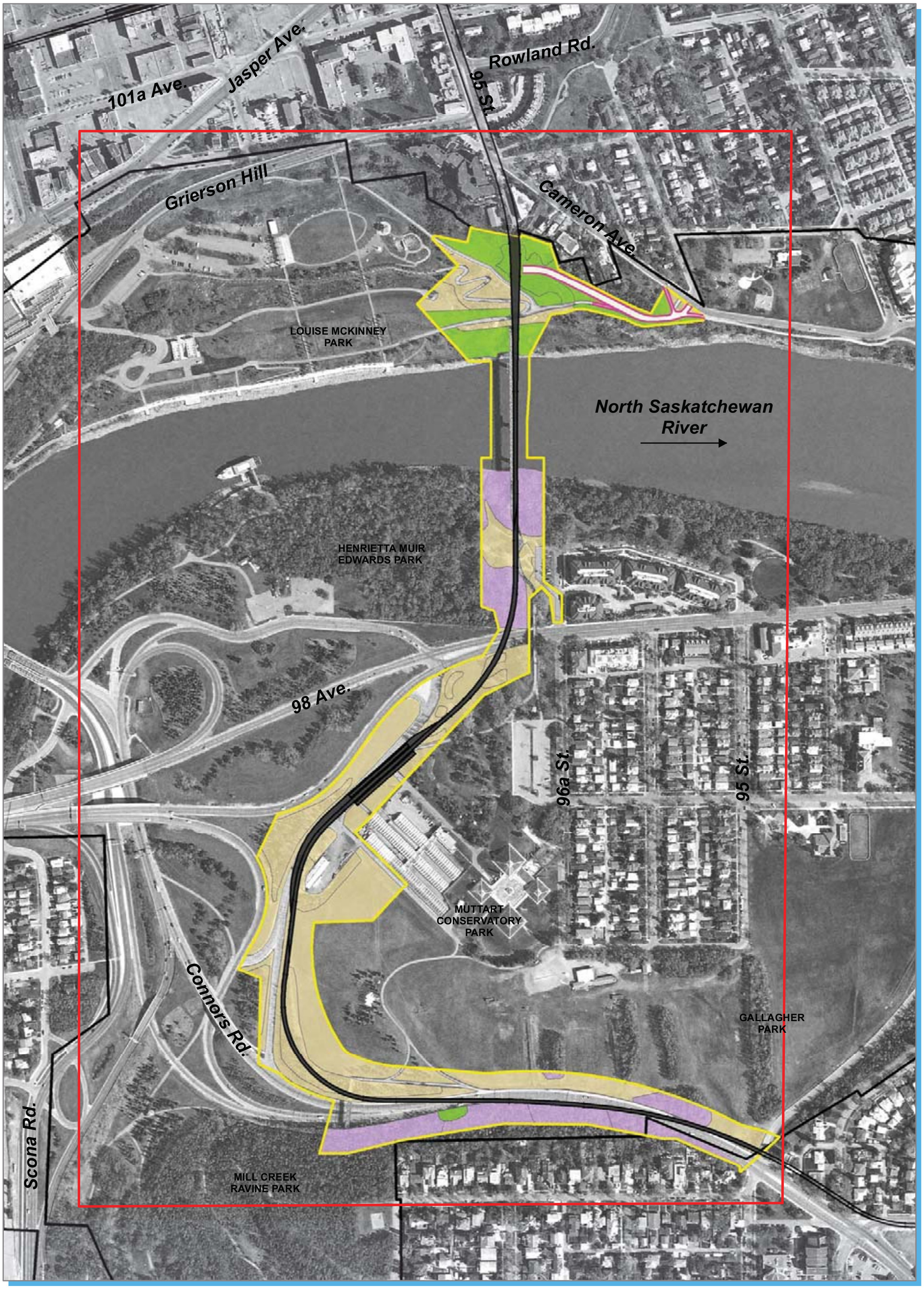
There are two overarching objectives of mitigation for vegetation losses:

1) Ensure that, in the long-term, all areas cleared of vegetation (except for the small areas to be occupied by permanent infrastructure) are returned to a condition that is as good as, or better, than the current condition. For the semi-natural communities on the north bank and north valley wall that are currently extremely weedy, the objective is to re-vegetate to a similarly structured, but native-dominated, herbaceous or shrubby community.

2) Ensure compliance with all conditions of Edmonton's Corporate Tree Management Policy.

Because plant communities in the study area range from highly-manicured to natural, a number of approaches to revegetation should be adopted. Manicured areas will be **landscaped** following construction; further information about landscaping these areas can be found in Section 6.2.4 (Visual Resources). Semi-natural areas will be subject to **naturalization** efforts (Figure 6.2) and areas of native forest will be targeted for **restoration**. Definitions are as follows:

- Naturalization: a less specialized and technical approach focused on establishing plant communities that will transition into a functioning ecosystem, which may be fully native or may comprise a combination of native and non-native species.



Legend

- EISA Study Area
- Project Area
- Proposed LRT
- Permanent Portal Access Road (Work-in-Progress/Not Yet Approved)
- Bylaw 7188 Boundary

Re-Vegetation Strategies*

- Naturalization Areas
- Restoration Areas
- Landscaping Areas

0 50 100 200 Meters

1:4,250

*Boundaries are approximate

Figure 6.2 Re-Vegetation Recommendations

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created: 04 July 2013

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- Restoration: a highly specialized and technical approach, with objectives being the recreation of a functional ecosystem using locally native materials. In this case, the objective will be to recreate native, diverse forest communities appropriate to site conditions (i.e., slope, aspect and moisture levels).

Specific revegetation protocols have not yet been developed. These will be done by the P3 Contractor, however, at a minimum, such protocols will include:

- Development of a restoration plan by a qualified restoration ecologist.
- Equitable compensation for any tree losses associated with the project, as mandated by the City's *Corporate Tree Management Policy* (C456),
- Development of a native, locally-appropriate seed mix for naturalization. Use of the City's naturalization seed mix is not recommended as it contains no native species, and is dominated by crested wheatgrass, which has strongly invasive tendencies.

Obligations under Edmonton's Corporate Tree Management Policy will be relayed to the Proponent in procurement documents and the proponent will be provided the appropriate contact information.

These mitigation measures will, over time, reduce the residual impact of lost vegetation to negligible. The impact is rated as negligible because the improvement in biodiversity on the north wall will compensate for the permanent loss of forest in other locations.

6.1.5.3 Introduction of Weedy Species

Impact

The alignment is located within a major urban area, where ground disturbance is common, and where native plant communities have been extensively disturbed. This type of environment provides ideal conditions for the establishment of weeds. Even the relatively natural parkland within the NSRV supports numerous weed species, as evidenced by the abundance of exotic, noxious and, in some areas, even prohibited noxious species observed within the study area.

Exposed and disturbed soils, which will be present within the construction footprint for considerable lengths of time, are highly vulnerable to weed invasion, and sources of weed seed are abundant within the city. The combination of these two factors makes weed establishment in cleared areas a near certainty in the absence of mitigation measures.

Unvegetated topsoil stockpiles could also be colonized by weeds. Soils that will be stripped from particularly weedy areas, such as the north bank of the river, likely contain an abundance of weed seed, which could germinate and establish on the stockpiles. Weeds could also establish from the soil seed bank when stockpiled soils are reapplied to cleared areas following construction. The predicted long storage period of up to four years will likely reduce the viability of weed seeds currently stored in soil seed banks;

however, if weeds are allowed to establish and set seed on the stockpiles during storage, they will replenish the seed bank annually with fresh seed.

Establishment of weeds, particularly those species listed as noxious or prohibited noxious under the Alberta *Weed Control Act*, could hinder the re-establishment of natural, diverse, native-dominated communities following construction. Areas cleared or otherwise disturbed for construction could become infested, and could act as a source from which seed could disperse to surrounding areas, thus spreading and/or worsening the infestation. Due to the presence of noxious and prohibited noxious weeds within the study area, this impact is considered adverse, major, long-term, and predictable.

Mitigation Measures and Residual Impact

Considering the project location within a large urbanized centre, 100% weed control is not feasible, nor is it the objective for mitigation. Rather, mitigation will strive to minimize and contain weed issues to the point where they will not jeopardize the viability and integrity of ecological communities within the study areas and to be compliant with Alberta's *Weed Control Act*. Measures that will achieve these objectives include:

- minimizing the extent and duration of clearing,
- minimizing the construction footprint,
- sowing stockpiled soils with a non-invasive cover crop, to be approved by LRT D and C,
- monitoring stockpiles and construction areas for weeds, and developing and implementing a weed control plan to address any issues as they develop,
- cleaning equipment prior to mobilizing to site, and inspecting all vehicles as they arrive onsite for weed seed or clumps of dirt/mud that could contain seeds,
- control of noxious weeds and eradication of prohibited noxious weeds, as mandated by the *Weed Control Act*.

With these measures in place, weed control within the study area should be adequate, and residual impacts are expected to be negligible.

6.1.5.4 Loss of Rare Plants

Impact

The City defines rare species as those with provincial ranks of S1, S2 or S3. One S2 species and seven S3 species were observed in the study area. Some of these are known to occur within the project area, while others are known to be outside of it. In addition, the exact locations of some species were not documented in 2012; thus, follow up surveys will be required in 2013 to ascertain which are within the impact area, and which are not.

The following species were documented as present within the project area:

- Smooth sweet cicely (*Osmorhiza longistylis*) (S2): eastern population only
- Yellow lady's slipper (*Cypripedium calceolus*)(S3)

- Herriot's sagewort (*Artemisia tilesii*) (S3)

The following species may be impacted by the project, but impacts remain uncertain until precise plant locations are ascertained:

- Purple peavine (*Lathyrus venosus*) (S3)
- Spotted coralroot (*Corallorhiza maculata*) (S3)
- High bush cranberry (*Viburnum opulus*) (S3)

The following species are not within the currently defined project area, but are nearby:

- Turned sedge (*Carex retrorsa*) (S3)
- Smooth sweet cicely (*Osmorhiza longistylis*) (S2): western population only
- Tall anemone (*Anemone riparia*) (S3)

Edmonton is a "hotspot" for at least two of these species – high bush cranberry and smooth sweet cicely. In other words, although these species are uncommon at the provincial scale, they tend to be locally concentrated in the Edmonton region, suggesting that Edmonton populations of these species have particularly high conservation significance, at the provincial scale. Considering the relatively large number of species potentially impacted (up to six), the conservation value of rare plant species in general, and the localized concentration of two of the species in the Edmonton area, impacts of the project on rare plants are considered to be adverse, major, permanent, and predictable.

Mitigation Measures and Residual Impact

The best form of mitigation of rare plant impacts is avoidance; however, the proposed alignment and the space needed for construction access and staging, renders avoidance impossible. Instead, mitigation will be attempted by transplanting rare plants to suitable locations within the NSRV, but outside of the project area. LRT D and C commits to undertaking the transplantations and specifically, the following transplantation plan components:

- Surveys in summer 2013 to ascertain the location of purple peavine, spotted coralroot and high bush cranberry in the study area,
- Surveys in summer 2013 to identify suitable transplant sites for all impacted rare species,
- Seed collection in 2013 to provide a source of plant material in case transplantation is not successful, including identification of a suitable seed curator.
- Transplantation of plants prior to the onset of construction, most likely in the summer of 2014,
- Post-transplantation monitoring for a period of five years.

LRT D and C, rather than the P3 contractor, will spearhead transplantation efforts and will be assisted by Edmonton's Office of Biodiversity, who is currently exploring the possibility for partnerships with interested community groups to assist with the field work as part of their established outreach programs.

The ecology and habitat requirements of many rare plant species are poorly understood, and little is known about what transplantation techniques will maximize transplant success. This limited knowledge, coupled with species-specific differences in habitat requirements and ecological amplitude (the range of conditions a species can tolerate) among species, this makes it difficult to apply scientific principles to maximize chances of success. Mitigation by transplantation should be considered experimental in nature, and results regarded as unpredictable. In light of this, residual impacts to rare plants are characterised as adverse, major to minor, long-term, and uncertain. However, regardless of success, this transplantation effort will result in the positive outcome of building local expertise in transplantation methods.

6.1.5.5 Disturbance to Recognized City Natural Areas

Impact

Two recognized City of Edmonton Natural Areas, 055RV (Mill Creek Ravine Park) and 048RV (HME Park) are found within the project area, and both will be disturbed by the project (Figure 6.2). Natural areas are recognized as an important component of the City's Ecological Network, providing valuable habitat for native plant and animal species and assisting with wildlife movement, thus increasing biodiversity. Generally speaking, Policy C531 dictates that disturbance to Natural Areas necessitates an impact analysis in the form of a Natural Site Assessment (NSA), and a long-term management plan laid out in a Site-Specific Natural Area Management Plan (Site-Specific NAMP). This EISA fulfills the functions of the NSA; recommended mitigation measures take the place of Site-Specific NAMPs.

Natural Area 048RV will be disturbed for construction, but permanent losses to the Natural Area are expected to be relatively small. By contrast, the south valley wall in Natural Area 055RV is expected to sustain longer-term impacts, as slopes will be cut and retained, resulting in a permanent loss of a small portion of the natural vegetation in the Natural Area. Impacts to two recognized Natural Areas are thus considered adverse, minor, long-term to permanent, and predictable.

Mitigation Measures and Residual Impact

The objectives for mitigation are to minimize short-term and long-term losses to Natural Areas. Short-term losses can be minimized by minimizing the construction footprint within Natural Areas. Long-term losses can be minimized by implementing the mitigation measures described for natural plant communities in Section 6.1.6.2 (Loss of Vegetation). As both Natural Areas are within the project area and will be disturbed for construction, and both will support at least a small amount of permanent infrastructure, impacts to Natural Areas cannot be fully mitigated. With proper restoration of areas cleared for construction, however, residual impacts will in time be reduced to negligible.

6.1.6 *Wildlife*

6.1.6.1 Overview

We examined the following potential impacts to wildlife:

- Loss of terrestrial wildlife habitat due to clearing activities.
- Habitat alienation during construction, demolition and operation activities.
- Breeding bird mortality.
- Loss of special status species due to clearing activities.

6.1.6.2 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. From north to south, the main areas of natural habitat to be cleared, based on the Reference Design project area are:

- grassland/shrub habitat above the SUP in Louise McKinney Park to accommodate construction of the tunnel, portal structure and access road (1.05 ha);
- deciduous woodland in HME Park from the NSR to 98th Avenue to accommodate construction of the elevated guideway component of the river bridge (0.77 ha); and
- deciduous woodland habitat along the south side of Connors Road to accommodate the realignment of the road and construction of retaining walls (1.85 ha).
- and/or a portion of two small deciduous forest patches north of Connors Road.

The remainder of clearing is in manicured areas that have little to no wildlife habitat value.

The majority of this habitat loss is temporary, the result of a need for construction working areas. A minor portion of this habitat loss will, however, be permanent to accommodate LRT infrastructure.

Mitigation Measures and Residual Impacts

Construction

All temporary working areas will be reclaimed after completion of construction, rendering their disturbance a temporary but long-term impact. LRT D and C supports restoring native forests to a similar community (see Figure 6.2) and naturalizing the north valley slope grassland/shrub community, which is currently dominated by non-native shrubs, be naturalized. Thus, the cleared native woodland areas in HME Park and the temporary working areas along the bottom of Connors Road slope will be restored to the community type currently present, rather than the species present.

The scale of habitat loss is important to an impact rating. The anticipated temporary loss is very small in the context of Edmonton's NSRV ARP or as a whole even at the scale of the EISA wildlife study area. At the local scale however, , which is important since the local context is much valued, the loss is more significant and results of our data suggest that even the small affected habitat patches contribute to biodiversity within the local study area. Despite this local habitat significance, the loss is rated as minor for the following reasons:

- The patches of lost habitat type can support only very small populations.
- Clearing will not affect uncommon habitat types.
- For the most important habitat types (mature, deciduous forests) adjacent habitat will remain.
- The loss is temporary and with successful plant community restoration, will again become viable habitat.

Considering all of the above, habitat loss associated with construction is rated as an adverse, minor, long-term and predictable impact. Re-establishment of lost habitat values will take years following reclamation initiation. In the absence of the planned restoration/naturalization, this impact would be rated as major in recognition of the larger, permanent loss and the effect of incremental clearing of natural river valley habitat. This perspective is offered here to highlight the importance of the planned restoration/naturalization efforts.

Operation

A small subset of the above areas represents the permanent habitat loss anticipated to result from this project. Considering the relatively small areas to be impacted this loss is rated as adverse, minor, permanent and predictable.

Mitigation Measures and Residual Impact

All mitigation measures described in vegetation that attempt to limit the project footprint will also mitigate temporary habitat loss. In addition, LRT D and C will implement the following wildlife habitat-specific measures:

- Require the P3 contractor's technical revegetation/reclamation/restoration plan to include specific wildlife habitat objectives designed to maximize habitat value for birds and mammals.
- Require the bidders to include a wildlife biologist on their specialist roster.
- Mitigate the permanent loss of native wildlife habitat through the implementation of the City's Corporate Tree Policy. Ensure that some of those compensation efforts take the form of extending existing native habitat patches in the local or regional wildlife study area, in an effort to reduce the total loss of woody habitat in that regional reach of the NSR system.

6.1.6.3 Habitat Alienation Impact

Construction

Activities and noise associated with construction have potential to disrupt wildlife species using adjacent habitat and movement corridors. This effect of habitat alienation reduces the amount of usable habitat available to individuals and could temporarily impede movement of wildlife. However, the impact is rated as minor for the following reasons:

- Most wildlife species in the area are likely already adapted to human disturbance.
- Additional disturbance caused by construction activity is expected to be relatively slight compared to the existing (baseline) human presence in the study area.
- Construction disturbance will be periodic over four years, and location specific within the project area.

The potential for construction traffic and other disturbances to alienate wildlife is greatest at the river crossing where construction is expected to extend for the entire four years and where the existing habitat is the furthest removed from current sources of disturbance.

Considering all of the above, the impact to wildlife from habitat alienation during demolition and construction activities is rated as adverse, minor, long-term, but uncertain. Habitat alienation is often rated as uncertain because indirect impacts resulting from alienation are inherently difficult to quantify.

Operation

Activities and noise occurring during operation have a lower potential than construction to disrupt wildlife species using adjacent habitat and movement corridors. The impact of habitat alienation during operation is rated as negligible based on the following:

- With the exception of at the river crossing, much of the study area already experiences high levels of traffic noise.
- LRT tracks will carry low-floor, relatively slow moving trains.
- Predictive noise models suggest that noise levels at the bridge will remain lower than those in the vicinity of the roads that currently traverse the river terrace.

Mitigation Measures and Residual Impact

Construction and Operation

No mitigation is required.

6.1.6.4 Breeding Bird Mortality

Impact

Construction

Clearing of natural vegetation can cause wildlife mortality, particularly during the spring breeding season when the mobility of many species is restricted. At these times, adults remain close to dens and nest sites, and young are not yet able to move long distances. If mortality is high during the spring, local populations may suffer short-term declines.

This effect is more pronounced in populations already at low levels. Migratory bird nests are protected under the federal *Migratory Birds Convention Act (MBCA)*, which states that nests cannot be disturbed or removed during the breeding season. There are also legal implications for mortality caused by clearing. Both the federal *MBCA* and the Alberta *Wildlife Act* prohibit activities that will lead to the destruction or disturbance of nesting sites of migratory and individual birds. Direct mortality and nest site disturbance resulting from construction activity and clearing would contravene those *Acts*. Should this occur, it would be an adverse, major, permanent and predictable impact. It is rated as major because it represents contravention of the law. The bridge structures also hold potential to support nesting birds.

Operation

During operation of the LRT, some bird strikes with trains may occur in the vicinity of the river where trains will operate at tree canopy height. Bird strikes are, however, expected to be infrequent since most NSRV bird species are highly mobile, LRT trains will move at relatively slow speeds and the operational zone of the train is narrow, reducing the potential for collision. Based on this information, impacts to breeding birds during operation are expected to be negligible.

Mitigation Measures and Residual Impact

Construction

LRT D and C will impose the following restrictions on the P3 contractor:

- Plan vegetation clearing and bridge demolition to avoid (i.e., trees, shrubs, long grasses) the bird breeding season which, in this region, generally extends from 15 April to 31 July. Avoidance of vegetation clearing during this window will significantly reduce the probability of causing any harm to breeding birds or other nesting/denning wildlife.
- Although it is recommended that no clearing be done during that window, it is possible that certain scenarios may require small amounts of clearing between 15 April and 31 July. In such an event, all habitat potentially affected by clearing activities should be surveyed by a qualified biologist to determine the presence of breeding birds. If active nests are noted, appropriate buffer zones will be established and all clearing activities will avoid such areas. If no nests are found, clearing can proceed without contravening governing legislation.

By following the above measures, the residual impact of the project on breeding bird mortality will be negligible. Note: the need to proactively clear vegetation well in advance of initiation of subsequent construction activities can create potential for erosion in exposed areas. This can be mitigated by clearing to ground surface only, leaving roots intact for erosion control.

Operation

No mitigation required.

6.1.6.5 Special Status Species

Impact

A total of four special status species, all with a moderate likelihood of occurrence in the proposed study area have low potential to occur in the local or project area: peregrine falcon, long-tailed weasel, northern bat, and Canadian toad. Following is an account of the project's potential to impact these species.

None of the project components are expected to directly influence the foraging behavior of peregrine falcons in the study area. Construction activity may alienate peregrine avian prey species from the area surrounding the project area, thereby reducing the probability of falcons foraging in those areas and reducing the potential for direct impact to peregrines. An abundance of foraging opportunities exist elsewhere in the NSRV. The potential impact to peregrine falcons is considered negligible.

Suitable habitat for long-tailed weasels is limited in the local project area and, if present, this highly mobile species is expected to leave the area and occupy other parts of its range. The potential to directly impact long-tailed weasels is considered negligible.

Northern bats generally occur in boreal forested areas and prefer mature conifer trees and snags for roosting; therefore, suitable habitat for this species is limited within the project area (Caceres and Pybus 1997). Riparian woodland habitat with mature conifers is present both east and west of the project area, but not in the project area. The potential to directly affect northern bats is considered negligible.

Canadian toad sightings in the Edmonton area are rare, but one of the most recent records of a Canadian toad comes from an area of Mill Creek Ravine south of the project area. After the breeding season, Canadian toads move away from wet areas to hibernate in uplands with sandy soils (Hamilton et al. 1998). There are no suitable Canadian toad breeding or hibernating habitat in the areas expected to be directly impacted by construction. The potential for presence of Canadian toads in the immediate project area is, therefore, considered low; accordingly, the potential impact to Canadian toads is negligible.

Mitigation Measures and Residual Impact

No specific mitigation measures are recommended for special status species. Refer to Section 6.1.7.2 for general mitigation measures aimed at reducing direct impacts to wildlife.

6.1.7 *Habitat Connectivity*

We examined the following potential impacts to habitat connectivity:

- Temporary and permanent loss of features that promote functional connectivity.
- Introduction of permanent barriers to wildlife movement.

These two impacts are closely related and will be discussed together below.

Impact

Construction

This assessment assumes the worst case scenario, that is, that project construction occurs simultaneously throughout the entire project area (Figure 1.1) requiring the P3 Contractor to isolate the entire area with impermeable site fencing. It is understood that major roads and a significant portion of the NSR will remain open to traffic/navigation. It is possible that the project area will be sectioned into more discrete areas with significant gaps available between them, but the potential for this approach is unknown at this time.

While it is desirable to prevent wildlife from entering active construction zones, for both worker and wildlife safety reasons, achieving this would have the undesirable result of effectively restricting daily and seasonal through-valley movement of most, if not all terrestrial wildlife in the area. Under such a scenario, this barrier effect would extend to movement between Mill Creek Ravine and the NSR valley to the east. The barrier presented by the anticipated fencing also has potential to affect seasonal and dispersal movements of more transient species that occasionally make use of the larger valley corridor system. Creating a cleared and fenced area approximately 60 wide in the riparian forest corridor also has potential to restrict short-distance daily movements of some bird species (i.e., movements across the construction area). This is likely to have the most significant adverse effect for some species during the bird breeding season when foraging movements are nearly constant and can be widespread. Moreover, fencing could result in redirection of some individual animals into neighbouring communities, potentially resulting in wildlife/people conflicts. Specific examples of species potentially rerouted include deer, coyotes, fox, skunk and grouse. Considering that the NSR is a major regional wildlife movement corridor and that construction is expected to occur over a four year period, this worst case scenario impact is rated as an adverse, major, long-term, predictable impact.

Construction clearing will result in loss of some woodland that currently contributes to continuous riparian habitat connectivity. While this impact is captured in the above analysis because these cleared areas would be fenced, this effect would temporarily remain in place upon removal of fencing, during the planned reclamation phase. The key connecting features that would be lost are mature forest situated in HME Park, forest on the upper valley wall south of Connors Road and a small patch of aspen forest (a stepping stone) on the north side of Connors Road. With the exception of the small stepping stone, this loss would be temporary (particularly the riparian habitat loss). At HME Park, in the early years following construction, the gap in the forest created by the guideway and its construction will likely remain as approximately 60m wide for a few years. Some species of birds such as black-capped chickadees, downy woodpeckers and nuthatches view gaps 45 m or wider to be barriers to daily movements (Tremblay and St. Clair 2009). This gap in vegetation immediately post-construction represents a temporary reduction in habitat connectivity (a lack of cover). The reduced connectivity manifested during the construction and early reclamation/restoration period is rated as an adverse, minor, long-term and predictable impact.

Operation

Several City policies indicate that the Valley Line-Stage 1 project should seek to minimize wildlife/rail line conflicts in the NSRV and retain or improve on the existing wildlife movement corridor function of the valley. In addition, in 2010, in keeping with the City's ecological network approach to conservation, Office of Biodiversity (then Office of Natural Areas) issued the Wildlife Passage Engineering Design Guidelines (WPEDG) to provide transportation designers and decision-makers with recommended measures and practices that will assist in incorporating the needs of wildlife into transportation projects. While the Valley Line-Stage 1 will traverse the entire valley (from valley wall to valley wall), the permanent new infrastructure generally parallels or replaces existing infrastructure and it is only in select locations that significant infrastructure will be a new feature, with potential to affect wildlife movement. Following is an analysis of the impact of each major project component on wildlife movement. This analysis was undertaken in detail during preliminary design using specific Reference Design dimensions, evaluating them for conformance to the Wildlife Passage Design Guidelines. Results were provided to the engineering team to inform ongoing design. Because design changes may occur moving forward, the assessment here is less specific but uses the Reference Design as in general base design.

North Saskatchewan River Bridge – North End

On the north side of the river, the river bridge deck will extend further back from the river than the current bridge, travel over the SUPs, and cut through a vegetated section of the valley wall to connect to the portal structure. The upper valley wall is not currently thought to be an important wildlife movement route; however, this new infrastructure will further impede wildlife movement across that slope. The maintenance access road, with associated retaining walls and the portal structure further reduce wildlife movement potential and may push wildlife down to the lower valley wall and the margins of the river. The pedestrian bridge will tie in to the park at approximately the same location as the current pedestrian bridge, leaving the NSR bank unoccupied, as it is now. This bank is the best movement corridor currently available at this location in the north valley; therefore, clearance under this bridge is critical. The final specific clearance to be provided beneath the pedestrian walkway over the NSR bank is unknown at this time; however, the Reference Design does provide the required clearance to support wildlife movement for any species, as is the case now. Vertical clearance notwithstanding, the addition of this more substantial structure across this section of the valley may act as a visual and structural barrier that could deter wildlife from moving beneath the bridge and along the river's edge. This effect could be temporary. Overall, impacts to habitat connectivity on the north bank are rated as adverse, minor to major, permanent, and uncertain. Impacts to movement in the north valley are rated as minor to major since movement is expected to be impeded even further in a reach of the north valley that may already be a pinch point for wildlife movement, as a result of slopes and a high concentration of SUPs. The uncertainty relates to insufficient field data regarding wildlife movement in that area and the lack of final design to assess.

North Saskatchewan River Bridge – South End

Currently, the most suitable wildlife corridor south of the river is the riparian habitat on the south river bank (beneath the existing Cloverdale pedestrian bridge) and terrace within HME Park. This area is relatively well forested and provides protective cover. Clearance under the footbridge currently accommodates the movement of small to large-sized wildlife species. The terrain is somewhat uneven, owing to the Mill Creek channel, but this is not an impediment, and for some species provides additional wildlife cover. Slopes are not impassable for any species. These factors suggest that this is the most permeable and highest functioning wildlife movement corridor through the project area and through this pinch point area in the valley.

The full length of the LRT track through HME Park will be elevated, including the river bridge and the contiguous guideway, merging with the bridge over 98th Avenue, thus the new structure will not be an impermeable barrier. As conceived in the Reference Design, minimum clearance between the bottom of the guideway and ground surface will be 4m (near the connection with the river bridge). That clearance will be suitable to accommodate passage of all potentially-occurring terrestrial wildlife species and over time, it is expected that wildlife moving through the area will move under the structure. The Reference Design structures in this area comply with the wildlife passage guideline for mammals. The guideway superstructure will be positioned at an elevation that will be approximately mid-way through the height of the adjacent tree canopy, thus it could pose a barrier to birds travelling through the forest. Although the guideway currently meets wildlife passage guidelines, it still presents as a new, navigational consideration that reduces connectivity by some degree. Thus unmitigated, the potential impacts to habitat connectivity on the south bank of the river and through HME Park are rated as adverse, minor, permanent, and uncertain. The uncertainty is associated with the lack of final design to assess.

Bridge Over 98th Avenue

The new LRT bridge over 98th Avenue will be located approximately 20 m to the west of the existing pedestrian bridge, and when combined with the existing structure, may act as a visual barrier to wildlife. This location is not assessed as a major movement route and, therefore, an impact here to habitat connectivity is considered negligible.

Muttart Stop and TPSS

The Muttart Stop and traction power sub-station (TPSS) will be located directly adjacent to existing Muttart Conservatory structures and service road on lands that do not currently support native vegetation. The construction of the Muttart Stop and TPSS will add to the existing infrastructure. These project components represent an increase in the infrastructure footprint and a visual obstruction (to wildlife) in that locality. In addition, five long retaining walls ranging from 2.5m to 6.0m tall are expected to be constructed in the areas surrounding the Muttart Stop. These retaining walls may pose a barrier to movement for some wildlife, especially smaller species. In general, the area will become less navigable; however, since the Muttart Stop and TPSS will be built in close proximity to existing structures and significant open space is present for wildlife movement in the surrounding areas, habitat connectivity in this area is unlikely to be measurably compromised. Wildlife currently moving through the area may be funneled north towards HME Park or upslope through Gallagher Park. Overall, impacts to habitat connectivity around the Muttart Stop and TPSS are rated as negligible.

LRT Track along Connors Road

The proposed addition of LRT track along Connors Road will widen the existing transportation corridor and the southern realignment of Connors Road will require four tall retaining walls, two on either side of the roadway. The low impact character of the LRT track is not itself expected to present a physical barrier to any wildlife movement; however, jersey barriers may be required and the widened ROW and the addition of LRT traffic at intervals of approximately 5 minutes during peak hours and 10-15 minutes during off-peak periods, in each direction, will decrease the permeability of that transportation corridor. In addition, the retaining walls that span nearly the length of the hill will function as an impassable barrier to most terrestrial wildlife movement and may pose the greatest impediment to wildlife movement. Some forested slope (to be reclaimed as described above) will remain, enabling animals to continue to move along the slope, to and from Mill Creek Ravine, although now along a narrower corridor. The retaining walls are expected to funnel individuals across the slope, along a shallow bench to a gap between the retaining walls leading to access to the ROW. Concentration of wildlife movement in this location could result in wildlife-vehicle collisions. Overall, the impact of the LRT track and related infrastructure along Connors Road is expected to impede local wildlife movement and to be an adverse and permanent impact. This is considered to be a major impact because of the high value ascribed to the Mill Creek Ravine-Cloverdale Ravine-NSR corridor. The severity is somewhat uncertain.

The southernmost alignment introduces the largest retaining walls along Connors hill, walls that would represent significant cliffs to wildlife. The northernmost alignment option under active development and consideration concurrent to preparation of this EISA is assumed not to require the same degree of retaining walls and therefore to be more desirable. The width of ROW for a more northern alignment is assumed to be the same but would require less clearing to the south and more clearing to the north of Connors Road. The clearing to the north would affect some of the stepping stones linkages to Cloverdale Ravine. On the basis of this very general assessment of alternatives, a more northern alignment seems unlikely to affect habitat connectivity as severely as would the southernmost alignment assessed in detail here. That said, regardless of the alignment option selected for this location, the introduction of the LRT through this area will reduce habitat connectivity on Connors Hill.

Mitigation Measures and Residual Impact

Construction

The overarching mitigation measure for loss of habitat connectivity/impediment of wildlife movement during construction is as follows:

- LRT D and C will require the P3 contractor to prepare a construction schedule and staging plan that demonstrates suitable and effective provision for wildlife during the course of the construction period. At a minimum, the plan will address the following items:
  - Means to provide for wildlife movement at key locations during the breeding season and fall dispersal period.
  - Evidence that wildlife movement through the study area will be a primary consideration when developing a fence decommissioning schedule. For example, remove or realign fences at earliest possible opportunities.
  - Ensure road culverts that may exist in the area remain open to allow for continuation of any wildlife movement function they might now provide.
  - Educate all workers regarding potential for wildlife/worker conflict and related procedures.
  - Develop procedures for handling wildlife migrating onto the site and that avoid worker/wildlife conflicts.
  - Demonstrated attempts to comply with the construction phase measures established in the City of Edmonton Wildlife Passage Design Guidelines.

- LRT D and C will develop performance measures for evaluating the wildlife movement components of the technical submission.

- LRT D and C will require the wildlife movement provisions to be prepared by a professional biologist with demonstrated experience in wildlife movement.

With the above mitigation measures in place and with effective plan implementation during construction, the residual impact on wildlife movement during construction should be reduced to adverse, minor, short-term but uncertain. The uncertainty is associated with the fact that specific plans are not available to be subject to a specific assessment of mitigation efficacy.

Operation

Mitigation measures to minimize reduction of habitat connectivity and impediments to wildlife movement as a result of introduction of LRT are as follows, on a site-specific basis.

North Saskatchewan River Bridge

- LRT D and C will require the P3 contractor to prepare a plan that demonstrates suitable and effective provision for wildlife movement along both the north and south banks of the NSR. The plan must comply with the City of Edmonton Wildlife Passage Engineering Design Guidelines. This will ensure little reduction in riparian corridor function,

- At a minimum, the plan will address the following items:

- Provide overhead clearance of at least 3 m beneath the NSR bridge, underslung pedestrian bridge, and guideway.
- Re-vegetate areas that have been cleared on either side of the bridge structure, along the river margins, and around the abutments to a natural state.
- Provide security cover features such as logs and small boulders inside wildlife underpasses.
- Plant native trees and shrubs less than or equal to the height of the underside of the bridge deck and ensure less than 45 m distance between trees located on opposite sides of the bridge.
- Fill riprap interstices with gravel/small rocks.
- Install willow stakes in the riprap to enhance the habitat value of the river's edge.
- Avoid spill lighting of the entire NSR bridge (including guideway).
- Separate the riparian wildlife passages and SUPs through naturalization landscaping.

With the above mitigation measures implemented, the residual impact on wildlife movement near the NSR is expected to be adverse, minor, permanent and predictable. It is predictable because similar measures have been effectively implemented elsewhere to facilitate wildlife movement.

Bridge Over 98th Avenue and Muttart Stop and TPSS

No mitigation required. The impact remains negligible.

LRT Track along Connors Road

- Regardless of alignment option selected, the P3 contractor will be required to provide for wildlife movement across Connors Road at an appropriate location on Connors Hill to connect Mill Creek Ravine to Cloverdale Ravine and to monitor performance of measure installed.
- The design must have input from a professional biologist with demonstrated relevant experience.
- The design will comply with the City of Edmonton Wildlife Passage Engineering Design Guidelines, for provision of movement for the Medium Terrestrial Design Group (skunks, porcupines, coyotes).
- LRT D and C will develop performance measures for evaluating the wildlife movement components of the technical submission.
- LRT D and C will require the P3 Contractor to monitor deer movement in the area of Connors Road and Cloverdale Hill for 5 post-construction autumns, and install appropriate means of promoting movement according to the City's Wildlife Passage Design Guidelines if OoB is of the opinion that the data collected suggest regular, annual or seasonal movement in the area.

Figure 6.3 provides an example of an option that would be appropriate to the Reference Design and realignment of Connors Road to the south. This concept can be used as an indicator of the expected level of effort to provide for movement. A concrete box culvert could be installed beneath the new transportation corridor approximately halfway up Connors Hill at the gap in the retaining walls. The culvert would be 2.2 m wide on the inside and approximately 35m long. It will be important to ensure that whatever structure is installed does not adversely affect drainage in the area.

- To encourage wildlife to use this structure, vegetation would be planted at both ends of the culvert to provide cover.
- Vegetation or fencing would also be used to funnel animals towards the culvert opening and a short retaining wall/fence may be required at the south end.
- Artificial substrate will be installed on the floor to encourage wildlife use.

With a structure such as this culvert installed, the impact of the LRT track and related infrastructure along Connors Road on wildlife movement is expected to be significantly reduced, but the residual impact remains rated as adverse, minor, permanent, and uncertain. Overtime, the impact may be reduced to negligible.

Should Connors road remain where it is or be realigned to the north, wildlife passage is still recommended to mitigate the widened ROW corridor and reduction in stepping stones north of Connors Road. Assessment of impacts of the north option would require more analysis.

6.2 Valued Socio-Economic Components

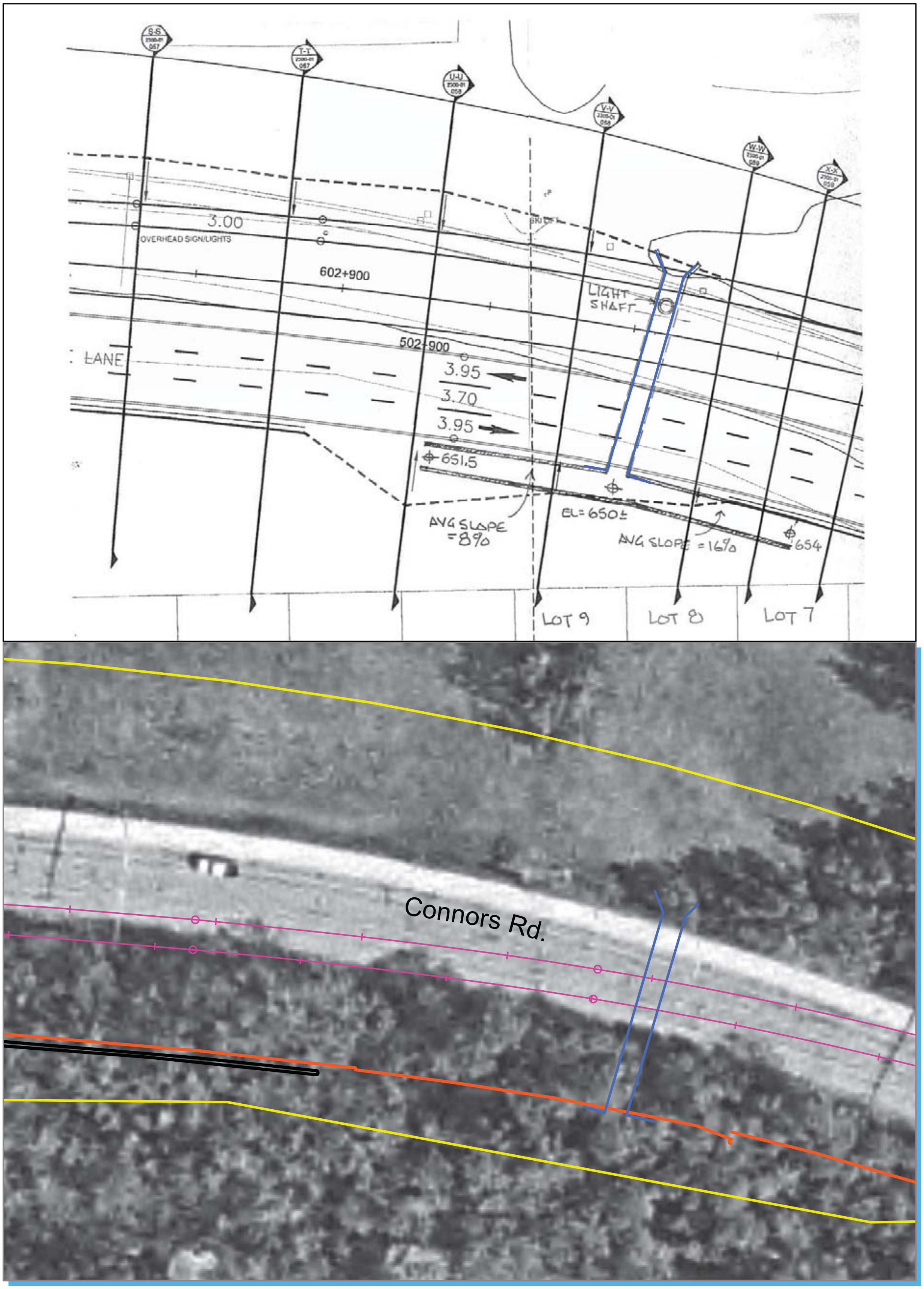
6.2.1 *Land Disposition and Land Use Zoning*

We examined the following potential impacts of the proposed project on land disposition and land use zoning:

- changes to land disposition, and leases,
- jurisdictional boundary concerns, and
- changes to land use zoning.

Land Disposition

Development of the LRT will require City of Edmonton Transportation Services to acquire certain land parcels that are privately owned, or are owned by City of Edmonton Community Services. Construction of the portal access road will require purchase of a single private lot; negotiations for this purchase are underway. It is LRT D and C's intention to have the LRT and all associated infrastructure (i.e., portal, bridges, station, TPSS, Connor's Road pedestrian bridge and two rain gardens in the near vicinity of the track) located in a road ROW (Ward pers.comm.). Transfer of lands from Community Services to Transportation Services to be undertaken once all property requirements have been confirmed, including along Connors Road (C. Cej, *pers. comm.*) It is anticipated that all necessary lands for the road ROW will be secured by 2015 (Fordice *pers. comm.*). The proposed dry pond at the base of Connors Hill is located on park land owned by City



Legend

- Conceptual Wildlife Culvert
- Project Area
- Proposed Connors Road South Curb
- Proposed Retaining Wall

0 5 10 20 Meters

1:500

*All details not shown, locations are approximate

Figure 6.3 Conceptual Wildlife Culvert

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created: 01 May 2013

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of Edmonton Community Services. These lands will either be integrated into the Connors Road ROW or retained by Community Services (to be confirmed between Transportation Services and Community Services (C. Cej, *pers. comm.*).

The project will require both temporary work areas and permanent structures within the bed and shore of the NSRV and/or Mill Creek. The bed and shore of all naturally-occurring water bodies are the property of the Province, and the appropriate permits (Temporary Field Authorization for construction activities and License of Occupation for permanent structures) must be in place prior to any work in the bed and shore of these two watercourses.

The most recent lease agreement between the Edmonton Ski Club lease and C of E has expired and a new agreement is in negotiation. C of E Transportation Services has ensured that the final agreement will contain clauses reflecting the new LRT. Lands leased to Riverboat Inc. are assumed to be out of the project area and, therefore, unlikely to be affected by the project. Any required negotiations regarding lease terms or land use would be handled through standard City procedures, if/as required.

In summary, the project will require changes to land disposition; associated impacts are considered minor, permanent and predictable. Whether they are adverse or positive is the opinion of current landowners.

Land Use Zoning

The one affected privately-owned parcel is currently zoned A (Metropolitan Recreational Area), similar to the majority of lands in the project area. Lands in the project area that are zoned A and AN currently support numerous transportation arteries; thus, the addition of new transportation infrastructure and associated drainage facilities situated within road ROW is not expected to require any rezoning. Impacts to land use zoning are thus considered negligible.

Mitigation Measures and Residual Impacts

No mitigation measures beyond implementation of standard city procedures are needed. On that basis, residual impacts are not expected.

6.2.2 *Residential Land Use*

6.2.2.1 Overview

We examined the following potential impacts of the proposed project on residential land use:

- Temporary increased noise and vibration during construction (and demolition) activities.
- Traffic disruptions associated with road closures.
- Dust and mud generation during construction.
- Permanent increase in noise and vibration from operation of the LRT rail line.

6.2.2.2 Noise and Vibration from Construction and Demolition Activities

Impact

When analyzing construction noise and vibration, major concerns considered are hearing damage due to excessive noise levels and human annoyance. In the absence of known construction methods, specialists concluded that construction and vibration noise could not be modeled at this time. Therefore, this assessment is limited to the following qualitative discussion.

We assume that residents in the Riverdale, Cloverdale and Bonnie Doon neighbourhoods are accustomed to regular levels of ambient ("white") noise and vibrations caused by traffic along Grierson Hill Road, 98th Avenue and Connors Road. However, a temporary change to noisier conditions will likely be considered by them to be an adverse impact. Severity of adverse impacts from construction noise and vibrations (as measured by a change from existing ambient levels) will vary based on the proximity of residents to construction activities.

Riverdale residents that border the NSRV within the study area will likely experience elevated noise and possibly some exposure to vibrations during tunnel, portal and north valley access road construction. Residents along Cameron Avenue will also be affected by construction vehicle traffic noise as vehicles access the project area. In particular, residents backing onto Louise McKinney Park will have an access road located very close to their homes, which can be expected to generate noise and possibly also vibrations.

In addition, noise levels in the westernmost part of Cloverdale, northernmost part of Bonnie Doon (and select residences in Strathearn) neighbourhoods will likely increase during select construction activities. In all neighbourhoods, it is expected that construction noise will be periodically high during construction activities. Activities such as pile driving are expected to generate particularly loud noise levels. Severity of adverse impacts from construction noise will vary based on the proximity of residents in these neighbourhoods to construction activities. These impacts have not been quantitatively assessed but are qualitatively assessed here as adverse, major, short or long-term but uncertain.

Mitigation Measures and Residual Impact

Construction noise will be generally limited to the hours permitted by the City of Edmonton Bylaw 14600 (*Community Standards Bylaw*), with some exceptions and variances, as approved by the City. Bylaw 14600 restricts normal working hours from 07:00-22:00 hours (09:00-21:00 on Sundays and holidays). These restrictions will mitigate annoyance to some degree.

In addition, LRT D and C will ensure that the P3 contractor provides advanced notification to residents in the Riverdale, Cloverdale and Bonnie Doon neighbourhoods of any scheduled activities that may exceed annoyance noise levels. In addition, the P3 contractor will be required to implement the following practices to manage noise and vibration levels:

- Wherever feasible, significant noise generating activities will be scheduled for times that would cause the least disruption.
- To limit noise emissions, all construction equipment will be maintained often and fitted with working mufflers.
- Avoid concurrent use of equipment that is expected to cause excessive noise; avoid unnecessary equipment idling.
- To adhere with Occupational Health and Safety requirements, construction noise levels outside of the project area will be kept below 85 dBA.
- Where feasible, use low vibration equipment and processes to limit impacts of vibration during construction and demolition.
- In construction and demolition areas bordering the Riverdale, Cloverdale and Bonnie Doon neighbourhoods, vibration generating equipment will be avoided in evenings.
- A construction area speed limit will be implemented and enforced to reduce the vibrations created by large fast moving construction equipment.
- Finally, a noise and vibrations complaint process will be setup to resolve any issues associated with residential complaints.

Even with mitigation, it is expected that for some residents, construction noise will remain an adverse, major, short or long-term impact, but this cannot be stated with certainty.

6.2.2.3 Noise and Vibration from Operation

Impact

The City's Urban Traffic Noise Policy (UTNP) (C506A) revised in 2013, outlines acceptable noise levels generated by new urban traffic and transit operations to be built through or adjacent to a developed residential area, where private yards will abut the transportation facility in residential neighbourhoods. In those cases, the City seeks to achieve a projected attenuated noise levels below 65 dBA_{Leq24}.

An operational noise and vibration study undertaken by Connected Transit Partnership (2013e) for preliminary design included one receptor in Cloverdale, three in Strathearn and six in Bonnie Doon (along Connors Road). One receptor near the top of Connors Hill, toward the Cloverdale Road intersection was identified as having the potential to experience operational noise levels requiring mitigation: At this receptor, noise levels are predicted to be between 60 and 70 dBA_{Leq24}. No sections of track near the Bonnie Doon neighbourhood have been identified as having the potential to be impacted by operational vibrations (CTP 2013c).

Based on this information, operational noise and vibrations impacts in the Cloverdale neighbourhood are rated as negligible. In the Bonnie Doon neighbourhood, vibrational impacts are rated as negligible and noise impacts are rated as adverse, minor to major, permanent and predictable.

Mitigation Measures and Residual Impact

- LRT D and C will commit to ensuring that rail tracks will be well maintained to reduce the squeal of trains.
- A noise barrier with sound absorption characteristics will be installed at the top of Connors Hill, between Connors Road and adjacent houses, unless new studies assessing the final design indicate that the LRT will meet the thresholds identified in the UTNP.

6.2.2.4 Traffic Disruptions Associated with Road Closures/Use

Impact

As with many projects, LRT construction will undeniably require traffic adjustments and represents an inconvenience/annoyance to Edmontonians and in particular to local residents. Following are some of the obvious expected traffic impacts; others will likely manifest during more detailed planning.

On the north side of the NSR, within the bylaw boundaries, Grierson Hill Road, Cameron Avenue and a short section of 95th Street are expected to experience moderate to high construction equipment traffic during construction in the north valley. Residential parking on Cameron Avenue may be disrupted if wider construction vehicles require access through the narrow street.

Sharing 98th Avenue with construction traffic will be congesting and particularly inconvenient for residents of The Landing. In addition, during construction of the 98th Avenue bridge on the south side of the river, temporary closure of 98th Avenue may be required. This would be a major inconvenience to Cloverdale residents who would have to use alternative routes such as Connors Roads to access downtown areas, thereby increasing commute times.

As currently conceived, Connors Road is expected to be closed for at least one year during construction. This would restrict access to downtown to either 98th Avenue or 99th Street and Scona Road, and increase traffic levels in these areas. Higher traffic levels on 98th Avenue could potentially affect the residents in the Cloverdale neighbourhood subjecting them to traffic bottlenecking, high traffic noise levels, and rendering left turns onto 98th Avenue more difficult.

If construction should prevent use of Cloverdale Hill for public transit during the EFMF, and require routing transit or pedestrians through residential streets, a change in transportation plans to and from the festival site would also have an impact on Cloverdale Residents.

Based on this information, traffic disruptions caused by road closures are rated as adverse, major, long-term and predictable.

Mitigation Measures and Residual Impact

LRT D and C will require the P3 contractor to provide a traffic management plan, for City approval. The plan will include the following items:

- Information on local or arterial roadway closures will be provided to Riverdale, Cloverdale and Bonnie Doon residents well in advance of construction works.
- Alternative routes for traffic and transit will be clearly marked and well-communicated with motorists and transit users prior to implementation.
- The intersection of Connors and Cloverdale Road will remain accessible to transit during the active EFMF period.
- The concurrent closure of 98th Avenue and Connors Road will be avoided to reduce downtown commuter delays.

While these measures will reduce the impact, the residual impact remains adverse, major, long-term and predictable.

6.2.2.5 Construction Generated Dust and Mud

Impact

Dust and mud are typically generated by the construction activities anticipated for this project. The volume is dependent on the intensity and timing of weather events and dust-generating activities. The LRT project is located in an urban area and dust and mud could affect residents in the Riverdale, Cloverdale and Bonnie Doon neighbourhoods who live within or close to the project area. During dry conditions, dust may be generated from exposed soils on the project site and associated areas. In most cases, dust generation would only be a nuisance; however, there may be a slight health risk for people with respiratory sensitivities during infrequent periods of high dust release. Mud may only be considered a nuisance but there is potential for significant quantities to be generated. The potential impacts of construction dust and mud are considered to be adverse, minor, long-term, and predictable. The severity is difficult to rate because this can be a subjective matter.

Mitigation Measures and Residual Impact

Best management practices related to dust and mud mitigation will be followed. These include minimizing exposure of dust producing areas employing standard construction dust management (e.g. watering where appropriate); stabilizing exposed soils with vegetation as soon as possible; utilizing wind fences; vehicle tire and track washing; and timely removal of mud clods from roadways. Any additives used in dust control water, will not contain chemicals with potential to adversely affect river or creek water. Based on these measures, residual impacts are expected to be negligible.

Maintaining City roads mud/dirt free also assist with preventing sediment release into street catch basins and ultimately the NSR and is a recommended best management practice. The City and AESRD have expressed explicit concerns about this in the past.

6.2.3 *Recreational Land Use*

Overview

The project area currently intersects with a large number of parks, recreational facilities and public recreational amenities (Figure 6.4). Impacts of the project on recreation are thus expected to be considerable, though many will be limited to the construction period. As the project area included in this assessment is based on a worst-case scenario estimate of the construction footprint, the impact assessment is similarly a worst-case scenario analysis. There are many potential opportunities to reduce many of the impacts through careful planning and staging, and consultation and coordination with affected community groups and stakeholders. As the project is still in a relatively early stage, many of these avenues have yet to be fully explored.

Examined potential impacts of the project on recreational land use include:

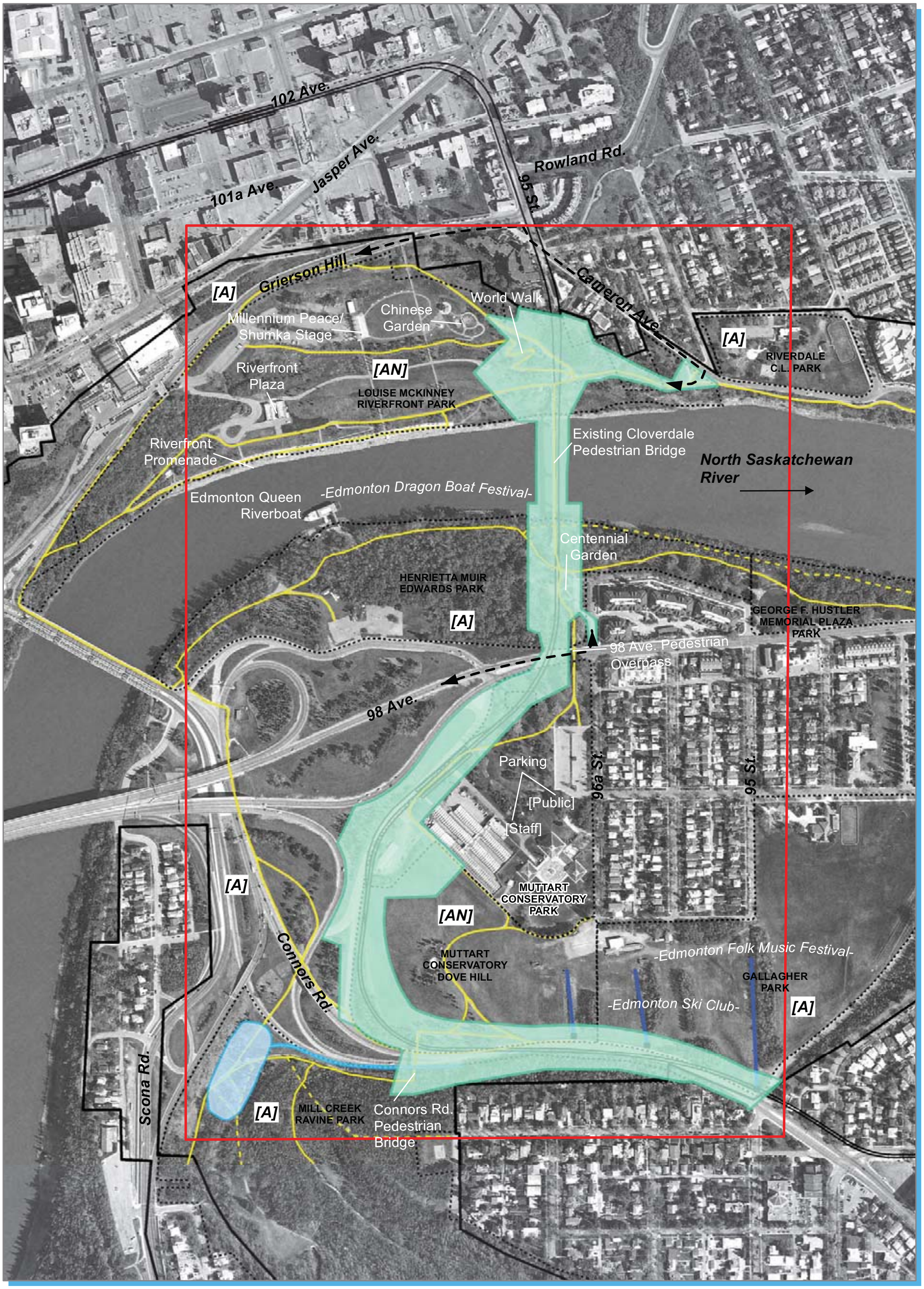
- impacts to the trail network,
- closure or relocation of other recreational infrastructure,
- disruptions to river navigation (boating) during construction,
- disruptions to special events (festivals, etc.),
- relocation of socially-important amenities, including gardens, donor benches and trees, the Trans Canada Trail pavilion, and the wishing tree,
- impacts to the operation of the Muttart Conservatory and the Edmonton Ski Club,
- impacts on park user experience,
- loss of green space,
- impacts to public parking areas,
- pathway realignments, and
- increased transit access to the river valley.

Aesthetic changes will result from the construction and presence of new infrastructure within river valley parkland. While it is understood that such changes can affect the experience of recreationists using the area, aesthetic impacts are more comprehensively covered under Visual Resources (Section 6.2.4), as they pertain to changes in the visual environment. Safety hazards are addressed in Section 6.2.6 (Worker and Public Safety).

6.2.3.1 Impacts to the Pathway Network

Impact

During construction, pathway connections are expected to be disrupted throughout the study area, necessitating detours. All pathways that intersect with the project area, as portrayed in Figure 6.4, are expected to be closed for part or all of the construction period; this includes SUPs, pedestrian bridges, unpaved pathways and the wheelchair-accessible World Walk. The duration of closures will likely vary throughout the area, as



Legend

- EISA Study Area
- Area Directly Impacted
- Proposed LRT
- Proposed Dry Pond and Vegetated Swale (Conceptual)
- Construction Access
- Bylaw 7188 Boundary
- Park Boundaries
- Ski Lift

Zoning

- [A] Metropolitan Recreation Area
- [AN] River Valley Activity Node

Pathway

- Shared Use Pathway
- Granular Pathway

0 50 100 200 Meters

1:5,000

*Muttart garden beds not shown; indirect impacts not shown
**Land use zoning source: City of Edmonton Planning and Development (2013)

Figure 6.4 Direct Recreational Impacts

City of Edmonton LRT Valley Line - Stage 1

Aerial Photograph Date: May 2012
Date Map Created: 04 July 2013

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some project components will entail a longer construction period than others. As the project area forms a swath through the entire river valley, from north to south, pathway closures have the potential to substantially impede both recreational and commuting users of the pathway network.

North Valley

A major river valley SUP connection point is located within the project area on the north side of the river, at the intersection of three SUPs that are important to pathway users in the river valley. They provide the east-west connection through Louise McKinney Park (Trans Canada Trail), a connection to the top-of-bank and downtown, and a connection across the Cloverdale pedestrian bridge. In this sense, the north bank of the river acts as a node in the SUP system. The steep slopes and relative narrowness of the valley north of the river limit potential detour routes; as such, it is likely that detours will necessitate pathway users to climb out of the valley east of the project area, and re-enter it to the west. Such a detour would require substantially more time and physical effort than the current east-west link across the north bank. The construction period on the north bank is expected to be relatively lengthy due to the size and complexity of structures in this area.

As such, impacts of the project on north bank pathways are rated as adverse, major, long-term, and predictable.

World Walk

Of the pathways on the north bank, the east portion of the World Walk (through the rose garden pathway) deserves separate mention. The World is the only accessible pedestrian pathway that allows access from the top of Louise McKinney Riverfront Park down to the lower east/west running SUP and Cloverdale footbridge. Considering its location within a landscaped garden and park, it is likely used a destination pathway as well as an access route. The World Walk is expected to be closed for some portion of the construction period, creating a significant access barrier to the lower levels of Louise McKinney Park and Trans Canada Trail. The World Walk is expected to be re-opened following construction; though some re-alignment of the path might be required. Additionally, the rose garden that currently borders the Walk may be relocated following construction, which could affect the quality of users' experience in the long-term. The closure of the sole accessible pathway in the area is thus rated as adverse, major, long-term, and predictable.

Cloverdale pedestrian bridge

The Cloverdale pedestrian bridge will be demolished early in the construction process, and the river crossing will be unavailable to pathway users until construction of the new bridge is complete. Because the Cloverdale pedestrian bridge is one of four dedicated pedestrian bridges in the City, it is considered to be a recreational asset in limited supply. Rates of use for the Cloverdale Pedestrian Bridge are unknown, making it difficult to quantitatively assess impacts; however, it is a connector for many routes between the city centre and south-central neighbourhoods such as Cloverdale, Bonnie Doon, Strathearn and Strathcona, and is purported to be used by both commuter and recreationists. It also connects to facilities and events such as Louise McKinney Park, the Muttart

Conservatory the Edmonton Queen Riverboat, and the Edmonton Folk Music Festival. The bridge may be closed for up to four years. Pathway users will be required to use alternative crossing points during the construction period. The nearest available crossing is the Low Level Bridge, located approximately 700 m west of the Cloverdale crossing. Pedestrian/cycle crossings are also available on the Dawson Bridge, located approximately 2 km northeast of the Cloverdale crossing. Both bridges are integrated into the network of river valley pathways. Considering the lengthy duration of the closure, the location of the bridge within the central area, the bridge's numerous connections to SUP pathways, and the number of recreational areas and amenities that might normally be accessed via the bridge, impacts of the bridge closure are rated as adverse, major, long-term and predictable.

South Bank/Terrace

The SUP paralleling the riverbank will be disrupted during construction of the bridge and elevated guideway. As bridge construction is expected to be a lengthy process, this SUP may be closed for most or all of the construction period, depending on how bridge construction is staged. Informal and unpaved pathways, such as the riverbank pathway in HME Park, will also be closed during construction. Alternative routes are available through this area: 98th Avenue provides an east-west route for cyclists, while sidewalks are available for pedestrian use along 98th Avenue, linking to the Low Level Bridge. However, these options may be seen by pathway users as unattractive and/or unsafe. The closure of SUP that runs through the Muttart grounds will comprise a significant loss of connectivity, as this pathway connects the riverbank pathways to pathways in the Connors Road/Mill Creek Ravine area. In the worst case scenario, impacts of the closure on south bank/terrace trails are thus rated adverse, major, long-term and predictable.

Connors Road Pedestrian Bridge and Mill Creek Ravine

The Connors Road pedestrian bridge will also be closed for an unknown period of time. It is assumed that demolition of the existing bridge and construction of the new bridge could be accomplished within a year; however, if adjacent connector pathways remain closed beyond this period, the effective closure length could be more than a year. The Connors Road pedestrian bridge offers the shortest and most direct connection between the riverbank and Muttart areas and the Mill Creek Ravine trail network.

A stormwater management facility is currently conceptually located at the northern tip of Mill Creek Ravine Park, in an area where two SUPs and a granular pathway converge, linking the Mill Creek Ravine pathway system to the Connors Road pedestrian bridge, and to pathways that run north towards the Low Level Bridge. Construction in this area could result in significant disruptions to pathway connectivity, and the relatively constricted space between the toe of the ravine slopes and the embankments of Scona Road may not provide sufficient space to allow for detours through this area. The ravine slopes and surrounding arterial roads make the northern tip of Mill Creek Ravine Park a pinch point in the river valley pathway system, and the loss of connectivity through the proposed dry pond site could significantly hinder connectivity between south central neighbourhoods and the city centre. Impacts of construction on trails in this area are thus considered adverse, major, short- to long-term and uncertain, with the uncertainty stemming from the fact that the dry pond location has not been finalized.

Impacts are summarized in Table 6.4.

Operations

There will be no long term losses in the SUP network associated with the project; that is, all SUPs that are closed for construction will be reopened when construction is complete. It is not known whether all granular pathways will be re-established following construction. A new SUP will be built along Connors Road in association with the LRT. The existing sidewalk is a shared-use sidewalk, that is, cycling is permitted. However, as the new pathway will be wider, it will be better able to accommodate multiple uses. Impacts of the operations phase on SUPs are thus positive to adverse, major, permanent and uncertain. The uncertain rating relates to the uncertainty regarding the replacement of unpaved pathways. If they are restored following constructions, impacts of the operations phase will be considered positive.

Table 6.4. Predicted Pathway Impacts by Area/Amenity

Area/Pathway	Predicted extent/duration/alignment of detours
North Bank	Limited space in the valley will likely require pathway users to climb out of valley, re-entering valley to the west of project area. Construction period may be long in this area due to complexity of bridge/portal structures.
Cloverdale pedestrian bridge	Construction will likely necessitate a lengthy closure period and substantial detours, significantly disrupting connectivity during construction period.
South bank	Detours expected to use routes along 98th Avenue for east-west connections; alternate SUPs may form the basis of north-south detours. Disruptions expected to be less substantial than on north bank.
Connors Road pedestrian bridge and Mill Creek Ravine	Alternate SUP route to Mill Creek through study area should be feasible with some adjustments to the existing network. Closures expected to be shorter than in other areas. Detours may be long if routes along existing pathways are used.
World Walk	LRT D and C and Community Services will investigate alternate fully accessible routes; no route has been confirmed.

Mitigation Measures and Residual Impact

The following mitigation recommendations apply to all pathways affected by the project, including those affected temporarily and permanently by the proposed dry pond. LRT D and C will require the P3 contractor to prepare an SUP/Pathway closure and detour plan that minimizes SUP unavailability, establishes a closure threshold and provides adequate detours. The plan will recognize the vital importance of these trails to Edmontonians and the need to find suitable alternatives and be responsive to site specific conditions. At a minimum the plan will:

- include clear and consistent wayfinding signs to facilitate navigation along unfamiliar detours,
- demonstrate that detours are as short/direct as possible, and minimize deviation from existing routes,
- be part of a larger public communications plan, whereby stakeholder groups (including trail users such as the Edmonton Bicycle Commuters Society and running clubs) will be notified of upcoming closures and detours.

The communications plan will for example, involve notification of River Valley Operations, communication with Park Rangers and notification on the City's website for Trail/Park Cautions and Closures.

During the P3 procurement phase, LRT D and C will develop performance measures to evaluate these submissions.

In addition, LRT D and C commits to finding an alternate 'fully-accessible route' into Louise McKinney Park and will collaborate on this with Community Services.

Minimizing the duration of closures and the length of detours, along with providing clear, proactive communication with stakeholders will do much to reduce the impact of pathway closures. That said, due to the number of closures, the closure of a river crossing and the long duration of the construction period, the effects of closures cannot be fully mitigated. Residual impacts are rated as adverse, major, short- to long-term and uncertain. The confidence rating relates to the uncertainty surrounding the duration of closures and the extent to which detours will inconvenience pathway users.

6.2.3.2 Closure of Other Recreational Infrastructure

Impact

Much of the recreational infrastructure in the study area (i.e. outside of the project area) can remain open during construction, including: the boat dock, Oval Lawn, Shumka Stage/Millennium Plaza, Riverfront Plaza and Promenade at Louise McKinney Park, the west portion of the World Walk, and access to Rafter's Landing and the Edmonton Queen Riverboat on the south bank. However, some infrastructure within the project area will be affected, including: a picnic shelter in HME Park, and, in Louise McKinney Park- some custom designed seating nodes, light standards and the Trans Canada Trail pavilion.

Community Services has indicated that the HME park picnic site can be demolished and that a compensation value will be determined. In Louise McKinney Park, all infrastructure temporarily removed for construction will be reinstalled in similar locations and in consultation with Community Services. Considering that the impact on LMP infrastructure is very local, affects only a few structures and will be replaced/reinstalled, impacts to recreational infrastructure are rated as negligible.

Mitigation and Residual Impact

No mitigation measures are required, and no residual impacts are expected.

6.2.3.3 Disruption of River Navigation (Small and Large Watercraft)

Impact

Construction

The federal *Navigable Waters Protection Act* mandates that navigability along the North Saskatchewan River be maintained at all times, and the proponent will be expected to comply with all federal requirements, as set out in federal permits. It is anticipated that Transport Canada will require that the river remain open at all times during demolition and construction, with the possible exception of short-term restrictions during overhead work. Nonetheless, instream bridge demolition and construction have the potential to temporarily disrupt recreational boating in two ways. First, there may be a negative impact on boating experience. Boaters in small crafts and City boat programmers might be generally disinclined to cross an active construction area both out of concern for their safety, and because the aesthetics of the river will be compromised during bridge demolition and construction. However, construction will affect only a very short stretch of the river, and boaters will have the option to use other parts of the NSR within the City. Riverboat tours, small and large water craft tours might be seen as less appealing when they occur in such close proximity to an active construction zone. Thus, while construction is not expected to preclude the operation of the riverboat, it could affect the operation's commercial viability. On the other hand, some customers might find the view to add interest. During the construction phase of the projects, impacts are rated as adverse, minor, periodic, but long-term owing to the four years of construction, and predictable.

Second, as permitted by Transport Canada, river access through the project area may be restricted for short periods (i.e., periods of several hours) when overhead work associated with the bridge superstructure is occurring, as a safety measure. This might affect unscheduled and programmed small crafts and may create conflict with the Edmonton Queen Riverboat's routine schedule, affecting their commerce.

Access to the river via Rafter's Landing is not expected to be affected by the project. Nor is the project expected to affect river access to the public dock at Louise McKinney.

Operations

Bridge designs have considered navigability needs of the Edmonton Queen Riverboat, the design vessel, and the new river bridge will provide a navigation window that is equal to or greater than that provided by the existing bridge. LRT D and C will insist that all proposed design innovations comply with this requirement, and Transport Canada will review the final plans and ensure that this is the case. Thus, the operations phase of the project will have negligible impacts on navigation.

Mitigation Measures and Residual Impact

Avoidance of major impacts to recreational boaters will be ensured through the permitting process required under the *Navigable Waters Protection Act*.

LRT D and C will require the P3 contractor to prepare a "navigable waters" plan to submit to the City and Transport Canada for permitting purposes. In addition to the information required for federal permitting, the City will request the plan to consider the following:

- Consideration of the Edmonton Queen riverboat when scheduling river closures;
- Consultation with Riverboat Inc., the operator of the Edmonton Queen Riverboat and all City recreational boating programmers (through Community Services); and
- Restriction of temporary closures to the winter season whenever possible.

In addition, LRT D and C will provide basic construction information and statistics to Riverboat Inc. to enable them to inform passengers about what they are seeing, such that the boat operators may capitalize on potential to create a feature of interest. Residual impacts are rated as adverse, minor, long-term and uncertain.

6.2.3.4 Disruptions to Special Events

Impact

Two major summer events take place within the project area: the Edmonton Dragon Boat Festival, which is held in the river and at Louise McKinney Park, and the Edmonton Folk Music Festival, held in Gallagher Park.

Construction

During construction, noise, pathway closures and detours, road closures and detours will impact both festivals, and for the Dragon Boat Festival, potential secondary access routes through Louise McKinney Park and in-stream works may also affect event activities.

The Folk Music Festival (EFMF) is a marquee event in Edmonton's summer festival schedule and an international attraction, drawing over 50,000 attendees each year. Considering the logistic and site requirements of the EFMF, including access, sightlines and acoustic environment, and the size of event, relocating the Festival during the construction period is not feasible. Similarly, holding the Festival in close proximity to an active construction zone would make the Festival non-viable due to noise, dust, access issues and other construction-related side effects. Impacts of the project on the Edmonton Folk Music Festival are thus rated as adverse, major, long-term (owing to potential to affect in more than one year), and predictable.

Dragon Boat Festival dates, always mid-August, are set into 2019 and annual festival agreements are in place with Community Services. The presence of river works and the absence of the Cloverdale bridge may preclude holding the feature event (the boat race) at this location, or may require shifting it upstream a short distance (if river hydraulics allow for this). The boat race launch and parking area are outside of the project area and would remain available. The other land-based festival components could still be supported; however, the adjacent construction area may affect user experience. In 2012, the Edmonton Dragon Boat Festival was held in an alternate location due to river conditions, indicating that this event can be relocated if necessary. On the other hand, depending on the alternate location chosen, relocation may negatively affect participation and/or attendance rates. Impacts of the project on the Dragon Boat Festival and EDBF Association are thus considered to be adverse, minor, long-term (owing to potential to affect in more than one year), and uncertain, with the uncertainty related to the effects that relocation would have on Festival success, or on the quality of experience should they choose not to relocate. The smaller festival size and the ability to relocate moderates the impact severity major to minor.

Operations

During the operations phase of the project, the Muttart Stop will comprise a new, quieter, more environmentally friendly transit mode for river valley festival and should provide easier access from more distant parts of the City. Neighbourhood parking is extremely limited during the EFMF, and access to the site on foot, bicycle or public transit is encouraged. Currently, a Park ‘n’ Ride service to the site is offered. The addition of the Muttart Stop in proximity to the Festival site might simplify Festival access for many attendees, and could reduce the volume of Park ‘n’ Ride buses and vehicles moving around Strathearn and Cloverdale, in proximity to residences. A secondary, adverse, impact during the operations phase may be a slight, permanent reduction in the area of the Festival grounds, as the top of the slope north of Connors Road will need to accommodate the LRT corridor. This effect would be greater if the north alignment option is selected for Connors Road. Considering the size of the Festival, this has potential to result in some crowding in concert viewing areas. That notwithstanding, the overall impact of the operations phase of the project on the EFMF is considered to be positive minor, permanent and predictable. The greater accessibility to the EDBF is also considered to be a positive, permanent, operational effect.

Should the City be successful in its bid to host the major, biannual event at Louise McKinney Park, LRT construction occurring within the project area may adversely affect the quality/atmosphere of the event. This potential future impact cannot be characterized at this time but is flagged as an issue requiring attention.

Mitigation and Residual Impact

The City has already made a commitment in writing to limit or cease construction activities for the duration of the Folk Music Festival (including the time required for set-up and take-down), and to coordinate with Festival organizers regarding timing and space needs (E. Elliott, *pers. comm.*). This represents a very effective mitigation measure but is not expected to eliminate the influence of construction on the Festival. For instance, closure of and construction along Connors Road might render the north gate inaccessible for one or more Festivals. It will be critical to keep the intersection of Connors Road and Cloverdale Hill accessible for the duration of the Festival and set-up/take-down periods. LRT D and C will communicate with Festival organizers to determine what measures will be needed for the Festival to continue throughout the construction period, and will incorporate the Festival’s requirements into procurement documents as contractual obligations. Considering the scale and duration of construction, some perturbation of the

Festival's normal functioning is inevitable; however, if the City can accommodate the needs of the EFMF in a way that is satisfactory to Festival organizers, residual impacts of construction on the Festival will be adverse, minor, long-term (but infrequent) and uncertain.

No agreement in principle or writing is known to exist with the Dragon Boat Festival Association, although consultations are under way; thus, residual impacts to this event remain adverse, minor, long-term (but infrequent) and uncertain. LRT D and C will consider the approach of negotiating a suspension of construction activities in this area for the duration of the four-day festival.
LRT D and C will consult with relevant City departments regarding the fate of the major festival under consideration and endeavor to resolve conflicts. A mitigation approach, if required, will be determined during the P3 Procurement phase.

6.2.3.5 Relocation of Socially-Important Amenities

Impact

The project area intersects with several amenities that have significant value to community groups or other stakeholders, including commemorative objects and volunteer gardens (Table 6.5). These will be discussed separately.

Table 6.5. Socially-Important Amenities Within the Project Area

Name	Location
Donor trees	Louise McKinney Park
Donor benches	Louise McKinney Park
Wishing tree	Louise McKinney Park
Trans Canada Trail Pavilion	Louise McKinney Park
Volunteer Garden Beds	
Centennial Garden	HME Park
Perennial Bed	Muttart Conservatory
"Plant-a-Row, Grow-a-Row" Bed	Muttart Conservatory

Commemorative Objects and Wishing Tree

Donor trees, benches, and the Trans Canada Pathway Pavilion are located within the project area in Louise McKinney Park. The "wishing tree" is also believed to be within the project area. Donor benches and trees are managed through the City's Legacy Program, which allows people to honour the memory of family member or friends, create living legacies, or celebrate particular events or accomplishments. Thus, donor benches and trees have significant sentimental value to participants of the Legacy Program.

Gardens

A small sliver of the northeast portion of the Chinese Garden, also located in Louise McKinney Park, overlaps with the project area. This area is occupied by soft landscaping elements (trees, shrubs and flowers). None of the garden's structures, such as the bridge and gazebo, are within the project area. The World Walk rose garden, by contrast, is fully within the project area and is expected to be removed during construction.

The Centennial Garden in HME Park conflicts with the proposed alignment and will require permanent relocation to a new site. Some of the existing Muttart Conservatory garden beds, including some volunteer beds are also within the project area. These include:

- The Edmonton Horticultural Society Perennial Bed,
- The Edmonton Food Bank “Plant-a-Row, Grow-a-Row” vegetable plot, maintained by the Yellowhead Youth Centre,
- The All-American Display Garden,
- Three unnamed beds featuring an assortment of flowers, grasses, shrubs and trees.

Volunteer gardeners take personal pride in their gardens, and the “Plant-a-Row, Grow-a-Row” garden provides fresh produce to the Edmonton Food Bank, which distributes the produce to people in need within Edmonton. Considering the social and sentimental value placed on the above-mentioned amenities, impacts to these amenities are rated as adverse, major, long-term and predictable. As part of project planning, LRT D and C has committed to either finding new permanent locations for these beds, or curating them and then reinstalling in or near the original location. For this reason the potential impact is rated as long-term, not permanent.

Mitigation and Residual Impacts

Locations of donor benches and trees, as well as the “wishing tree” will be verified by the City prior to contract award, and relocations handled by the City using standard City policies and procedures and in consultation with Community Services. The Trans Canada Trail Pavilion will be removed for the duration of construction, but is expected to be replaced after construction is completed. Residual impacts to these amenities are thus rated as adverse, minor, short- to long-term, and predictable.

LRT will require the contractor to adhere to the following:

- The contractor must attempt to avoid direct impacts to the Chinese Garden by adjusting the boundaries of the project area to exclude the garden completely. The garden is expected to be expanded at the far southeast end, where it meets the World Walk beds. The LRT project must not disturb any permanent garden structures installed in this area, and LRT D and C will consult City Parks regarding future plans for the garden prior to the onset of construction in this area.
- The World Walk garden will either be restored at its current site following construction, or relocated to a new, permanent site.

LRT D and C will find a new location for the Centennial Garden. The George F. Hustler Memorial Plaza, located approximately 200 m to the east of the garden’s current location, is being considered; however, no relocation site has yet been confirmed. The relocation of the Centennial Garden in particular might not be viewed favourably by stakeholders, particularly if it is relocated to a site that is considered to be less attractive, less accessible or less visible. The volunteer planting beds at the Muttart Conservatory will be reinstated following construction. As with any garden, it will take a few years to establish mature plant material, depending on the growth rates of individual species. However, the project will not permanently preclude horticultural activities for affected community groups, nor will valued gardens be permanently removed from the landscape. Over time, residual impacts will be reduced to negligible.

6.2.3.6 Impacts to the Muttart Conservatory and Edmonton Ski Club

Impact

Muttart Conservatory - Construction

This discussion will focus only on the impacts of the project on the indoor activities of the Muttart Conservatory, as impacts to the grounds have been addressed in the previous section. The facilities' greenhouses are located outside of the project area, and are not expected to be impacted by the project. Similarly, the public parking lot is located outside of the project area, and is accessed via 96A Street, which is expected to remain open for the duration of construction. Thus, the construction phase of the project is not expected to impact visitor access to or experience of the Conservatory's indoor facilities.

Work on the Muttart Stop and the Muttart access road will affect access to the rear entrance of Muttart. Provision of an alternative and equally functional access arrangement is an operational requirement for the Muttart. In addition, the Conservatory will lose the use of its storage building while the existing shed is demolished and a new shed constructed, and will need to make arrangements for an alternate storage space in the interim period. Unmitigated, impacts of the construction phase of the project on facility access and operations is thus considered to be adverse, minor, short-term and predictable, but with negligible impacts on visitor experience.

Muttart Conservatory - Operations

The addition of LRT infrastructure west of the conservatory will necessitate slight permanent changes to rear building entrance access routes, as shown by line work on Figure 2.1. This is a negligible impact. During the operations phase of the project, public access to the facility will be enhanced via the presence of the Muttart Stop in close proximity to the Conservatory. This will greatly improve transit access to the Conservatory, with trains passing through the stop at intervals of 5-15 minutes, seven days a week. As such, the operations phase of the project will have a positive, minor, permanent and predicable impact on the Muttart Conservatory.

Edmonton Ski Club- Construction

The project area, as currently defined, overlaps with the upper slopes of the Edmonton Ski Club, and three of the Club's five lifts have termini that fall within the project area. Depending on the realignment of Connors Road, up to three towers may be impacted and relocated. As with the Muttart Conservatory, the parking lot of the Edmonton Ski Club is accessed via 96A Street; thus, access to the Club is not expected to be affected by construction. However, noise and dust, associated with construction along Connors Road may negatively affect user experience, considering the close proximity of the ski runs to the project area.

Overall, impacts of project construction on the Edmonton Ski Club are thus rated as adverse, minor to major, permanent and uncertain. The uncertainty is related to the as yet undetermined number of towers to be affected and the area of land to be affected temporarily during construction.

Edmonton Ski Club- Operation

If the northernmost alignment for Connors Road is selected, the land take associated with the project is the most significant and may necessitate run realignment and have potential to shorten some of the Club's runs. The Club's runs are already relatively short for some downhill purposes, such that shortening them has potential to affect the quality of users' experience. This potential impact is rated as adverse, major, permanent but uncertain. Without knowing the amount of land required for the project and without evaluating the potential new tower locations, the impact remains rated as uncertain.

During the operations phase, the Muttart Stop may provide improved access for some Ski Club users, a positive, minor, permanent impact. It is rated as minor, because owing to the need to carry large equipment, the young age of many users, and the distance (approximately 340 m) to the club entrance, this may not be a popular form of transit to the ski club.

Overall, impacts of operations phase of the project to the Edmonton Ski Club are thus rated as adverse, minor to major, permanent and uncertain. The uncertainty is related to the as yet undetermined alignment along Connors Road. .

Mitigation Measures and Residual Impact

Muttart Conservatory

LRT D and C will ensure that the P3 Contractor provides for alternative and equally functional access at all times, to ensure continuous Muttart operations at all time. In addition, LRT D and C will work with the conservatory to find temporary alternate storage space, as needed, and should make an effort to minimize the time during which the storage building is not available. However, the loss of the storage building and temporary alternate access cannot be fully mitigated as some inconvenience will accrue; thus, residual impacts remain adverse, minor, short-term and predictable. The replacement storage building will be of similar size and will provide for similar use as noted in Section 2.3.6.

Edmonton Ski Club

Upon finalization of the Connors Road alignment, LRT D&C will compensate the Ski Club appropriately for any impacts that may occur as a result of construction along Connors Road and will replace the affected towers with towers of equal value and ensure that any lands affected temporarily by construction will be reclaimed. If reforestation/restoration efforts are undertaken for impacts north of Connors Road and on ski club lands, LRT D and C will consult with the ski club to reduce conflicts between lift/run adjustments and reforestation efforts. In addition, LRT D and C will require the P3 contractor to demonstrate the necessity of any encroachment on the Ski Club lands for construction and staging, and to demonstrate that all possible alternatives have been explored. These measures will reduce the impacts of the project on the Ski Club, residual impacts of construction are expected to be adverse, minor, short- to long-term and uncertain.

Impacts of operation will be mitigated by LRT D and C ensuring that any required run realignments are strategically designed to fully provide for existing ski club capabilities. The residual impact is rated as negligible as LRT D and C's intent is to fully mitigate this impact, however, the ability to do this is uncertain in the absence of known land take and a detailed run evaluation. The residual impact on operations from improved access is rated as a positive, minor one.

6.2.3.7 Impacts to User Experience

Impact

While parkland outside of the construction area is expected to remain accessible during the construction period, the indirect impacts of construction, including dust, noise and vibration, and reduced appeal of areas near the construction zone, will likely reduce the quality of park users' experience. Areas such as the Oval Lawn, Riverfront Promenade, and Muttart Conservatory grounds are likely to lose much of their appeal while construction is ongoing. Access to some park areas will also be impeded. The nearby construction therefore has potential to affect the agreements in place between Community Services and small festival groups that use Louise McKinney Park. This situation would be exacerbated in Louise McKinney Park if construction areas are accessed from the west, across the width of the park. Groups hosting small and large events may wish to relocate their events during the construction phase of the project. At present, Louise McKinney Park is conceived as a secondary access route only. Should it ever become a primary route, the impact on park users would be more severe. This impact is considered to be adverse, minor to major, short- to long-term, and predictable. The unpredictability is related to the uncertainty around the final secondary access route and uses of that route.

During the operations phase, the new LRT/pedestrian bridge will affect user experience and movement, as it is a significantly different bridge structure than the existing footbridge. The wider pedestrian walkways and better viewing areas will likely improve user experience. Though the bridge structure may be more aesthetically pleasing to some, the location of the pedestrian walkway underneath the LRT guideway will provide a different experience and create a more enclosed and less desirable pedestrian experience. Impacts of the operations phase of the project on user experience are thus adverse or positive, minor, permanent and predictable.

Mitigation Measures and Residual Impact

Measures recommended in Section 6.2.2 (Residential Land Use) will also serve to improve the quality of user experience during the construction phase. In addition, LRT D and C will maintain a construction website that informs park users of upcoming construction activities, to allow them to adjust park destinations they wish and will provide supporting information to Community Services as they contend with impacts to park users. That said, construction will necessarily have a negative impact on the aesthetic and acoustic environment in the study area, and residual impacts remain adverse, minor to major, short- to long-term and predictable.

6.2.3.8 Impacts to Public Parking

Impact

Construction will necessitate the closure of the relatively small public parking lot at HME park. The duration of closure is not known. Parking lots at the Muttart Conservatory, Edmonton Queen Riverboat, Edmonton Ski Club and Louise McKinney Park are all outside of the project area and at this time are, therefore, not anticipated to be affected by the project. An alternative parking lot is available to the public slightly west of the HME parking lot, beside the Edmonton Queen Riverboat parking area. This should provide sufficient replacement public parking for the duration of construction. The parking lot in HME Park will reopen following construction. Impacts of the project on public parking are thus considered negligible. As has been done historically, requests for construction use of parking lots outside of the project area will be handled as they arise.

Mitigation Measures and Residual Impact

LRT D and C will require the P3 contractor to provide signage advising park users of closures and alternative parking areas. No residual effects are expected.

6.2.3.9 Loss of Green Space

Impact

The addition of the LRT into established parkland areas will necessitate the permanent conversion of a small amount of parkland to transportation infrastructure; however, given the relatively small footprint of permanent infrastructure, and the efforts made to parallel and/or replace existing infrastructure, this impact is considered negligible.

Mitigation Measures and Residual Impact

No mitigation measures are needed, and no residual impacts are expected.

6.2.3.10 Permanent Realignment of Shared-Use Pathways

Impact

The addition of LRT infrastructure will necessitate minor pathway realignments in the project area. From north to south, potential realignments include:

- The SUP that runs from Grierson Hill to the Cloverdale pedestrian bridge may require realignment based on the space requirements of the portal.
- Minor adjustments of pathway alignments may be required on both riverbanks following the replacement of the existing Cloverdale pedestrian bridge with the new river bridge.
- The connection between the river bridge and the 98th Avenue overpass might require realignment based on the position of guideway piers and post-construction landscaping plans.
- The SUP that currently runs along the west side of the Conservatory will require shifting, as it conflicts with the LRT alignment. If the SUP through the Muttart Conservatory grounds crosses the tracks, a safe crossing point will need to be established.
- A redundant section of pathway between the current and future north abutments of the Connors Road pedestrian bridge will be abandoned.
- As currently conceived, the current location and positioning of the Mill Creek dry pond will require the realignment of two SUPs and a granular pathway.

In general, realignments are expected to be minor and will not substantially alter the layout of the pathway network. Detailed plans for realignments are not available at this time; however, it is expected that some portions of some pathways may become somewhat longer, others might be shortened slightly. In light of this, the impacts of pathway realignments are rated as neutral, minor and permanent.

Mitigation Measures and Residual Impact

No mitigation measures are necessary, as predicted impacts are neutral.

6.2.3.11 Increased Transit Access to the River Valley

Impact

The LRT stop at the Muttart Conservatory will provide convenient access to recreational activities and facilities in the immediate area, as well as providing strong pedestrian connections to other recreational amenities and facilities connected by the river valley's extensive pathway network. If bicycles are allowed on the LRT during non-peak hours, as is the policy on existing LRT lines, the Muttart Stop will act as an access point for cyclists wishing to use the river valley pathway network, thus facilitating access to the pathway network for cyclists who do not live in proximity to the river valley. Bicycle parking will be provided at the Stop. Large events, such as the Folk Music Festival will greatly benefit from the public transportation service improvements that the LRT will provide. As such, the addition of an LRT stop in the river valley is expected to have a positive, major, permanent and predictable impact on river valley recreation.

Mitigation Measures and Residual Impact

No mitigation measures are necessary as the impact is positive.

6.2.3.12 Overarching Recreation Mitigation Measure

Considering all of the potential for indirect and direct adverse impacts to recreational land use, in the study area, LRT D and C will require the P3 Contractor to provide a comprehensive Communications Plan to the City, for the purpose of informing citizens and specific stakeholder groups, in a timely way of anticipated facility disruptions, detours to be provided, anticipated construction activities schedule etc. Note that some events are scheduled years in advance.

6.2.4 *Visual Resources*

6.2.4.1 Visual Impact Overview

Considering the linear span of the project, the elevated project components, valley topography, the excellent topographic vantage points framing the project area, and the proximity and direct sightlines of several residences, impacts of the project to existing visual resources could be significant. The high potential for adverse impacts to visual resources was recognized at the outset of the preliminary design exercise and this is reflected in a Reference Design package that includes site-specific conceptual landscaping and aesthetic considerations and an arguably elegant bridge structure, among other measures. Nevertheless, potential to adversely affect existing viewscapes remains, both during construction and operation phases, particularly from certain locations. Construction will give rise to temporary visual impacts on a relatively large scale. Operations impacts centre on the introduction of permanent new infrastructure in the river valley. The following sections separately address the potential impacts examined for these two project phases. For the purposes of this discussion, site preparation and landscaping are included in the construction phase.

6.2.4.2 Construction

Impact

As with all large-scale construction projects, the aesthetics of the project area will be adversely affected during construction as the required activities are not compatible with the project setting. Cleared and stripped areas, heavy equipment and active construction are expected to be visible for the duration of the construction period. In the absence of information about construction methods or staging we assume that these activities will be often simultaneously evident throughout the project area and for a period of four years. This would translate into disturbance of approximately 12 ha of river valley parkland. This scenario represents the worst case.

Based on available vantage points and estimated sightlines, construction has potential to strongly affect the quality of views from the following locations:

- Localities within surrounding residential neighbourhoods (Bonnie Doon, Strathearn, the Quarters, Cloverdale),
- The top of Connors Road, 98th Avenue and Cloverdale Road,
- Scona Road,
- Localities within the parks in the study area,
- Parks outside the study area that offer distant views to the project area, including Forest Heights Park and Riverdale Park,
- Downtown, including east Jasper Avenue, the Shaw Conference Centre and high-rises that overlook the valley.

Site fencing is assumed to be required at all active construction areas, as a safety measure and to protect against vandalism. This may help with local screening, but as a result of river valley topography, local screening will do little to ameliorate more distant, landscape views. Following construction, portions of the project area not permanently occupied by LRT infrastructure will be re-vegetated. Areas of cleared vegetation will be restored (in the case of naturally-forested areas), naturalized (in the case of the north river valley) or landscaped (in the case of areas below Connors Road). Both restoration and landscaping are expected to improve the visual quality of the area, with visual impacts lessening over time. However, as with any soft landscaping efforts, the visual impact will linger until vegetation matures. Visual impacts of construction are thus expected to persist into the early stages of the operations phase. The impacts of the construction phase on visual resources in and around the project area are rated as adverse, major, long-term and predictable.

Mitigation Measures and Residual Impacts

During construction, some visual impacts could be mitigated through seeking to maximize visual screening at construction sites close to residents and park users. Once construction is complete, visual impacts of construction could be eliminated, over time, through careful and site-specific reclamation and landscaping efforts that respect and reflect the natural and developed parkland aesthetics of the river valley. At this time, landscaping design is not sufficiently advanced to describe in detail how mitigation will be achieved, but additional design is expected to occur throughout the remainder of 2013. After that, final landscaping design will be carried out by the P3 contractor. The City recognizes the importance of high quality and locally-appropriate landscaping, and the procurement documents will specify design objectives and standards that final landscaping design must achieve. The City will also establish means of evaluating proposed deviations from the Reference Design.

These efforts will, in time, bring back the previous ‘green’ river valley. If appropriately implemented, monitored and remediated when monitoring indicates that remedial efforts are warranted, visual impacts are anticipated to fully mitigate the construction impact. The duration of residual impacts will, however, be variable. Some areas, such as those to be reclaimed to ornamental gardens will recover in two to five years following reclamation initiation; other areas, particularly those to be restored to forest, will require many years to fully erase the visual effects of construction activities. Therefore, the scale of long-term visual impacts would also be mitigated by any attempt to minimize the overall area of disturbance.

The following three objectives will serve to reduce visual impacts during the construction period:

- Use of screening in key locations close to residences and high use areas,
- Minimization of the duration of construction in any given area,
- Minimization of the construction footprint.

These objectives should be considered in the development of procurement documents, and the Contractor should be required to provide a technical plan that demonstrates how construction staging and reclamation staging will achieve a minimum footprint and an abbreviated period of disturbance. Examples of measures that could be included in such a plan are:

- Delay clearing until just prior to the onset of construction in any given area; avoid clearing the entire project area at the beginning of the construction period.
- Use existing infrastructure such as parking lots and roads for construction staging only in consultation with Community Services and as approved by the City.
- Access the north valley area via Cameron Road rather than taking the longer, more visible route across Louise McKinney Park from the west.
- Use the picnic area in HME Park for staging rather than clearing forest. Community Services has indicated that demolition of the picnic structure is acceptable.
- When clearing forest, create soft, undulating edges instead of hard, straight edges. This will also reduce visual impacts during the period when restoration and landscaping plantings are maturing.

While the above measures will reduce the visual impacts associated with construction and eventually eliminate them, the impacts of LRT construction on the visual resources in the study area, considering the nature of the impact, even with mitigation applied, the impact remains rated as adverse, major, long-term and predictable.

6.2.4.3 Operations

Mitigation of effects associated with the permanent presence of significant new infrastructure in the river valley has been a key design element throughout preliminary design. Efforts began with establishing sustainable urban integration design guidelines for the project and culminated with specific recommendations regarding infrastructure form, integrative landscaping, and aesthetic treatments of the elevated bridge and guideway, retaining walls and amenities such as park furnishings, to achieve compatible and aesthetically pleasing designs. The City is in the process of developing review procedures that will assign a “pass” or “fail” rating for bidder design submissions. This will allow the City to exert quality control as design is advanced by bidding contractors, and to ensure that the established aesthetic objectives are achieved.

Ultimately, the degree to which the completed LRT project detracts from or enhances the visual environment in the river valley will depend in part on design details, such as architectural themes and finishes, and landscaping design. Vegetation can be incorporated into landscaping to provide natural-looking screening of structures that are likely to be visually unappealing or intrusive. This can be effective at both the local and landscape scales. This and other measures would serve to mitigate impacts by softening the visual character of structures and integrating them into the surrounding landscape. Because of the preliminary nature of these intended built-in mitigations, this assessment can be no more specific about their implementation. Therefore, these measures are considered as built-in mitigation measures that must be further developed.

Changes to the visual environment will be exerted at two scales, landscape (long-distance) and local (short-distance). Viewscape changes from select long-distance views include those from the top-of-bank at 98th Avenue, Connors Road and Louise McKinney Park. Local (short-distance) views are those from within the study area. The introduction of new infrastructure in relatively close proximity to homes or park users affects short-distance views, even with pleasing architecture, simply by blocking longer views or replacing natural features. Figure 5.9 indicates areas identified as having the highest potential to be affected by altered views. The following sections discuss the anticipated changes to long-distance and short-distance views that are assumed to be realized by the presence of new infrastructure.

Long-distance Views

Impact

The portal structure, river bridge, elevated guideway, at-grade tracks, and Connors Road retaining walls are all expected to be visible from distant views, including areas along the top-of-bank at Connors Road, 98th Avenue, as well as areas in the Strathearn, Bonnie Doon, Quarters, and Downtown neighbourhoods where sightlines allow.

The new river bridge will become a strong architectural element that frames views of the downtown skyline when viewed from downstream, changing the character of some of Edmonton's most well-known and iconic views (Plates 5.41 and 5.42). The addition of trackway along Connors Road will widen the existing transportation corridor, thus increasing its visual presence. Retaining walls south of Connors Road will change the visual character of the south valley wall, as natural forest will be replaced with non-natural walls that could be up to 8 m tall in some areas. The retaining walls are not expected to be visible to the residents along the top-of-bank in Bonnie Doon; however, viewscapes from these residences may be altered by the removal of trees along the south valley wall, possibly resulting in more open views of the river valley. Whether this is a negative or positive change is very much a question of subjective perception: some residents may enjoy the more open view, while others might prefer the more sheltered views offered by the existing forested slopes. Similarly, some structures, such as the river bridge, are likely to be viewed as a positive change by some stakeholders, and an adverse change by others. Other structures, such as the portal and retaining walls, are expected to be viewed by most as a negative change to the landscape. Overall, changes to long-distance views are considered to be adverse or positive, major, permanent and predictable.

Plate 5.41. Current view from 98th Avenue/Strathearn

Plate 5.42. Future view from 98th Avenue/Strathearn

Mitigation Measures and Residual Impact

Work continues on mitigation measures to soften the impact of the project on long-distance views. For example, the City is experimenting with green tracks (grassed rail corridors) for use along Connors Road. Landscaping, architectural design and finishes that respect and complement the existing river valley aesthetic will reduce the visual impact of the new, large structures. Hard and soft landscaping elements can serve to soften the transition between structures and their parkland surroundings, thus integrating the structures as visual elements within a landscape, rather than visual intrusions imposed upon the landscape. The perceived intrusiveness of structures will likely diminish over time, as ornamental and natural vegetation matures, and as stakeholders become accustomed to the presence of the new structures. While mitigation measures can reduce the degree to which changes to the landscape are viewed as negative, there will be a permanent impact on long-distance views. Residual impacts to long-distance views are therefore rated as adverse or positive (depending on opinion), major to minor (again, subjective), permanent, and predictable.

Views from Louise McKinney Park and the River

Impact

The portal will comprise a large structure in a portion of the north valley wall that is currently characterised by relatively natural valley slopes. The portal access road will necessitate a widening of the existing pathway between Louise McKinney Park and Cameron Road, as well as the addition of new roadway on the upper valley slopes near the portal structure. The upper deck of the river bridge will pass over the eastern portion of the park as an elevated structure, which is currently open to the sky (Plates 5.43 and 5.44). These additions will be highly visible elements that will change the visual character of that locality for park users. The presence of the bridge deck will impact the visual experience of SUP users, as they will be required to enter the space under the bridge as they travel through the area or access the pedestrian bridge. Some park users might find the change to be intrusive to their experience of the valley, while others might not find it bothersome.

Plate 5.43. Current view looking west past the trailhead to the Cloverdale pedestrian bridge

Plate 5.44. Future view looking west past the trailhead to the Cloverdale pedestrian bridge

Although a pedestrian bridge currently exists in the same location and alignment as the proposed bridge, the size and mass of the new structure will be considerably increased. In addition, the materials – currently proposed as concrete with steel cables – may be perceived as less compatible with the natural environment than is the wood and corten steel bridge now in place. In short, the proposed extradosed river bridge will result in a new aesthetic in the river valley. Whether the change is negative or positive is very much a subjective judgment, and opinions on the aesthetics of the new bridge will vary; some may view the new bridge as being too large or too modern for the parkland surroundings, while others may find the modern design of the bridge to be an aesthetically pleasing addition, particularly when viewed against the downtown skyline. Current and projected future views of the bridge from the north end of Louise McKinney Park are provided in Plates 5.45 and 5.46.

Plate 5.45. Current view from the top-of-bank above Louise McKinney Park

Plate 5.46. Future view from the top-of-bank at Louise McKinney Park

The visual experience *from* the pedestrian bridge will be somewhat altered once the LRT is constructed. The existing bridge is open to the sky. On the new bridge, pedestrians will be located under a solid structure, potentially resulting in a more “enclosed” feel than the current bridge offers. Views outwards will be relatively unaltered, though they will be framed slightly differently based on changes in bridge piers and railings. Overall, impacts of the river bridge and portal structure on the visual environment at Louise McKinney Park and the NSR are considered to be adverse or positive (depending on opinion), major, permanent and predictable.

Mitigation Measures and Residual Impacts

The visual impact of the portal and bridge over Louise McKinney Park will be partially determined by the character and quality of design details such as the finishing applied on the completed structures, including piers, the architectural character of the portal structure, and landscaping efforts, particularly around the portal structure. Landscaping and finishes will be designed in accordance with the objectives described in Section 6.2.4.1 (Visual Impacts Overview). The establishment of naturalized plantings in the vicinity of the portal to screen the structure could do much to lessen visual impacts in this area, although, as with any vegetative screening, this would likely be more effective in summer than in winter. Special effort could be made to re-vegetate the covered portion of the portal. The portal rain garden is expected to support a variety of ornamental plants; these will add colour and visual interest to the area. However, due to the sheer size of the portal and bridge structures, it is assumed that impacts can only be partially mitigated. The perception of the new river bridge as a negative change to local viewscapes is a subjective matter, and for those who view the new bridge negatively, the change cannot be mitigated. Residual impacts are thus expected to remain adverse or positive, major, permanent, and predictable.

Views from HME Park and Cloverdale

Impact

The elevated guideway across the south bank of the river will comprise a new visual element in what is currently a relatively natural landscape. Two groups of stakeholders, Cloverdale residents and park users in HME Park, will be impacted by the addition of the guideway into the landscape. Cloverdale residents living along 96A Street, particularly east-facing residents living in The Landing condominium complex, will have their views impacted by the size and mass of the guideway. The guideway may become one of the most prominent elements in views from this area, creating a visual barrier between the residential property and the picnic area and forest. Residents whose properties are lower than the guideway will have a view of the underside of the structure. The relocation of the Centennial Garden will also change the composition of the park views.

Within the park, the guideway will become the most significant architectural element on the landscape, forming a roof-like structure that both runs through and frames the park. The relatively low elevation of the structure will likely engender an enclosed sense of space. The structure itself will not impede pedestrian movement or directly impact recreational uses; however, the aesthetic feel of the space will be altered. Construction is assumed to necessitate the removal and replacement of park amenities such as the group picnic site and brick pavement. These amenities are aging and outdated, and may be replaced by new amenities following construction. Discussions with Community Services are underway. Though the design for the area is unresolved at this time, updated park amenities are expected to have an effect on park aesthetics.

Further south, views of LRT infrastructure from Cloverdale will be partially blocked by the existing 98th Avenue pedestrian overpass, as well as Muttart Conservatory buildings and landscaping, although the guideway, railroad siding and Muttart Stop may be visible to some residents in upper floors of multi-storey buildings. Views from the homes along the southern portions of 96A Street are not expected to be substantially changed by the addition of LRT infrastructure due to screening by the Muttart buildings. In general however, visual impacts of the project in this area are rated as adverse, major to minor (depending on location), permanent and predictable.

Mitigation Measures and Residual Impacts

Aesthetic finishes on the guideway and landscaping of adjacent areas will be vital to minimizing the negative visual impacts of the guideway on residents and park users. Aesthetic considerations will be given high consideration in the design of guideway infrastructure such as drain spouts and rails. Landscape design for HME Park will strive to incorporate the guideway structure into park landscaping, using it to create the sense of a gateway into the park. A cohesive park design that integrates the guideway as a visual element will reduce the visual impact of the guideway to some extent. However, due to the size of the guideway and the degree to which it alters the character of local viewscapes, and the degree to which guideway and landscaping design remain unresolved, residual impacts are considered adverse, major to minor, permanent and uncertain.

Views from the Muttart Conservatory Area

Impact

Views from within and near the Muttart Conservatory grounds will be affected by the addition of the elevated approach, retaining walls, LRT stop, railroad siding, TPSS and stormwater management facility, and the replacement and relocation of the existing Muttart storage shed. These elements will be highly visible from arterial roads north and west of the conservatory. From areas within and east of the conservatory grounds, landscaping elements, particularly mature trees, will serve to partially screen views of infrastructure.

Preliminary designs for the Muttart Stop have emphasized the importance of providing a natural look that will integrate into the parkland surroundings; however, it may still be viewed by some as an intrusion into the landscape, owing largely to its size and the presence of retaining walls. Others may view it as complementary to the landscape. Views to the southeast *from* Muttart Stop will overlook the Conservatory's working greenhouses, which serve as a work/storage area for the Conservatory and are not particularly attractive, nor well-screened from all views.

Temporary storage tracks, or siding, are required at key locations along the Valley Line-Stage 1 alignment, including the NSRV. The river valley railroad siding will be located northwest of the stop; trains stored on the siding track will thus be highly visible from the north and west, but are expected to be at least partially screened from the south and east by the Muttart buildings and landscaping, and potentially the Muttart Stop shelters.

The TPSS, storage shed and stormwater management facility are not expected to be particularly visible from Cloverdale homes or the Muttart grounds, as they will be largely if not entirely screened by the Conservatory's public and working greenhouses. This area is expected to be most visible from some roadways to the west and high points in the parkland to the south and southeast. The TPSS will be roofed, thus improving its visual quality when seen from above. While visually unobtrusive, the existing Muttart storage facility is not architecturally distinct, nor does it have a high degree of visual appeal. The storage facility will be rebuilt to the southeast of its current location, closer to the access road adjacent to the southwest wall of the greenhouse complex and thus more hidden from view. The stormwater management facility will be located near the current location of the storage yard, and is currently conceived as a rain garden. The replacement of the storage facility and yard with a garden would constitute a positive change in the visual character of the area. Changes to viewscapes in the Muttart area are therefore rated as adverse or positive, major, permanent and predictable.

Mitigation Measures and Residual Impact

Storage of trains on the siding track should be minimized. Aesthetic finishes for the TPSS have not been finalized, but coordinating the finishes of the TPSS and storage facility, and choosing finishes that respect the parkland quality of the surrounding area will help integrate the two buildings into the landscape and reduce their visual impact. Discussions are underway concerning means of providing natural and structural screening of the Conservatory's working greenhouses and yard (as part of the LRT project), to make these areas less visible from the Muttart Stop. Because design details remain unresolved, and because large structures such as the elevated approach and retaining walls will inevitably have a substantial presence on the landscape, residual visual impacts in the Muttart area remain positive to adverse, major, permanent and predictable.

Connors Road Viewshed

Impact

The Connors Road viewshed includes views along and from Connors Road. The long-distance views from the top of Connors Road are addressed above in the "Long-distance views" subsection; this section will address only views from within the Connors Road area.

The addition of tracks and associated infrastructure along Connors Road, along with the addition of large retaining walls on Connors Road, and a new, realigned pedestrian bridge will all substantially change the visual character of this area. The tracks will widen the existing right-of-way, increasing the visual presence of the Connors Road corridor. The overhead catenary system will add a vertical element to the visual impact. Retaining walls will have a considerable visual presence in the area, and will be visible from both Connors Road and from adjacent parkland areas.

The current pedestrian bridge crossing Connors Road will be replaced with a new structure, at a different angle. This will have the greatest effect on pedestrians using the pedestrian bridge and vehicles traveling on Connors Road. As with the new river bridge, opinions are likely to vary on whether the new pedestrian bridge constitutes a positive or negative change to the visual character of this part of the valley. While the new bridge will be longer, it will also be an aesthetically lighter structure, and may be viewed by many as being more visually pleasing than the existing bridge. Impacts of the project on the Connors Road viewshed are rated as positive to adverse, major, permanent and predictable. Positive impacts are related to the predicted positive response to the new pedestrian bridge by at least some stakeholders. Overall, changes to the Connors Road viewshed are considered adverse or positive, major, permanent and predictable.

Mitigation Measures and Residual Impact

The above-mentioned impacts can be mitigated by some degree by landscaping that integrates the corridor into the surrounding parkland. Green tracks would significantly reduce the visual impacts of this section of the alignment, and likely provide a feature of visual interest. The visual impacts of the Connors Road retaining walls can be lessened by the application of finishes that are aesthetically-appropriate in the context of river valley parkland. A natural-looking stone finish, for example, would be much less visually incongruous than an unfinished concrete wall. While the final choice of wall finishes will be made by the P3 contractor, landscape architects will make stipulations regarding the aesthetic qualities that wall finishes must provide; these are currently in development and will be incorporated into P3 procurement documents. This will serve to lessen, but not eliminate, the visual impact of the retaining walls. Residual impacts thus remain adverse or positive, permanent, predictable and major, owing to the long expanse and height of the proposed retaining walls. Finally, mitigation should include examination of the requirement for retaining walls associated with the northern realignment of Connors Road. If aligning LRT tracks north of the existing Connors Road would result in lower, or fewer retaining walls, it may be the recommended option from the perspective of visual impacts.

6.2.5 *Utilities*

Impact

It is apparent that some utility installation and relocation work must occur within the project area. Work within the project lands involves lands that will be subject to disturbance from other LRT related activities (such as clearing and excavation) and whose impacts are therefore captured elsewhere in this document. Importantly, this work also creates potential for some relocation of existing and new utility tie-in work to occur outside of the project area. Utility work outside of the project area work has more potential to result in unforeseen impacts than does work inside the project area. Relocation of existing utilities will be done primarily by the utility owner, prior to and sometimes during LRT construction activities. The P3 Contractor will perform the majority of new utility installation work, particularly utility servicing work. Complete utility work details are not yet fully developed, but the following information regarding potentially affected utilities is taken from the Utilities Preliminary Design Report (CTP 2013). This information provides some indication of potential for impact inside and outside of the project area.

Electrical Power

The LRT bridge structure crossing 98 Avenue has been designed to avoid impacting the EPCOR 72kV transmission power cable on the north side of the road.

An overhead power line also running on the north side of 98 Avenue will be in conflict with the future bridge structure so is to be relocated and buried. This line also supplies power to Henrietta Louise Edwards Park. This line is planned to be relocated in 2013. An existing power line at the top of Connors Road will also be lowered. The lowering will be done by pushing a new line from north of Connors Road underneath the road to reconnect on the south side. This work is also scheduled for 2013.

A new underground power line will be required to service the Muttart traction power substation. The routing of the power line and location of associated cubicles and transformers will be dependent upon the final LRT design configuration and is therefore not known at this time.

Water

A 150mm cast iron water main, circa 1920, north of 98 Avenue does not conflict with LRT bridge construction but is likely to be partially abandoned. Casing of the water main, should the abandonment not occur or should it fall west of the bridge location, could be required to increase protection and retain future accessibility. Maintenance ability may be reduced once LRT construction has been completed, thus contributing to the probability for casing installation. Preliminary LRT design calls for the installation of a new hydrant at this location for fire support. This work would likely require the replacement of at least a portion of the cast iron pipe with PVC. All of the above work would be in the near vicinity of the existing sidewalk.

On Connors Road, the 762 mm steel transmission water line may be cased below the future LRT alignment. EPCOR are considering whether this line could be left in place, should it meet LRT separation requirements.

The 508 Steel, circa 1951, water line at the top of Connors Road will need to be cased, and based upon the work that occurs on the 406 Steel gas main, may need to be lowered.

Natural Gas

ATCO Gas has suggested that the 406 IP5 ST line beneath the Muttart Stop not be moved. During the P3 contract, Muttart Stop designers should consult with ATCO Gas to ensure that construction and operation will not disrupt LRT operation or determine alternate solutions including relocation. Due to the topography in the area and changes to design track elevation and location that may come with detailed design, ATCO may require the gas line to be realigned. It is expected that this realignment would take less than two months.

The 406 IP ST line at the top of Connors Road may need to be lowered below the future track alignment if it does not meet with LRT separation requirements. ATCO are investigating the depth of this line to confirm its location and formulate their mitigation proposal.

Storm/Sanitary Sewers

Sewer installations and relocation work will be designed and constructed by the P3 Contractor.

Traffic Signals and Roadway/Pathway Lighting

This work will be designed and constructed by the P3 Contractor, as administrated by the P3 Contractor.

In summary, overall there is potential for utilities work to extend beyond the project area. Utility related work will occur prior to and during LRT construction. The attendant impact on other river valley resources cannot be accurately identified at this time. The impact is therefore rated as adverse, major, permanent and predictable.

Mitigation Measures and Residual Impact

All relocation work beginning prior to project turn over to the P3 Contractor and any relocation or new installation tie-in work by the P3 Contractor involving lands outside of the project area will be subject to the Bylaw 7188 environmental review process. This measure should ensure that any significant impacts are identified and appropriately mitigated.

Utility companies will be responsible for adherence to any applicable bylaws in the development and construction of work they will complete, including the application for and administration of obtaining any required approvals.

6.2.6 *Worker and Public Safety*

6.2.6.1 Identification of Concerns Specific to the Project

This section does not constitute a detailed prescription of safety measures that should be employed during project construction activities. That was considered beyond the scope of this EISA. Our assumption is that the design, construction and operation of the LRT will conform to all applicable municipal, provincial or federal worker and public safety regulations or protocols. Our analysis of worker and public safety considered environmental elements that might pose risks to worker and public safety, particularly those linked to identified environmental impacts or local resources. This was done by considering all of the information presented in the preceding chapters of this document to identify physical locations or activities unique to this project that might result in concerns.

For the proposed project, worker and public safety concerns are most likely to arise in areas where the construction would be located near existing public facilities, infrastructure, residences, water or steep slopes or where known safety risks had been identified by the public or regulators. The following elements were identified as having potential to result in worker or public safety concerns:

- The interface of the construction area with parkland, recreational facilities and transportation networks,
- Construction in close proximity to residences,
- Homeless communities taking shelter in local treed areas,
- The potential for wildfires associated with construction in proximity to natural fuel loads during dry periods,
- Treefall associated with bank cuts on Connors Road,
- Slope instability associated with construction activities on the north bank,
- Recreational use of river during bridge demolition and construction (including superstructure work over open channel),
- Work sites in proximity to the river, and on steep and potentially unstable slopes,
- Wildlife /worker conflicts,
- Accidental release of hazardous materials to the river, affecting downstream users.

Because all of these present risks to human health and safety, they are all considered to be adverse and major, with the exception of worker wildlife conflicts, which are considered a negligible risk for reasons described below; however, they are not all equally likely to occur. Because they are associated with the construction phase of the project, risks are considered to be short- to long-term. Some impacts are predictable in the absence of mitigation measures, while other are uncertain. The confidence of impacts is thus rated individually for each impact in the following sections.

Impact

The Interface of Construction Areas and Public Areas

The presence of active construction area in close proximity to public parkland, recreational facilities and transportation networks (including the pathway network) creates a potential public safety risk. Without proper delineation of the construction area, and appropriate barricades to preclude public access, members of the public could access constructions zones, thus placing themselves at risk of injury. In the absence of mitigation measures, this impact considered likely to occur. All damages to parkland to be restored to City of Edmonton satisfaction, in accordance with City of Edmonton 2009 Design and Construction Standards current at time of RFP issuance. Any damages that pose an immediate safety hazard to park and trail use (e.g. deep tire ruts adjacent to or in the trail itself, should be addressed immediately to minimize City liability.

Construction in Close Proximity to Residences

The interface of the construction area with residential areas in Riverdale, Cloverdale and Bonnie Doon could also present a public safety hazard. The steep slopes and dense forest along the south valley wall may preclude fencing of the southern boundary of the project area, leaving it accessible via the properties along the top-of-bank. The residences along the edge of the valley in Riverdale and Bonnie Doon may not all have back fences, leading to potential ambiguity regarding the end of private property lots and/or the beginning of the project area. While the steep topography of these slopes make it unlikely that nearby residents will inadvertently walk into the project area, it remains a possibility, particularly in Riverdale, in the absence of clear demarcation of construction areas. In the absence of mitigation, this impact is likely to occur.

Construction in Areas Likely to Shelter the Homeless

There are known homeless communities with temporary camps set up in the area north of the future portal and possibly in the vicinity of the shelter at Henrietta Muir Edwards Park. Construction would put these people are at risk of personal injury. In the absence of mitigation, this impact is likely to occur.

Wildfires Caused by Construction and Demolition Activities

In dry conditions, grasses and other vegetation can act as fuel for wildfires. Construction activities provide potential sources of ignition. During such conditions, particularly in late summer and fall when vegetation is dry, accidental ignition by sparks from machinery, construction materials, construction equipment or workers' cigarettes could spread quickly. Nearby residents and recreationists would be at risk in the event of a fast-spreading fire.

The potential for such a fire is relatively limited throughout much of the study area. Manicured lawns and gardens do not provide a substantial amount of fuel, and the north-facing slopes and floodplain on the south bank area are characterised by relatively moist conditions that are not particularly conducive to fires. Unmanicured, south-facing areas on the north bank are likely to be most susceptible to burning. In the event of a large fire, property damage, injury or loss of life could result. City fire crews are nearby, however, and could respond quickly if a fire did begin. This impact is rated as unlikely to occur, since work areas will be fenced.

Treefall on Connors Road

Bank cuts on Connors Road could cut into the root network on mature trees on upper, non-cut portions of the slopes. Significant encroachment on root system could result in treefall if the remainder of the root system is not sufficiently strong to maintain stability. Trees with compromised root systems are more susceptible to events such as windthrow, where trees are uprooted by strong gusts of wind. If nearby workers are struck by falling trees, serious injury or death could result. In the absence of mitigative/safety measures, this impact is considered likely to occur and precautionary measures should be implemented. These same measures would protect public safety. The tree removal plan must be approved by a City of Edmonton Urban Forester.

Slope Instability Associated with Construction on the North Bank

The north bank has been identified as having marginal stability, and the demolition and removal of subsurface structures, excavation associated with construction, and the additional loading associated with LRT infrastructure could potentially trigger slope instabilities. Slope failure could endanger the safety of workers on the north bank, as well as members of the public using nearby park areas. This impact is considered unlikely to occur because future designs will be subject to geotechnical review.

Hazards to Recreational River Users

Superstructure construction over the river could result in hazards to recreationists using the river. Recreational boaters passing below an active construction site would be at risk of being hit by falling objects, potentially resulting in injury or death. This could present a risk to recreationists, particularly smaller crafts. This impact is considered unlikely, considering the safety/navigation protocols that will be prescribed by Transport Canada.

Work Sites on Steep Slopes and in Proximity to the River

During high water periods, such as the spring, current velocities could also be strong enough to endanger the safety of any workers that fall in the river. Work will also take place on steep slopes on the north and south valley walls of the river. Falls into the river or down steep slopes could result in serious injury or death. These impacts are unlikely considering the safety measures required by industry.

Wildlife-Worker Conflicts

Numerous wildlife species live in or travel through the NSRV. Some, such as coyote, can be dangerous can could present a hazard to workers. However, the risk is attenuated by several factors. First, the project area offers suboptimal wildlife habitat. Second, fencing around work areas should preclude access to work sites by wildlife. Third, the noise and activity associated with construction will deter most wildlife species from using the area while construction is ongoing. Finally, many wildlife species are most active at night, reducing the potential for interactions with workers. The likelihood of worker-wildlife conflicts resulting in human injury is thought to be low.

Accidental Release of Hazardous Materials into the River

Spills involving significant amounts of hazardous materials could potentially pose a threat to the public downstream of the spill. If downstream municipalities (e.g., Fort Saskatchewan) rely on the NSR for their drinking water, spills could endanger their water supplies. This impact is unlikely to occur.

6.2.6.2 Mitigation Measures and Residual Impact

The following measures will be considered to reduce the likelihood of impacts.

The Interface Between Construction Areas and Public/Residential Areas

Fencing and signage will be required to clearly identify construction areas, and detours should be clearly signed and communicated with user groups. The south boundary of the construction zone on the south valley wall require some form of demarcation. While fencing might be precluded by the topography and dense forest, alternatives such as high visibility flagging and signage should be considered. These measures will reduce residual impacts to negligible.

Construction in Areas Likely to Shelter the Homeless

Before site activities begin, the P3 Contractor should contact appropriate agencies so that measures can be taken to accommodate individuals' relocation and provide contact with appropriate relief agencies and/or Social Workers.

Wildfires

The following measures will help reduce the potential for construction activities, vehicles or personnel to initiate a wildfire:

- Firefighting equipment will be available near any flammable storage sites, including fuels, lubricants and other petroleum products.
- Smoking in areas supporting vegetation will be prohibited. A designated smoking area will also be established.
- A procedure for on-site fire response will be developed and communicated to all site personnel. That plan will include contact information for local fire and emergency departments.

Treefall

Prior to bank cuts, the P3 contractor should consult with an arborist regarding the stability of the remaining trees in the area above the cuts. An urban forester should also inspect the area following cuts, and any trees identified as potential hazard trees, or trees in areas where treefall hazard is deemed particularly high, should be removed. All tree removal decisions must be approved by a City of Edmonton Urban Forester.

Hazards to Recreational River Users

The contractor can temporarily reduce passage under the bridge while high risk construction occurs on the superstructure. During certain other activities, hoarding may be required.

Hazards to Workers

The contractor will consider these particular risks while developing safety procedures.

Hazardous Materials Spills

Measures for preventing and mitigating spills are described in Section 6.1.3.4 (Introduction of Deleterious Substances). Conscientious application of the measures described will reduce residual impact likelihood.

6.3 Valued Historic Components

6.3.1 Historical Resources

Potential impacts to historic resources are limited to potential for disturbance of previously undocumented archaeological or paleontological resources.

Impacts

The HRIA completed for preliminary engineering concluded that potential to impact historical resources is low (The Archaeology Group 2012) and recommended that the Province issue a Clearance Letter. A Clearance Letter has not yet been issued for the project, but a response from Alberta Culture is expected imminently.

Aeon Paleontological Consulting identified bedrock layers as having paleontological potential, and noted that the project has the potential to impact paleontological resources where construction intersects with bedrock. Further, this was thought to be most likely to occur where bedrock is near the surface (i.e., on the north bank, in the river bed and on Connors Hill), and where structures require deep foundations. Aeon submitted a report to the Province recommending a Clearance Letter be issued conditional on monitoring. Specific recommendations were as follows:

Area A: southern portion of LRT tunnel; to be excavated through bedrock and associated development of tunnel portal/north valley slope around tunnel portal.

> *Monitor spoil during bedrock excavation portion of LRT tunnel development and associated slope/bridge abutment development around tunnel portal.*

Area B: North Saskatchewan River LRT bridge abutments and piers. If construction techniques utilize open caissons, this may allow inspection of exposed bedrock or survey of excavated sediments.

> *Monitor excavation pits **only if** open caissons/pier pits used are accessible for monitoring and if excavation will impact in situ bedrock to a depth greater than 0.5 m (i.e. monitoring contingent upon accessibility and construction techniques).*

Area C: middle slope of Connors Road. If existing roadway requires realignment, then grading and retaining wall development may require redevelopment of south valley slope.

> *Monitor **only if** existing roadway requires realignment, including excavation and grading of valley slope (e.g. to install retaining walls).*

Finally, Aeon notes that "as design and construction plans are finalized, the impact to fossil resources/bedrock in the three suggested monitoring areas above may need to be reassessed. If construction techniques or design plans suggest that impact to bedrock will be minimal or monitoring is unlikely to recover fossil resources then the Royal Tyrrell Museum and Heritage Resources Management Branch can be advised and the suggested monitoring program adjusted accordingly."

Historical Resources and paleontological resources will be addressed in one Clearance Letter from the Province. Impacts to historical resources are rated as negligible, provided paleontological monitoring recommendations are heeded, as indicated in the final Clearance Letter from the Province.

Mitigation Measures and Residual Impacts

LRT D and C will ensure that the following mitigation measures are undertaken:

- Include the Clearance Letter from the Province in the P3 procurement package, and require compliance with all conditions.
- If historical or paleontological resources are encountered during construction, work will cease immediately, and the Historic Resources Management Branch and/or the Royal Tyrell Museum will be notified.
- Monitoring will be implemented as dictated by the Province.
- Finally, LRT D and C will review final designs, and if project plans have changed to the point where a further paleontological review is deemed necessary, the P3 contractor will engage a paleontologist to undertake the required review.

With these measures in place, residual impacts are reduced to negligible.

7.0 SUMMARY ASSESSMENT

7.1 Summary of Residual Impacts

Considering the scale of the proposed project in the river valley, few residual impacts are anticipated to remain following implementation of the identified mitigation measures, although some important impacts will occur. Residual impacts identified in this assessment can be grouped into four categories:

- adverse impacts (both major and minor);
- adverse or positive impacts (depending on aesthetic preferences),(major to minor);
- positive or neutral impacts; and
- uncharacterized impacts.

7.1.1 *Adverse Impacts*

This EISA identified several major and minor residual adverse impacts, most pertaining to construction and most involving recreational land use, residential land use and visual resources. This is not surprising since impacts to river valley recreational use or nearby residents during construction can be challenging to fully mitigate in the case of a major construction project. Following is a summary of the adverse residual impacts.

7.1.1.1 Major, Adverse Residual Impacts

<u>Vegetation</u>

- Disturbance of rare plants: adverse, major to minor, long-term and uncertain. *This major to minor rating is related to the uncertainty of transplantation success of rare plants. Transplantation of rare plants is an emerging practice with attendant uncertainties.*

<u>Residential Land Use</u>

- Traffic disruptions due to construction: adverse, major, long-term and predictable.
- Even with mitigation, it is expected that for some residents, construction noise will remain an adverse, major, short or long-term impact, but this cannot be stated with certainty. (*This assessment of severity was <u>not</u> based on construction noise assessment data.)*

<u>Recreational Land Use</u>

- Pathway closures: adverse, major, short- to long-term and uncertain. *The uncertainty is associated with the content of the forthcoming construction period trail closure/detour plan.*
- User experience: adverse, major, short- to long-term and predictable.

<u>Visual Resources</u>

- Visual impacts associated with construction: adverse, major, long-term and predictable.

Views of new LRT infrastructure from HME Park and Cloverdale: adverse, major to minor, permanent and uncertain. *The uncertainty is associated with the incomplete nature of the final landscaping plan for the new gateway to HME Park.*

7.1.1.2 Minor, Adverse Residual Impacts

Geomorphology and Hydrology

- Temporary alteration of abandoned Mill Creek channel: adverse, minor, long-term and predictable.

Wildlife

- Habitat loss: adverse, minor long-term and predictable during construction, and adverse, minor, permanent and predictable during operations.

Habitat Connectivity

- Habitat connectivity: adverse, minor, permanent and predictable.
- Wildlife movement: adverse, minor, permanent and predictable.

Recreational Land Use

- Impacts to the Edmonton Queen Riverboat: adverse, minor, long-term and uncertain.
- Disruptions to Special Events: adverse, minor, long-term (but infrequent) and uncertain.
- Impacts to Socially-Valued Amenities: adverse, minor, short- to long-term and predictable.
- Impacts to Recreational Facilities: adverse, minor, and short-term to permanent, but some are uncertain.

7.1.2 *'Adverse or Positive' Impacts*

Several identified impacts to visual resources could be rated as positive or adverse, depending on personal opinion and values; all relate to the presence of permanent infrastructure.

Visual Resources

- Impacts to long-distance views: adverse or positive, major to minor, permanent and predictable.
- Views from Louise McKinney Park and the river: adverse or positive, major, permanent and predictable.
- Views from the Muttart Conservatory area: adverse or positive, major, permanent and predictable.
- Views from the Connors Road viewshed: adverse or positive, permanent, predictable and major.

7.1.3 *Positive and Neutral Impacts*

The project is anticipated to result in several positive residual impacts, some of them major:

- removal of disturbed contaminated soils: positive, major to minor (depending on area involved), permanent and predictable;
- reduction of the number of instream bridge piers from three to two, thus reducing disruptions to river hydraulics: positive, minor and permanent and predictable;
- resolution of some minor ponding that currently occurs under some circumstances at the bottom of Connors Hill: positive, minor, permanent, and predictable;
- increased transit access to the river valley recreation opportunities; positive, minor and major, permanent and predictable.

In addition, the following impacts to visual resources may be viewed as positive or neutral:

- impacts to long-distance views,
- changes to views in Louise McKinney Park and the river,
- changes to views in the Muttart,
- changes to views in the Connors Road viewshed.

Two impacts were rated as neutral, assuming effective mitigation:

<u>Hydrology</u>

- Introduction of landfill contaminants to NSR during construction.

<u>Recreational Land Use</u>

- Minor pathway realignments and additions.

7.1.4 *Uncharacterized*

The following list of residual impacts illustrates the influence exerted by the P3 process on this EISA. These potential impacts remain as uncharacterized, largely as a result of uncertain design or construction practice, and are, therefore, flagged as requiring more examination during the P3 procurement. It may be possible to address all of these before or during the detailed design process.

<u>Fish and Fish Habitat</u>

- Interruption of critical fish movements during demolition and construction.
- Sedimentation from bridge drainage during operations.

<u>Soils</u>

- Compaction of topsoils and subsoils during construction having major to minor implications for restoration: *residual impact not rated owing to insufficient information.*

- Degradation of soil physical, chemical and biological properties having major to minor implications for restoration: *residual impact not rated owing to insufficient information.*

7.2 Summary of Mitigation Measures

This section is *not* a comprehensive review of all mitigation measures, rather, it is intended to summarise key mitigation measures that will most effectively reduce or eliminate project impacts on the biophysical and socio-cultural environment in the study area. This section comprises three components:

- a list of deliverables that LRT D and C will require from the P3 contractor, either from bidders during the P3 procurement process, or from the selected P3 contractor, as deemed appropriate,
- a list of performance measures to be developed by LRT D and C, and
- a list of recommended mitigation measures that effectively mitigate multiple impacts, often across multiple VECs.

7.2.1 *Deliverables Required by LRT D and C*

As a means of mitigating several of the environmental and socio-environmental concerns associated with the project, LRT D and C will require the P3 contractor to develop a number of deliverables to demonstrate adequate consideration and effective control of potential impacts identified in this EISA. Recommended deliverables include:

- A construction plan that demonstrates:
    - adequate consideration and control of slope stability issues in the north valley and on the south valley wall,
    - a risk management plan (may or may be prepared by the City), including a monitoring plan, that accounts for handling contaminated soils and groundwater.
    - a staging plan for instream work that accounts for the RAP and demonstrates adequate consideration of impacts to fish habitat and sensitive periods of fish life cycles.
    - suitable provision for wildlife movement through the valley during construction,
    - suitable provision of pathway connectivity during construction,
    - a weed control program,
    - a traffic management plan,
    - a communication plan,
- an EMS prepared to the standards of ISO 14001,
- an ECO Plan,
- a TESCP that meets or exceeds standards of ESC guidelines prepared by the City of Edmonton and Alberta Transportation, and is approved by a CPESC,
- specific measures to protect the north bank against fluvial erosion,

- a sediment-monitoring program specific to instream construction work (unless not required by DFO or AESRD)
- a hazardous materials assessment of the existing Cloverdale pedestrian bridge, to inform demolition planning,
- a bridge demolition plan,
- a forest restoration plan developed by a restoration ecologist, and
- a navigable waters plan.

Some of these deliverables, such as the EMS, ECO Plan and construction plans, should be provided during the bidding process to demonstrate consortiums' readiness to manage a large project such as the LRT in an environmentally and socially-responsible fashion. This approach might not be deemed appropriate for all the requested plans.

7.2.1.1 Other Key Mitigation Measures

The following mitigation measures were recommended to mitigate two or more identified impacts. As such, they represent particularly effective means of reducing and/or eliminating some of the potential impacts associated with the project. LRT D and C should consider making some or all of the following requirements to be integrated into procurement documents.

Minimizing the project footprint would minimize or prevent the following impacts:
- loss of vegetation,
- introduction of weedy species,
- loss of rare plants,
- disturbance of recognized Natural Areas, and
- visual impacts from numerous vantage points.

Adopting a staged approach to construction would prevent or minimize the following impacts:
- degradation of soil physical, biological and chemical properties,
- soil erosion and sedimentation,
- introduction of weedy species,
- pathway closures and detours,
- visual impacts from numerous vantage points.

Practicing progressive reclamation would prevent or minimize the following impacts:
- soil erosion and sedimentation,
- degradation of soil physical, chemical and biological properties,
- introduction of weedy species,
- visual impacts.

Clipping the project area to avoid working in the Mill Creek channel would prevent the following impacts:
- disturbance to the geomorphology of Mill Creek channel,

- disturbance to surface drainage patterns.

Developing an EMS and ECO Plan to the recommended standards would prevent or minimize the following impacts:

- topsoil loss through erosion,
- sedimentation of the river,
- hazardous materials spills on soils,
- introduction of deleterious substances to the river, and
- degradation of fish habitat resulting from sedimentation or hazardous materials spills.

7.2.2 *Performance Measures*

As a means of quantitatively assessing performance and providing means of quality control, LRT D and C will develop performance measures for all required technical plans, for example:

- the TESCP,
- wildlife movement measures,
- SUP closure and detour plan,
- river pedestrian bridge demolition,
- contaminant risk assessment and monitoring,
- restoration plan.

Several VECs fall under the jurisdiction of the federal or provincial government (fish and fish habitat, watercourse navigation, water course crossing construction practices), who have well-established performance criteria on which the City can rely.

7.3 Summary of Monitoring Requirements

This document sets out numerous monitoring commitments for both the P3 contractor and the City. These are summarized below.

7.3.1 *P3 Contractor Responsibilities*

The following monitoring commitments will be required of the P3 contractor:

- Monitor disturbed areas, most intensively in those areas immediately adjacent to the NSR, to ensure that vegetation has become sufficiently established to provide permanent erosion and sediment control protection.
- During instream construction, develop a sediment monitoring program using specific monitoring procedures, compliance criteria, and reporting protocols to ensure minimal introduction of sediments.
- Monitor fish movement through the construction area during in-stream works.
- Monitor soil stockpiles and construction areas for weed introduction.
- Monitor performance of all wildlife movement measures/structures installed.

- Monitor deer movement in the area of Connors Road and Cloverdale Hill for 5 post-construction autumns, and install appropriate means of promoting movement according to the City's Wildlife Passage Design Guidelines if OoB is of the opinion that the data collected suggest regular, annual or seasonal movement in the area.
- If Mill Creek channel is disturbed, monitor ESC and restoration measures over the life of the project.
- Post-construction, monitor down gradient mobilization of contamination resulting from construction activities on the north and south sides of the river. This may be a very long-term initiative (e.g., greater than the 30 year P3 period). It will require development of a detailed monitoring plan initiated by the contractor.

And, unless otherwise indicated by the Province, paleontological monitoring will be required as follows (see *Section 6.3.1* for conditions):

- Spoil monitoring of bedrock during excavation of LRT tunnel and associated slope/bridge abutment development around tunnel portal.
- Monitoring of both excavation pits around bridge abutments and piers, and excavation and grading around the middle slope of Connors Road.

7.3.2 *City of Edmonton Responsibilities*

The following monitoring commitments will apply to the City:

- Transplanted rare plants will be monitored for a period of five years post-transplantation.

7.4 Unresolved Issues

Some impacts remain unresolved, many owing to 1) undeveloped design detail at the time of writing, and 2) unknown construction methodologies. The following impacts are unresolved to some degree but will be addressed during the next project phase:

- Maintenance of slope stability on the south valley wall.
- Disturbance to Mill Creek channel.
- Finalization of LRT/Connors Road alignment (has assessment and mitigation implications) (in progress).
- Development and implementation of rare plant transplantation programs (in progress, see below).
- Identification of an alternate, temporary 'fully-accessible route' into Louise McKinney Park (in progress).

Should the City be successful in its bid to host a major, biannual event at Louise McKinney Park, LRT construction occurring within the project area may adversely affect the quality/atmosphere of the event. This potential future conflict is flagged as an issue requiring attention.

7.5 Future Work

The following is a brief summary of future environmental studies or mitigation work required in support of the project. Future work falls into two categories: studies that are currently in progress, by the City, but were not completed in time for results to be incorporated into the EISA; and, studies likely to be required before or during detailed design.

7.5.1 *Studies in Progress*

- Development of mitigating landscaping options for disturbed gardens at Muttart and Louise McKinney parks.
- Identification of a suitable, temporary means of providing ‘fully-accessible access’ to the lower areas of Louise McKinney Park.
- Development of a rare plant transplantation program (and implementation).

7.5.2 *Further Studies Needed*

The following studies have *not* been initiated, but will be needed to inform design and/or permitting efforts.

- Geotechnical investigations in the vicinity of the portal access road alignment,
- Investigation of the fish habitat potential of Lower Mill Creek.
- Assessment of fish and fish habitat impacts associated with specific instream works, and development of appropriate mitigation measures – by P3 Contractor.
- Development of acceptable means of isolating instream works such that navigability of the NSR during construction is protected – by P3 Contractor.
- Examination of final design and construction plans for the potential to impact fossil resources/bedrock in the three identified monitoring areas to confirm need for paleontological monitoring during construction- by P3 Contractor.

7.6 Permitting

The majority of anticipated provincial and federal environmental permits require final design and provision of detailed instream construction methodology. Thus, provincial and federal permitting will be the responsibility of the P3 contractor.

In addition,

- LRT D and C should continue enquiries to P3 Canada Fund, regarding potential for environmental assessment requirements associated with funding.

- LRT D and C should also continue consultation with Albert Public Lands regarding licensing of the new river bridge and potential for requirement for First Nations consultation.

7.7 Resolution of Key Environmental Issues

Following are some very brief answers to the questions initially posed in Chapter 4.

7.7.1 Valued Ecosystem Components

7.7.1.1 Geology/Geomorphology

Will construction activities on the north bank and north valley wall, including demolition of the existing Cloverdale bridge impact slope stability?
No. The Reference Design indicates that stable sloes can be achieved. Construction methods for the project have yet to be developed; however, LRT D and C will require that the P3 contractor develop a construction methodology that demonstrates consideration and control of potential slope stability issues in the north valley. They will also require additional geotechnical evaluations for any proposed design deviations and for work in the area of the portal access road

Does slope instability have the potential to affect the structural integrity of LRT infrastructure?
No. Extensive geotechnical work has been carried out in support of the proposed project, including analyses of potential slope movements in the north valley.

Can the upper south valley wall (Connors Hill) remain stable following construction?
Yes. Once construction methods are developed, measures will be put into place to ensure the stability of the south valley walls slopes during construction.

Is there potential for slope stability issues to cause unexpected delays in construction?
Yes. As with any large construction project, there is the potential for environmental conditions to cause construction delays. However, all possible efforts are being made to minimize the chance of construction delays, including thorough background investigations of geotechnical conditions, and consideration of geotechnical conditions in project design and construction planning.

7.7.1.2 Soils

Will project activities trigger surface erosion?
They may, but erosion will be minimized, controlled and contained. LRT D and C will require the P3 contractor to prepare an EMS, ECO Plan, and TESCP to the highest standards. All plans will be subject to review and approval by the City.

Will project activities cause soil compaction, degradation or loss?
Likely. These impacts are, to some degree, an inevitable outcome of large construction projects. That said, these impacts will be minimized by the implementation of best management practices for soil stripping, stockpiling, and handling. These practices are expected to reduce impacts to the point that they do not jeopardize reclamation efforts.

Do contaminated soils occur within the project site? Could the project result in mobilization of contaminants or contaminated soils?
Yes. Contaminated soils, associated with former landfill and incinerator/landfill activities, are present on the north and south sides of the river. In consultation with AESRD, LRT D and C will take a risk management approach to contamination in the project area and require the contractor to follow a detailed risk management plan and a long-term post-construction monitoring plan.

Will use of staging areas for fuel, lubricants and other supplies pose a risk for soil contamination during construction?
Yes, but the EMS and ECO Plan will contain provisions to adequately control the risk of spills.

7.7.1.3 Hydrology

Will work on slopes in the valley and instream (for demolition and construction activities) result in release of deleterious substances into the North Saskatchewan River?
This is unlikely as the EMS and ECO Plan will contain provisions to adequately control the risk of spills. In addition to the provisions in these plans, fuels will be stored appropriately to minimize risk of spills and releases to the river. The P3 Contractor will be required to prepare a river bridge demolition plan that meets the approval of municipal, provincial and federal review agencies.

Could bridge piers or supporting subsurface structures in the vicinity of the abandoned landfill create preferential pathways for leachate migration?
Unlikely, for three reasons: First, local soils in the north valley have low permeability. Second, groundwater recharge in the area is limited, as upstream portions of the catchment are largely drained by the municipal storm sewer system. Finally, structures will be in direct contact with soils, limiting the potential for preferential pathways to form. Monitoring will be undertaken, regardless.

Will the existing river bed, and therefore hydraulics, be permanently altered by placement of fill material for temporary berm construction?
Yes, however, the impact is expected to be temporary. Provisions in the approval from Transport Canada will specify that all introduced material to the river must be removed in theory eliminating the potential for an adverse, permanent impact.

Will the addition of impermeable surfaces lead to increased runoff and have an adverse effect on existing stormwater infrastructure or river water quality?
No. Drainage design has adequately considered the need not to stress the storm sewer system and to ensure some treatment of stormwater discharges. LID stormwater management systems, including swales and rain gardens, will improve the quality of stormwater entering the municipal storm sewer system, and, ultimately, the river. The net effect on water quality is expected to be positive.

Will bridge deck runoff be released into the North Saskatchewan River, resulting in introduction of deleterious substances?
No. Bridge deck runoff will drain into the river; however, deck drains will be fitted with grit separators to ensure that grit applied for traction is not introduced into the river. No other deleterious substances are expected to be used on either the train or pedestrian decks of the bridge. Bridge drainage will, therefore, have a negligible impact on river water quality.

Will LRT maintenance activities adversely affect river water quality?
No. A siding track originally positioned on the river bridge has been relocated to Muttart Stop. Thus, there will be no storage or maintenance of trains on the river bridge. The train bridge deck will drain to pipes fitted with grit separators to provide for treatment of materials used for winter maintenance.

7.7.1.4 Fish and Fish Habitat

Will pedestrian bridge demolition temporarily alter river flows and consequently, downstream fish habitat?
Yes. During bridge demolition and construction phases of instream works will need to be isolated from flowing waters which typically result in channel constriction and increased water velocities. Depending on the extent of the channel constriction and the subsequent impact on water velocities, it is possible that upstream fish movements would be temporarily impeded (Pisces 2013).

Will it be possible to restore fish habitat after demolition and removal of the existing bridge piers?
Yes. Permits issued for instream work by federal permitting authorities usually specify removal of all materials introduced into the river to construct isolation features.

Will new bridge construction or operation activities introduce deleterious substances into the North Saskatchewan River, either directly or through the stormwater management system, thereby affecting water quality/fish habitat?
Unlikely. The commitment for LRT D and C to require the P3 contractor to submit the required technical plans will address this potential impact, with one addition: the plans will include an assessment of the existing Cloverdale bridge to contain hazardous materials such as lead-based paint and creosote and demolishing plans must be prepared accordingly to ensure proper containment of hazardous materials.

Will any rare or sensitive fish species be affected by the project footprint?
Unlikely. No special status fish species were documented during November 2010 sampling. Lake sturgeon is known in some areas of the North Saskatchewan River. Pisces (2010) found one site within the Cloverdale Bridge project area that met lake sturgeon habitat criteria; however, no historical record of lake sturgeon occupying this habitat (FWMIS 2010, D. Watters *pers.comm*. 2010).

Will any permanent habitat loss or alteration result from new permanent structures associated with the project?
No. The three instream piers present in the Cloverdale bridge will be replaced with two instream piers from the new NSR bridge. The removal of one instream pier will help return hydrology and habitat in the immediate area to natural conditions.

7.7.1.5 Vegetation

Will the project result in significant disturbance to, or loss of, natural, semi-natural and manicured plant communities?
No. Construction will require clearing of vegetation within the project; however, all cleared areas will be re-vegetated except for those that will support permanent LRT infrastructure. Re-vegetation objectives and methods will differ for natural, semi-natural and manicured areas, with a focus on restoring vegetation communities to a condition that is equal to, or better than, existing conditions.

Will naturally-occurring or ornamental trees on City lands be removed or damaged during construction?
Yes. A number of trees are located in the project area, and some of these will be removed for construction. However, all tree losses will be compensated as per the requirements of the City of Edmonton Corporate Tree Management Policy.

Does the project have the potential to affect rare, threatened or endangered plants or plant communities?
Yes. A minimum of three and maximum of six rare species are known to occur within the project area. All rare species within the project area will be transplanted to suitable sites prior to the onset of construction; transplantations will be monitored owing to uncertainty associated with the success of these efforts.

Will vegetation in recognized Natural Areas be affected?
No. A very small portion of two recognized Natural Areas will be cleared for construction; however, with successful restoration, overall losses to the Natural Areas are expected to be negligible.

Will the project result in the introduction of or increase in weeds within the river valley?
Possibly. While all possible measures will be taken to prevent weed issues during construction and reclamation, the project area is located within an urban area where weeds are prevalent. Additionally, many weedy species, including a small number of noxious and prohibited noxious species, are present within or near the project area. However, with proper management, weeds should not threaten the long-term integrity of communities within and near the project area.

7.7.1.6 Wildlife

Will critical wildlife habitat be lost?

No. Critical wildlife habitat was not documented within the study area, although a small area of habitat most suited to urban-tolerant species will be removed.

Will any special status wildlife species be affected by project construction?
No. Special status species are not expected to be affected by this project.

Will the project result in wildlife mortality?
There is little chance of wildlife mortality and all advisable precautions will be taken.
Does the project have potential to temporarily or permanently alienate wildlife from available habitat?
Some very local, temporary alienation could occur during select construction activities, however this was rated as a minor impact considering the already high human presence in the area, including heavy traffic volumes.

7.7.1.7 Habitat Connectivity

Will wildlife movement or habitat connectivity be compromised by construction or operation of the new LRT line? More specifically, will the LRT create a barrier for wildlife movement between Mill Creek and the NSRV?
Some of the infrastructure will act as a barrier during construction and also, in a lesser way, during operation; however, design efforts have been made to facilitate wildlife movement and all structures proposed to date are compliant with the City's wildlife passage guidelines or could be with appropriate mitigation. Wildlife movement monitoring will be undertaken following construction.

7.7.2 Valued Socio-Economic Components

7.7.2.1 Land Disposition and Land Use Zoning

Will any additional land acquisition be needed to construct the project?
Yes. Negotiations are currently underway for the necessary land acquisitions and ROW creation. Land acquisition issues are not expected to delay the project.

Will land use zoning changes be required?
No. Land use zoning changes should not be required.

Will the project cross any other land jurisdictions, requiring right-of-way?
Yes. All facilities will be in a new LRT ROW. Negotiations are underway. Provincial permits will be required for work and structures in the riverbed.

Will any City lessees be affected?
Unlikely. The Edmonton Ski Club's lease is currently in renegotiation with full knowledge of the LRT development. It is not known whether the Edmonton Queen Riverboat has a lease agreement with the City for their activities. Any lease the Edmonton Queen Riverboat has is assumed to affect lands outside of the project area.

7.7.2.2 Residential Land Use

Will construction of the proposed project affect traffic along 98th Avenue or Connors Road?
Yes. A traffic management plan will be required.

Will construction of the proposed project affect access to the Muttart Conservatory?
All access will be maintained. There may be some traffic delays associated with construction traffic on 98 Avenue.

Will construction adversely affect local traffic or local road conditions?
Construction will be required on Connors Road requiring closure for at least one year. Construction access routes will affect local traffic. This will be an adverse impact.

Will any construction activities generate high levels of particulate matter, including dust or airborne contaminants? Yes, it seems likely that dust and mud will be generated in the project area owing to the large scale structures being installed and the large amounts of materials to be moved in and out of the area. Mitigative measures will be employed.

Will construction or operation noise adversely affect residents within or at the crest of the river valley? It seems very likely that nearby residents will be affected. Noise attenuation measures have been identified.

Will vibrations associated with construction and LRT operation adversely affect local homes or associated infrastructure? No. Studies to date have shown no effect of vibrations on river valley infrastructure.

Will the LRT positively contribute to improved air quality in the river valley through a reduction in motor vehicle volumes? Yes. It is assumed that providing LRT public transportation will result in fewer cars on Edmonton's roads. Quantitative/modelling studies have not been undertaken.

Will the operating LRT and Muttart Stop adversely affect local traffic or parking?
Yes and no. The line will cross near the entrance to the Muttart staff parking lot but traffic volumes are low and the impact is not expected to be material. The line and stop are designed to integrate with existing bus routes and provide a destination location at the Muttart Conservatory.

7.7.2.3 Recreational Land Use

Will local pathway disruptions during the construction period be suitably mitigated for all users, including those availing themselves of wheelchair accessibility?
Uncertain. Detours will be provided for users of the SUP system; however, detours have only been conceptually developed at this time. The degree to which detours disrupt the recreational network is not yet known but a plan will be prepared. The City is

investigating alternate fully-accessible pathways into the valley, but a route has not yet been confirmed.

Will access to the river, valley parks, the Muttart Conservatory or the Edmonton Ski Club be disrupted during construction and/or operations?
No. Parks and facilities will remain fully-accessible during construction, with the exception of those portions of parks that intersect with the project area. The stretch of the river in the vicinity of the river bridge may be closed for short periods during overhead construction; however, the river will otherwise remain navigable throughout the construction period. During the operations phase, an LRT stop will be available in the river valley, which will positively affect the accessibility of the valley.

Will the Trans-Canada Pathway kiosk, wishing tree or donor trees or benches require temporary or permanent relocation?
Yes. All such amenities in the project area will be identified and either protected or relocated in accordance with standard City procedures.

Will gardens be disturbed by construction, and how will this be mitigated?
Yes. Gardens within the project area will be removed during construction. All affected gardens will be replaced by the City, either in their current location, or, if this is not feasible, in suitable nearby locations.

Will LRT train operations disrupt recreational use in the study area?
No. All recreational areas, amenities and networks will be re-established following construction. The presence of an LRT stop in the valley will also increase the accessibility of many nearby amenities; this will be a positive change.

Will any long-term losses or alterations to recreational infrastructure occur as a result of the project?
Alterations, yes, but no losses. Minor pathway realignments will be required following the addition of new infrastructure in the study area; however, these will not comprise substantial changes to the pathway system. Some ski club lift terminals will require relocation and some runs may have to be adjusted. At present, some uncertainty exists regarding the ability to adjust runs to fully equivalent capability but the commitment to do so is there.

Will construction or operations interfere with special events such as the Edmonton Folk Music Festival and Dragon Boat Festival (EDBF)?
Yes, to some degree. The City has demonstrated a commitment to ensure that the Edmonton Folk Music Festival is able to function during construction; however, some minor adjustments to normal festival operations are inevitable. The acoustic environment will not be affected. The EDBF will be temporarily affected during construction and the race may be affected during the in-stream works as the race finish line is currently situated at the Cloverdale bridge.

Will bicycle parking be provided at the Muttart Stop?
Yes. Design details are not currently available; however, some form of bicycle parking will be provided at the Stop.

Will the project result in a loss of green space?
A relatively small amount of green space will be lost during the construction phase, but the vast majority of this (with the exception of land occupied by permanent infrastructure) will be returned to parkland following construction completion.

7.7.2.4 Visual Resources

Will construction activities adversely affect the visual resources of the North Saskatchewan River Valley?
Yes. As with all large construction projects, the quality of the visual environment in the study area will be compromised during the construction period; however, recommendations have been made that would considerably reduce the visual impact of construction activities.

Will the new LRT components affect the quality of views from within the valley or from the top-of-bank?
Yes, but not necessarily in a negative way. The visual impacts of the LRT have been a consideration in the design process, and considerable efforts have been made to design an alignment that will blend into and complement its surroundings, rather than one that is visually intrusive. Landscaping will be used as a screen, and landscape design will aim to soften the visual presence of LRT infrastructure. The new river bridge and Connors Road pedestrian bridges are likely to be viewed as positive changes by many.

Will the new LRT components affect the quality of views from residential areas within and outside of the NSRV?
Yes, but see the response to the preceding point. Changes to river valley views are inevitable, but need not be negative.

Will utilitarian infrastructure be screened, and will screening be natural in character?
Yes, natural (i.e., vegetative) screening will be incorporated into landscape design.

7.7.2.5 Utilities

Will relocation or installation of underground utilities increase the area to be disturbed?
There is some potential for limited disturbance outside of the project area. Further investigation will be required during detailed design. All impacts will be mitigated.

7.7.2.6 Worker and Public Safety

Are there any potential interactions between project activities, the project area, and/or identified environmental impacts specific to this project and to the

environment at the study site that could create a risk to worker and/or public health?
Yes. A number of potentially hazardous interactions have been identified; however, implementation of recommended mitigation measures will be adequate to control risks.

7.7.3 *Valued Historic Components*

Are historical resources vulnerable to disturbance by the project or has the Province provided historical resources clearance that indicates that resources are not at risk and clears the project for construction?
Studies have indicated low potential for historic resources to be affected. Alberta Culture has not yet issued a Clearance Letter for the project; however, a response is expected imminently.

Do project activities have the potential to adversely impact any undocumented historic (including paleontological) resource sites or artifacts? Will the Province require monitoring of any subsurface construction activities?
Yes/probably. Bedrock layers have been identified as having paleontological potential, and some LRT structures might intersect with bedrock layers. As a Clearance Letter has not yet been received by the province, monitoring requirements are unknown; however a specialist has recommended construction monitoring at select locations.

7.8 Summary and Conclusions

The Valley Line–Stage 1 LRT requires a river valley crossing to connect to southeast Edmonton. It is clear that federal and provincial government legislation, environmental permitting processes, standard operating procedures and best management practices can serve to protect Edmonton’s aquatic resources and some terrestrial resources such as migratory birds. However, the remainder of Edmonton’s natural and social resources is protected solely by City of Edmonton plans, bylaws and policies. One of the most powerful instruments at Edmonton’s disposal is the NSRV ARP Bylaw (7188) and the attendant environmental assessment process. This process has provided an opportunity for LRT D and C to examine the proposed project’s potential impacts on all river valley resources including, perhaps most importantly, those solely within the City’s jurisdiction. The assessment process has identified several natural and recreational resources likely to be adversely affected, and several impacts on residents living in proximity to the river valley, but has also identified numerous means of mitigating adverse effects. Some identified means are high level, such as requiring development of plans and procedures to take into the next project phase, others are quite specific, such as requiring maintenance of vegetation roots when clearing in advance of other construction activities, and, transplantation of rare plants.

A specific example of an issue that is municipal only is the final alignment of Connors Road. Results of this assessment suggest that prudent stewardship of City Natural Areas (native vegetation), habitat connectivity, wildlife movement, and aesthetics, dictates that the alignment most closely assessed here (the southerly alignment) be shifted to the north. Conversely, the potential of the northern alignment to more adversely affect recreation amenities and events, suggests consideration of the southern alignment. Therefore, this assessment concludes that a more central alignment, one between the two options should be investigated.

The P3 delivery model for Valley Line-Stage 1 LRT has influenced this assessment and will continue to influence environmental planning and protection. The procurement process is the City's next opportunity to ensure that sound stewardship of river valley resources carries on under the purview of the P3 proponent. This assessment has identified numerous means of doing this and provides specific commitments and suggestions that will to be carried forward into the P3 Procurement phase. As the P3 procurement documents are developed and the City begins to evaluate proposals that deviate from the Reference Design, several municipal plans and policies, such as Edmonton's environmental strategy, suggest that these proposals should be evaluated, in part, on their adverse or positive impact on specific river valley resources that are under the sole jurisdiction of the City. The measures and recommendations set out in this EISA provide guidance to assist in doing this. The documents to be prepared in the P3 Procurement phase will provide specific performance measures for proposal evaluation. LRT D and C has committed to providing opportunity for numerous City representatives to participate in preparation of performance specifications and plan evaluation. In addition, where a P3 proposal deviates significantly from the Reference Design or physically affects lands or resources outside of the project area and on Bylaw 7188 lands, the proposal will be subject to assessment under Bylaw 7188.

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8.2 Personal Communications

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Appendix A. Advances on Alignment at Connors Road

Subsequent Planning Advances for LRT Alignment along Connors Road

Development of an EISA for a project as large in scale as the Valley Line-Stage 1 is a lengthy process and requires that the design be "frozen" at the beginning of the assessment. The main body of this EISA, drafted in April and early May 2013, therefore reflects design achieved as of early April 2013 and as documented in detailed design reports prepared by the consulting engineers. Importantly, since that time, concurrent with the draft EISA preparation and review, design work continued on the track corridor alignment where it parallels Connors Road (on Connors Hill) and three alignment options were evaluated. Although it was not feasible to integrate that concurrent work into the main body of the EISA, resource and assessment information was available to the engineering design process and their options evaluation did incorporate environmental information and considered potential impacts. The additional Connors Road design work culminated in a final alignment recommendation that was submitted to LRT D and C in April 2013. The memo (Connected Transit Partnership 2013) concluded the following:

> "…Option 3 (full encroachment to the south slope) has the highest negative ratings in terms of south slope environmental impacts, south slope structural requirements, roadworks, constructability/road closures, visual impacts and costs. Therefore, Option 3 has been eliminated from any further evaluation.
>
> Options 1 and 2 are both feasible alternatives, with Option 1 having the greatest impacts on the Ski Hill, Folk Festival gatherings, and Option 2 providing a more balanced impact including the community to the south and somewhat reduced impacts to the north.
>
> In May 2012, City Council approved a P3 delivery methodology for the Valley Line Stage 1 (Mill Woods to Centre West). P3 delivery constitutes design, build, finance, operate and maintain for a 30 year term. One advantage of a P3 delivery is the potential for consortia to bring innovative and optimized, design and construction solutions to the project.
>
> The North Saskatchewan River Valley is a highly visible and sensitive area with numerous geotechnical, environmental and topographical challenges. To facilitate and encourage P3 consortia to bring forward innovative, aesthetic and cost effective solutions, the procurement process will include a number of technical submissions that will be evaluated either as "pass-fail" gates or perhaps as part of a qualitative scoring in addition to bottom line cost.
>
> Option 1 will be included in the Reference Design and presented at Stage 5 Public Open Houses with a caveat stating that flexibility will be included in the contract documents to permit the P3 consortia to propose alternatives that do not encroach any further south than Option 2. This flexibility will allow the P3 consortia to be innovative in optimizing the current 30% design as the detailed designs are developed. "

This recommendation was formally adopted by LRT D and C in June 2013 and will be carried forward as part of the Reference Design into the P3 Procurement phase. The recommendation is now public. It was presented in discussions with select affected stakeholders, at an LRT public open house held on 19 June 2013 and is now available on the City's website.

This EISA was finalized in early July 2013. Finalization includes provision of this appendix to acknowledge the above advances and decisions made around the Connor Road alignment since the draft preparation. Specifically, this appendix includes the following components:

- This update statement, prepared by Spencer Environmental.
- The full CTP 2013 Connors Road Report from which the above excerpt was taken.
- A copy of the display board presented at 19 June 2013 public open house.

Option 3, the southernmost alignment, was the primary option analysed in the draft EISA, and in the main body of this final EISA document. With the above-described recent developments, Option 3 has been removed from consideration in favour of a more northern alignment. This decision agrees with a recommendation in the EISA to consider a more northerly LRT alignment along Connors Road. As a result of this decision, and with appropriate mitigation and construction techniques, many of the impacts identified in the main body of this EISA for lands in the vicinity of Connors Road will now be reduced. This is particularly true with respect to visual impacts, permanent loss of wildlife habitat, permanent loss of vegetation, barriers to wildlife movement and encroachment on a recognized Natural Area. Conversely, there may be a greater need for a reforestation patch directly north of the corridor to provide for habitat connectivity. In addition, some socio-economic impacts may be increased in association with the increased encroachment on Gallagher Park. A more northerly alignment may also reduce impacts on rare plants, depending on the final alignment in relation to the precise locations of rare plants populations.

Report Cited:

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City of Edmonton

Preliminary Engineering – Southeast to West LRT (Valley Line, Stage 1) Connors Road Report

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Project Number:

60222337

Date:

April, 2013

Lead by AECOM, connectEd Transit Partnership is a brand to identify the numerous specialist subconsultants that have the global market leadership and local presence to provide the City of Edmonton with the required consulting services to develop and implement highly reliable and effective public transport . The connectEd Transit Partnership is comprised of AECOM, Hatch Mott MacDonald, DIALOG, ISL, GEC and various other specialized consultants.

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- may be based on information provided to Consultant which has not been independently verified;
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- was prepared for the specific purposes described in the Report and the Agreement; and
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Executive Summary

The Southeast LRT Concept Plan, Downtown to Mill Woods was approved by City Council on January 19, 2011. The Concept Plan proposed LRT on the north side of the existing Connors Road. This alignment requires the placement of fill material and retaining structures and impacts the existing Gallagher Park and ski hill operated by the Edmonton Ski Club. Initial geotechnical reviews identified concerns regarding the fills and retaining structures on the north side and their impact on slope stability.

A thorough investigation of the Connors Road alignment options has been ongoing throughout Preliminary Design of the Valley Line Stage 1. The Concept Plan, initial geotechnical reviews, and value engineering workshops all suggested investigating the realignment of Connors Road to the south in an effort to minimize fills on the north side of Connors Road and to minimize impacts on the ski hill and Gallagher Park. All materials presented to date through the public engagement process have illustrated Option 3, realigning Connors Road to the south (full encroachment into the south slope). Presentation of this alignment option has spurred several additional meetings with affected stakeholders.

In the early stages of Preliminary Engineering, several solutions were developed and assessed based on the impacts to the Edmonton Ski Club and Gallagher Park, slope stability, geotechnical and environmental risks, and noise. Optimization of design and consideration of stakeholder and public input led to three Connors Road alignment options that were analysed to a high geotechnical level to mitigate concerns relating slope stability. From a geotechnical perspective, all three Options are deemed feasible provided that adequate slope reinforcement measures are implemented to improve the stability of the existing slopes and minimize the risk of future slope movements. As a result of geotechnical feasibility, other factors such as environmental, roadworks, drainage, structures, ski hill/folk festival and community impacts, constructability, visual impact in the river valley, and costs are all critical items to consider.

Based on the Connors Road Alignment Options – Comparison Matrix provided in this report, it is clear that Option 3 (full encroachment to the upper south slope) has the highest negative rating on several criteria. CTP therefore recommends that Option 3 be eliminated from any further evaluation.

Options 1 and 2 are both feasible alternatives, with Option 1 having the greatest impacts on the Ski Hill and Folk Festival gatherings, and Option 2 providing a more balanced impact including the community to the south and somewhat reduced impacts to the north.

In May 2012, City Council approved a Public Private Partnership (P3) delivery methodology for the Valley Line Stage 1 (southeast Stage). P3 delivery constitutes design, build, finance, operate, and maintain for a 30 year term. One advantage of a P3 delivery is the potential for consortia to bring innovative and optimized design and construction solutions to the project.

The North Saskatchewan River Valley is a highly visible and sensitive area with numerous geotechnical, environmental, and topographical challenges. To facilitate and encourage P3 consortia to bring forward innovative, aesthetic, and cost effective solutions, the procurement process will include a number of technical submissions that will be evaluated either as “pass-fail” gates or perhaps as part of a qualitative scoring in addition to bottom line cost. In terms of moving forward, CTP recommends that Option 1 be included in the Reference Design and presented at Stage 5 Public Open Houses with a caveat stating that flexibility will be included in the contract documents to permit the P3 consortia to propose alternatives that do not encroach any further south than Option 2.

Table of Contents

List of Figures

List of Tables

1. Concept Plan

The City of Edmonton's strategic transportation vision "The Way We Move" provides the framework for how the City will accommodate future transportation challenges. Expansion of the City's light rail transit (LRT) system was identified as a key component in creating a livable, sustainable city. Following the approval of "The Way We Move", the LRT Network Plan was developed. This plan recommended low floor vehicle technology for new LRT lines that do not interline with the existing high floor vehicle technology currently in operation in Edmonton. Features of this new, urban style LRT include smaller scale stops that are spaced closer together, serving multiple activity centres with greater emphasis on integration into adjacent communities.

During the Valley Line Stage 1 Corridor Selection, two corridors, Connors Road and Dawson Bridge, were advanced to a second screening analysis. The Connors Road alignment was selected as the preferred corridor for the following reasons:

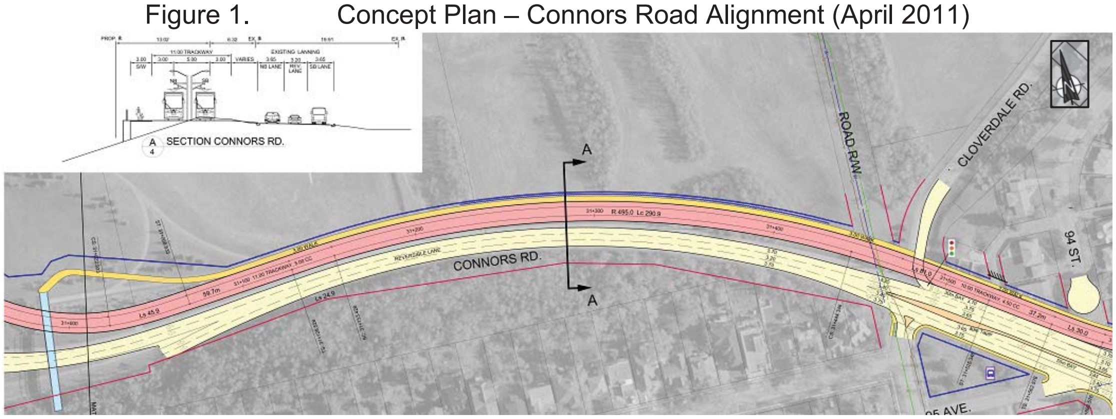
- better aligns with the goal of promoting a compact urban form,
- most direct corridor resulting in faster travel times,
- results in strong potential ridership,
- reinforces current major transit patterns from Downtown to Mill Woods,
- results in slightly fewer impacts to programmed parks areas, and
- shows an advantage in serving redevelopment areas.

The Valley Line Stage 1, Downtown to Mill Woods, Recommended Corridor was approved by City Council in December 2009. At the same meeting, City Council also approved initiation of Concept Planning to evaluate a preferred alignment within the corridor, traffic impacts, costs and other issues.

The Southeast LRT Concept Plan, Downtown to Mill Woods, was approved by City Council on January 19, 2011. The Concept Plan proposed LRT on the north side of the existing Connors Road as illustrated in Figure 1. Concept Plan – Connors Road Alignment. The Concept Plan alignment requires fill material and retaining structures to support the LRT and impacts the existing Gallagher Park and ski hill operated by the Edmonton Ski Club. This alignment does not impact the existing topography and vegetation on the south side of Connors Road.

The Concept Plan stated that during future phases of design development, consideration should be given to the evaluation of realigning Connors Road to the south to reduce the amount of retaining structure and to reduce the overall impact on the Edmonton Ski Club hill and Gallagher Park. The idea to further consider realigning Connors Road to the south was noted on several occasions throughout the Concept Plan.

Figure 1. Concept Plan – Connors Road Alignment (April 2011)



During Concept Planning, an initial desktop geotechnical review was conducted by Thurber Engineering Ltd. The geotechnical review stated the following:

"Placement of fill on the lower slope below the existing roadway has the potential to reduce the local stability of the existing slope and will need to be evaluated during future phases of the design.

There is insufficient existing geotechnical information on the soil and groundwater conditions to quantitatively assess the potential impact of the SELRT grade construction on the slope stability. However, based on the preliminary assessment it is considered that widening of the right of way with appropriate retaining structures is technically feasible from a geotechnical aspect. It is expected that the retaining walls may require support by piles and possibly also tie backs or other support methods, depending on the wall height, in order to maintain adequate slope factor of safety.

Consideration may also be given to partial relocation of the existing Connors Road southwards towards the upper slope section near the crest of the valley to reduce the potential amount of fill over the down slope side of the roadway. This may potentially reduce the overall impact on the valley slope stability and should be evaluated during subsequent phases of the study to optimize the slope works. Any cuts into the existing slopes would have to be retained by appropriate retaining walls designed to maintain the existing level of slope support."

2. Value Engineering

During an initial Value Engineering workshop conducted in November of 2011, a list of concerns was generated for the Valley Line Stage 1. The suggestions were evaluated at a high level and higher risk items were shortlisted for further evaluation. Due to the geotechnical history in this area, environmental impacts in the North Saskatchewan River Valley and impacts on the Edmonton Ski Club and Gallagher Park, the alignment of the LRT through the Connors Road corridor was identified as a high risk area. It should be noted that the following concerns were also raised by stakeholders during the Concept Planning phase: negative impact on the Edmonton Ski Club due to reduction in length and slope of ski hill; and Edmonton Folk Festival concerns regarding noise pollution and encroachment into Gallagher Park.

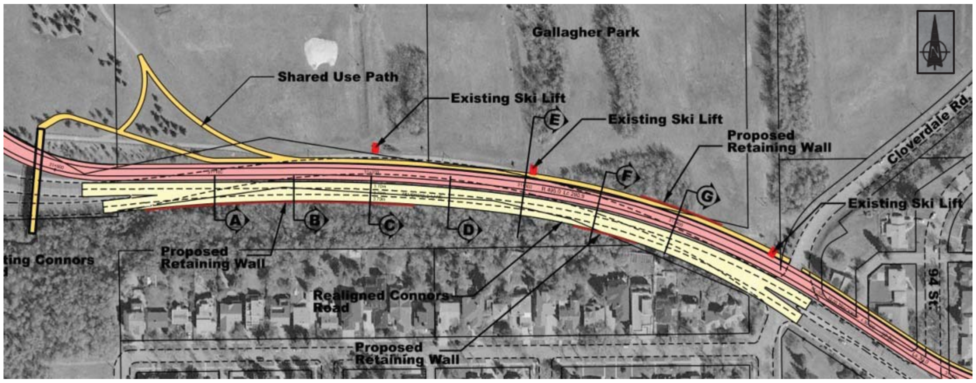
Mitigation strategies developed at the Value Engineering workshop to address high risk concerns related to the Connors Road corridor included the following:

- remove traffic lane from Connors Road,
- move Connors Road to the south,
- align tracks closer to Connors Road,
- terrace trackway and roadway, and
- cut and cover.

Following the Value Engineering workshop, the option of eliminating a lane of traffic from Connors Road was reviewed. Connors Road operates as a 3 lane arterial and is one of a limited number of commuter corridors from southeast Edmonton that provides access to a North Saskatchewan River Crossing and Downtown Edmonton. Connors Road currently carries 24,000 vehicles\day and as the City grows, estimated volumes on Connors Road will escalate to 36,000\day in 2041. Eliminating the existing reversible lane would force existing and future traffic volumes to divert onto the surrounding roadway network, specifically 99 Street and 75 Street. The reassignment of traffic from Connors Road will add significantly to the congestion levels on both 99 Street and 75 Street. Reducing the number of lanes from three to two lanes would reduce the encroachment onto the hill by approximately 4m, which would not be sufficient to eliminate the need for retaining fills and structures. Removal of traffic lanes on Connors Road was not identified in the City Council Approved Concept Plan, does not eliminate the need for retaining fill on the north side of Connors, and will result in significant added congestion on the adjacent roadway network. Therefore, the option of removing a traffic lane from Connors Road was eliminated from any future evaluation.

Further consideration of the mitigation strategies developed at the Value Engineering workshop resulted in a technical evaluation of realigning Connors Road to the south (approximately 15m) in conjunction with reducing the separation between the LRT and Connors Road (see Figure 2. Preliminary Engineering – Connors Road Realignment (February 2012)). This realignment results in the loss of approximately 0.7 acres of existing City-owned woodland on the south side of Connors Road, and aligns a majority of the proposed LRT alignment along the existing Connors Road.

Figure 2. Preliminary Engineering - Connors Road Realignment (February 2012)



Four alternative design solutions that had been previously discussed at the Value Engineering workshop were prepared for Cross Section B and are illustrated in Figure 3. Preliminary Engineering - Connors Road Realignment Options (February 2012). The following outlines the high level details of these four design solutions:

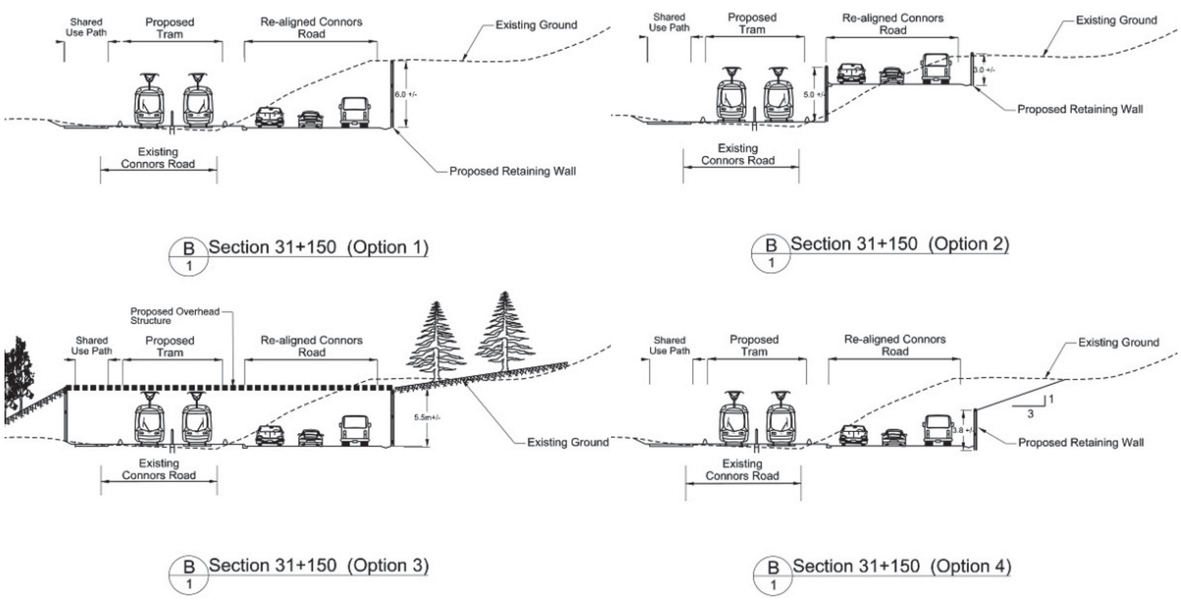
- Option 1: full height retaining wall
  - Approximately 6.0m height of retaining wall
  - Option carried forward for further evaluation

- Option 2: terraced trackway and roadway
  - Two retaining walls varying between 3m to 5m in height
  - Option eliminated due to structural costs

- Option 3: cut and cover
  - Approximate cut of 5.5m with an extension of park space as cover
  - Option eliminated due to structural costs

- Option 4: increased slope of hillside with reduced retaining wall height
  - Approximately 3.8m height of retaining wall
  - Increased excavation and impact to woodland south of Connors Road
  - Option carried forward for further evaluation

Figure 3. Preliminary Engineering - Connors Road Realignment Options (February 2012)



The conclusion from this initial evaluation was to proceed with further evaluation of realigning Connors Road to the south with consideration of both Option 1 and Option 4 cross sections, and to collate additional geotechnical information on the existing soils and slope stability.

3. Preliminary Engineering Geotechnical Site Investigation

An initial geotechnical site investigation throughout the North Saskatchewan River Valley was carried out by Thurber Engineering Ltd between October and November 2011. The site investigation for the LRT alignment was comprised of the following:

- desktop review of air photos, available geologic/geotechnical data, topographic information and archived records of historic activities in the area,
- site visits,
- test hole drilling and instrument monitoring, and
- laboratory testing.

Following the completion of the borehole drilling and testing, a geotechnical report was prepared summarizing the overall appraisal of the geotechnical conditions along the alignment, the potential challenges related to geotechnical issues, and impacts of the geologic/geotechnical conditions on the proposed LRT facilities.

In regard to Connors Road, the geotechnical report stated:

"The stratigraphic profile in the area consists of man-made fills associated with the grading and landscaping activities in the seventies and eighties, colluviums materials derived from sloughing and slumping of the valley slope, native lucustrine and glacial deposits overlying bedrock. Because of the steeply sloping terrain at the Edmonton Ski Club, fill heights could be up to 5m in places. Depending on its lateral extent and height the placement of additional fill may trigger slope instabilities. Two failure modes are possible: shallow slumping of the existing fill and colluvium material and deep seated sliding along the bentonite zones or weak horizons in the bedrock.

Existing fills at the test holes were up to 4.6m thick in some places and appeared to be the thickest near the top of Connors Road. Test hole results indicated that the fill comprised clayey soils with pockets of organic material and was firm to stiff in consistency. It is possible that existing fills associated with the grading of the ski hill were placed in a somewhat uncontrolled manner. Slope instabilities associated with loading of these fills and any underlying disturbed colluviums are of concern. In addition, the variability and lower quality of the fill material and the inclination of the hill slopes could have adverse impacts on the capacity of pile foundations subjected to lateral loads.

Test holes identified a bentonite seam some 8m below the elevation of the slope toe. It is not anticipated that this bentonite zone will have a substantial impact on stability. Nevertheless, some of the bentonite faces of the clay shale bedrock were characterized by low shear strength. Fill loading may trigger instabilities seated in these weaker horizons of the bedrock. It should be noted however that there is no known history of instability at this site and the presence of a wide river terrace in front of the slope toe protects it from river action.

Once the configuration of the LRT structures in this area is developed, slope stability analyses will be performed to assess the two failure modes identified above, and recommendations pertaining to any required slope stabilization measures will be provided. In general, however, design measures aimed at reducing the lateral extent and height of additional fills would be preferred. Such measures may include shifting both Connors Road and the proposed LRT alignment to the south, or supporting the LRT track way on a structural system that requires minimal or no fills."

4. Stakeholder Involvement

4.1 Public Involvement Plan

As defined in City of Edmonton's Public Involvement Policy and Framework, a Public Involvement Plan was developed for the Valley Line (Southeast to West) LRT Preliminary Design stage. The approved Public Involvement Plan recommended five stages of consultation as follows:

- Stage 1 - Pre Consultation (November 2011 – February 2012)
- Stage 2 – Initiation (March – April 2012)
- Stage 3 – Consultation (May – June 2012)
- Stage 4 – Refinement (September 2012 – May 2013)
- Stage 5 – Conclusion (June 2013 – November 2013)

The Valley Line extends from Lewis Farms in west Edmonton to Mill Woods Town centre in southeast Edmonton. The line is 27 km long, and to facilitate the public involvement process, the line was split into the following 6 areas:

- Area 1- Mill Woods Town Centre to Whitemud Drive
- Area 2 - Whitemud Drive to Argyll Road
- Area 3 - Argyll Road to Strathearn
- Area 4 - Strathearn to Centre West
- Area 5 - Centre West to 149 Street and,
- Area 6 - 149 Street to Lewis Farms

4.2 Consultation

Connors Road is located within Area 4 - Strathearn to Centre West. All open houses for Area 4 were held at the Northern Alberta Pioneers Cabin (a.k.a. Old Timers Cabin) on Scona Road. Open Houses that have been conducted to date for Area 4 are listed below:

- Stage 2 - April 11, 2012,
- Stage 3 – June 14, 2012, and
- Stage 4 - September 24, 2012.

Throughout all of these open houses, the Connors Road alignment was shown as realigned to the south with retaining walls. In addition to the open houses, meetings specifically relating to Connors Road were also held with the Cloverdale Community League, Edmonton Ski Club, Edmonton Folk Music Festival and 95 Avenue resident groups.

Concerns with the proposed design heard at these meetings include:

- Geotechnical stability
- Construction- and operation-related noise and vibration
- Impacts to wildlife and natural areas
- Aesthetics of bank and realigned road and track rights of way from north and south views
- Potential impacts to private property and components (wall, deck, landscaping) at the top of bank

The analysis that follows has considered the above-listed concerns.

4.3 Connors Road Alignment Evaluation

Continued consultation between the City of Edmonton and the aforementioned stakeholders resulted in an agreement to evaluate the following three alignment options for Connors Road and the LRT:

- Option 1 – Concept Plan
  - retain existing Connors Road with trackway encroaching to north into Gallagher Park
- Option 2 - Partial encroachment to the south
  - trackway not to encroach south of the existing Connors Road south curb
- Option 3 – Full encroachment to the south
  - as shown at Stage 2, Stage 3, and Stage 4 open houses

4.3.1 Urban Traffic Noise Policy

When the City plans to build or upgrade a major transportation facility, such as the Southeast to West LRT, adjacent to or through a residential area, it must follow the Urban Traffic Noise Policy (C506A) to determine if and where noise attenuation (noise barriers) should be built. The policy states:

"The City of Edmonton will seek to achieve a projected attenuated noise level below 65 dBA Leq24 or as low as technically, administratively, and economically practicable, where any urban transportation facility (arterial roadways or light rail transit) is proposed to be built or upgraded through or adjacent to a developed residential area where private backyards will abut the transportation facility."

Noise modelling was undertaken and confirmed through the Preliminary Design stage of the project, and has identified that noise levels exceed 65 dBA Leq24 in the areas adjacent to five residential properties on 95 Avenue. Therefore, the properties abutting the LRT right of way are eligible for the construction of a noise attenuation mechanism such as a wall, per Figure 4 below. The location of this wall is common to all three of the design Options that follow.

Figure 4. Noise Attenuation Structure Location

The City of Edmonton will contact eligible property owners later in 2013 to solicit feedback on 1-3 options for the finishing treatment of this noise attenuation wall.

4.3.2 Option 1 – Concept Plan

4.3.2.1 Road Alignment

Option 1 maintains the existing Connors Road alignment as illustrated on Figure 5. Option 1 - Concept Plan - Road Alignment. Maintaining the existing Connors Road results in no impact to the existing road structure, road drainage, utilities and also preserves the existing woodland environment to the south of Connors Road. This option does not warrant retaining structures on the south side of Connors Road. From a traffic management and constructability point of view, it will be possible to maintain a minimum of two lanes of traffic flow on Connors Road during construction with only some minor, off-peak lane closures. Roadway rehabilitation (pavement, curb, and gutter) costs have been included in Option 1 estimates.

Figure 5. Option 1 - Concept Plan - Road Alignment

4.3.2.2 Track Alignment

Option 1 track alignment is located immediately north of the existing Connors Road, encroaching into Gallagher Park and the ski hill as illustrated on Figure 6. Option 1 - Concept Plan - Track Alignment. Option 1 track alignment geometry has been optimized to reduce the separation between the existing Connors Road and the track. This track alignment poses the largest impacts to Gallagher Park, north of Connors Road, and will result in the greatest loss of existing vegetation north of Connors. Impacts to the Edmonton Ski Club include the reduction in length of the ski hill and the relocation of three existing ski lift structures. Of the three options reviewed, Option 1 presents the most significant impact to the ski hill. Option 1 requires an additional separate drainage system for the trackway.

Figure 6. Option 1 - Concept Plan - Track Alignment

4.3.2.3 Structures

Given the geotechnical concern about placement of fills on the north side of Connors Road and potential future slope movement, a significant length of the LRT will be supported on piles, which are underground structural supports. This is required to support both the track and the shared use path, and to serve as a slope reinforcement element to protect the stability of the slope (see Figure 7. Option 1 – Concept Plan – Structures). Pile lengths of approximately 25m are required to provide sufficient embedment into bedrock. Option 1 maintains the existing Connors Road alignment, and therefore does not introduce retaining wall requirements along the South side of Connors Road.

Figure 7. Option 1 - Concept Plan - Structures

4.3.2.4 Cost Estimate

Option 1 has an approximate cost of approximately $12 million (Table 1. Option 1 – Concept Plan – Cost Estimate). This cost includes site clearance removals, road rehabilitation, structures and relocation of three ski lift structures. No costs associated with any potential off-corridor road improvements have been included in this estimate.

Table 1. Option 1 - Concept Plan - Cost Estimate

Item	Total
Removals	$50,000
Roadworks	$800,000
Structures	$5,500,000
Impact on Ski Hill	$750,000
Sub-Total	**$7,100,000**
Other (Design, Contingencies, Management, General)	$4,000,000
Total	**$11,100,000**

4.3.3 Option 2 – Partial Encroachment to South

4.3.3.1 Road Alignment

Option 2 is a compromise of both Option 1 and Option 3, in which Connors Road is realigned so that it only partially encroaches into the existing slope on the south side (Figure 8. Option 2 - Partial Encroachment to South - Road Alignment). The existing road structure from just east of the existing pedestrian overpass to west of the 95 Street intersection will require total reconstruction along with relocation of existing utilities. Option 2 includes installation of new drainage to accommodate both the realigned Connors Road and tracks, accompanied by a new storm water management facility at the base of Connors Hill. Partial encroachment to the south introduces the need for a retaining structure on the south side of Connors Road, impacting the existing woodland area to the south. To construct the realigned Connors Road and associated retaining walls, total closure of Connors Road will be required for at least one construction season. Timing of the closure will have to be co-ordinated with roadway closures associated with construction on Walterdale Bridge. Traffic detouring and management will have to be determined to confirm routing and potential off-corridor improvements prior to implementation.

Figure 8. Option 2 - Partial Encroachment to South - Road Alignment

4.3.3.2 Track Alignment

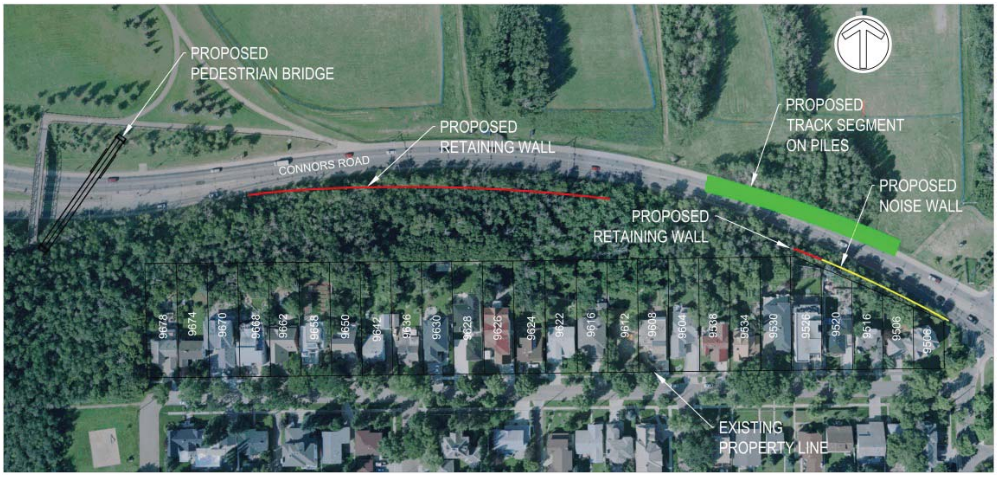
Option 2 locates the track alignment immediately north of the realigned Connors Road, such that it does not encroach any further south than the existing south curb of Connors Road (see Figure 9. Option 2 - Partial Encroachment to South - Track Alignment). As with all the presented alignment options, the track alignment impacts the existing vegetation north of Connors Road. This option has less of an impact on the ski hill than Option 1, requiring the relocation of only two ski lift structures. Option 2 requires an additional separate drainage system for trackway.

Figure 9. Option 2 - Partial Encroachment to South - Track Alignment

4.3.3.3 Structures

Given that an increased length of track is accommodated on the existing Connors Road, the length of track on piles is reduced from Option 1 as shown on Figure 10. Option 2 - Partial Encroachment to South - Structures. Encroachment into the south slope of the existing Connors Road necessitates construction of two retaining walls totalling approximately 260m in length. The west wall has a maximum of height of 6m and the east wall a maximum height of 3m. It should be noted that the east wall would be jointly used in conjunction with the required noise wall to provide attenuation to residential properties west of 95 Street. To achieve adequate long term stability for the excavated slopes, two types of pile retaining walls are recommended. For the shallower cuts near the top of Connors Road, a row of discrete cantilever piles with permanent shotcrete lagging is recommended. For the deeper cuts along the central section of the alignment, concrete soldier piles, ground anchors and permanent shotcrete lagging is recommended. Geosynthetic wall drains should be installed behind the shotcrete and connected to a drainage pipe to prevent hydrostatic water pressure from building behind the wall. Site clearance and construction associated with the retaining walls on the south side of Connors Road will be challenging.

Figure 10. Option 2 - Partial Encroachment to South - Structures



4.3.3.4 Cost Estimate

Option 2 has an approximate cost of $21 million (Table 2. Option 2 – Encroachment into South Slope – Cost Estimate). This cost includes site clearance, removals, road reconstruction, structures, relocation of two ski lift structures, and drainage improvements. No costs associated with any potential off-corridor road improvements have been included in this estimate.

Table 2. Option 2 – Partial Encroachment into South Slope – Cost Estimate

Item	Total
Removals	$200,000
Roadworks	$1,750,000
Structures	$11,000,000
Impact on Ski Hill	$500,000
Sub-Total	**$13,450,000**
Other (Design, Contingencies, Management, General)	$7,500,000
Total	**$20,950,000**

4.3.4 Option 3 - Full Encroachment to South

4.3.4.1 Road Alignment

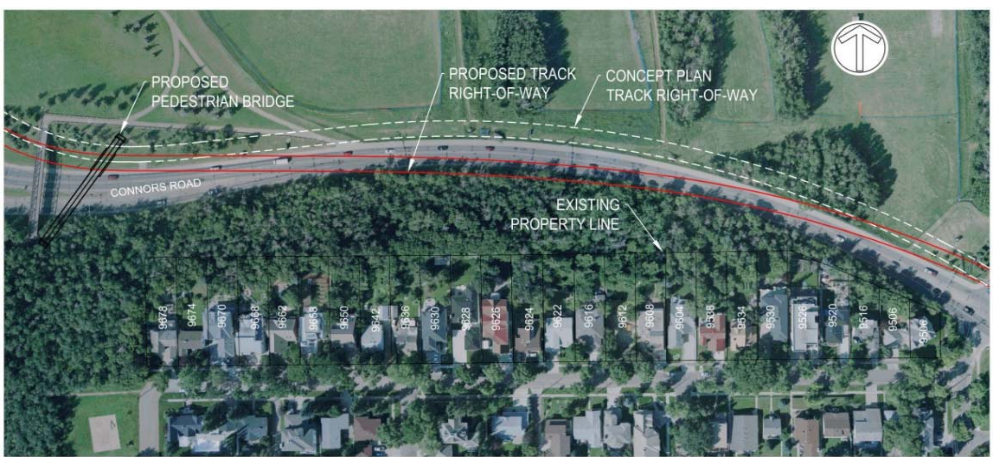
Option 3 consists of the deepest encroachment into the existing south slope. (Figure 11. Option 3 - Full Encroachment to South - Road Alignment). Virtually the entire length of Connors Road from the existing pedestrian overpass to 95 Street will be realigned, requiring the removal of the equivalent length of the existing Connors Road and all associated utilities. As with Option 2, this option requires the installation of new drainage to accommodate both the realigned Connors Road and tracks, accompanied by a new storm water management facility at the base of Connors Hill. Full encroachment into the south side requires longer and higher retaining walls and has the greatest impact on the existing south side vegetation. To construct the realigned Connors Road and associated retaining walls, total closure of Connors Road will be required for at least one construction season. Timing of the closure will have to be co-ordinated with roadway closures associated with construction on Walterdale Bridge. Traffic detouring and management will have to be determined to confirm routing and potential off corridor improvements prior to implementation.

Figure 11. Option 3 - Full Encroachment to South - Road Alignment

4.3.4.2 Track Alignment

The Option 3 track alignment is located immediately north to the proposed realigned Connors Road as illustrated in Figure 12. Option 3 - Full Encroachment to South - Track Alignment). Option 3 has the least impact on the existing vegetation on the north side of Connors Road. As for the Edmonton Ski Club ski hill, only one ski lift structure at the top of Connors Road has to be relocated. Option 3 requires an additional separate drainage system for the track.

Figure 12. Option 3 - Full Encroachment to South - Track Alignment



4.3.4.3 Structures

A short section, approximately 80m, of track towards the top of Connors Road is supported on piles as illustrated in Figure 13. Option 3 - Full Encroachment to South - Structures). The deepest encroachment into the south slope necessitates the longest and highest retaining walls. Similar to Option 2, two separate walls totalling approximately 355m in length are required. The west wall has a maximum of height of 7m and the east wall a maximum height of 3m. It should be noted that the east wall would be jointly used in conjunction with the required noise wall to provide attenuation to residential properties west of 95 Street. To achieve adequate long term stability for the excavated slopes, two types of pile retaining walls are recommended. For the shallower cuts near the top of Connors Road, a row of discrete cantilever piles with permanent shotcrete lagging is recommended. For the deeper cuts along the central section of the alignment, concrete soldier piles, ground anchors and permanent shotcrete lagging is recommended. Geosynthetic wall drains should be installed behind the shotcrete and connected to a drainage pipe to prevent hydrostatic water pressure from building behind the wall.

Site clearance and construction associated with the retaining walls on the south side of Connors Road will be challenging.

Figure 13. Option 3 - Full Encroachment to South – Structures

4.3.4.4 Cost Estimate

Option 3 has an approximate cost of $27 million (Table 3. Option 3 – Full Encroachment into South Slope – Cost Estimate). This cost includes site clearance, removals, road reconstruction, structures and relocation of a single ski lift pole, and drainage improvements. No costs associated with any potential off corridor road improvements have been included in this estimate.

Table 3. Option 3 - Full Encroachment into South Slope - Cost Estimate

Item	Total
Removals	$200,000
Roadworks	$2,500,000
Structures	$13,500,000
Impact on Ski Hill	$250,000
Sub-Total	**$16,450,000**
Other (Design, Contingencies, Management, General)	$9,000,000
Total	**$25,450,000**

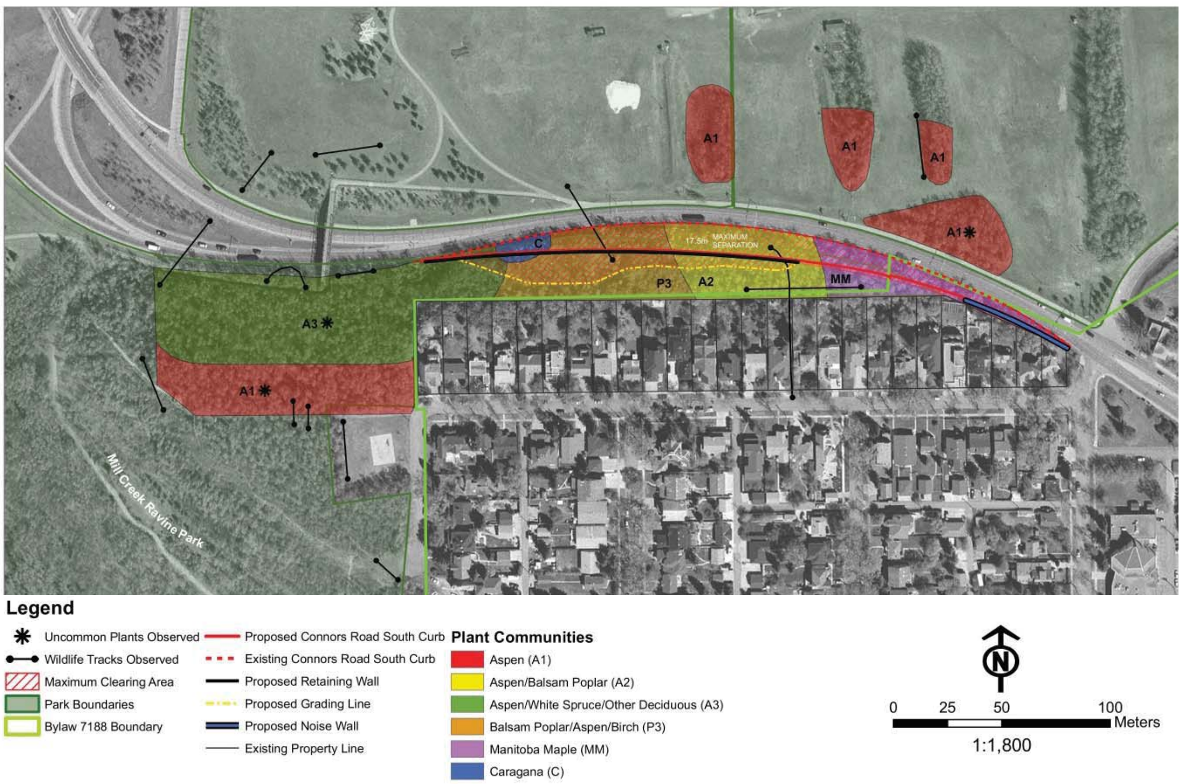
5. Environmental Assessments

Two environmental assessments have been undertaken to identify impacts of LRT and associated construction as listed below:

- Summary of Findings from Environmental Assessment Investigations at Connors Hill (November 2012), and
- Wildlife Passage Considerations and Assessment.

These assessments included vegetation surveys, rare plant surveys (Figure 14. Existing Plant Communities), breeding bird surveys, wildlife movement analysis, ecological connectivity assessment, qualitative evaluation of the habitat quality and rarity within the river valley.

Figure 14. Existing Plant Communities



In addition, as a result of the Valley Line Stage 1 crossing through the North Saskatchewan River Valley, an Environmental Impact Assessment is required to fulfill the requirements of the City of Edmonton's North Saskatchewan River Valley Area Redevelopment Plan (NSRV ARP) (Bylaw 7188). This assessment is ongoing and is anticipated to be presented to City Council later this year.

6. Constructability

In assessing the three options for Connors Road, a series of meetings were held with designers and contractors to collect their input on construction methodologies and scheduling. Presentations and descriptions of all three options were provided along with the geotechnical and environmental reports.

Findings are as follows:

- Accessibility of large construction machinery to the south slope is very challenging and will result in long and intrusive road closures
- Stressed anchors to be installed at approximately 20 degrees to the horizontal for retaining walls on the south side
- Piles to be drilled
- Wall faces to be drained
- To avoid stability issues, construction of retaining walls on the south side will be implemented through small segments at a time. Construction will then “leap-frog” to other sections of the wall, allowing sufficient time for curing before stressing and installation of anchors. This technique requires that specialized construction equipment will continually be moving up and down Connors Road which is inefficient and very time consuming.
- All construction work to be carried out minimizing grading, cuts and fill, and disturbance to existing vegetation.
- Costs and constructability challenges for Option 1 are less than for Options 2 and 3
- Connors Road can remain open during construction of Option 1, but must be closed during construction of both Option 2 and Option 3

7. Conclusion and Recommendations

A thorough investigation of the Connors Road alignment options has been ongoing throughout Preliminary Design of the Valley Line Stage 1. The Concept Plan, initial geotechnical reviews, and value engineering workshops all suggested investigating the realignment of Connors Road to the south in an effort to minimize fills on the north side of Connors Road and to minimize impacts on the ski hill and Gallagher Park. All materials presented to date through the public involvement process have illustrated realigning Connors Road to the south (Option 3 - full encroachment). Presentation of this option has spurred several additional meetings with affected stakeholders and has provided an opportunity for the City to learn about concerns of stakeholders in the area.

In the early stages of Preliminary Engineering, several solutions were developed and assessed based on the impacts to the Edmonton Ski Club and Gallagher Park, slope stability, geotechnical and environmental risks, and noise. Optimization of design and consideration of public input led to three Connors Road alignment options that were analysed to a high geotechnical level to mitigate concerns relating to slope stability.
From a geotechnical perspective, all three Options are deemed feasible provided that adequate slope reinforcement measures are implemented to improve the stability of the existing slopes and minimize the risk of future slope movements. As a result of geotechnical feasibility, other factors such as environmental, roadworks, drainage, structures, ski hill/folk festival impacts, constructability, visual impact in the river valley, and costs are all critical items to consider, as illustrated below in Table 4. Connors Road Alignment Options – Comparison Matrix.

Table 4. Connors Road Alignment Options – Comparison Matrix

Issues associated with Connors Road Alignment	Option 1	Option 2	Option 3
Environmental *Impacts to existing vegetation (grasses, shrubs, trees, etc.) and wildlife:* *- Temporary displacement during construction* *- Permanent displacement due to trackway, roadway, etc. infrastructure*			
• North	3	2	1
• South	1	2	3
Roadworks/Drainage/Utilities *Magnitude of new infrastructure for roadways, drainage, and utilities; extent of upgrades required to existing infrastructure*	1	2	3
Structures** *Extent of structural infrastructure required for trackway, roadway, geotechnical stability, etc.*			
• North	3	2	1
• South	1	2	3
Existing Land Use Impacts *Extent of impact to the existing ski hill slopes, existing skill hill ski lift infrastructure, and Folk Festival*	3	2	1
Constructability *Challenges and risks associated with construction of retaining walls, track structure on piles; impacts to traffic during construction; etc.*	1	2	3
Visual Impact on the River Valley *Level of visual impact on the River Valley assumed directly correlated to the extent of exposed surface of proposed infrastructure*	1	2	3
Cost *Total cost of existing infrastructure removals, construction of roadway, trackway, SUP, geotechnical structural infrastructure, drainage, etc.*	1	2	3
Total	15	18	21

*Note: 1 = lowest (positive)
3 = highest (negative)

**All options include measures to improve stability of existing slope and minimize risk of future slope movement

Based on the above matrix, it is clear that Option 3 (full encroachment to the south slope) has the highest negative ratings in terms of south slope environmental impacts, south slope structural requirements, roadworks, constructability/road closures, visual impacts and costs. Therefore, Option 3 has been eliminated from any further evaluation.

Options 1 and 2 are both feasible alternatives, with Option 1 having the greatest impacts on the Ski Hill, Folk Festival gatherings, and Option 2 providing a more balanced impact including the community to the south and somewhat reduced impacts to the north.

In May 2012, City Council approved a P3 delivery methodology for the Valley Line Stage 1 (Mill Woods to Centre West).
P3 delivery constitutes design, build, finance, operate and maintain for a 30 year term. One advantage of a P3 delivery is the potential for consortia to bring innovative and optimized, design and construction solutions to the project.

The North Saskatchewan River Valley is a highly visible and sensitive area with numerous geotechnical, environmental and topographical challenges. To facilitate and encourage P3 consortia to bring forward innovative, aesthetic and cost effective solutions, the procurement process will include a number of technical submissions that will be evaluated either as “pass-fail” gates or perhaps as part of a qualitative scoring in addition to bottom line cost.

Option 1 will be included in the Reference Design and presented at Stage 5 Public Open Houses with a caveat stating that flexibility will be included in the contract documents to permit the P3 consortia to propose alternatives that do not encroach any further south than Option 2. This flexibility will allow the P3 consortia to be innovative in optimizing the current 30% design as the detailed designs are developed.

Connors Road Alignment

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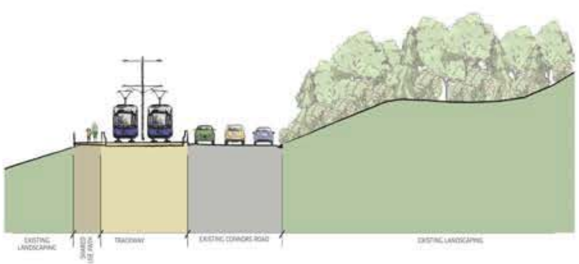
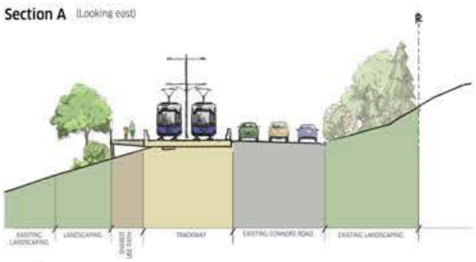
The final recommended preliminary design of Connors Road shown here includes the option of designing and constructing Connors Road as far south as illustrated with the dashed red line.

Legend



Section A (Looking east)



Section B (Looking east)

Concept Rendering View 1

View above looks west down Connors Road.
(See • symbol on plan.)

Concept Rendering View 2

View above looks east up Connors Road.
(See • symbol on plan.)

Edmonton

Appendix B. Materials Consulted in Preparation of Project Description

Materials consulted in the preparation of the project description included 100% design reports and design drawing packages provided by CTP. Specifically, the following documents were consulted during the preparation of the project description.

Final Design Development Reports:
North Saskatchewan River Bridge
Stormwater Management (Revised Final Version)
Traction Power and OCS
Track Design
Quarters Tunnel: Ramps and Portals
Right-of-Way (ROW) Structures
Landscape Architecture
Connors Road Pedestrian Bridge
Stops

Drawing Packages:
Stops
Quarters Tunnel
TPSS
98th Avenue Bridge
Connors Road Pedestrian Bridge
North Saskatchewan River Bridge
River Valley Retaining Walls
Landscape Work

Appendix C. Public Involvement Process

Project:	Southeast to West LRT: Preliminary Design
Department/Branch Responsible:	Transportation Services, LRT Design & Construction
Project Manager:	Nat Alampi – General Supervisor, LRT Design & Construction / SE to W LRT Project Lead, City of Edmonton Elicia Elliott, Public Involvement Advisor, Public Engagement, SE to W LRT
Consultant (if applicable):	Gale Simpson, gWhiz Consulting Ltd. (Co-Lead) Jan Bloomfield, Strategy Plus (Co-Lead) Al Parsons, Gray Scott Consulting Group Ltd. (Strategic Advisor)
Draft or Final Plan:	Final Public Involvement Plan (PIP) 2011-12-23
Other city participants or partners:	

Public Involvement Commitment

Public Involvement (PI) is an integral part and necessary component of major development projects in the City of Edmonton and members of the public have a growing expectation to be involved in initiatives that will impact them. The City is committed to involving key internal and external stakeholders and other interested members of the public during the Preliminary Design Phase of the Southeast to West Light Rail Transit (SE to W LRT) Project.

A comprehensive PI Process was undertaken during the Concept Planning Phase of the SE to W LRT project, and the City wishes to continue to involve stakeholders and the public.

The PI efforts in the Preliminary Design will focus on the following objectives:

- Design the Public Involvement Plan(PIP) based on the *Involving Edmonton Framework - Commitments and Standards of Practice* and best practices around the world (See Appendix A) to set the expectations for Public Involvement;
- Conduct Public Involvement activities across the Continuum of Public Involvement(as described further on page 7) in order to understand and address concerns raised by stakeholders and the public;
- Build awareness, knowledge and understanding with stakeholders and the public about the benefits of low-floor Light Rail Transit (LF LRT) technology as it relates to passenger experience, community integration, and transportation network integration;
- Gather input and feedback from key internal and external stakeholders to coincide with critical milestones in the Preliminary Design;
- Understand the issues and concerns of stakeholders and mitigate issues to the greatest extent possible;
- Build and maintain trusting and respectful relationships amongst stakeholders, the public, and the City of Edmonton through the Public Involvement Process.

This Plan has been vetted through the Public Involvement Readiness Test

<u>Elicia Elliott</u>
Sign off

Background

DESCRIPTION OF THE OVERALL PROJECT OR INITIATIVE:	The Concept Planning phase of this project defined the major features of the SE to W LRT (from Mill Woods to Lewis Farms), including the corridor and alignment, station locations, integration with the transportation network, preliminary property requirements, and cost estimates. Concept Plans have been approved by City Council, with the exception of the Downtown Connector, which is on Council's Agenda on January 18, 2012. Preliminary Design will build on the approved Concept Plans by conducting more analysis of how the new low floor LRT will operate, as well as how the system will integrate into the existing and planned (future) transportation network and adjacent communities. The Public Involvement Process consists of five stages and will be conducted from 2011-2013. ▪ Stage 1: Pre-Consultation ▪ Stage 2: Initiation ▪ Stage 3: Consultation ▪ Stage 4: Refinement ▪ Stage 5: Conclusion The 27 km project from Mill Woods Town Centre to Lewis Farms Transit Centre is divided into six geographic areas and the Public Involvement activities will be specific to each of these areas. ▪ Area 1: Mill Woods Town Centre to Whitemud Drive ▪ Area 2: Whitemud Drive to Argyll Road ▪ Area 3: Argyll Road to Strathearn ▪ Area 4: Strathearn to City Centre West ▪ Area 5: City Centre West to 149 Street ▪ Area 6: 149 Street to Lewis Farms Transit Centre
THE DECISION BEING MADE IS:	**Finalizing the Preliminary Design for a 27 km urban-style low-floor LRT system from Mill Woods Town Centre to Lewis Farms Transit Centre.**
DECISION MAKERS	Final decision-making rests with Transportation Services – LRT Design & Construction Branch at the City of Edmonton.

THE SCOPE (IMPACT, AND COMPLEXITY) OF THIS DECISION IS:	The end product of this project is the Preliminary Design for a 27 km urban-style low-floor LRT system from Mill Woods Town Centre to Lewis Farms Transit Centre. The identified corridor and alignment runs through a highly developed urban environment, and impacts to communities, property owners and residents are likely. The Public Involvement Process is built around understanding issues and concerns and finding solutions or strategies to mitigate issues. Where there is no opportunity for Public Involvement (i.e. decisions were made in the Concept Planning Phase, or the subject matter falls into the areas of the Continuum of Public Involvement not available for influence), the public will be informed of ongoing developments. A number of past and ongoing studies, plans, and policies are important to consider throughout the Preliminary Design and Public Involvement activities of the project, including but not limited to: ▪ City of Edmonton Transportation Master Plan– The Way We Move ▪ City of Edmonton Municipal Development Plan– The Way We Grow ▪ City of Edmonton Capital City Downtown Redevelopment Plan(draft version) ▪ City of Edmonton Concept Plans for WLRT, SELRT, Downtown LRT ▪ City of Edmonton Draft TOD Guidelines ▪ Mill Woods Station Area Plan ▪ Stony Plain Road Streetscape Improvement Project ▪ Jasper Place Revitalization Strategy ▪ City of Edmonton Neighbourhood Renewal projects Other studies, plans, and policies will inform the Preliminary Design and Public Involvement Processes as they arise.

THE TIMELINE FOR THIS PROCESS IS:	There are five stages to this Public Involvement Process. By dividing the 27 km into six distinct areas, it will allow the technical team to give its complete attention to each area in a more concentrated way. Details regarding the Level of Involvement and Public Involvement activities related to each of the five stages are provided in the Public Involvement Strategy. **<u>STAGE 1 – PRE-CONSULTATION</u>** The Pre-Consultation Stage is focused on developing the Public Involvement Plan that will define the opportunities for Public Involvement during the project. The PIP will be based on input and information from the Concept Planning Phase, as well as new information gathered through interviews with key stakeholders and an online survey. **(All Areas: Nov 2011 – Feb 2012)** **<u>STAGE 2 – INITIATION</u>** The Public Involvement Process will begin in all six areas in the Initiation Stage. The first Area Meetings with the public and online opportunities are tentatively scheduled to begin according to the schedule below. Anyone who is interested in this project will have opportunities to be involved by attending the Area Meeting for their area, or by participating online. **<u>Areas & Dates</u>:** **Area 1 –** Mill Woods Town Centre to Whitemud Drive – Feb-Mar 2012 **Area 2 –** Whitemud Drive to Argyll Road– Feb-Mar 2012 **Area 3** – Argyll Road to Strathearn – Feb-Mar 2012 **Area 4 –** Strathearn to City Centre West – Feb-Mar 2012 **Area 5 –** City Centre West to 149 Street – Apr-May 2012 **Area 6 –** 149 Street to Lewis Farms Transit Centre – Apr-May 2012 **<u>Stage: 3 – CONSULTATION</u>** The focus of the Area Meetings in Stage 3 will be to present first stage concept designs for each area, proposed changes to roadways and related concepts for connectivity and pedestrian/cyclist access, as well as noise attenuation (where applicable), as well as to provide overall project updates. Participants will have opportunities to be involved by attending the meeting in their area or by participating online. Reports from the Area Meetings and online input will be posted on the website and participants will be informed about how their input was used in the technical developments.

	<u>Areas & Dates</u>: **Area 1 –** Mill Woods Town Centre to Whitemud Drive – May-June 2012 **Area 2 –** Whitemud Drive to Argyll Road– May-June 2012 **Area 3** – Argyll Road to Strathearn – May-June 2012 **Area 4 –** Strathearn to City Centre West – May-June 2012 **Area 5 –** City Centre West to 149 Street – Nov-Dec 2012 **Area 6 –** 149 Street to Lewis Farms Transit Centre – Nov-Dec 2012 **<u>Stage: 4 – REFINEMENT</u>** Participants in this third round of Area Meetings will review and provide final input on the proposed designs and other key elements discussed in Stages 2 and 3, as well as receive updates on the ongoing technical developments. Participants will have opportunities to be involved by attending the meeting in their area or by participating online. Reports from the Area Meetings and online input will be posted on the website and participants will be informed about how their input was used in the technical developments. **<u>Areas & Dates</u>:** **Area 1 –** Mill Woods Town Centre to Whitemud Drive – Sep-Oct 2012 **Area 2 –** Whitemud Drive to Argyll Road– Sep-Oct 2012 **Area 3** – Argyll Road to Strathearn – Sep-Oct 2012 **Area 4 –** Strathearn to City Centre West – Sep-Oct 2012 **Area 5 –** City Centre West to 149 Street – May-June 2013 **Area 6 –** 149 Street to Lewis Farms Transit Centre – May-June 2013 **<u>Stage: 5 – CONCLUSION</u>** The final designs and future project information will be shared with the general public in a public information/open house format for final review and comments before being submitted to The City. Information that is shared at the Open Houses will be posted on the project website, along with an opportunity for viewers to provide comments via an online survey that will be available for a specified period of time. Reports from the Open Houses and online input will be posted on the website, along with a final evaluation of the overall Public Involvement Process. **<u>Areas & Dates</u>:** **Area 1 –** Mill Woods Town Centre to Whitemud Drive – Jan-Feb 2013 **Area 2 –** Whitemud Drive to Argyll Road – Jan-Feb 2013 **Area 3** – Argyll Road to Strathearn – Jan-Feb 2013 **Area 4 –** Strathearn to City Centre West – Jan-Feb 2013 **Area 5 –** City Centre West to 149 Street – Nov-Dec 2013 **Area 6 –** 149 Street to Lewis Farms Transit Centre – Nov-Dec 2013

<table>
<tr><td>THE PUBLIC IS BEING INVOLVED BECAUSE:</td><td colspan="5">Public Involvement is an integral part and necessary component of major development projects in the City of Edmonton and members of the public have a growing expectation to be involved in initiatives that will impact them.

In 2005, The City introduced the Public Involvement Policy which frames the commitment: The City of Edmonton believes that a key element of representative democracy is that people have a right to be involved in decisions that affect them. This is practiced through the three Core Commitments / Guiding Principles outlined in Appendix A.

The design and ultimately the construction of the SE to W LRT will affect Edmontonians who live or do business in the established communities along the route. As such, The City is committed to involving stakeholders, as well as all interested members of the public, in the Preliminary Design Phase of the SE to W LRT project.

The Public Involvement Process for the Preliminary Design Phase will endeavour to involve a wide range of stakeholders and all interested members of the public through a variety of activities over several stages of design development. The proposed face to face meetings and the online activities are designed to capture input from participants on specific key elements of the project that will be considered by the technical team as part of design development.

Best efforts will be placed on encouraging all interested parties to get involved in the Process, either through participation in face to face meetings or online activities. It is expected that a variety of issues, concerns, and ideas will come forward during the Process, including some matters which could not be addressed in the Concept Planning phase.</td></tr>
<tr><td rowspan="3">LEVEL OF INVOLVEMENT:</td><td colspan="5">Overall Level of Involvement: Information Sharing / Consultation

This Public Involvement Process will incorporate all three categories of the Continuum as described below:</td></tr>
<tr><td>Information Sharing</td><td colspan="2">Consultation</td><td colspan="2">Active Participation</td></tr>
<tr><td>• Sharing information to build awareness</td><td>• Testing ideas or concepts to build knowledge</td><td>• Collaborating to develop solutions to build commitment</td><td>• Sharing decision making to build ownership</td><td>• Delegating decision making to build responsibility</td></tr>
</table>

LEVEL OF INVOLVEMENT:	Information Sharing Where decisions have been made in the Concept Planning Phase, or will be made based on engineering standards and guidelines, the public will be kept informed about those decisions. This includes: ▪ SE to W LRT corridor location ▪ Track alignment ▪ Technical design guidelines ▪ LRT stop/station locations ▪ Transit Centre locations ▪ Operations & Maintenance Facility (OMF) location ▪ Cost Estimates ▪ Vehicle design and branding ▪ Construction staging ▪ Property requirements ▪ Land re-development and TOD potential Consultation ▪ Structural aesthetics (Visual integration of the system into the existing landscape and adjacent communities) ▪ LRT stop/station aesthetics ▪ Landscape architecture aesthetics ▪ Public Art opportunities ▪ Connectivity to the existing transportation network across all modes of transportation ▪ Aesthetics for noise attenuation mechanisms, where identified per the City of Edmonton Urban Traffic Noise Policy 506[1] ▪ Understanding the impacts to stakeholders and working together to mitigate issues where possible Active Participation ▪ In areas where sound attenuation is warranted as per the City of Edmonton Urban Traffic Noise Policy 506, adjacent property owners will have the opportunity to vote on the installation of any noise attenuation mechanisms.[2]

[1] In the case of an existing residential area, where noise mitigation measures are appropriate and supported, the City will seek to involve community stakeholders in the selection of suitable materials and the design of the structure.

[2] The City of Edmonton will undertake a survey of affected property owners to determine support for the installation of any noise attenuation measures proposed under the City's retrofit noise attenuation program. Affected property owners are those who are immediately adjacent to the proposed noise attenuation measure (berm and/or noise wall), in an area encompassing the entire length of the proposed noise attenuation device. Endorsement of the proposed project will be considered sufficient if 60% or more of property owners indicate support (targeting a 100% response rate).

THE SPECIFIC INFORMATION BEING SOUGHT IS:	Various, as reflected above.
HOW WILL INFORMATION BE USED IN THE DECISION MAKING?	The information assembled through the Public Involvement Process will directly impact the design Process related to the key elements where the public can affect decisions being made.

Public Involvement Methods Strategy

<table>
<tr><th>Potential Participants</th><th>Proposed Level of Involvement (Information Sharing, Consultation, or Active Participation)</th><th>Involvement Strategy</th></tr>
<tr><td colspan="2">STAGE 1</td><td>PRE-CONSULTATION
Nov 2011 – Feb 2012</td></tr>
<tr><td>Key Stakeholders

Interested members of the public</td><td>Information Sharing and Consultation to receive feedback to help finalize the Public Involvement Plan(PIP)</td><td>Stakeholder Interviews & Online Survey - Building on the foundation of current knowledge

In advance of finalizing the Public Involvement Plan, contact a number of key stakeholders, including some who participated in concept planning and some who did not.

<u>Objectives:</u>
▪ To inform participants about the upcoming Public Involvement Process
▪ To ask a series of questions with the intention of gathering information to clarify the issues and add any new items to the issues list that will further inform the Public Involvement Plan

Activities
▪ Conduct interviews with key stakeholders (mix of face to face and telephone) and solicit input through an online survey to confirm issues and concerns and make appropriate adjustments to the Public Involvement Plan prior to its being finalized.
▪ PI Team to liaise with City Communications staff to develop information for Area 4 as it relates to timing of interviews (pending Council decision regarding downtown alignment).
▪ Liaise with City staff to develop required materials for public involvement.</td></tr>
<tr><td>Key Stakeholders & General Public</td><td>Consultation to finalize the PIP</td><td>Public Involvement Plan(PIP)

Once the interviews have been conducted, the PIP Highlights document will be reviewed and refined to accommodate new information and posted online.</td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 2</th><th>INITIATION
Feb – Mar 2012 (Areas 1-4)
Apr – May 2012 (Areas 5-6)</th></tr>
<tr><td>Key External Stakeholders (See Appendix B)

Interested Members of the Public</td><td>Information Sharing to build awareness</td><td>Area Meetings: The Public Involvement Process will begin in all six areas in the Initiation Stage. The Area Meetings (one in each of the six areas) will be a combination of information sharing (presentations and information updates), as well as seeking input from participants on the various elements where public input will be considered by the technical team in the developing design.

Anyone who is interested in this project will have opportunities to be involved by attending the meeting for their area, or by participating online. While interested stakeholders will be encouraged to participate in their Area Meetings in each of Stages 2 to 4, this will not be a prerequisite. Reports from the Area Meetings and online input will be posted on the website and participants will be informed about how their input was used in the technical developments.

The focus of Stage 2 Public Involvement is to:

<u>Information Sharing</u>
▪ Provide an overview of the Public Involvement Process, schedule and how issues and concerns will be addressed through the Process; clarify the items that are open for public feedback and those for which information updates will be provided.
▪ Present background information from the Concept Planning Phase, updated with new information obtained from a Value Engineering Process.
▪ Provide an initial look at the property requirements and land re-development
▪ Present information on the urban low floor light rail vehicles</td></tr>
</table>

	Consulting to collect targeted feedback	<u>Consulting to collect targeted feedback</u> ▪ Introduce architectural concepts and work with participants to generate ideas and themes specific to each area. ▪ Provide information and discuss the safety and security of the system and areas around the neighborhood stops and stations. Provide initial information on proposed changes to roadways and related community access and egress, traffic and parking issues, bus movements, proposed pedestrian access to the LRT and cyclist facilities **Participants for the Area Meetings**: Key stakeholders will be invited and, through local advertising, interested members of the public will also be invited to take part in the Process. Participants will be asked to commit to all three Area Meetings for continuity, but this will not be mandatory. **Reports**: Reports of input received at Area Meetings will be posted on the project website.
Key Stakeholders Interested members of the public	Information Sharing to build awareness Consulting to collect targeted feedback	**Online Consultation**: ▪ Information that is shared at the Area Meetings will be posted on the project website, along with specific questions for viewers to respond to via an online survey that will be accessible for a specified period of time. ▪ Ongoing opportunities for online participation will be provided throughout the Public Involvement Process. **Reports** of the input from the online input will be posted on the project website.

Affected Property Owners Unique or Hard to Reach Stakeholder Groups (e.g., seniors, multi-cultural communities)	Collaborating	**1-on-1/Special Meetings (as required)** Separate meetings are likely to be necessary with property owners who are directly impacted by the developing design. These meetings will be arranged as required. Meetings will be organized as required throughout the Process to accommodate for unique issues and impacts, and hard to reach stakeholder groups (e.g., seniors, multi-cultural communities).
STAGE 3		**CONSULTATION** **May - June 2012 (Areas 1-4)** **Nov - Dec 2012 (Areas 4 & 5)**
Key External Stakeholders (See Appendix B)	Information Sharing	A second round of **Area Meetings** will be held, tentatively staring with Areas 1 to 4 in the May to June 2012 timeframe, and Areas 5 and 6 in November-December 2012. Participants will have opportunities to be involved by attending the meeting in their area or by participating online. The Area Meetings (one in each of the six areas) will be a combination of information sharing (presentations and information updates) as well as seeking input from participants on the various elements where public input is being considered in the design development. Information Sharing ▪ Update on status of the Process and ongoing technical developments ▪ Proposed mitigation of safety and security issues. ▪ Any changes to property requirements and land re-development. ▪ Updates on light rail vehicles specifications

Interested Members of the Public	Consultation to test concepts and obtain input to develop better solutions	<u>Consultation to Test Concepts</u> ▪ Present first stage concept designs for each area, structures and tunnels (where they apply) & seek input. ▪ Present first stage concept designs for landscape architecture & seek input. ▪ Present any proposed changes to roadways and related community access and egress, traffic and parking issues, bus movements that may have arisen in the Preliminary Design & seek input. ▪ Present proposed concepts for connectivity and pedestrian access to the LRT and cyclist facilities & seek input. ▪ Present proposed mechanisms for noise attenuation (in the areas identified in Concept Planning) as per the City of Edmonton Urban Noise Policy.
Key Stakeholders Interested members of the public	Information Sharing to build awareness Consulting to collect targeted feedback	**Participants** for the Area Meetings: People who participated in earlier Stages, as well as others who declare an interest in participating. **Reports** of the input from the Area Meetings and how it will be used will be posted on the project website. **Online Consultation**: ▪ Information that is shared at the Area Meetings will be posted on the project website, along with specific questions for viewers to respond to via an online survey that will be accessible for a specified period of time. ▪ Ongoing opportunities for online participation will be provided throughout the Public Involvement Process. **Reports** of the input from the online input will be posted on the project website.

Affected Property Owners Unique or Hard to Reach Stakeholder Groups (e.g., seniors, multi-cultural communities)	Collaborating	**1-on-1 / Special Meetings (as required)** Separate meetings are likely to be necessary with property owners who are directly impacted by the developing design. These meetings will be arranged as required. Meetings will be organized as required throughout the Process to accommodate for unique issues and impacts, and hard to reach stakeholder groups (e.g., seniors, multi-cultural communities).
STAGE 4		**REFINEMENT** **Sep - Oct 2012 (Areas 1-4)** **May-June 2013 (Areas 5-6)**
Key External Stakeholders (See Appendix B) Interested Members of the Public	Information Sharing Consultation to test concepts and obtain input to develop better solutions	The focus of the meetings in Stage 4 will be for participants to review and provide final input on key elements and for the technical team to provide information on the status of technical items Information Sharing ▪ Update on status of the Process and ongoing technical developments ▪ Proposed mitigation of safety and security issues. ▪ Any changes to property requirements and land re-development. ▪ Light rail vehicles – any outstanding items ▪ Consultation to Test Concepts ▪ Present refined concept designs for each area, and seek final input. ▪ Present any proposed changes to roadways and related community access and egress, traffic and parking issues, bus movements that may have arisen in the Preliminary Design & seek final input. ▪ Present proposed concepts for connectivity and pedestrian access to the LRT and cyclist facilities & seek input. ▪ Present proposed mechanisms for noise attenuation (in the areas identified in Concept Planning) as per the City of Edmonton Urban Traffic Noise Policy.

Key External Stakeholders (See Appendix B) Interested Members of the Public	Information Sharing Consultation to test concepts and obtain input to develop better solutions	**Participants** for the Area Meetings: People who participated in earlier Stages, as well as others who declare an interest in participating. **Reports** of the input from the Area Meetings and how it will be used will be posted on the project website.
Key Stakeholders Interested members of the public	Information Sharing to build awareness Consulting to collect targeted feedback	**Online Consultation**: ▪ Information that is shared at the Area Meetings will be posted on the project website, along with specific questions for viewers to respond to via an online survey that will be accessible for a specified period of time. ▪ Ongoing opportunities for online participation will be provided throughout the Public Involvement Process. **Reports** of the input from the online input will be posted on the project website.
Affected Property Owners Unique or Hard to Reach Stakeholder Groups (e.g., seniors, multi-cultural communities)	Collaborating	**1-on-1 / Special Meetings (as required)** Separate meetings are likely to be necessary with property owners who are directly impacted by the developing design. Meetings will be organized as required throughout the Process to accommodate for unique issues and impacts, and hard to reach stakeholder groups (e.g., seniors, multi-cultural communities).

STAGE 5		**CONCLUSION** **Jan-Feb 2013 (Areas 1-4)** **Sep-Oct 2013 (Areas 5-6)**
General Public	Two way Information Sharing	**Open House / Information Session** Share information in the form of display boards and other materials as deemed necessary to show the final design concepts and related information for all six Areas. Collect feedback from participants to be included in the final report.
Key Stakeholders Interested members of the public	Information Sharing to build awareness	**Online Consultation**: Information that is shared at the Open Houses will be posted on the project website, along with an opportunity for viewers to provide comments via an online survey that will be accessible for a specified period of time. **Reports** of the input from the online input will be posted on the project website, along with a final evaluation of the overall Public Involvement Process.
Affected Property Owners	Collaborating	**1-on-1 Meetings (as required)** Separate meetings are likely to be necessary with property owners who are directly impacted by the developing design. Meetings will be organized as required throughout the Process to accommodate for unique issues and impacts.

Special Outreach Strategy

Please note: All of the "Broad Participation" methods we have identified above will include special outreach to identified stakeholders and stakeholder groups to ensure the widest possible range of participation and views.

Public Requiring Outreach	Strategy
Hearing impaired	Advertise that services are available during public events that will meet their specific needs.
Participants whose first language is not English	Advertise that language services are available during public events that will meet their specific needs.

Communications Strategy

The Communications Strategy for the PI efforts described in this document is being developed in concert with the PIP.

Evaluation Strategy

What are the indicators of success for the Public Involvement Process?	• A clear definition of the project goals and objectives and the role of the public in the Process • Participants understand how the information collected will be used in the development of the Preliminary Design • A Process that considers accessibility needs of participants and provides opportunities for the involvement of a wide range of demographic and special interest groups • A transparent Process that allows easy access to the information collected not only to participants, but to any and all interested parties • Participants are satisfied with how the Process evolved and that their involvement provided meaningful and valuable input to the engineering design development as outlined in the Continuum of Public Involvement • Communication was clear, simple and easy to understand

What will we measure or evaluate about the Public Involvement Process?	• Demographic participant targets were met (targets to be set based on ETS transit user profiles, demographic /census profiles from City, past participation levels, etc.) • Wide range of stakeholders were reached and participated in the PI program • Participant satisfaction re: inclusiveness and appropriateness of the Process and individual methods/ activities • Public support of the Process
When and how?	• Initial stakeholder identification & analysis; ongoing review to ascertain if the stakeholder list is growing and how people are being engaged • Ongoing evaluation of engaged participants – at each PI event and online to determine satisfaction levels; this will include qualitative evaluation for face to face events (visual observations , informal chats with participants, team debriefs, as well as exit surveys/comment forms) and online surveys/feedback opportunities • Include survey questions to demonstrate the percentage of stakeholders who understand the scope of the Process; percentage of those who express confidence in the Process; and those who support the Process • Monitor media and social media relative to comments / questions raised
What will we do with the results of the evaluation?	• Results of initial stakeholder interviews will be used to revise the PIP if necessary • Ongoing evaluation will be used to adjust the Process if and when is necessary • All evaluation results will be included in the PI Reports

Appendix A – Guiding Principles

City of Edmonton Commitments & Standards of Practice

COMMITMENTS TO PUBLIC INVOLVEMENT	PROCESS DESIGN WILL DEMONSTRATE THESE STANDARDS OF PRACTICE
OUR COMMITMENT TO CITIZEN ENGAGEMENT	▪ Public Involvement Processes will be designed to involve the appropriate people at the appropriate time in the appropriate way through the completion and communication of a Public Involvement Plan for all Processes ▪ The Continuum of Public Involvement will be used to ensure involvement Processes align with the scope, complexity and outcomes of the decision being made. ▪ A balance and range of public perspectives will be provided to decision makers for consideration in the decision Process. ▪ Processes will be appropriate resourced to ensure effective implementation.
OUR COMMITMENT TO HONOURING PEOPLE	▪ The purpose and goal of the involvement will be identified at the outset of the Process. ▪ Participants will know what is included in the discussion and what isn't, what decisions will be made or have been made, and who will make the final decision. ▪ Timing, location and format will reflect considerations for effective participation. ▪ Where appropriate, outreach Processes will be used to include the public who need support to participate.
OUR COMMITMENT TO ACCESSIBLE INVOLVEMENT	▪ Information is accessible: o It is always provided the simplest form possible – in plain language or understandable graphic formats. o Translation or interpretation services are provided when necessary. ▪ Facilities are accessible: o Location and physical accessibility are always considered. ▪ Information is readily available so the public can participate in an informed discussion.

International Association for Public Participation (IAP2)*

IAP2 Core Values

1. Public participation is based on the belief that those who are affected by a decision have a right to be involved in the decision-making Process.
2. Public participation includes the promise that the public's contribution will influence the decision.
3. Public participation promotes sustainable decisions by recognizing and communicating the needs and interests of all participants, including decision makers.
4. Public participation seeks out and facilitates the involvement of those potentially affected by or interested in a decision.
5. Public participation seeks input from participants in designing how they participate.
6. Public participation provides participants with the information they need to participate in a meaningful way.
7. Public participation communicates to participants how their input affected the decision.

IAP2 Code of Ethics

1. PURPOSE. We support public participation as a Process to make better decisions that incorporate the interests and concerns of all affected stakeholders and meet the needs of the decision-making body.
2. ROLE OF THE PRACTITIONER. We will enhance the public's participation in the decision-making Process and assist decision-makers in being responsive to the public's concerns and suggestions.
3. TRUST. We will undertake and encourage actions that build trust and credibility for the Process and among all the participants.
4. DEFINING THE PUBLIC'S ROLE. We will carefully consider and accurately portray the public's role in the decision-making Process.
5. OPENNESS. We will encourage the disclosure of all information relevant to the public's understanding and evaluation of a decision.
6. ACCESS TO THE PROCESS. We will ensure that stakeholders have fair and equal access to the public participation Process and the opportunity to influence decisions.
7. RESPECT FOR COMMUNITIES. We will avoid strategies that risk polarizing community interests or that appear to "divide and conquer."
8. ADVOCACY. We will advocate for the public participation Process and will not advocate for a particular interest, party or project outcome.
9. COMMITMENTS. We ensure that all commitments made to the public, including those made by the decision-maker, are made in good faith.
10. SUPPORT THE PRACTICE. We will mentor new practitioners in the field and educate the decision makers and the public about the value and use of public participation.

*IAP2 – The International Association for Public Participation – Recognized world leader in developing the practice of public participation - www.iap2.org

Appendix B – Preliminary Stakeholder List

AREAS 1-4 Identified Stakeholders

COMMUNITY LEAGUES

- Argyll
- Avonmore
- Boyle/ McCauley
- Bonnie Doon
- Capilano
- Central McDougall
- Cloverdale
- Downtown Edmonton
- Forest/Terrace Heights
- Fulton Place
- Gold Bar
- Holyrood
- Idylwylde
- Kenilworth
- King Edward Park
- Knottwood
- Lakewood
- Leefield
- Millhurst
- North Millbourne
- Ottewell
- Ridgewood
- Riverdale
- Strathearn
- Woodvale

BUSINESSES/ASSOCIATIONS

- 75th Street Businesses
- Alberta Home Builders
- Art Gallery of Alberta
- Bank of Montreal
- Building Owners & Management Assoc.
- Bonnie Doon Shopping Centre
- Canadian National Railway
- Canadian Pacific Railway
- Chamber of Commerce
- Citadel Theatre
- City Centre Mall
- Davies Industrial– East and West
- Downtown Business Assoc.
- Edmonton Public Library
- Chinese Benevolent Association
- Manulife Place
- McIntyre Industrial
- Mill Woods Golf Course
- Roper Industrial
- South Edmonton Business Association (SEBA)
- University of Alberta
- Urban Development Institute
- Winspear
- YMCA

COMMUNITY LEAGUE COUNCILS

- Southeast Edmonton Community League Council (SECLA*)*
- Mill Woods Presidents Council (all Mill Woods Community Leagues)
- Central Area Council of Community Leagues

INSTITUTIONAL ORGANIZATIONS

- Edmonton Catholic School Board
- Edmonton Public School Board
- Alberta Health Services (Grey Nuns')University of Alberta

OTHER GROUPS

- Advisory Board on Services for Persons with Disabilities
- City of Edmonton Youth Council
- Edmonton Bicycle Commuters Society
- Edmonton Folk Music Festival
- Edmonton Ski Club
- Edmonton Transit Users
- ETSAB (Edmonton Transit Service Advisory Board)
- NextGen Initiative
- Seniors
- TPRAC (Trails, Paths, Routes Advisory Committee)

AREAS 5-6 Identified Stakeholders

COMMUNITY LEAGUES

- Aldergrove
- Belmead
- Britannia/ Youngstown
- Boyle Street
- Canora
- Crestwood
- Downtown Edmonton
- Elmwood
- Glenwood
- Glenora
- Grovenor
- High Park
- Jasper Park
- Laurier Heights
- Lewis Farms
- Lynnwood
- McQueen
- Meadowlark
- North Glenora
- Oliver
- Parkview
- Queen Mary Park
- Rio Terrace
- Riverdale
- Summerlea
- Thorncliff
- West Jasper/ Sherwood
- Westmount
- West Meadowlark

BUSINESSES/ASSOCIATIONS

- 124th Street Business Assoc.
- Building Owners & Management Assoc.
- Chamber of Commerce
- City Centre Mall
- Corner Pharmacy
- Downtown Business Assoc.
- Downtown Farmers Market
- Edmonton Bicycle Commuters Society
- Jasper Place Revitalization
- Manulife Place
- Meadowlark Mall
- Melcor
- Stony Plain BRZ
- West Edmonton Mall
- West Edmonton Business Association
- Western Cycle
- YMCA

COMMUNITY LEAGUE COUNCILS

- West Edmonton Community Council (WECC)

INSTITUTIONAL ORGANIZATIONS

- Alberta Health Services/Misericordia Hospital/AADAC
- Edmonton Catholic Schools
- Edmonton Public School Board
- MacEwan University
- Norquest College
- St. Paul's Anglican Church
- University of Alberta

RESIDENT ASSOCIATIONS

- Chapelle Manor
- Groat Farms Residents Association

OTHER GROUPS

- Advisory Board on Services for Persons with Disabilities
- City of Edmonton Youth Council
- Edmonton Bicycle Commuters Society
- Edmonton Transit Users
- NextGen Initiative
- Seniors
- ETSAB (Edmonton Transit Service Advisory Board)
- TPRAC (Trails, Paths, Routes Advisory Committee)

Environmental Impact Assessment (EIA)

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HAVE YOUR SAY

Have Your Say!

To comply with the City of Edmonton's River Valley Area Redevelopment Plan (Bylaw 7188), an Environmental Impact Assessment of the project is being conducted.

Your input is important.

Please provide any information that you wish the project team to consider regarding the environment within, or adjacent to, the project boundaries. A draft is complete.

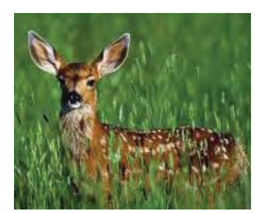
Put your comments directly on the map with sticky notes or complete the comment form today or online at www.edmonton.ca/setowestlrt

Your comments will be compiled and considered during the finalization of the environmental assessment and future development of mitigation measures.

As part of the EIA, the following field investigations have been completed or are underway:

- **Vegetation** – vegetation and rare plant surveys, completed in summer 2012.
- **Wildlife** – a breeding bird survey, completed in spring 2012; wildlife movement reconnaissance, winter 2012.
- **Fish** –a fish and fish habitat assessment, completed as part of the earlier planning phase.
- **Geotechnical** – a series of boreholes have been drilled in the river valley, to characterize fills, surficial deposits, and bedrock and, where appropriate, assess contaminants.
- **Hydrology** – borehole data is being used to assess groundwater conditions.
- **Historical Resources** – archaeological and paleontological impact assessments, completed in 2011.
- **Noise and vibration assessment** – completed in 2012.



THE CITY OF Edmonton

Environmental Impact Assessment (EIA)

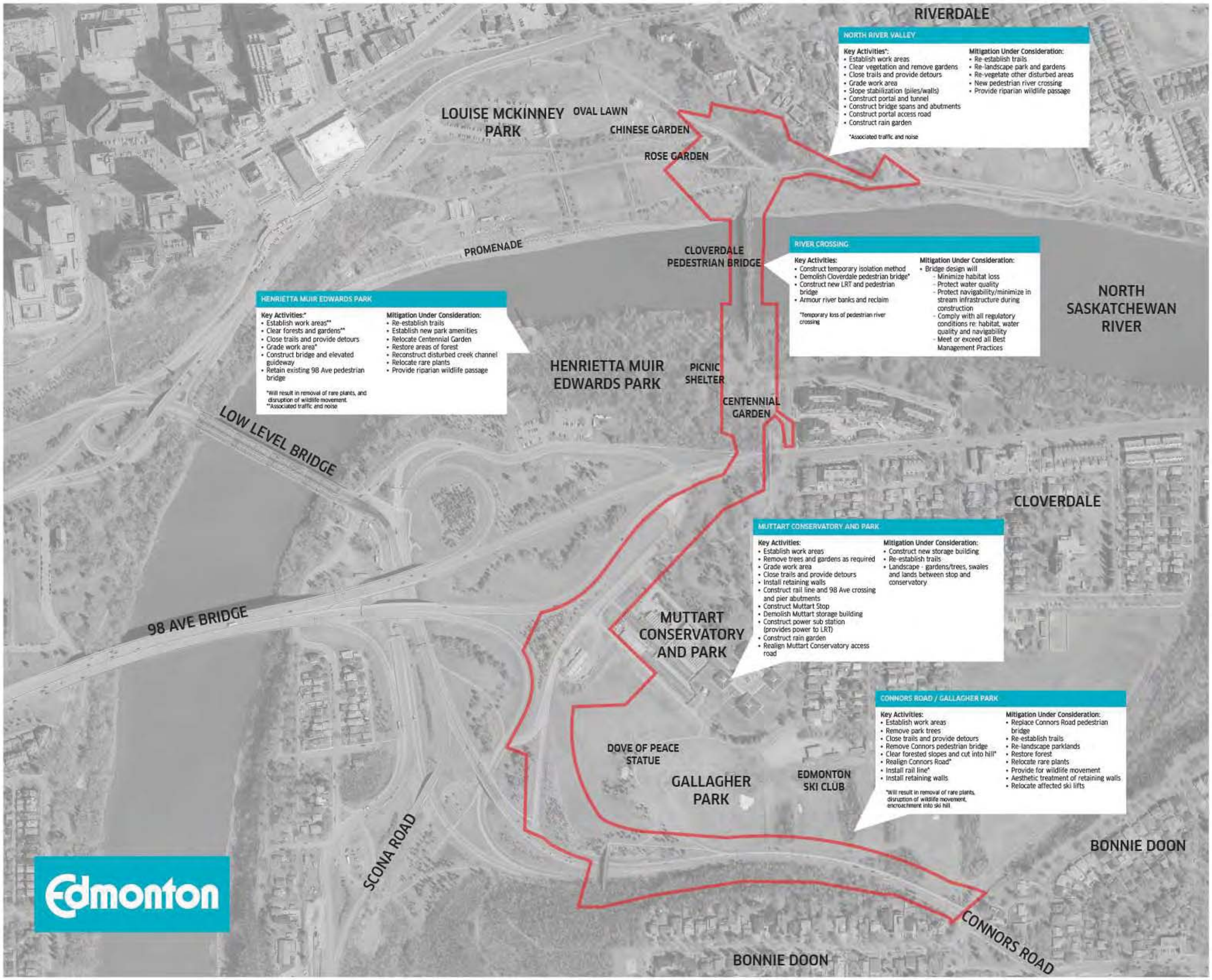
An Environmental Impact Assessment (EIA) document is being prepared to meet the requirements of the City of Edmonton's North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188).

The EIA:

- Describes existing environmental conditions
- Assesses potential impacts
- Describes mitigation measures intended to eliminate or reduce impacts to each Valued Environmental Component (VEC)
- The following VECs are being assessed to identify ways in which the proposed project could affect biophysical and socio-economic resources:
  - **geology and geomorphology (including slope stability)**
  - **soils**
  - **surface water and groundwater**
  - **vegetation**
  - **wildlife**
  - **habitat connectivity**
  - **fish and aquatic resources**
  - **land disposition and zoning**
  - **residential land use**
  - **recreational land use**
  - **utilities**
  - **worker and public safety**
  - **visual resources**
  - **historical resources**

- The EIA may also be submitted to Fisheries and Oceans Canada and Transport Canada as supporting information for ***Fisheries Act*** and ***Navigable Waters Protection Act*** approvals, respectively.

ENVIRONMENTAL IMPACT ASSESSMENT
Key Activities and Mitigation Under Consideration



ENVIRONMENTAL IMPACT ASSESSMENT

Existing Trails, Possible Detours and Proposed Construction Areas

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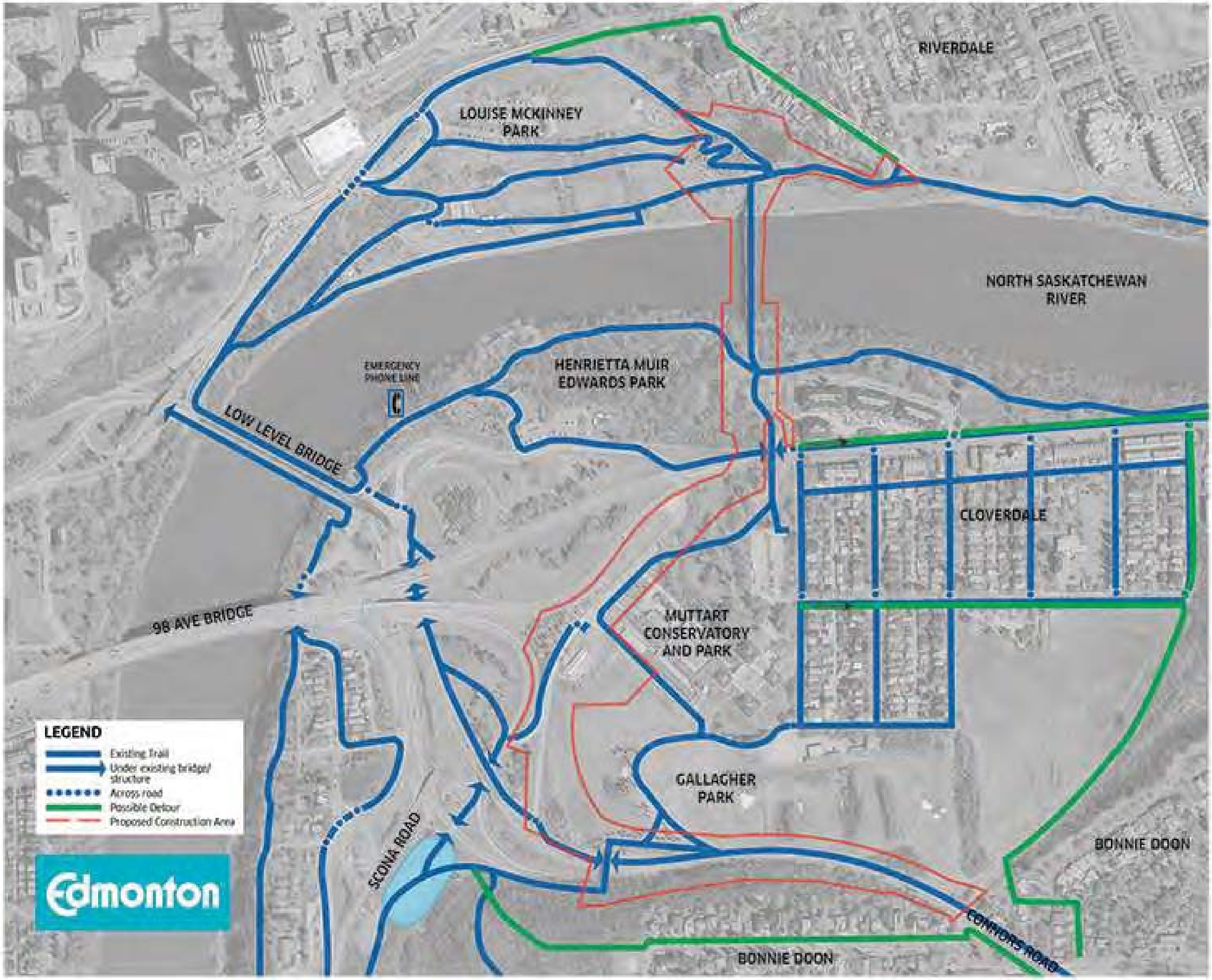

Verbatim river valley EISA-related comments provided from all sources, including website, as a result of PI sessions held in May and June 2013.

Alignment/River Crossing

- Why are we clearing trees along the river rather than crossing at the low level bridge which would also give access to Mckinley Park.
- Please, don't cut a swath through our river valley instead, send the LRT across the river over or beside the Low Level Bridge. Not only do your plans impact our river valley, it will impact residents with unnecessary noise given that you have the other viable option! You didn't send the LRT across the river from the university, on 87th Avenue, something that would have made a great deal of sense and saved a lot of money. You didn't do it because the residents of that area wouldn't hear of it. Give the east end residents the same courtesy please only this time, giving them this courtesy will also save a big swath of our river valley trees and vegetation! Keeping the LRT to main roads and taking it across the river at the Low Level Bridge will keep Edmonton's city plan a smart and fair plan for LRT expansion. If we can spend all we just did on the downtown arena, why can't we spend a few extra dollars to save our river valley and keep the LRT from intruding into residential neighbourhoods. And, it would sure look a whole lot better to have the LRT cross where it is logical for it to cross - at the Low Level Bridge!
- The proposed crossing from Riverdale to Cloverdale will result in the clear-cutting of a huge area on the south side of the river. It is worth spending the extra money to send the line over the Low Level bridge instead (with the added advantage of a possible Louise McKinney Park stop).
- I've just been told that the planned crossing from Riverdale to Cloverdale will involve a mass clearcut of trees in the area. Please find a way to avoid this environmental destruction. You have (and can design more) alternative routes available to you! What about going over the Lower Level Bridge?
- While I wasn't able to attend the meeting, I did get an update on it afterwards and I'm concerned about the environmental destruction that will result from the Riverdale-> Cloverdale crossing. This crossing would destroy one of the most beautiful parts of the river valley, and an area that many animals and birds call home. Could this crossing be moved, perhaps further west?
- I am extremely concerned about the loss of mature trees and other vegetation implicated in the construction of the new river crossing from Riverdale to Cloverdale, especially on the south side of the river. This area is home to many, many birds and I think it should remain undisturbed. Even the bridge is home to birds--there are nesting pairs of Canada geese that return every year to use the bridge trestles. If we are committed to maintaining our river valley as a "ribbon of green" then the environment should trump all other criteria in sensitive areas of the LRT line--and this river crossing is certainly that.
- While I know the LRT planners say the route has been more or less determined, I think this crossing should be reconsidered. No one at Wednesday's meeting could tell me why it is not possible for the track to travel down Grierson Hill alongside the existing road and cross at the Low Level Bridge area. The tracks could remain underground from the Quarters station as needed to accommodate the grade required by the tracks. A stop could be implemented at Louise McKinney Park to increase usage of that park, and there would be a vastly decreased

environmental impact if the line crossed the river here rather than at the Riverdale-Cloverdale foot bridge. The Cloverdale/Muttart stop could then be slightly shifted westward to avoid moving the Muttart gardens, and then travel up Connor's Road from here.

This route would also, as noted above, enable a stop in Louise McKinney Park. This stop would enable increased use of the LRT, and could achieve the goal of the once-discussed funicular in transporting people into the park.

- There has been no effort to mitigate the impacts of the LRT as it traverses Cloverdale. Since the beginning the City appears to view this community as a soft target with each update from the City highlighting yet another change that increases the impact on this neighborhood. The latest is the shifting of track northward so that it is cantilevered over the ski hill for 180 meters. This change was made after the City insisted that the hill was too unstable and Conners Hill Road would have to be shifted southward. After a very small number of influential residents living above Conners Hill indicated they did not like the shift the City decided that it was preferable to increase the impact on Cloverdale and the skill club rather than face the discontent of a couple of favored citizens.
- You're not being fair or smart. Keep the LRT crossing at the Low Level Bridge!
- I would prefer an underground LRT to an above-ground LRT. But I feel MOST strongly about the river crossing and do not agree with its placement due to its environmental impact. Regardless of cost I think this crossing needs to be shifted westward to protect a very environmentally sensitive area. (And this shift would have the added benefit of increasing usability by incorporating a stop in Louise McKinney Park.)
- Please do not push Connors Road into the south, I've had difficulty getting a commitment to this.

Bridge Design

- Concerned about the env impact when old bridge supports (pedway bridge) are removed from the river and new bridge supports are added.
- As I mentioned before, I'm not satisfied with the design of the bridge over the river, due to the pillar being in the river.
- I would have vastly preferred a design like the New Walterdale Bridge, or another design that keeps the pillar(s) on shore. The reasons I would prefer a bridge design not touching the river are:
  - Less impact on the aquatic environment
  - Less risk of flood damage
  - Less risk for boaters
  - Better aesthetics.

  The rest of the project looks excellent to me, and I cannot wait to have 5 corners of the City linked to Churchill Station by rail.
- My only concern with the environmental impact of this project is the bridge pillar in the river. I'm not convinced it's neccessary, nor desirable, and could even be a risk in the event of a major flood.

Muttart Stop

- The proposed 200 metre siding next to the Muttart Station represents a major addition to the LRT infrastructure in the central river valley parklands and therefore conflicts with the City's commitment to minimize the environmental impact of LRT in the valley. It should be relocated.
- Also I am concerned that not enough effort has been put into ensuring there is minimal impact to the community of Cloverdale. An example of this is the plan to have side railings for storage of LRT train cars in Cloverdale which I think is totally inappropriate.
- If the stop is to be at the back of Muttart then the Muttart needs to change. You are essentially dropping people off at an industrial greenhouse and asking them to walk a long distance. Think elderly and handicapped and women with stroller. That part of the Muttart is scary. Move the greenhouses to another site and add to the Muttart (another Pyramid)! *(@ Muttart stop)*

Vegetation/Forests

- Clearcutting of the river valley is not an acceptable avenue for this development.
- South side trees on Connors Road – natural habitat.
- What happens to left over lands – hopefully heavily treed *(arrow pointing to east edge of detail box for Connors Road)*
- Please, don't cut a swath through our river valley instead, send the LRT across the river over or beside the Low Level Bridge.
- The proposed crossing from Riverdale to Cloverdale will result in the clear-cutting of a huge area on the south side of the river.
- I've just been told that the planned crossing from Riverdale to Cloverdale will involve a mass clearcut of trees in the area.
- I am extremely concerned about the loss of mature trees and other vegetation implicated in the construction of the new river crossing from Riverdale to Cloverdale, especially on the south side of the river.

Wildlife • At 9624-95 Avenue (rear) there is a motion activated wildlife camera to monitor coyote activities. We have resident porcupine, squirrels, nesting birds and seasonal passage of young deer. There is also an occasional pond partway down the hill about 10 meters south of Connors Road. • Concern about impact to wildlife corridor with LRT tracks coming down Connors Road. Where will animals go? *(S of Connors Road)* • Park and the woodlands to the east of Cloverdale Hill. Presumably the LRT tracks will be fenced off. How will wildlife cross Connors Road now? This is a major disruption to the only remaining corridor not directly at the riverbank. Terrible idea! *(@ Ski Hill)* • This is a wildlife corridor that connects to Mill Creek Ravine to Gallaher • The river valley is a wildlife corridor. The LRT blocks this. What is being done to maintain this corridor? *(@ Ski Hill)* • Even the bridge is home to birds--there are nesting pairs of Canada geese that return every year to use the bridge trestles.
Impacts to Cloverdale • Also the bridge location across the river and across 98 Avenue will have too much impact on the community. I would recommend that genuine input from the community be obtained before the plans are finalized. • There has been no effort to mitigate the impacts of the LRT as it traverses Cloverdale. Since the beginning the City appears to view this community as a soft target with each update from the City highlighting yet another change that increases the impact on this neighborhood. The latest is the shifting of track northward so that it is cantilevered over the ski hill for 180 meters. This change was made after the City insisted that the hill was too unstable and Conners Hill Road would have to be shifted southward. After a very small number of influential residents living above Conners Hill indicated they did not like the shift the City decided that it was preferable to increase the impact on Cloverdale and the skill club rather than face the discontent of a couple of favored citizens.
Impacts on the Folk Festival • Noise on Folk Festival will likely increase with Option 1 – retainment walls on south side will bounce noise back into valley instead of trees and houses at top of Connors Road absorbing the sound. *(SW corner of 95 Street and 95 Avenue intersection)* • Edmonton Folk Festival – Have the planners stood on the stage and seen why entertainers rave about coming to our world famous festival? The view, the quiet city scene - not trains every 5 minutes during their performance. *(NW corner of 95 Avenue and 95 Street intersection)*

Ski Club

- The impact on Gallagher Hill and Edmonton Ski Club will be huge with the option that takes the largest amount of hill without moving the road. The other option of taking some of the south bank of Connors hill will also have a huge environmental and stabilization concerns. No good option with the route.
- I am also not confident that important existing facilities like the Edmonton Ski Club will survive the construction of this facility.
- I am somewhat worried about the viability of the ESC and also the stability of the Connor's Hill section of track.
- I'm not concerned about changes to ski hill, LRT is more important that ski hill use. *(Gallagher Park)*
- Save the ski hill!! Quality of life in the city issue. *(@ Ski Hill)*

Slope Stability on Connors Hill

- I am somewhat worried about the viability of the ESC and also the stability of the Connor's Hill section of track.

General

- Environmental impact (erosion of green space) and lack of community input into the decision making. It is important that we build the LRT but I am not confident the proper route has been selected.
- I didn't attend the meeting on June 19th (as I didn't know anything about it), but I'm really concerned that your preliminary designs involve such massive environmental destruction.
- While I am totally in favour of expanding public transportation in Edmonton, I want to ensure that the environmental impact is fully considered.

Appendix D. River Hydraulics Report

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Tel: 780-436-5868
Fax: 780-436-1645
email: eyaremko@nhc-edm.com

northwest hydraulic consultants

memorandum

To:	Nadia Contant, Project Biologist Spencer Environmental Managemet Services	**Date:**	21-12-2010
From:	**Eugene Yaremko (NHC)**	**No. Pages:**	2 + Figures
CC:		**Project No.:**	17575
		Ref. No.:	
Re:	**LRT Cloverdale Bridge Project** North Saskatchewan River Survey		

Because morphological information was quite limited for the North Saskatchewan River in the reach encompassing the proposed LRT Cloverdale bridge, the city of Edmonton retained NHC to undertake a comprehensive river survey. A single river cross section was available in the vicinity of the pedestrian bridge that was obtained as part of the provincial river floodplain study. As well, there were a few uncontrolled cross sections that were apparently collected as part of an aquatic study. Ultimately, much better morphological information will be required for EA assessments and engineering design work during upcoming phases of this project.

With the approval of the City, NHC undertook a river survey of the North Saskatchewan River November 15, 2010. River bottom and bank data were collected at sufficient density to enable generation of a 0.25 m contour interval plan that would be utilized for hydraulic modelling. The survey consisted of utilizing a boat-mounted continuous river bottom echo sounder, together with satellite-based horizontal positioning equipment that provided precise accuracy with regard to locations of x,y,z coordinates. Characterization information of the river bed and bank material was also collected.

Figure 1 provides the 0.5 m contour plan generated from the survey. The length of surveyed river extended approximately 1.1 km downstream and 1.0 km upstream of the pedestrian bridge crossing near the easterly boundary of Louise Mc Kinney Park.

Figure 2 provides a 0.25 m contour interval plan centered on the proposed bridge site.

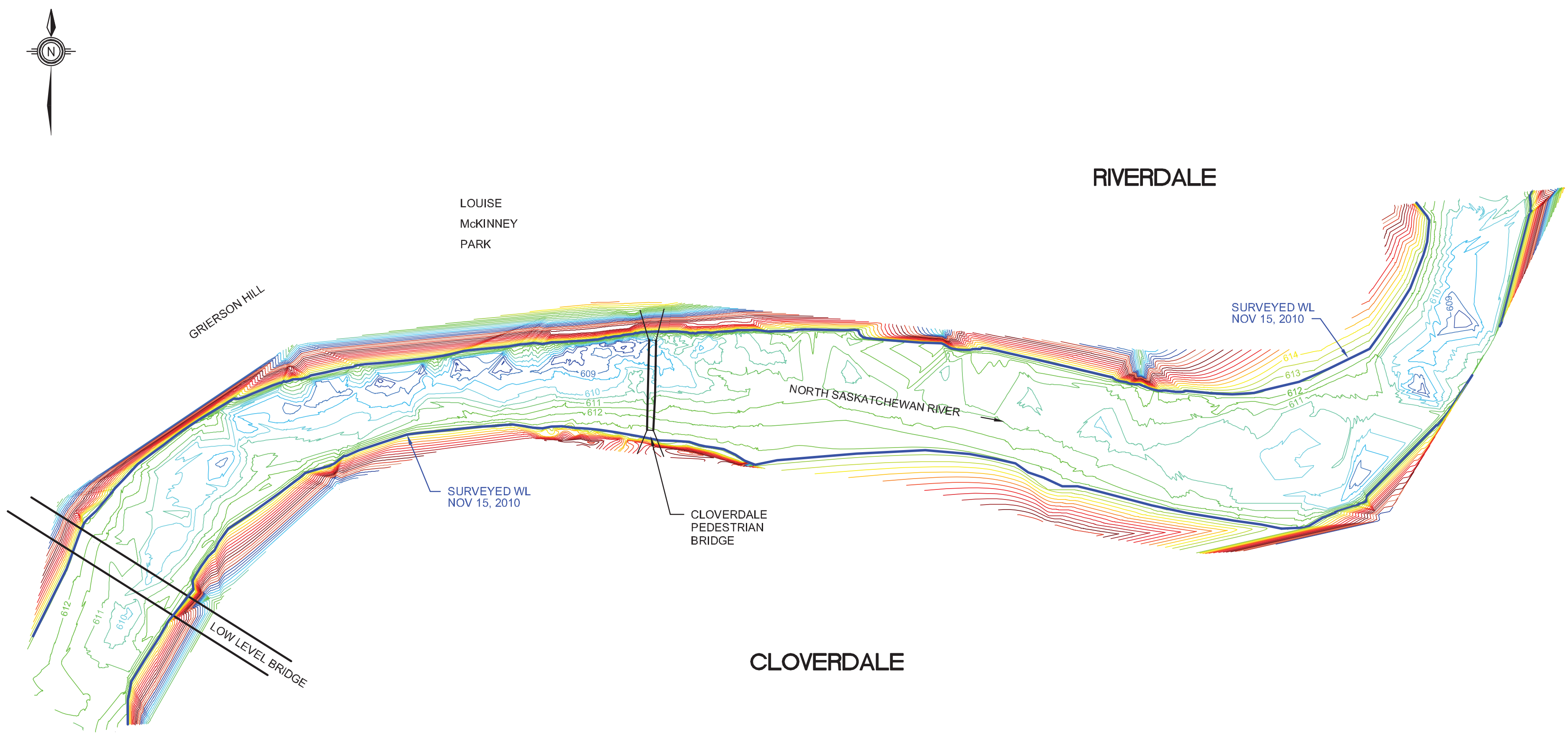
The survey data and drawings are available in digital form to members of the bridge EA and design team.

If you have any questions, please give me a call in our Edmonton office at (780) 436-5868.

Sincerely,

northwest hydraulic consultants

E.K. Yaremko, P.Eng.
Principal



DESIGN NOTES

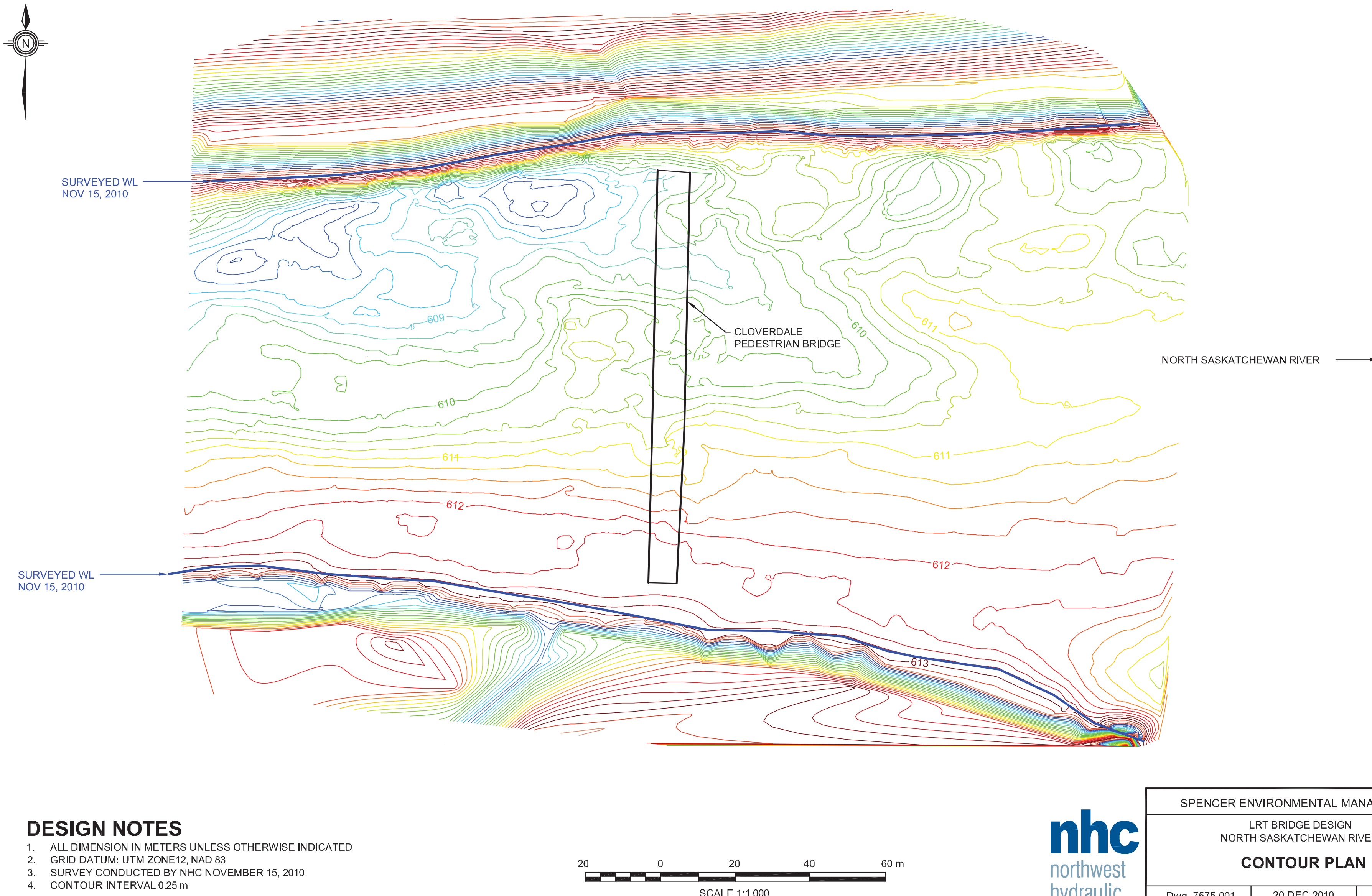
1. ALL DIMENSION IN METERS UNLESS OTHERWISE INDICATED
2. GRID DATUM: UTM ZONE12, NAD 83
3. SURVEY CONDUCTED BY NHC NOVEMBER 15, 2010
4. CONTOUR INTERVAL 0.5 m

100 0 100 m

SCALE 1:5,000

nhc northwest hydraulic consultants

SPENCER ENVIRONMENTAL MANAGEMENT		
LRT BRIDGE DESIGN NORTH SASKATCHEWAN RIVER **RIVER BATHYMETRY**		
Dwg. 7575-002	20 DEC 2010	**Figure 1**
northwest hydraulic consultants ltd.		



DESIGN NOTES

1. ALL DIMENSION IN METERS UNLESS OTHERWISE INDICATED
2. GRID DATUM: UTM ZONE12, NAD 83
3. SURVEY CONDUCTED BY NHC NOVEMBER 15, 2010
4. CONTOUR INTERVAL 0.25 m

nhc northwest hydraulic consultants

SPENCER ENVIRONMENTAL MANAGEMENT		
LRT BRIDGE DESIGN NORTH SASKATCHEWAN RIVER **CONTOUR PLAN**		
Dwg. 7575-001	20 DEC 2010	**Figure 2**
northwest hydraulic consultants ltd.		

Filename: P:\ Projects (Active)\7575 - LRT Bridge Design - Spencer\3 Drawings\7575-001.dwg 12/21/2010 11:02:18 AM

Appendix E. Fisheries Reports

PRELIMINARY FISHERIES RESOURCES IMPACT ASSESSMENT FOR THE PROPOSED CLOVERDALE LIGHT RAIL TRANSIT BRIDGE OVER THE NORTH SASKATCHEWAN RIVER

Prepared for: Spencer Environmental Management Services Ltd.
Edmonton, Alberta
April, 2013

PISCES ENVIRONMENTAL CONSULTING SERVICES LTD.

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PRELIMINARY FISHERIES RESOURCES IMPACT ASSESSMENT FOR THE PROPOSED CLOVERDALE LIGHT RAIL TRANSIT BRIDGE OVER THE NORTH SASKATCHEWAN RIVER

Prepared for:
Spencer Environmental Management Services Ltd.
Edmonton, Alberta

Prepared by:
Pisces Environmental Consulting Services Ltd.
Red Deer, Alberta

April 2013

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TABLE OF CONTENTS

LIST OF FIGURES

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1.0 INTRODUCTION

1.1 BACKGROUND

The City of Edmonton is planning to expand Light Rail Transit (LRT) service with the City. The southeast extension will extend service from downtown Edmonton to the community of Millwoods. The proposed alignment for this extension would commence near 97th Street and 102nd Avenue, travel across the North Saskatchewan River, continue along the north side of Connors Road to 75th Street, proceed south to Mill Creek crossing the ravine near 83rd Street before crossing Whitemud Drive and terminating at approximately 28th Avenue. The project would require that the existing Cloverdale pedestrian bridge across the North Saskatchewan River (NSR) be demolished and a new LRT/pedestrian bridge be constructed at the same location (Appendix A: Figure 2.1).

In 2010, Pisces Environmental Consulting Services Ltd. (Pisces) conducted an assessment of the existing fisheries and habitat resources in the vicinity of the proposed project. Results from the assessment were described in the document entitled *Assessment of the Fisheries Resources and Habitat of the North Saskatchewan River for the Proposed Cloverdale LRT Bridge Crossing* (Pisces 2010). The project has progressed and preliminary design has been completed (the reference design). The preferred design for the new bridge consists of an extradosed structure with an underslung pedestrian bridge with two instream piers. This document presents a preliminary analysis of the potential impacts to fisheries resources as a result of the proposed project and includes a discussion of recommended mitigation measures to minimize adverse effects.

1.2 PROJECT DESCRIPTION

The existing pedestrian bridge over the North Saskatchewan River has a total of four spans and three instream piers. The preliminary designs for the new LRT/Pedestrian bridge indicates that there will be two instream piers. An abutment will support the north end of the new bridge while the south end of the bridge will be supported by a series of land-based piers (Appendix B). The extent of riprap armouring that will be required has not been determined but it is expected that both the north and south banks will require some armouring.

The reference design indicates that the new bridge will follow the alignment of the existing bridge, which will necessitate the demolition of the existing bridge prior to construction of the new bridge. Construction plans and schedules have not been determined at this time.

2.0 SUMMARY OF EXISTING CONDITIONS

The following is a brief summary of assessment results presented in the *Assessment of the Fisheries Resources and Habitat of the North Saskatchewan River for the Proposed Cloverdale LRT Bridge Crossing* (Pisces 2010). A copy of this report is provided in Appendix A.

The 2010 study area encompassed approximately 2.5 kilometres of the North Saskatchewan River in the vicinity of the proposed bridge crossing extending from 0.5 kilometres upstream to 2.0 kilometres downstream of the existing Cloverdale pedestrian bridge (Appendix A: Figure 2.1). The *Code of Practice for Watercourse Crossings* St. Paul Management Area Map indicates that the portion of the NSR with the study area is designated as Class C habitat, which is considered moderately sensitive and broadly distributed within the province (Alberta Environment 2006). A section of Class A habitat, which is defined as highly sensitive habitat that is critical for Lake Sturgeon (*Acipenser fulvenscens*), is located approximately 2.5 km downstream of the existing bridge (Alberta Environment 2006).

The habitat within the study section consisted primarily of moderate depth, slow, run habitat, interspersed with discrete areas of deep-water habitat and shallow shoals. In general the substrate was a mixture of fine materials and cobble, with increasing percentages of fines in areas where water velocities were lower and increasing percentages of course substrate (gravel, cobble, and boulder) in higher velocity areas. Cover was relatively scarce within the study section; boulders (from the rip-rap) and water depth were the primary refuge. The streambank assessment indicated that the river banks were steep, relatively well vegetated with grass, shrubs and trees, and were composed of fine materials. Streambank armouring with rip-rap was quite common within the study section, particularly along the north river bank.

The average wetted width of the channel was approximately 160 metres. Water depths were generally less than two metres with the exception of the area immediately upstream of the existing bridge where depths exceeded four metres.

The NSR supports a wide array of sport and non-sport fish species (Appendix A: Table 4.2). Of particular importance is the Lake Sturgeon, which is designated as “Threatened” provincially and has been assessed as “Endangered “by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2006). As of April 2013, the federal government has not made a decision on whether or not the NSR Lake Sturgeon population should be listed under the *Species At Risk Act*.

3.0 POTENTIAL IMPACTS AND MITIGATION

3.1 PROJECT IMPACTS

Bridge construction and/or demolition can impact fish and fish habitat through direct and indirect sources that are typically dependent on the design of the structure, timing of construction and construction and demolition techniques. Principal potential impacts to fisheries resources associated with the proposed project are related to:

- interruption of critical fish movements;
- sediment introduction;
- pollutant loading;
- fish mortality during the construction phase; and
- the loss or alteration of fish habitat.

The presence of critical Lake Sturgeon habitat in the general vicinity of the proposed project crossing magnifies these potential issues.

Fish Distribution

Fish move between habitats for a variety of reasons. Individuals migrate for spawning, to search for food, to escape predators, or to leave undesirable habitat. Interference with fish passage becomes most critical when instream construction activities are scheduled to coincide with spawning times. According to the Code of Practice for Watercourse Crossings St. Paul Management Area Map (Alberta Environment 2006), the North Saskatchewan River is a mapped Class C waterbody and is subject to a restricted activity period (RAP) from September 16th to July 31st which is in place to protect both spring and fall spawning species.

Instream work associated with the proposed project will need be isolated from flowing water in order to facilitate both the demolition and construction phases of the project. Isolation works typically result in channel constriction and increased water velocities. Depending on the extent of the channel constriction and the subsequent impact on water velocities, it is possible that upstream fish movements can be impeded.

Once constructed the bridge is not expected to affect fish movements since it will not pose a physical barrier to fish and it is not expected to have an impact on water velocities.

Sediment

Sediment is generated at stream crossing sites during instream construction and from surface runoff over disturbed ground around the site during, and after, construction.

Sedimentation can have adverse effects on fish health and fish behavior. During construction there is potential for particulate sediment to become suspended in the water column. Increased levels of TSS (total suspended solids) in the water column may lead fish to exhibit an avoidance response (Waters 1995), however Gregory *et al.* (1993) note that fish may use elevated TSS for cover. Further increases in TSS can cause physiological stress that can result in respiratory difficulty and, in extreme cases, mortality. While individual species sensitivity to suspended sediment is variable, the effects are dependent on two variables: the concentration of TSS to which fish are exposed and the time of exposure (Newcombe and Jenson 1996). Sediment deposition during egg incubation periods for fish can also smother eggs that can result in increased mortality.

Increased sediment loads can impact habitat quantity and quality. Sediment loads that exceed the transport capacity of the receiving stream may result in deposition, which may reduce pool depth and fill in the interstitial spaces in coarse substrates (gravels and cobbles) that serve as spawning habitat and produce invertebrates used as food by fish (Waters 1995).

The potential for sediment to affect fish populations and habitat of the North Saskatchewan River is moderate. The transport capacity of the river is substantial and the stream bank assessment for this portion of the subject watercourse indicates that the banks are potentially unstable as they are composed primarily of fines that can be readily mobilized during construction by rain or high water.

Pollutant Loading

Deleterious substances, such as hydrocarbons, can be introduced into fish habitat during construction activities as well as when the bridge is in service. Debris from the bridge demolition could also contain delirious substances. Deleterious substances can potentially cause adverse effects to fish health, degradation of fish habitat, or fish mortality.

Fish Mortality

Instream work that requires isolation of a portion of a waterbody has the potential to result in entrapment of fish that can result in mortality once the isolated area is dewatered.

Direct Loss or Alteration of Fish Habitat

The direct alteration or loss of fish habitat i.e. Harmful Alteration, Disruption or Destruction (HADD) can occur during instream construction associated with the construction and/or demolition of watercourse crossing structures. The magnitude of permanent HADD depends upon the type and size of the crossing structure and is typically directly related to the instream footprint (i.e. instream piers and streambank armouring) of the crossing structure. In addition, the use of isolation works to facilitate instream works can temporarily impact fish habitat and its accessibility. The extent that habitat alteration is considered harmful depends on the quality and sensitivity of fish habitat that is impacted.

Reference design plans indicate that the new bridge will have two instream piers compared to the three instream piers that currently exist. The north abutment and the land-based piers on the south side of the river will not be located within the active channel and are not expected to affect fish habitat. It is assumed that some riprap armouring will be necessary to protect the streambanks and bridge structure. Armouring placed on the north bank is not expected to impact fish habitat since that bank already has extensive rip-rap; impacts resulting from the placement of armour on the south bank will depend on the extent of proposed bank protection works, which are still to be determined.

Impacts to fish habitat as a result of isolation works to facilitate bridge demolition and/or construction will depend on the isolation method as well as the size of the isolation areas.

3.2 Mitigation

The following mitigation measures have been developed after review of the reference design plans that have been provided. Additional mitigation measures may be required depending on final design and construction plans.

Construction Timing

The development of the construction schedule should take into account the restricted activity period (September 16^{th} to July 31^{st}) and should be devised so that the phases of construction with the most potential to impact critical life cycle phases for fish (i.e. the installation and removal of isolation works) are not completed during sensitive periods. In particular construction and removal of isolation works should be scheduled to avoid April 1^{st} to July 31^{st} – the spring portion of the restricted activity period – to mitigate potential effects on important spring spawning species including Lake Sturgeon. Given habitat attributes found within the study section, Mountain Whitefish (*Prosopium williamsoni*) is likely the only fall spawning species that would use the habitat in the immediate vicinity of the project for spawning. They are quite adaptable and will utilize a wide range of habitat conditions for spawning (Thompson and Davies 1976). However, the habitat in the vicinity of the project is neither unique nor in short supply in the NSR and is therefore not considered critical to Mountain Whitefish. As such, while it would be optimal to avoid completing the installation and/or removal of berms during the fall, it may be possible if deemed integral to the overall construction schedule. Additional field investigations (i.e. kick net surveys for Whitefish eggs) and/or mitigation strategies (i.e. restricted compliance limits during sediment monitoring) may be required if instream work within the restricted activity period is required.

Scheduling the demolition work for the winter period so that work could be completed from the ice surface may minimize potential impacts to fisheries resources associated with the removal of the existing bridge.

Isolation of Instream Works

Instream work associated with the bridge construction and demolition should be isolated from flowing water so that construction of piers, abutments, and any other bridge components within the active channel are completed in the dry. While regulators often prefer that non-earthen cofferdams be installed, the installation of armoured berms constructed of high plastic clay is the most commonly used isolation method when the isolation works will be in place for long periods and need to withstand winter conditions and large fluctuations in flow.

Fish Movements

The potential impacts relating to fish passage can be mitigated through implementation of a number of strategies including:

- Minimize the size of isolation works so that constriction of North Saskatchewan River is minimized.
- Implement construction schedule so that constriction of the North Saskatchewan River is minimized (i.e. sequential process whereby only one side of the river is isolated at a time);
- Develop a hydraulic model to assess the effect of potential river constriction on water velocities and to provide level of confidence that there will be zones where velocities are low enough to allow for upstream fish movements.
- Monitoring to assess fish movements through the construction area during the project.

Erosion and Sediment Control

Implementation of surface runoff controls during the construction phase and maintaining those controls during the early operation phase are imperative to mitigate the potential effects of sediment introduction. Sediment in surface runoff water from disturbed ground at and adjacent to crossing sites can be controlled in the short term by utilizing surface controls as described by Alberta Infrastructure's Fish Habitat Manual (2009). Post construction stabilization, principally by revegetation of exposed cuts, fills and ditches will mitigate the longer-term potential effects of sediment generation. A list of best management practices (BMP's) for controlling erosion and sediment at construction sites has been compiled in Alberta Transportation's Design Guidelines for Erosion and Sediment Control for Highways (2011). These BMP's should be reviewed and appropriate BMP's selected based on local site conditions.

Sediment Monitoring

A sediment-monitoring program should be implemented during instream construction. The extent of such a program will depend on site logistics and construction scheduling. The monitoring program should identify specific monitoring procedures, compliance criteria, and reporting protocols to ensure minimum introduction of sediments during instream construction.

Deleterious Substances

During construction and demolition, heavy equipment entering the active channel of the NSR should be thoroughly cleaned and inspected prior to commencement of work. In addition, refueling of heavy machinery should be done in an area away from the river, in an area where potential spills will not potentially enter the aquatic environment.

During demolition, debris should be trapped and contained to insure potential contaminants will not enter the river.

Interception of the bridge deck runoff before it enters the river and direction of runoff to settling ponds and/or other treatment facilities will mitigate the longer-term potential effects of deleterious substance loading during the operation of the bridge.

Fish Mortality

Fish salvage operations should be conducted in all isolated work areas with the intent of removing fish that are trapped in the isolated areas and transferring them to a suitable release location in the NSR.

If a pump is used to de-water fish-bearing waters the pump intake should be screened in accordance with Fisheries and Oceans Freshwater End-of-Pipe Fish Screen Guideline (DFO 1995).

Direct Loss or Alteration of Fish Habitat

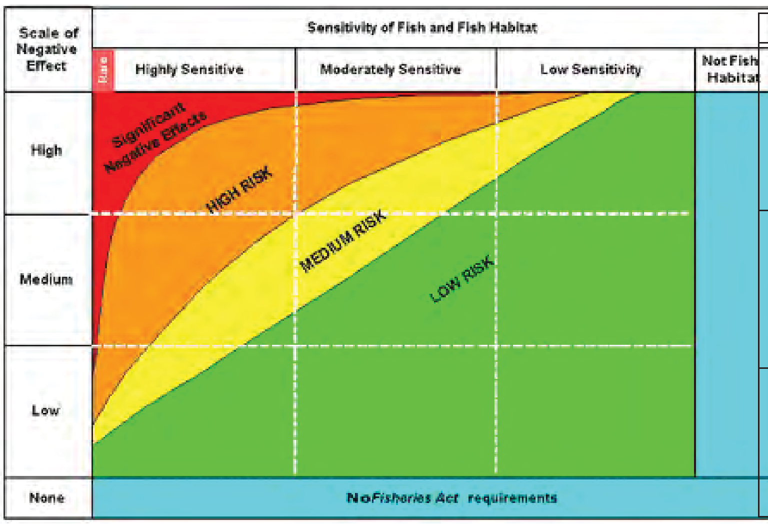
Potential loss or alteration of fish habitat can be mitigated through implementation of a number of strategies including:

- Disturbances to fish habitat should be minimized during the construction period and any impacted channel or bank should be rebuilt to replicate natural conditions
- The size of the isolation area(s) should be minimized.
- Isolation works must be completely removed from the river.
- Use of bioengineering techniques to stabilize streambanks.

3.3 RESIDUAL IMPACTS

Residual impacts (ie. Harmful Alteration, Disruption, or Destruction of fish habitat (HADD)) can occur during watercourse crossing construction if potential impacts of the project cannot be fully mitigated (DFO 2007).

Fisheries and Oceans Canada (DFO) provides a risk management based framework for determining whether a proposed project has the potential to result in HADD of fish habitat (Figure 1). HADD can occur depending on the potential magnitude of effect of a proposed project on fish and fish habitat (ie. the Scale of Negative Effect) and the sensitivity of the habitat potentially affected (ie. the Sensitivity of Fish and Fish Habitat).



Risk Rating	Description
Low Risk	• effects are well understood and readily mitigable using standard measures • not likely to result in HADD provided appropriate mitigation measures are applied • management option typically 'No HADD Likely as Proposed' letter
Medium Risk	• effects are routine in nature and resulting HADD is small-scale and/or temporary in duration, and have predictable outcomes with a low level of uncertainty surrounding potential negative effects • streamlined authorization process often suitable
High Risk	• effects are variable and involve sensitive fish and fish habitat resulting in potential HADD that is large-scale and may occur of a long period of time • require site-specific review and *Fisheries Act* Authorization

Figure 1. Risk assessment matrix for the assessment of HADD (from DFO 2007).

Scale of Negative Effect

The Scale of Negative Effect depends on the extent of the project, the duration of the effect, and the intensity of the change. The proposed bridge will be a permanent structure (potential for long term impact) but is not expected to have a major footprint since there will be fewer piers and impacts to riparian areas will be limited since bank armouring is already prevalent in the area. Isolation works will be temporary and as such the footprint is expected to be short-lived. Given these factors and based on current project information the Scale of Negative Effect for the project is rated low.

__Sensitivity of Fish and Fish Habitat__

The sensitivity of the habitat depends on what species may utilize the habitat, the potential of the habitat to provide for critical life cycle phases, the rarity of the habitat, as well as the resiliency of the habitat. The habitat potentially impacted by the proposed project is utilized by a wide variety of fish species for a number of life cycle phases. The habitat within the study section was not rare within the NSR, however, there is critical Lake Sturgeon habitat located some distance downstream of the project. Overall, the habitat is considered to be moderately resilient. Given these factors, the sensitivity of the habitat potentially affected by the project is judged moderate/high.

__Risk Analysis__

Considering available project information and assuming that recommended mitigation measures will be properly implemented the potential for HADD of fish habitat, based on application of the DFO Risk Assessment Matrix (Figure 1), is expected to be low. However, final determination of HADD will depend on final design and construction plans and review of the project by Fisheries and Oceans Canada.

4.0 CLOSURE

We believe the project information presented in this report is accurate but cannot guarantee its accuracy or completeness. Any use that a third party makes of this report is the responsibility of such third party. Should any portion of the report require clarification, please contact the undersigned.

Pisces Environmental Consulting Services Ltd.

Qualified Aquatic Environment Specialists and Field Staff:

Scott Holroyd, BSc.
Fisheries Biologist
Author

Erik Stemo, P. Biol.
Senior Fisheries Biologist

REFERENCES

Alberta Environment. 2006. Code of Practice for Watercourse Crossings (made under the Water Act and the Water (Ministerial) Regulation). Queen's Printer for Alberta.

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APPENDIX A:
Fisheries Resources Assessment for Cloverdale LRT Bridge (Pisces 2010)

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PISCES ENVIRONMENTAL

ASSESSMENT OF THE FISHERIES RESOURCES AND HABITAT OF THE NORTH SASKATCHEWAN RIVER FOR THE PROPOSED CLOVERDALE LRT BRIDGE CROSSING

PISCES ENVIRONMENTAL CONSULTING SERVICES LTD.

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ASSESSMENT OF THE FISHERIES RESOURCES AND HABITAT OF THE NORTH SASKATCHEWAN RIVER FOR THE PROPOSED CLOVERDALE LRT BRIDGE CROSSING

Prepared for:
Spencer Environmental Management Services Ltd.
Edmonton, Alberta

Prepared by:
Pisces Environmental Consulting Services Ltd.
Red Deer, Alberta

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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1.0 INTRODUCTION

The City of Edmonton is planning to expand LRT service within the City and conceptual designs are underway for two LRT extensions. One of these extensions, referred to as the southeast extension, will extend service from downtown Edmonton to the community of Millwoods. The proposed alignment for this extension would commence near 97th Street and 102nd Avenue, travel across the North Saskatchewan River, continue along the north side of Connors Road to 75th Street, proceed south to Mill Creek crossing the ravine near 83rd Street before crossing Whitemud Drive and terminating at approximately 28th Avenue. The project would require that the existing Cloverdale pedestrian bridge be demolished and an new LRT/pedestrian bridge be constructed at the same location (Figure 2.1).

As part of the environmental overview process undertaken by the City, Pisces Environmental Consulting Services Ltd. (Pisces) completed an assessment of the fisheries resources and habitat of the North Saskatchewan River in the vicinity of the proposed crossing site in November 2010. The primary objectives of the assessment were to:

- review existing information and consult with regional fisheries managers regarding the fish community of the North Saskatchewan River;
- conduct fall season electrofishing surveys in the vicinity of the project;
- complete a fisheries habitat inventory at and adjacent to the proposed bridge crossing;
- identify potential Lake Sturgeon (*Acipenser fulvescens*) habitat in the vicinity of the project;
- assess the stream bank conditions at, and adjacent to, the proposed disturbance area;
- develop a technical document to support information requirements under the Federal *Fisheries Act*, Alberta Environment’s *Code of Practice for Watercourse Crossings*.

2.0 STUDY AREA

The study area encompassed approximately 2.5 kilometres of the North Saskatchewan River in the vicinity of the proposed bridge crossing extending from 0.5 kilometres upstream to 2.0 kilometres downstream of the existing Cloverdale pedestrian bridge (Figure 2.1).

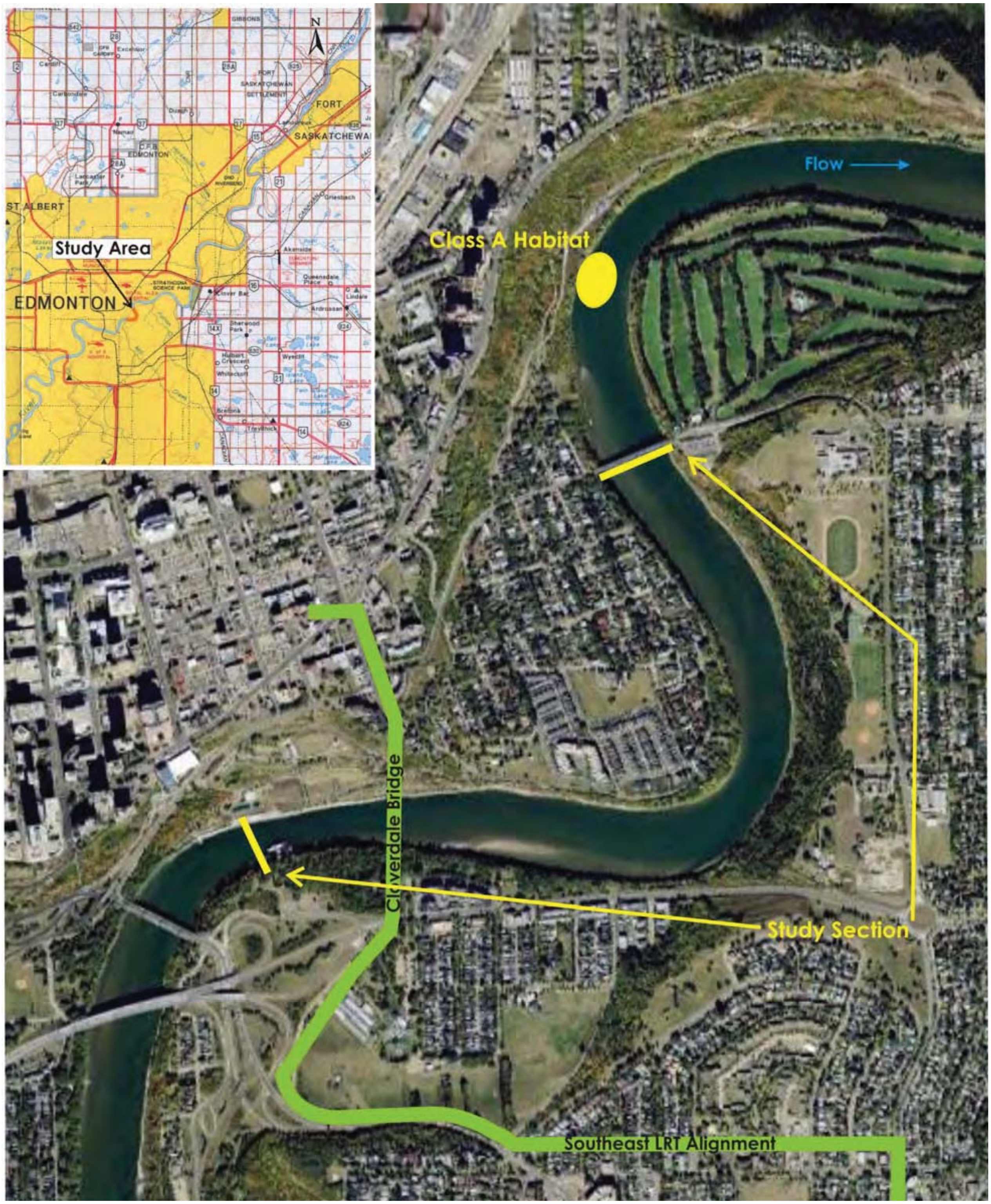


Figure 2.1. Study area location for Cloverdale LRT bridge crossing

Project: City of Edmonton Cloverdale Bridge Replacement	
Prepared For: Spencer Environmental Management Services Ltd.	
Pisces Environmental Consulting Services Ltd.	

According to the *Code of Practice for Watercourse Crossings* Edmonton Management Area Map, the majority of the river in the vicinity of the proposed project is classified as Class C habitat which is considered moderately sensitive and broadly distributed within the province (Alberta Environment 2006). In addition, there are several sections of the North Saskatchewan River in the vicinity of Edmonton that are designated as Class A habitat, which is defined as highly sensitive habitat that is critical to the continued viability of a population of fish in the area (Figure 2.1., Alberta Environment 2006).

3.0 METHODS

Pisces conducted the assessment following the standard procedures described in Appendix A. These standard procedures meet the criteria outlined by the Water Act – *Code of Practice for Watercourse Crossing* and Fisheries and Oceans Canada information requirements.

Field investigations were conducted from November 1st to 3rd, 2010.

3.1 HABITAT INVENTORY

The habitat of the North Saskatchewan River was inventoried using the Large River Classification System developed by R.L. & L. Environmental Services Ltd. (O'Neil and Hildebrand 1986). This system is based on gross morphology and habitat types along riverbanks and is, therefore, suited to assessment of large mainstream rivers that do not show defined instream channel units such as pools, riffles, or runs. The procedure defines the type of channel present as Unobstructed (Type U), Singular Island (Type S), and Multiple Island (Type M) and maps available habitat based on bank habitat types and special habitat features (such as tributary confluences). Inventory data was detailed on air photos (approximately 1:8000) in the field. Detailed descriptions of the assessment parameters of the large River Habitat Classification System are provided in Appendix A.

A Lowrance X-16 depth sounder was used to determine water depth throughout the study section and to identify deep water that would be suitable Sturgeon holding habitat. Two transects, established parallel with the stream flow were situated at approximately one-third and two-thirds of channel width. Substrate composition at the existing bridge crossing site was assessed using an Aquaview underwater camera at transect locations.

3.2 Fish Presence

Electrofishing surveys were completed on November 1st, 2010 utilizing a jet boat and Smith-Root GPP Electro-fisher. Fish sampling was conducted while drifting downstream along transects with sampling concentrated along shorelines where cover (primarily rip-rap) was present.

In addition, the Fisheries Management Information System (FWMIS) maintained by Alberta Sustainable Resource Development, as well as other available literature with record of historical sampling of the river were reviewed.

3.3 Stream bank and Channel Assessment

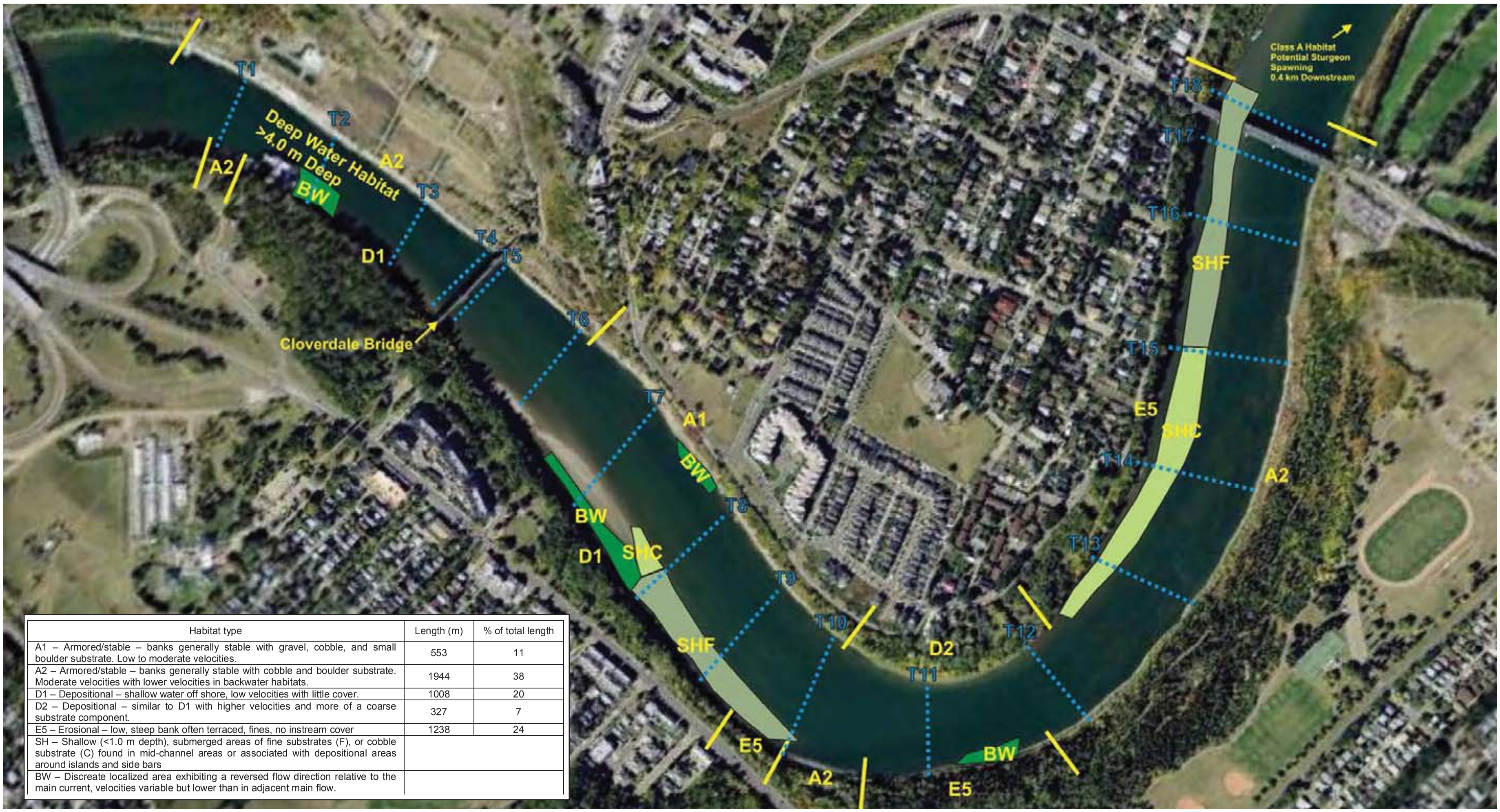
Eighteen transects, generally at intervals of approximately 150 metres, were established across the channel throughout the study section. Transect 1 was established furthest upstream of the proposed crossing site with transect numbers increasing with downstream direction (Figure 5.1). At each transect a Lowrance X-16 depth sounder was used to establish a cross section of the channel. A detailed description of the physical measurements taken at each transect is provided in Appendix A.

4.0 RESULTS

4.1 Habitat Inventory

The North Saskatchewan River consists of one main channel within the study section. As such, the channel was classified as “U” (unobstructed channel).

Approximately 38% of the study section was classified as armored habitat (A2) (Figure 4.1). Erosional habitat (E5) accounted for approximately 35% of the study section while depositional habitat (D1 and D2) comprised approximately 27% of the study section (Figure 4.1). Water depths offshore were generally less than 2 metres deep, however the area immediately upstream of the crossing site was almost 5 metres deep. The shoals located in the study area were generally very shallow (<0.5 m deep) with fine and coarse substrate components both present. Backwater



Habitat type	Length (m)	% of total length
A1 – Armored/stable – banks generally stable with gravel, cobble, and small boulder substrate. Low to moderate velocities.	553	11
A2 – Armored/stable – banks generally stable with cobble and boulder substrate. Moderate velocities with lower velocities in backwater habitats.	1944	38
D1 – Depositional – shallow water off shore, low velocities with little cover.	1008	20
D2 – Depositional – similar to D1 with higher velocities and more of a coarse substrate component.	327	7
E5 – Erosional – low, steep bank often terraced, fines, no instream cover	1238	24
SH – Shallow (<1.0 m depth), submerged areas of fine substrates (F), or cobble substrate (C) found in mid-channel areas or associated with depositional areas around islands and side bars		
BW – Discreate localized area exhibiting a reversed flow direction relative to the main current, velocities variable but lower than in adjacent main flow.		

FIGURE 4.1.

Habitat mapping and transect locations for the North Saskatchewan River adjacent to the proposed Cloverdale LRT bridge crossing.

N W E S

Scale: 1:5400

100 0 100 200 m

Project: City of Edmonton Cloverdale Bridge Replacement

Prepared For: Spencer Environmental Management Services Ltd.

Created: December 2010

Pisces Environmental Consulting Services Ltd.

areas, generally the result of streambank irregularities, were also found within the study section but did not account for a large segment of the total habitat area.

Object cover was generally scarce within the study section with the exception of boulders (provided by rip-rap) that were common in A2 habitat areas. Depth and turbidity also provided cover for fish. The streambed was primarily composed of a mixture of coarse substrates and fine material with cobbles and fines the most common. Coarse substrates (cobble, boulder, gravel) were more common in areas of higher velocities while low velocity areas generally had a greater proportion of fine materials.

Photos depicting habitat conditions at the time of assessment are provided in Appendix B.

4.2 Fish Capture

A 1400 metre long electrofishing survey completed adjacent to the existing Cloverdale bridge resulted in the capture of Mooneye, Mountain Whitefish, Northern Pike, Walleye, Emerald Shiner, Longnose Sucker, Spottail Shiner, Trout-perch, and White Sucker during 2308 seconds of electro-fisher on time (Table 4.1). The majority of fish were captured along rip-rap shoreline or at the edge of deep water habitat. A detailed record of fish captured and sampling effort expended in November, 2010 is provided in Appendix C. Additional 2010 sampling completed approximately 1.2 kilometres upstream of the Cloverdale bridge found the same species as well as Burbot (Pisces *in prep* 2010.).

Table 4.1 Summary of fish captured near Cloverdale Bridge in November, 2010

Species	**Number**	**Length (mm) (range)**	**Weight (g) (range)**
Emerald Shiner	4	72 (57-85)	3 (1-5)
Longnose Sucker	1	146	43
Mountain Whitefish	5	292 (179-324)	339 (68-475)
Mooneye	3	253(243-266)	236(198-301)
Northern Pike	1	232	83
Spottail Shiner	1	62	1
Trout-Perch	1	58	2
Walleye	2	193 (174-212)	82 (68-95)
White Sucker	1	405	1078

Historical fish presence data for the North Saskatchewan River in the vicinity of the City of Edmonton indicates that there is a diverse community in this section of the river including 11 sport and 19 non-sport fish species (Table 4.2). At present, none of the species historically reported from this section of the river are listed on Schedule 1 under the *Federal Species at Risk Act* (SARA). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has assessed lake sturgeon as endangered (COSEWIC 2006). As of December, 2010, the ministerial response to the COSEWIC status assessment for Lake Sturgeon indicates that the Minister of Fisheries and Oceans will undertake consultations on whether or not the Lake Sturgeon Saskatchewan River populations should be listed under the Species at Risk Act (SARA 2010).

Table 4.2 Historical record of fish species captured from the North Saskatchewan River in the vicinity of Edmonton, Alberta.

Common Name	**Scientific Name**	**Provincial Status** (ASRD 2005)	**Federal Status** (SARA 2010)	**Historical Inventories**
Brook Stickleback	*Culaea inconstans*	Secure	Not Listed	b
Brook Trout	*Salvelinus fontinalis*	Exotic/Alien	Not Listed	b
Brown Trout	*Salmo trutta*	Exotic/Alien	Not Listed	a,b
Bull Trout	*Salvelinus confluentus*	Sensitive	Not Listed	a
Burbot	*Lota lota*	Secure	Not Listed	a,b
Emerald Shiner	*Notropis atherinoides*	Secure	Not Listed	b,c
Fathead Minnow	*Pimephales promelas*	Secure	Not Listed	b
Finescale Dace	*Phoxinus neogaeus*	Undetermined	Not Listed	b
Flathead Chub	*Platygobio gracilis*	Secure	Not Listed	b
Goldeye	*Hiodon alosoides*	Secure	Not Listed	a,b
Lake Chub	*Couesius plumbeus*	Secure	Not Listed	b
Lake Sturgeon	*Acipenser fulvescens*	At Risk	Under Consideration	a,b
Longnose Dace	*Rhinichthys cataractae*	Secure	Not Listed	b
Longnose Sucker	*Catostomus catostomus*	Secure	Not Listed	b.c
Mooneye	*Hiodon tergisus*	Secure	Not Listed	b,c
Mountain Sucker	*Catostomus platyrhnchus*	Secure	Not Listed	b
Mountain Whitefish	*Prosopium williamsoni*	Secure	Not Listed	a,b,c
Northern Pike	*Esox lucius*	Secure	Not Listed	a,b,c
Northern Redbelly Dace	*Phoxinus eos*	Sensitive	Not Listed	b
Pearl Dace	*Margariscus margarita*	Undetermined	Not Listed	b
Quillback	*Carpoides cyprinus*	Undetermined	Not Listed	b
River Shiner	*Notropis blennius*	Undetermined	Not Listed	b
Sauger	*Stizostedion canadense*	Sensitive	Not Listed	a,b
Shorthead Redhorse	*Moxostoma macrolepidotum*	Secure	Not Listed	b
Silver Redhorse	*Moxostoma anisurum*	Undetermined	Not Listed	b
Spoonhead Sculpin	*Cottus ricei*	May be at Risk	Not Listed	b
Spottail Shiner	*Notropis hudsonius*	Secure	Not Listed	b,c
Trout-perch	*Percopsis omiscomaycus*	Secure	Not Listed	b,c
Walleye	*Sander vitreus*	Secure	Not Listed	a,b,c
White Sucker	*Catostomus commersoni*	Secure	Not Listed	b,c

* a Allan (1984)
b FMIS (2010)
c this study

4.3 STREAM BANK AND CHANNEL ASSESSMENT

The North Saskatchewan River, near Edmonton, meanders through an entrenched stream cut valley. Valley walls range in height but are generally steep and composed of fine material. The banks within the study section were primarily stable and relatively well vegetated with grass, shrubs, and trees. Streambank armoring with rip-rap was common within the study section along stretches that would likely have been naturally unstable.

The wetted width averaged 159 metres within the study section (across the 18 transects). Water depths were generally less than two metres with the exception of the area immediately upstream of the Cloverdale Bridge where depths exceeded four metres. Cross sections of the channel were measured from the right-upstream-bank (RUB) to the left-upstream-bank (LUB) producing a cross section image of the channel as it would appear looking in the downstream direction. Cross sections of the channel at each transect are presented in Figures 4.2 to 4.6.

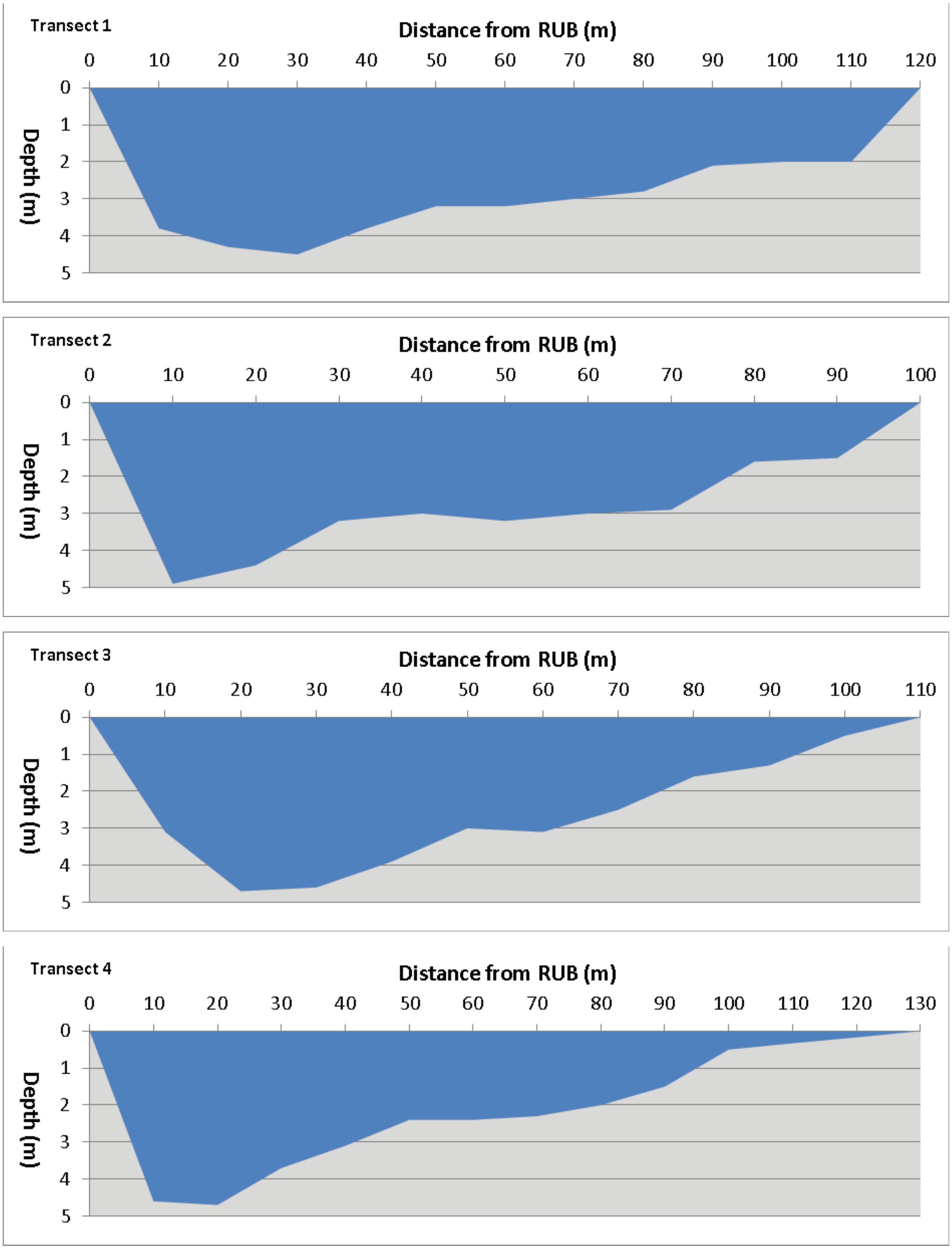


Figure 4.2. Channel cross section at Transects 1-4.

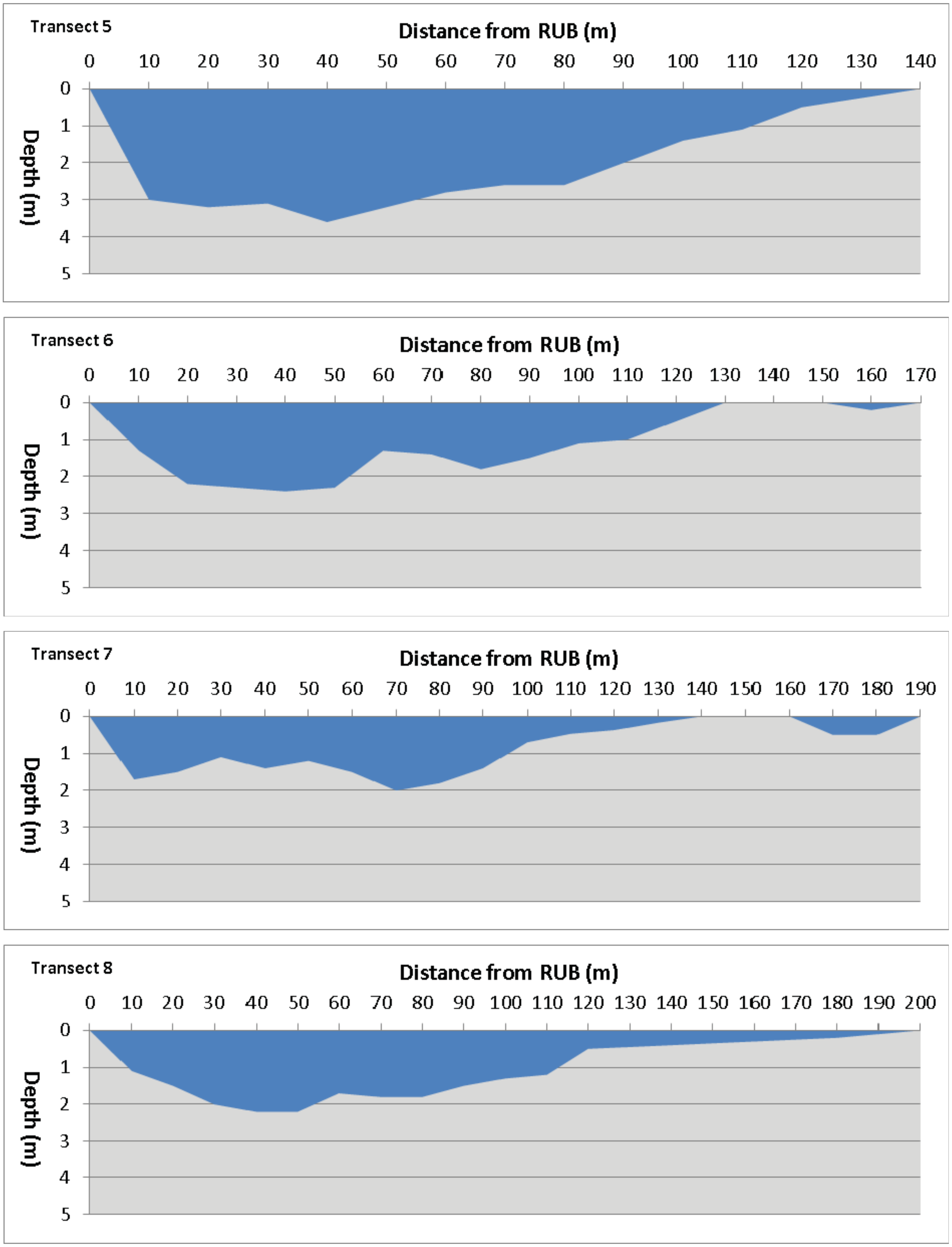


Figure 4.3. Channel cross section at Transects 5-8.

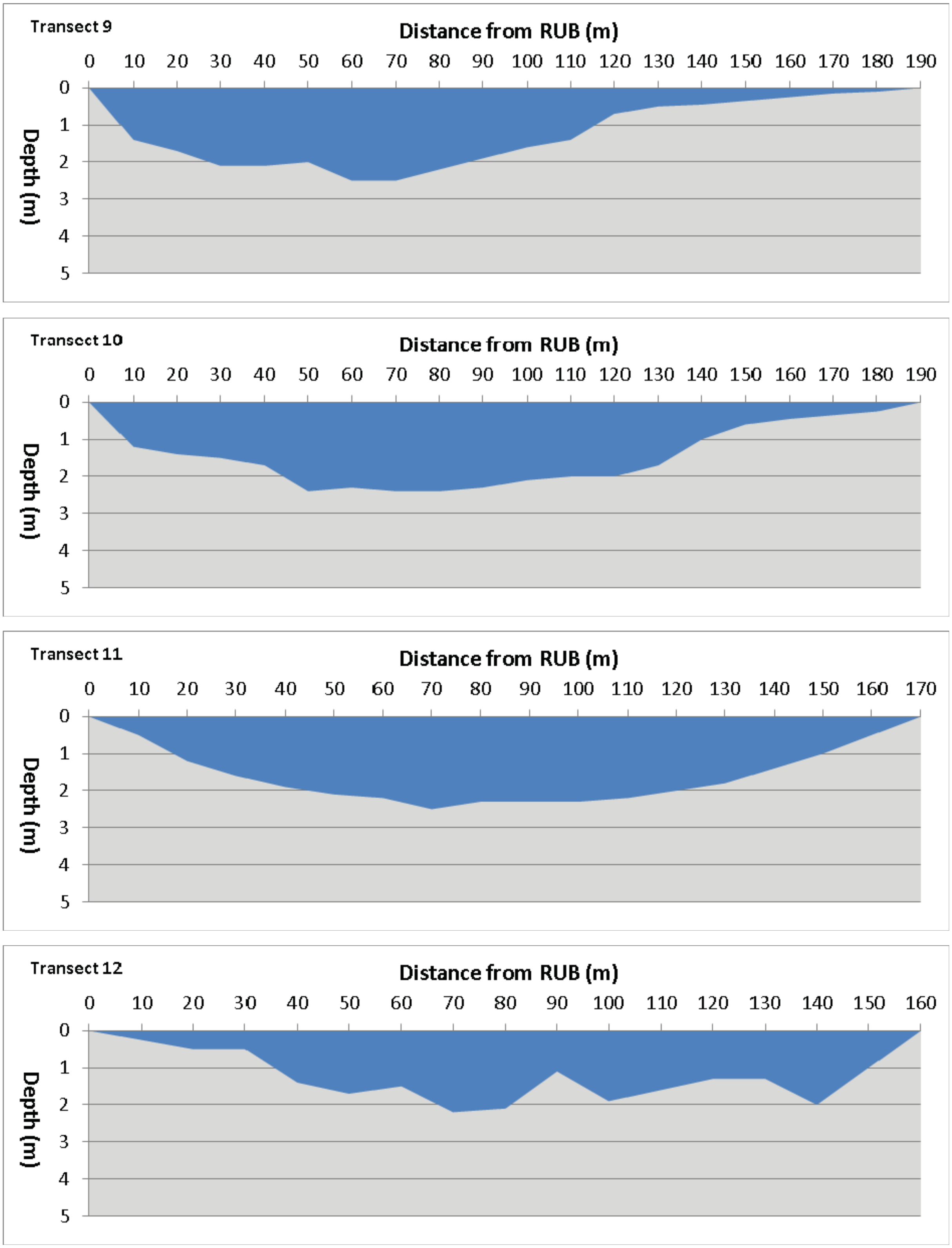


Figure .4.4 Channel cross section at Transects 9-12.

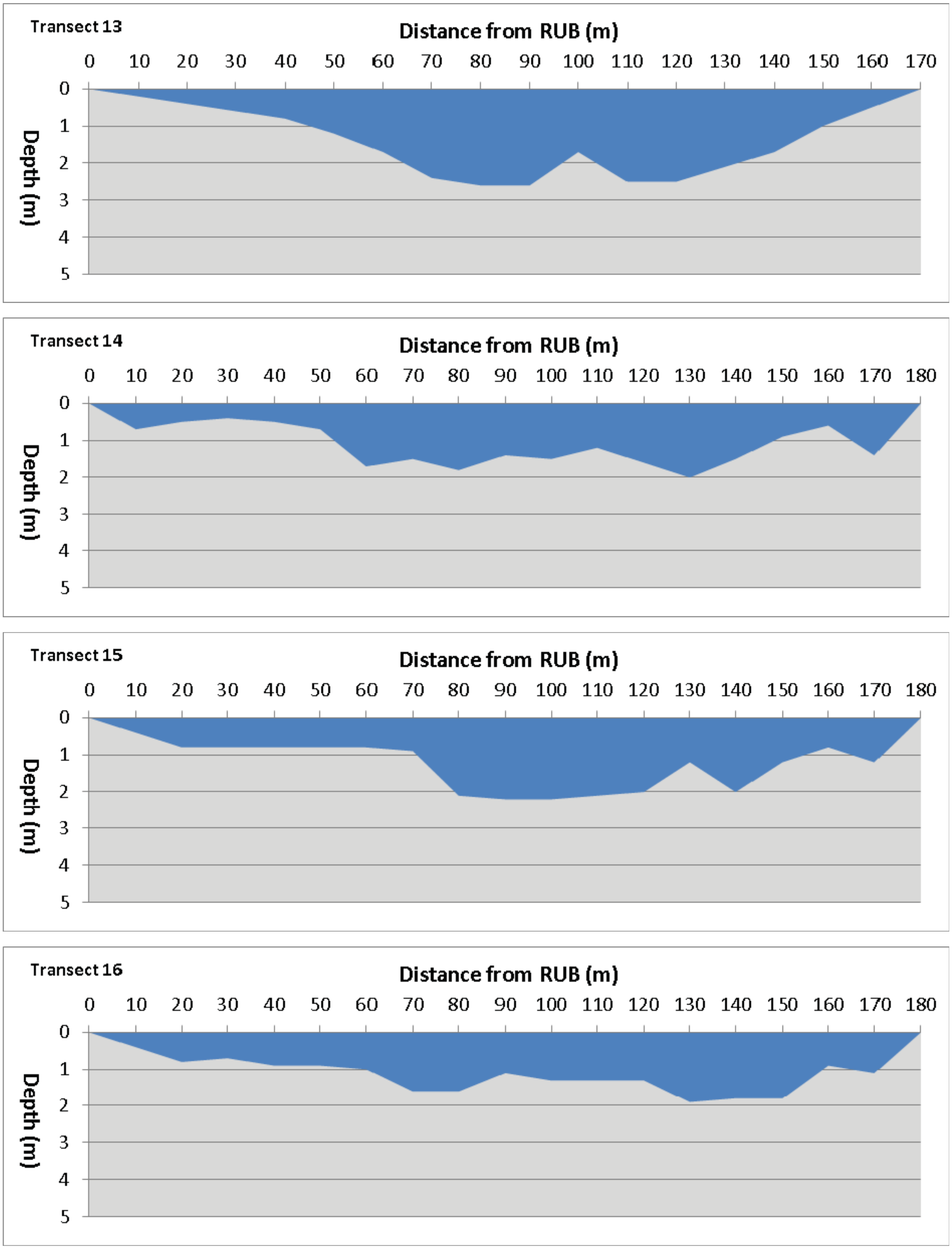


Figure 4.5. Channel cross section at Transects 13-16.

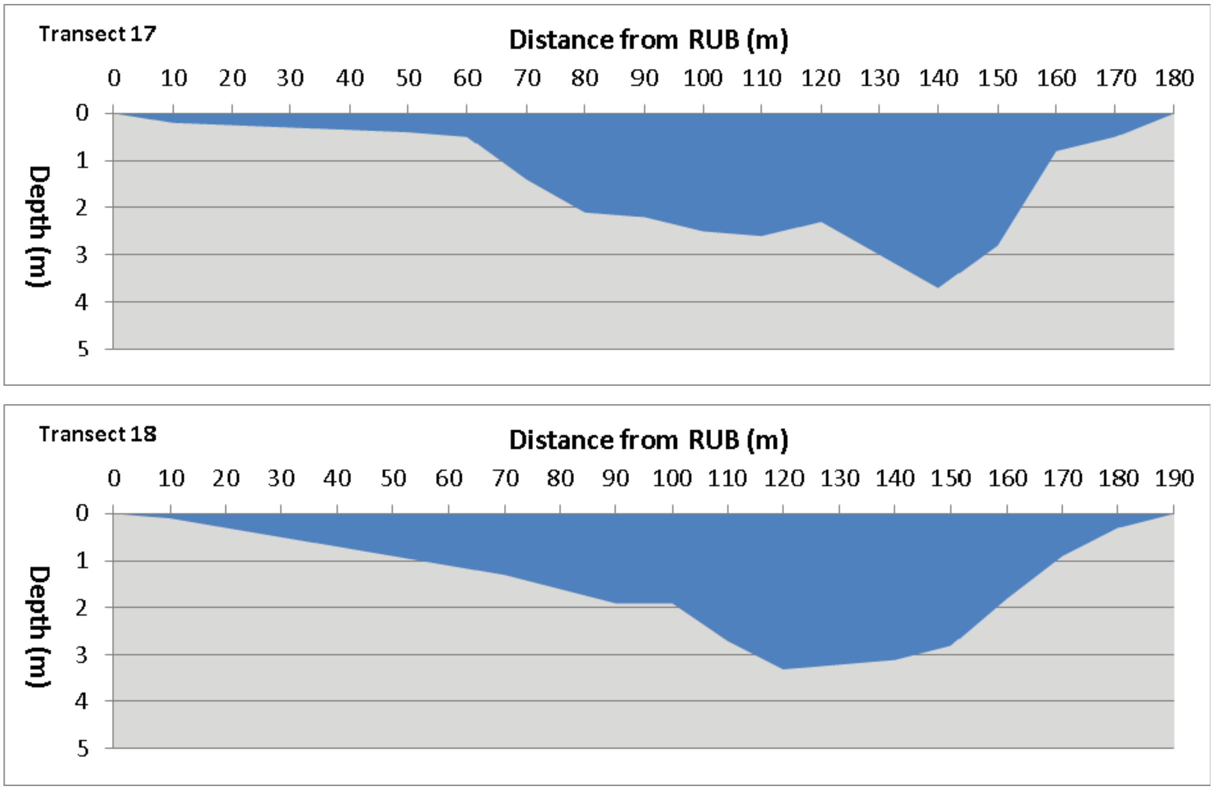


Figure 4.6. Channel cross section at Transects 17-18.

5.0 DISCUSSION

Fish Presence

While 2010 sampling totals were relatively low, the results were consistent with previous sampling of the North Saskatchewan River in the City of Edmonton in terms of species presence. In 1984, Allan reported nine sport fish species in the main-stem of the North Saskatchewan River near Edmonton. According to Allan (1984), Northern Pike, Walleye, and Goldeye were common or seasonally abundant; Sauger, Mooneye, and Yellow Perch occurred occasionally; and Lake Sturgeon, Mountain Whitefish, and Bull Trout were rare. Seasonal sampling completed within the City limits in the early nineties found 17 different species occupying the study section but discovered that the fish population was mainly comprised of nine sport and non-sport species (Table 4.2, Kippen Gibbs 1993). Mountain Whitefish and Goldeye were the most common sport fish species captured while non-sport species were dominated by Longnose Sucker, White Sucker, Shorthead Redhorse, and Longnose Dace (Kippen Gibbs 1993). Seasonal abundance (between spring, summer and fall) was relatively constant for most species however, Mountain Whitefish, Goldeye, and Shorthead Redhorse all exhibited some variation (Kippen Gibbs 1993). Mountain Whitefish were present in moderate numbers in the spring; were almost absent in the summer; and dominated the sport-fish catch in the fall (Kippen Gibbs 1993). Goldeye were the most common sport fish in the spring and summer but were virtually absent in the fall and Shorthead Redhorse also decreased in relative abundance in the fall compared to other seasons (Kippen Gibbs 1993).

Habitat Utilization

Much of the habitat in the Edmonton area consists of moderate depth placid run habitat that is neither unique nor in short supply within the North Saskatchewan River (Kippen Gibbs 1993, Stemo 2006). As such, habitat utilization of the area is varied as some species may frequent the area on a seasonal basis while others may occupy this section of the river during all life cycle phases on a year-round basis. The Alberta Government has classified most of the North Saskatchewan River as Class C habitat which by definition is considered widely distributed and moderately sensitive (Alberta Environment 2006). However, some portions of the North

Saskatchewan, including areas downstream of the study area have been designated as Class A Lake Sturgeon habitat (Alberta Environment 2006).

Lake Sturgeon have a limited presence in Alberta and the North Saskatchewan River population is one of only two sub-populations in Alberta. According to Alberta Sustainable Resource Development (2005), the Lake Sturgeon is considered ‘threatened’ and the Federal Government is considering listing the North Saskatchewan River population based on the ‘endangered’ recommendation of COSEWIC (2006). An assessment of Lake Sturgeon populations in the North Saskatchewan River conducted in 1992 focussed on a 240 kilometre section of the river extending from approximately 110 kilometres upstream of Edmonton to approximately 130 kilometres downstream of the city (Watters 1993). Abundance was low and individuals appeared to have a grouped distribution with fish concentrated in a few specific locations (Watters 1993). Several habitat characteristics that were common between these sites were identified as preferential for Sturgeon including a back eddy below a gravel bar or island, with deep water (>3.8 m) adjacent to the river bank (Watters 1993). Investigations in 2010 found one site that met this criteria located immediately upstream of the existing Cloverdale Bridge. However, there is no historical record of Lake Sturgeon occupying this habitat (FWMIS 2010, Watters *Pers. Comm* 2010).

Mountain Whitefish utilize a range of habitat for spawning including riffle, run or deep pool habitat (Thompson and Davies 1976, McAfee 1966) and have demonstrated an adaptability in utilizing varying substrates and water depths. Mountain Whitefish eggs have been found in water ranging from 0.1 to 1.0 metres (IEC Beak Consultants 1984, Ford *et. al* 1995) and have been reported to use coarse substrates ranging from 50 to 500 millimetres in diameter (Northecote and Ennis 1994, Thompson 1974). Considering these wide-ranging characteristics it appears that habitat that may be suitable for spawning is relatively common within the study section and likely the entire reach of the North Saskatchewan River near the City of Edmonton. In addition, suitable rearing, feeding, and overwintering habitat did not appear to be limited within the study section.

The Goldeye that occupy the river in the vicinity of the project are part of a large migratory population that are very abundant in the Edmonton area during the early summer and migrate downstream to the lower reaches of the North Saskatchewan River to overwinter (Allan 1984). Munson (1978) postulated that Goldeye spawn in Alberta during the spring and eggs and/or fry drift downstream to Saskatchewan until they reach maturity at age 3 or 4 at which time the adults return to Alberta. Spawning is believed to occur in lower velocity areas (backwaters or pools) with some turbidity and it seems possible that spawning may occur in the Edmonton area.

The margins of the river likely provide rearing habitat for Walleye and the capture of juvenile Walleye in fall 2010 suggests that the study section is utilized for this life cycle phase. Walleye typically spawn on clean gravel or rubble substrate 2.5-15 centimetres in diameter (McMahon et al 1984) in areas with slow to moderate velocities. While this type of habitat is relatively common with the study section, the relatively low densities of Walleye captures historically suggests that spawning activity may be limited in this part of the North Saskatchewan River.

The role of aquatic vegetation in the life cycle of northern pike is of considerable importance, specifically in reproduction and rearing (Craig 1996). It is widely agreed that meeting spawning habitat requirements (including the presence of adequate vegetation) is the most critical conditions for establishing a durable pike population (Inskip 1982, Raat 1988). Suitable vegetation for Northern Pike reproduction was not present within the study section and it seems more likely that Pike spawn in tributary streams such as Whitemud Creek. River margins and backwater areas within the study section are probably used by Northern Pike for rearing and the deeper runs may provide overwintering habitat.

Burbot are generally widespread in the North Saskatchewan River (Mayhood 1995) and it seems likely that they occupy the river in the vicinity of Edmonton (including the study section) throughout the year for all life cycle phases.

Larger bodied coarse fish species and forage fish species are relatively abundant in the North Saskatchewan River near Edmonton (Kippen Gibbs 1993) and likely occupy the study section on a year-round basis. Habitat attributes within the river appear to be suitable for spawning, rearing, feeding and overwintering. Ripe fish have been captured in Edmonton in the past (Kippen Gibbs 1993) which suggests that some spawning has been attempted and the it seems likely that deeper habitat could be used during the winter. These habitats were not rare within the study section and are considered to be quite common in the North Saskatchewan River in general.

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7.0 PERSONAL COMMUNICATIONS

Watters, D. December, 2010. Senior Fisheries Technician Alberta Sustainable Resource Development, Edmonton, Alberta.

APPENDIX A:

Assessment Methods

STANDARD PROCEDURES FOR WATERCOURSE CROSSING ASSESSMENTS TO MEET WATER ACT CODE OF PRACTICE AND DEPARTMENT OF FISHERIES AND OCEANS INFORMATION REQUIREMENTS

Existing Information

An information search and review will be conducted to determine the necessity for field investigation as per Schedule 4, Section 1, Subsection (1)(b)(i) and Subsection 2(a) of the Code of Practice.

Preliminary Assessment

Determine if the watercourse meets the definition of a ‘water body’ under the meaning of Section 1 (2)(bb) of the Code of Practice. If the watercourse does not have defined bed and banks, whether water is present or not, then proceed with those physical assessment components, particularly photographs, to demonstrate that the watercourse does not have defined bed and banks and is not therefore a ‘water body’ and does not have any fish habitat attributes. If the watercourse is a water body, proceed with a full assessment.

Physical Assessment

Study Sections:

Determine the legal land location and UTM coordinates of the crossing site and if possible, a bridge file number.

Establish three study sections, one upstream of the crossing site beyond any influence of the crossing, one encompassing the crossing site disturbance zone, and one downstream of the crossing site. The upstream section should not be less than 50 to 100 m in length. The downstream section should not be less than 300 m in length, allowing for instream obstructions and other local conditions, and should include the entire expected zone of sediment influence. The zone of influence can be estimated using Table 1 or can be calculated using the formula in Table 2. The study sections can be contiguous if the boundaries of the disturbance zone and the upstream boundary of the zone of sediment influence are clearly identified.

Habitat:

For small to medium sized rivers, habitat and cover types, as described in Table 3, within the study section(s) will be measured (m^2) and mapped (where appropriate). The percent composition of each substrate type present (Table 4) and bank vegetation type (Table 5) will be recorded for each habitat type unit. Record all data on a standard Pisces Habitat Inventory form (HI/95-1).

For large rivers, bank habitat types, as described in Table 6, within the study section(s) will be mapped.

Establish 5 equidistantly spaced transects with the middle transect (number 3) centered on the approximate center line of the crossing structure. Transects should be spaced such that they encompass the disturbance zone. At each transect measure bank full and wetted width (m), water depth at 0.25, 0.5 and 0.75 of the wetted width, substrate types across the transect and bank height (m), slope (degrees), composition (Table 7) and stability (stable or eroding). Table 6 describes the parameters in more detail. At the middle transect measure water velocity at 0.25, 0.5 and 0.75 of wetted width. If a structure is present at the middle transect, take measurements at the next transect upstream.

Determine dissolved oxygen concentration, pH, turbidity, conductivity and temperature at one location on transect #3 (Table 8). Obtain photographs showing both banks at the crossing site and the stream channel immediately upstream and downstream of the crossing site, including if possible the transect locations. Record all data on a standard Pisces Stream Bank Assessment form (BA/98-2).

Classify the water body according to the Rosgen channel type classification system described in Table 9.

Other Features:

Note presence of any major groundwater sources.
Note presence of any barriers to fish movement.
Describe any adjacent land use activities that are affecting the water body.
If an existing crossing structure is to be replaced, describe and photograph the existing structure.

Biological Assessment

Determine, by appropriate means (electrofishing, seining, trapping, observation), fish species composition in the study section. An electrofishing sample section need not be the same length as the habitat inventory section, but should not be less than 300 m where conditions allow. Record number of each species captured or observed, effort and area sampled. Weigh (g) and measure fork length (mm) of all sport fish species captured. Where possible record the life stage, gender and maturity of sport fish captured. Record sample section length and width and duration of capture effort. Record all data on a fish capture record form (ECR/95-1).

Where fish passage is an issue, identify the species and size of fish appropriate for passage design purposes.

Effects Assessment

Assess potential adverse and positive effects of the works and their construction. Potential adverse effects may include, but are not necessarily limited to, sediment, fish passage, habitat loss and/or changes in flow regime. Designs, plans and construction procedures are required to quantify changes in habitat type and availability.

Where residual effects are identified, the cumulative effect of the residual effect of the watercourse crossing structure relative to the cumulative effects of other watercourse crossings in a cumulative effects study area will be assessed. The CEA study area for small streams normally encompasses the entire watershed of that stream. For rivers, a portion of the watershed will be used.

Specifications and Recommendations

Under most circumstances, the Code of Practice requires that a Qualified Aquatic Environment Specialist (QAES) certify that if the specifications and recommendations of the QAES and the plans prepared under Section 6 of the Code of Practice are adhered to, the works will be in compliance with the requirements of Part 1 (a) of Schedule 2 of the Code of Practice. A QAES cannot and should not provide specifications and recommendations or issue a certification unless the QAES has reviewed any plans (design drawings, location plans, construction procedures) prepared under Section 6 and Schedule 2 and determined that the plans are adequate to address potential effects and identify mitigation and/or compensation strategies.

Specifications and recommendations of a QAES may include but may not be restricted to the following:

1) timing of construction
2) construction procedures
3) structure design
4) mitigation and/or compensation measures

pertinent to the protection of habitat or mitigation of potential adverse effects on fish or fish habitat.

Mitigation and/or compensation measures should be described in sufficient detail in text and on drawings or plans to meet the information requirements of the Department of Fisheries and Oceans. Determine areas (m^2) of habitat by type that will be altered, disrupted or destroyed and the area of habitat by type that will be created as compensation or mitigation.

Documentation

Documentation may take the form of a formal report or a ‘letter of advice’. In either case the following subjects should be addressed:

description and location of the study site(s)
methods used for the fisheries resource assessment
results of the assessment, including habitat maps and photographs
assessment of potential adverse and positive effects
description of mitigation and/or compensation measures, given as Code of Practice specifications and recommendations
copies of the appropriate plans, drawings and descriptions of construction procedures and mitigation/compensation measures supplied by the client/owner
references
appendices containing detailed information on fish captures

Table 1. Criteria for estimating the length of the zone of influence downstream of a crossing site.

Stream Type	Stream characteristics						Length of zone
	Width	Slope	Energy	Dominant substrate	Velocity	Habitat	
L1	< 10 m	low	low	fines	low	runs and flats	300 m
L2	> 10 m	low	low	fines	low	runs and flats	500 m
M1	< 10 m	moderate	moderate	fines and coarses	moderate	long runs separated by short riffles	300 m
M2	> 10 m	moderate	moderate	fines and coarses	moderate	long runs separated by short riffles	500 m
H1	< 10 m	moderate to high	high	coarses	moderate to high	frequent riffles and cascades	300 m
H2	> 10 < 20 m	moderate to high	high	coarses	moderate to high	frequent riffles, cascades and high velocity runs	1000 m
H3	> 20 m	moderate to high	high	coarses	moderate to high	frequent riffles and high velocity runs	> 1000 m

Table 2. Procedure for calculating the length of the zone of sediment influence and particle fall velocity (m/s).

Determine specific critical settling velocity (W_c) for the stream using $W_c = (V*S)/1.65$, where V is average water velocity (m/s) and S is stream gradient (m/m). If W_c is > fall velocity for the selected particle size given in the table below, then use Table 1 for length of zone of sediment influence. If W_c is < fall velocity for the selected particle size given below, then calculate the length of the zone of influence (L_{dz} in m) using $L_{dz} = (d*V)/w$, where d is the average water depth (m), V is the average water velocity (m/s) and w is the fall velocity (m/s) for the selected particle size as given below.			
Water Temperature (C)	Type L Stream Fine sand 0.1 mm	Type M Stream Sand 0.4 mm	Type H Stream Coarse sand 1.0 mm
0	0.0002	0.0036	0.0119
5	0.0002	0.0038	0.0121
10	0.0003	0.0039	0.0123
15	0.0003	0.0041	0.0124
20	0.0003	0.0042	0.0125
25	0.0004	0.0043	0.0126

Table 3: Parameters used for habitat mapping and inventories, small to medium size rivers.

DESCRIPTION					
habitat type	water depth	Surface	flow	substrate	velocity
Riffle (RF)	<0.5 m	irregular broken	turbulent	coarse	high
Class 1 Run (R1) R1o	>1.0 m >2.0 m	irregular rarely broken	moderate turbulence	coarse	moderate to high
Class 2 Run (R2)	0.5 to 1.0 m	irregular rarely broken	moderate turbulence	coarse	moderate to high
Class 3 Run (R3)	<0.5 m	irregular rarely broken	moderate turbulence	coarse	moderate
Class 1 Pool (P1) P1o	>1.0 m >2.0 m	smooth	low turbulence	variable	low, variable
Class 2 Pool (P2)	0.5 to 1.0 m	smooth	low turbulence	variable	low, variable
Class 3 Pool (P3)	<0.5 m	smooth	low turbulence	variable	low, variable
Class 1 Flat (F1) F1o	>1.0 m >2.0 m	smooth	laminar	fines	low
Class 2 Flat (F2)	0.5 to 1.0 m	smooth	laminar	fines	low
Class 3 Flat (F3)	<0.5 m	smooth	laminar	fines	low
Cascade (CA)	<0.5 m	irregular, broken	very turbulent	very coarse	highly variable
Rapids (RA)	>0.5 m	irregular, broken	very turbulent	very coarse	highly variable
Chutes (CH)	<0.5 m	irregular	shooting	bedrock	high
COVER COMPONENTS					
Woody Debris (WD)	large, in stream woody debris				
Overhanging Bank (OB)	undercut, overhanging bank				
Overhanging Vegetation (OV)	overhanging terrestrial vegetation				
Aquatic Vegetation (AV)	dense, well distributed aquatic vegetation providing cover				
Boulder Garden (BG)	dense, well distributed boulders providing cover				
OTHER FEATURES					
Ledges (LG)	bedrock outcrops forming hydraulic controls				
Log Ledge (LL)	large woody debris forming a hydraulic jump, typically with a scour pool beneath				
Beaver Dams (BD)	beaver dams				
Log Jam (LJ)	accumulation of woody debris across channel with water flowing through				

Table 4. Substrate types and description (from American Geophysical Union, Subcommittee on Sediment Terminology).

Type	bedrock	boulder	cobble	gravel	fines
abbreviation	BR	BL	CB	GR	FN
size (mm)	N/a	>250	64-250	2-64	<2

Table 5. Bank vegetation types.

Type	Trees	Shrubs	Grass	Exposed
Abbreviation	Tr	Sh	Gr	Exp

Table 6. Parameters used for habitat mapping and inventories, large rivers

BANK HABITAT TYPE		
Category	Code	Description
Armoured/ Stable	A1	Banks generally stable and at repose with cobble/small boulder/gravel substrates predominating; uniform shoreline configuration with few/minor bank irregularities; velocities adjacent to bank generally low/moderate, instream cover limited to substrate roughness; overheadcover provided by turbidity or occasional large woody debris.
	A2	Banks generally stable and at repose with cobble/small boulder and large boulder substrates predominating; irregular shoreline configuration generally consisting of a series armored cobble/boulder outcrops that produce backwater habitats; velocities adjacent to bank generally moderate with low velocities provide in BW habitats; instream cover provided by substrate roughness; overhead cover from depth, turbidity and LWD; occasionally associated with C1, E4 and E5 banks.
	A3	Similar to A2 in terms of bank configuration and composition although generally with higher composition of large boulders/bedrock fractures; very irregular shoreline produced by large boulders and bedrock outcrops; velocities adjacent to bank generally moderate to high; instream cover provided by roughness; overhead cover from depth and turbidity; exhibits greater depth offshore than A1 or A2; often associated with C1 banks.
Canyon	C1 n	k substrate consists primarily of large cobble/boulder/bedrock; generally stable at bank/water interface although on upper bank slumps/rock falls common; typically deep with high velocities offshore; abundant velocity cover provided by substrate roughness and bank irregularities.
	C2	ock banks associated with canyon cliffs or bedrock outcrops; deep to moderate depths offshore with generally moderate to fast velocities; regular bank form; velocity cover occasionally provided by bedrock fractures.
	C2B	Similar to C2 but bank is regular with no instream cover.
	C3	k substrate consists primarily of fines with some gravel/cobble at base; moderately eroding at bank/water interface; slumping on upper bank common. Moderate to high velocities, no instream cover.
Depositional	D1	with shallow water depths offshore; substrate consists predominantly of fines; low velocities; instream cover generally absent, or if present consisting of shallow depressions between dunes, embedded coarse substrate particles or woody debris; generally associated with bar formations.
	D2	Low relief, gently sloping bank with shallow water depths offshore; substrate consists of coarse particles (gravel/cobble); low to moderate velocities offshore; areas with higher velocities usually producing riffles; overhead cover from turbidity, or turbulence; instream cover from substrate; often associated with bars and shoals.
	D3 o	D2 but with coarser substrates more dominant; boulders often embedded in cobble/gravel matrix; higher average velocities than D1 or D2; abundant instream cover from coarse substrate; overhead cover from turbulence; often associated with riffles or rapids; a transitional type between armoured and depositional.
Erosional	E1	High, eroding, steep banks; often terraced; unstable, frequently slumping and eroding; fine substrates; moderate to high offshore velocities; steep bank profile extends under water surface resulting in deep water immediately offshore; abundant instream cover from woody debris; overhead cover from partially submerged vegetation, depth and turbidity.
	E2	Similar to E1 but without woody debris or submerged vegetation; depth offshore less than E1.
	E3	High, steep eroding banks, substrates consist of loose till deposits; moderate to high velocities offshore; moderate depths offshore; instream cover limited to substrate roughness, overhead cover to turbidity.
	E4	Steep, eroding or slumping highwall bank; substrates variable but consisting primarily of fines; moderate to high velocities offshore; offshore depth moderate to deep; limited instream cover; overhead cover from depth and turbidity
	E4B	Same as E4, but with log jam and/or large woody debris cover.

	E5	Low, steep banks often with terraced profile; predominantly fine substrates; low velocities offshore; offshore depths usually shallow to moderate; instream cover absent; often associated with BW habitats in A1 and A2 types; overhead cover limited to turbidity.
	E6	Low slumping/eroding bank, substrates either cobble/gravel or fines with cobble/gravel patches; depths offshore moderate; velocities moderate to high; instream cover from boulders or woody debris; overhead cover from overhanging vegetation, depth and turbidity; may include numerous small BW.

Table 6 cont.

	SPECIAL HABITAT FEATURES
Tributary Confluences (TC)	confluence area of tributary entering mainstem; classified according to flows at time of survey and wetted width at the mouth. TC1-intermittent flow (dry/trickle); ephemeral stream TC2-flowing; width at mouth <5.0 m TC3-flowing; width at mouth 5-15 m TC4-flowing; width at mouth 15-30 m TC5-flowing; width at mouth 30-60 m TC6-flowing: width at mouth >60 m
Shoal (SH)	shallow (<1.0 m depth), submerged areas of coarse (SHC) or fine (SHF) substrates generally found in mid-channel areas or associated with depositional areas around islands and side bars. Shoal boundaries are visually assessed and approximate locations mapped
Backwater (BW)	discrete, localized area of variable size, exhibiting a reversed flow direction relative to the main current; generally produced by bank irregularities; velocities variable but generally lower than in adjacent main flow; substrate similar to that in adjacent channel although usually with higher percentage of fines

Table 7. Stream bank assessment components.

Height (m)	height from the bank base to the top of bank
Angle/slope (^{o})	angle of bank from the base to the top of bank
Water contact (m)	distance from base of bank to water
Cover (m^2) (WD, OB, OV, AV, BL)	material or objects providing cover for fish originating from the bank (woody debris, overhanging bank, overhanging vegetation, aquatic vegetation, boulder cover)
Vegetation Cover (Gr, Sh, Tr, Exp)	cover of live vegetation and exposed ground on the bank (grass, trees, shrubs, exposed)
Stream bank composition (FN, GR, CB, BL, BR)	material that the bank is made of (fines, gravel, cobble, boulder, bedrock)
Streambed composition (FN, GR, CB, BL, BR)	material that the stream bed is made of (fines, gravel, cobble, boulder, bedrock)

Table 8. Other Physical and Chemical parameters measured.

Wetted width (m)	width of channel presently containing water
Bank full width (m)	width of channel at the top of bank
Water temperature (^oC)*	measured with a 1 degree Celsius accuracy thermometer
Velocity (m/s)	calculated by measuring the time it takes a float to travel a measured distance
Conductivity (μMHOS)*	measured using a Yellow Springs Instrument Co. model 33 Salinity – Conductivity – Temperature meter
Turbidity (NTU)*	measured using a LaMotte 2020 Turbidimeter
pH*	measured using a Hanna Instruments pHep 3 pH meter
Dissolved O_2 (mg/l)*	measured using a model FF-1A Hach kit

* measured at one transect only

Table 9. Channel types of Rosgen.

Type	Description	Slope	Landform
Aa	Very steep, deeply entrenched with debris transport	>10%	High relief, deeply entrenched and erosional. Vertical steps with deep scour pools and waterfalls
A	Steep, entrenched, step-pool with high energy and debris transport	4-10%	High relief, entrenched and confined. Cascading reaches with frequently spaced deep pools in a step-pool bed morphology
B	Moderately entrenched, moderate gradient, riffle-dominated, infrequently spaced pools with very stable banks and profile	2-3.9%	Moderate relief, colluvial deposition and/or residual soil, moderate entrenchment, and moderate width:depth ration. Predominately rapids with occasional pools in a narrow, gently sloping valley
C	Low gradient, meandering, point bar, riffle, pool, alluvial channels with broad, well-defined floodplain	<2%	Broad valley with terraces associated with the floodplain, alluvial soils, slightly entrenched, and well-defined meandering channel. Riffle-pool streambed morphology
D	Wide channel with longitudinal and traverse bars with eroding banks	<4%	Broad valley with abundant sediment in alluvial and colluvial fans, glacial debris, and other depositional features exhibiting active lateral adjustment
Da	Anastomosing channels that are narrow and deep with stable banks, very gentle relief, highly variable sinuosity, and an expansive well-vegetated floodplain and associated wetlands	<0.5%	Broad, low-gradient valleys with fine alluvium and/or lacustrine soil. Anastomosing geologic control creating fine deposition with well-vegetated bars that are laterally stable and broad wetland floodplain
E	Low gradient, riffle-pool with very efficient and stable meandering rate, low width:depth ratio, and little deposition	<2%	Broad valley-meadow. High sinuosity with stable well-vegetated banks and floodplain of alluvial material. Riffle-pool morphology with very low width:depth ratio
F	Entrenched meandering riffle-pool with a low gradient and high width:depth ratio	<2%	Entrenched in highly weathered material with gentle gradient and high width:depth ratio Riffle-pool morphology with meandering channel that is laterally unstable with high bank erosion
G	Entrenched “gully” step-pool with moderate gradient and low width:depth ratio	2-3.9%	Gully, step-pool morphology with moderate slopes, low width:depth ratio, narrow valleys that are deeply incised alluvial or colluvial material. Unstable with grade control problems and high bank erosion rates

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APPENDIX B:

Colour Plates

Plate 1– Armored (A2) habitat. Photo facing upstream from 0.2 km upstream of Cloverdale footbridge.

Plate 2.- Armored habitat (A2) on RUB immediately adjacent to Cloverdale footbridge (facing downstream).

Plate 3 – Armored habitat (A1) along RUB 0.4 km downstream of Cloverdale Bridge.

Plate 4 – Transition of RUB Bank 0.6 km downstream of Cloverdale Bridge from depositional habitat (D1) to erosional habitat (E5).

Plate 5 – Depositional habitat (D2) along RUB 1 km downstream of Cloverdale bridge.

Plate 6 – Erosional habitat (E5) along RUB 1.4 km downstream of Cloverdale bridge.

	
Plate 7–. Armored habitat (A2) on LUB approximately 1.4 km downstream of Cloverdale Bridge.	Plate 8– Looking upstream from downstream end of study section (approximately 2 km downstream of Cloverdale Bridge).
	
Plate 9 – Looking upstream from downstream end of study section (approximately 2 km downstream of Cloverdale Bridge).	

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APPENDIX C:

Electrofishing Record

Table C-1 Fish Captured immediately downstream of Cloverdale Bridge.

Waterbody	North Saskatchewan River	
Date	01-Nov-10	
Seconds	1149	
Species	**Length (mm)**	**Weight (g)**
EMSH	82	5
NRPK	232	83
SPSH	62	1

Table C-2 Fish Captured along right upstream rip-rap bank immediately upstream of Cloverdale Bridge.

Waterbody	North Saskatchewan River	
Date	01-Nov-10	
Seconds	1159	
Species	**Length (mm)**	**Weight (g)**
EMSH	57	1
EMSH	62	1
EMSH	85	4
LNSC	146	43
MNWH	179	68
MNWH	312	361
MNWH	321	383
MNWH	324	475
MNWH	324	408
MOON	243	198
MOON	250	208
MOON	266	301
TRPR	58	2
WALL	174	68
WALL	212	95
WHSC	405	1078

APPENDIX B:
Reference Design Plans (selected sections)

SHEET NO.	DRAWING NO.	TITLE
NORTH SASKATCHEWAN RIVER BRIDGE		
-	-	NORTH SASKATCHEWAN RIVER BRIDGE COVER SHEET
029	SEW-2400-01-PE-1000	NORTH SASKATCHEWAN RIVER BRIDGE DRAWING INDEX AND GENERAL NOTES
030	SEW-2400-01-PE-1001	NORTH SASKATCHEWAN RIVER BRIDGE SITE PLAN
031	SEW-2400-01-PE-1002	NORTH SASKATCHEWAN RIVER BRIDGE BOREHOLE LOCATION PLAN
032	SEW-2400-01-PE-1003	NORTH SASKATCHEWAN RIVER BRIDGE BOREHOLE STRATIGRAPHY
033	SEW-2400-01-PE-1100	NORTH SASKATCHEWAN RIVER BRIDGE SINGLE TOWER EXTRADOSED OPTION PLAN AND PROFILE
034	SEW-2400-01-PE-1101	NORTH SASKATCHEWAN RIVER BRIDGE SINGLE TOWER EXTRADOSED OPTION NORTH ABUTMENT - PLAN AND PROFILE SHEET 1 OF 3
035	SEW-2400-01-PE-1102	NORTH SASKATCHEWAN RIVER BRIDGE SINGLE TOWER EXTRADOSED OPTION RIVER SPAN - PLAN AND PROFILE SHEET 2 OF 3
036	SEW-2400-01-PE-1103	NORTH SASKATCHEWAN RIVER BRIDGE SINGLE TOWER EXTRADOSED OPTION SOUTH APPROACH - PLAN AND PROFILE SHEET 3 OF 3
037	SEW-2400-01-PE-1104	NORTH SASKATCHEWAN RIVER BRIDGE VARIABLE DEPTH CONCRETE BOX GIRDER OPTION PLAN AND PROFILE
038	SEW-2400-01-PE-1105	NORTH SASKATCHEWAN RIVER BRIDGE VARIABLE DEPTH CONCRETE BOX GIRDER OPTION NORTH ABUTMENT - PLAN AND PROFILE SHEET 1 OF 3
039	SEW-2400-01-PE-1106	NORTH SASKATCHEWAN RIVER BRIDGE VARIABLE DEPTH CONCRETE BOX GIRDER OPTION RIVER SPAN - PLAN AND PROFILE SHEET 2 OF 3
040	SEW-2400-01-PE-1107	NORTH SASKATCHEWAN RIVER BRIDGE VARIABLE DEPTH CONCRETE BOX GIRDER OPTION SOUTH APPROACH - PLAN AND PROFILE SHEET 3 OF 3
041	SEW-2400-01-PE-1130	NORTH SASKATCHEWAN RIVER BRIDGE SINGLE TOWER EXTRADOSED OPTION CROSS SECTIONS SHEET 1 OF 2
042	SEW-2400-01-PE-1131	NORTH SASKATCHEWAN RIVER BRIDGE SINGLE TOWER EXTRADOSED OPTION CROSS SECTIONS SHEET 2 OF 2
043	SEW-2400-01-PE-1132	NORTH SASKATCHEWAN RIVER BRIDGE VARIABLE DEPTH CONCRETE BOX GIRDER OPTION CROSS SECTIONS SHEET 1 OF 2
044	SEW-2400-01-PE-1132	NORTH SASKATCHEWAN RIVER BRIDGE VARIABLE DEPTH CONCRETE BOX GIRDER OPTION CROSS SECTIONS SHEET 2 OF 2
045	SEW-2400-01-PE-1134	NORTH SASKATCHEWAN RIVER BRIDGE SUSPENDED PEDESTRIAN DECK NORTH ABUTMENT AND SOUTH ABUTMENT
046	SEW-2400-01-PE-1135	NORTH SASKATCHEWAN RIVER BRIDGE SUSPENDED PEDESTRIAN DECK PIER LOOKOUT - OPTION 1
047	SEW-2400-01-PE-1136	NORTH SASKATCHEWAN RIVER BRIDGE SUSPENDED PEDESTRIAN DECK PIER LOOKOUT - OPTION 2

GENERAL NOTES:

GENERAL

1. DRAWINGS DESCRIBE PRELIMINARY ENGINEERING DESIGN FOR SINGLE TOWER EXTRADOSED AND VARIABLE DEPTH CONCRETE BOX GIRDER BRIDGE OPTIONS.
2. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE DESIGN DEVELOPMENT REPORT FOR THE NORTH SASKATCHEWAN RIVER BRIDGE,CITY OF EDMONTON LRT DESIGN GUIDELINES AND ALL OTHER SEtoW PROJECT DOCUMENTS.
3. ALL DIMENSIONS SHOWN IN PLAN AND PROFILE DRAWINGS ARE IN METERS AND CROSS SECTION DRAWINGS ARE IN MILLIMETERS.
4. DRAWINGS ARE BASED ON TRACK AND ROADS GEOMETRY AS PER DECEMBER 7, 2012.
5. STATIONS ARE IN METERS MEASURED ALONG THE SOUTHBOUND TRACK.
6. ALL PROFILES ARE DRAWN WITH REFERENCE TO THE SOUTHBOUND TRACK.

DESIGN SPECIFICATIONS AND GUIDELINES

1. CANADIAN HIGHWAY BRIDGE DESIGN CODE CAN/CSA-S6-06.
2. CITY OF EDMONTON LRT DESIGN GUIDELINES, LATEST.
3. CEB-FIP MODEL CODE FOR CONCRETE STRUCTURES,1990.
4. AASHTO LRFD STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 2012.
5. PTI RECOMMENDATIONS FOR STAY CABLE DESIGN, TESTING AND INSTALLATION, 2007.
6. AREMA MANUAL OF RAILWAY ENGINEERING, 2012
7. AASHTO GUIDE SPECIFICATIONS FOR DESIGN AND CONSTRUCTION OF SEGMENTAL BRIDGES, 1999.

SERVICE LIFE

1. THE STRUCTURE SHALL HAVE A DESIGN LIFE OF 100 YEARS WITHOUT REPLACEMENT OF ANY MAJOR COMPONENTS. OTHER COMPONENTS OR ELEMENTS MAY HAVE LESSER SERVICE LIFE AND SHALL BE DESIGNED TO BE REPLACED OR REHABILITATED DURING THE 100 YEARS DESIGN LIFE OF THE BRIDGE.

DESIGN LOADING

1. DEAD LOAD CONSISTS OF THE FOLLOWING:
   - PERMANENT MATERIALS WHICH INCLUDE ALL CONCRETE COMPONENTS, STEEL REINFORCEMENT, POST-TENSIONING COMPONENTS AND ANCHORAGES, STRUCTURAL STEEL.
   - SUPERIMPOSED LOAD COMPONENTS INCLUDING WALKWAY, INVERT CONCRETE AND PLINTHS AND RAILINGS.
   - ALLOWANCE FOR LRT FACILITIES SUCH AS TRACKS, CATENARIES, POLES, SIGNALS, COMMUNICATION, ELECTRICAL, DRAINAGE PIPES AND OTHER UTILITIES ATTACHED TO THE BRIDGE.
2. LRT VEHICLE LOADING AS PER THE LATEST EDITION OF THE CITY OF EDMONTON LRT GUIDELINES.

CONSTRUCTION MATERIALS

1. CONCRETE STRENGTHS ARE ASSUMED AS FOLLOW
   a. GIRDERS 45 MPa
   b. PIERS, ABUTMENTS, PILE CAPS 35 MPa
   c. PILES 30 MPa
2. REINFORCING STEEL TO CSA-G30.18-09 GRADE 400R.
3. PRE-STRESSING STEEL: SEVEN-WIRE, UNCOATED, LOW-RELAXATION, TO ASTM A416-12a, GRADE 1860.
4. ALL STAY CABLES FOR THE EXTRADOSED BRIDGE SHALL BE SEVEN WIRE LOW RELAXATION STRANDS PROTECTED BY A "FLOW-FILLED" EPOXY COATING OR INDIVIDUAL GREASING IN ADDITION TO A HIGH DENSITY POLYETHYLENE SHEATH. STAY CABLE ANCHORAGES SHALL ALLOW FOR CABLE REPLACEMENT.

FOUNDATION AND SOIL INFORMATION

1. SUBSTRUCTURE DESIGN IN ACCORDANCE WITH THE LATEST REVISION OF GEOTECHNICAL REPORTS EDMONTON SOUTHEAST LRT EXTENSION APPRAISAL OF GEOTECHNICAL CONDITIONS, MARCH 14 2012, EDMONTON SOUTHEAST LRT EXTENSION PRELIMINARY SLOPE STABILIZATION ASSESSMENT, MAY 2012, EDMONTON SOUTHEAST LIGHT RAIL TRANSIT EXTENSION DEFORMATION ANALYSIS OF NORTH VALLEY SLOPE WITH STABILIZATION PILES, FEBRUARY 26, 2013 PREPARED BY THURBER.
2. EDMONTON LRT EXPANSION PROJECT DOWNTOWN TO MILLWOODS, SOUTHEAST EDMONTON FUNCTIONAL PLANNING STUDY GEOTECHNICAL ASSESSMENT REPORT TO CH2M HILL BY THURBER
3. REFER TO GEOTECHNICAL REPORT FOR BOREHOLE STRATIGRAPHY.

SURVEY INFORMATION

1. THE TOPOGRAPHIC SURVEY IS REFERENCED TO GRID. THE COMBINED SCALE FACTOR IS INDICATED BELOW. DIMENSIONS SHOWN ON THESE DRAWINGS ARE TO GROUND.
   a. DATUM CODE NAD 83
   b. MAPPING PLANE 3TM
   c. REFERENCE MERIDIAN 114°
   d. COMBINED SCALE FACTOR 0.99981 APPLIED ABOUT THE ORIGIN (0,0)

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A	N/A	-	-

issue data

no.	description	date	checked

revisions

AECOM Consultant

A1 bar scale: NOT TO SCALE

drawn by: A. ANAND

designed by

checked by: N. SAN PEDRO

date: 28-03-2013

permit

consultant job no: 60222337

seal

consultant reviewed by: S. ALEXANDER

AECOM Prime Consultant

THE CITY OF Edmonton TRANSPORTATION SERVICES

prime consultant job no: 60222337

Hatch Mott MacDonald ISL Engineering and Land Services DIALOG gec architecture

PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by: G. MENZIES

drawing title: NORTH SASKATCHEWAN RIVER BRIDGE DRAWING INDEX AND GENERAL NOTES

SE to W LRT

MILL WOODS TO LEWIS FARMS

drawing no.: SEW-2400-01-PE-1000

REV

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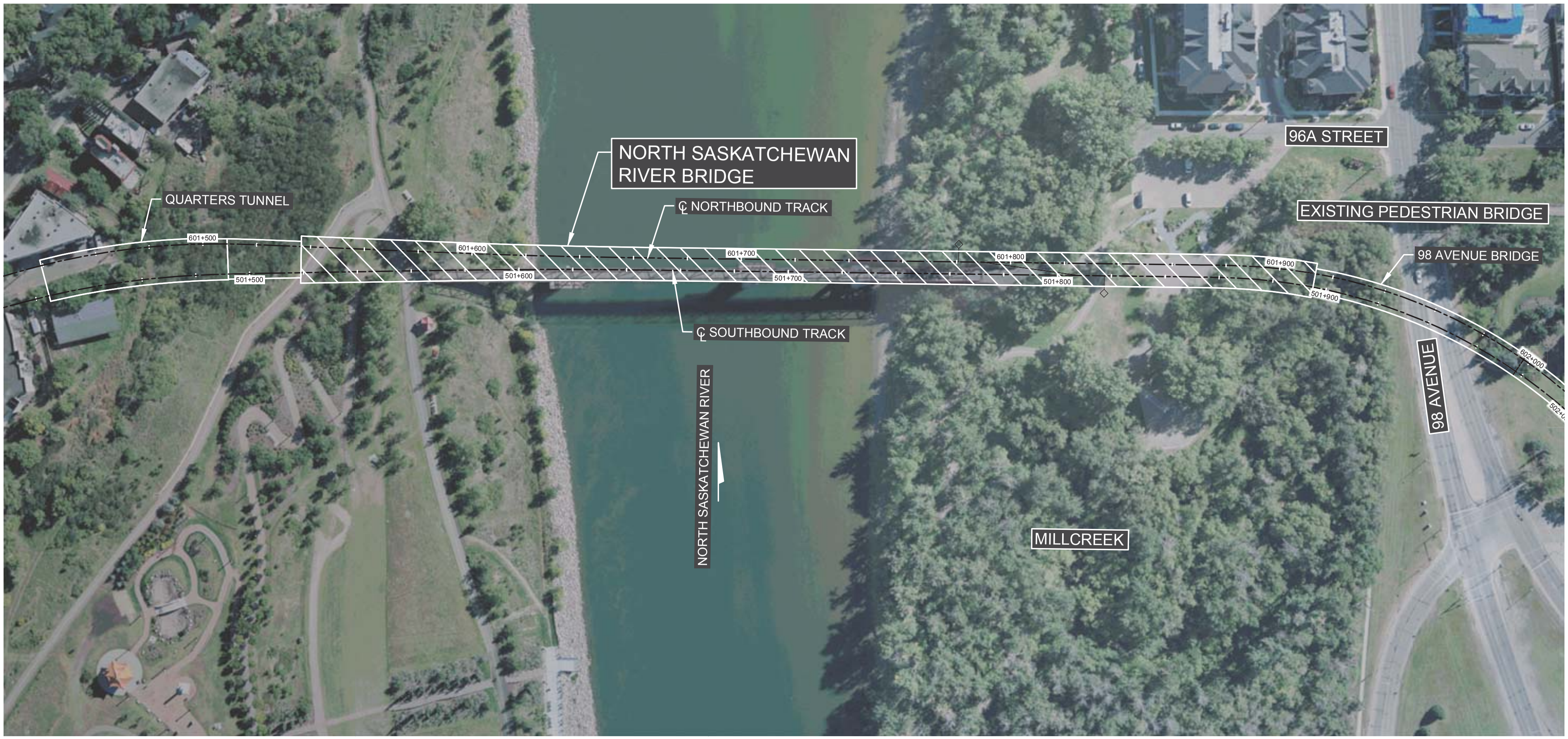

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A	ISSUED FOR 60% REVIEW	22-06-12	R.M.
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	issue data		

no.	description	date	checked
	revisions		

AECOM Consultant

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drawn by A. ANAND

designed by R. MARZAN

checked by N. SAN PEDRO

date 28-03-2013

permit

consultant job no 60222337

seal

consultant reviewed by S. ALEXANDER

AECOM Prime Consultant

The City of Edmonton TRANSPORTATION SERVICES

prime consultant job no 60222337

Hatch Mott MacDonald

ISL Engineering and Land Services

DIALOG

gec architecture

PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

drawing title
NORTH SASKATCHEWAN RIVER BRIDGE
SITE PLAN

SE to W LRT
MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-1001

REV

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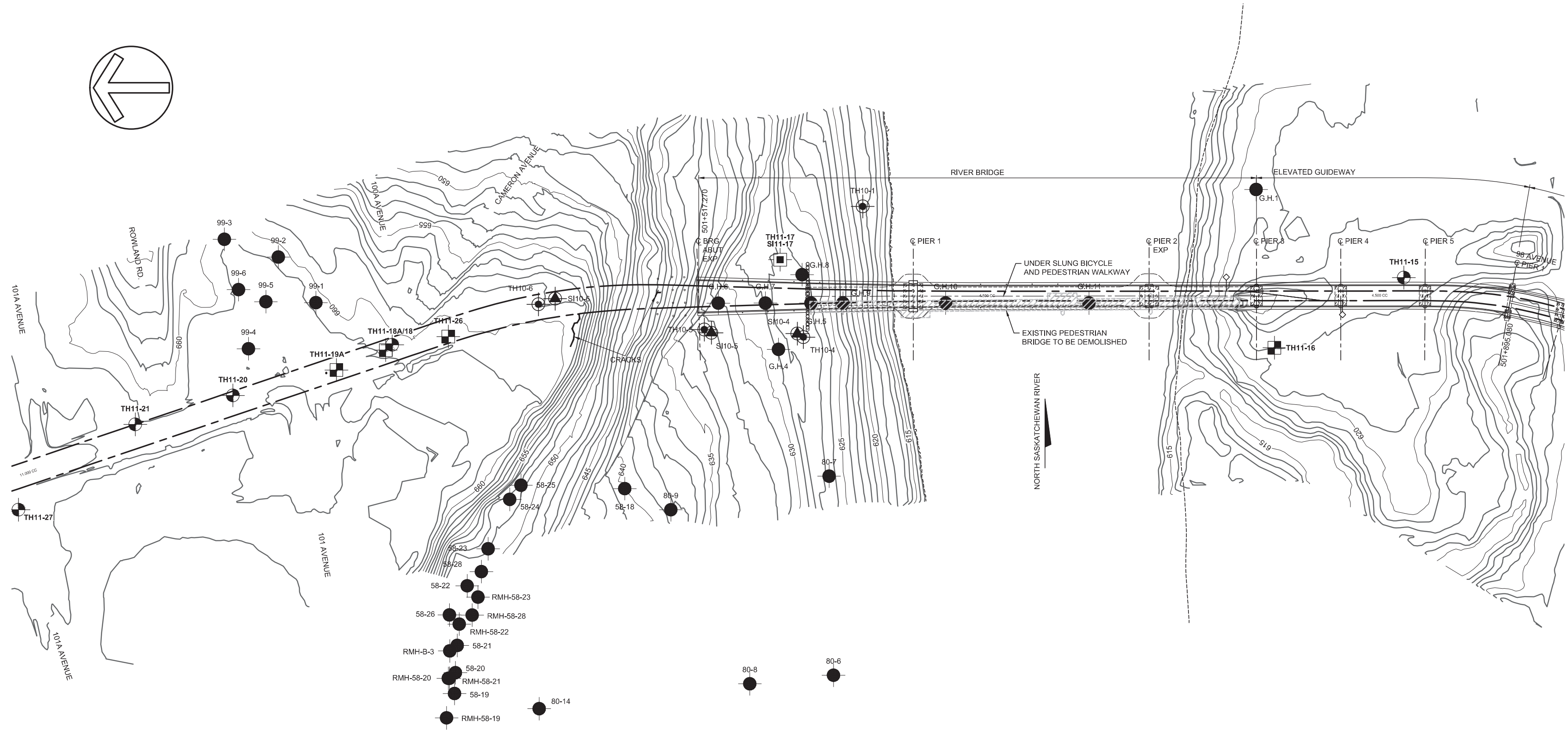

LEGEND

- 2011/2012 TEST HOLE LOCATION (AUGER)
- 2011/2012 TEST HOLE LOCATION (CORING)
- 2011 CORING TEST HOLE LOCATION AND SLOPE INCLINOMETER
- PREVIOUS TEST HOLE (BY THURBER)
- PREVIOUS TEST HOLE (BY OTHERS)
- EXISTING SLOPE INCLINOMETER

NOTES:

FOR GEOTECHNICAL INFORMATION, SEE REPORT "EDMONTON SOUTHEAST LRT EXTENSION APPRAISAL OF GEOTECHNICAL CONDITIONS, MARCH 14 2012"

no.	description	date	appd
C	FINAL PRELIMINARY ENGINEERING	28-03-13	THURBER
B	N/A	–	–
A	N/A	–	–

issue data

no.	description	date	checked

revisions

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Consultant

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drawn by THURBER | designed by THURBER | checked by THURBER | date 10–SEP–12

permit

seal

consultant job no 60222337

consultant reviewed by THURBER

AECOM Prime Consultant

Edmonton TRANSPORTATION SERVICES

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PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by THURBER

drawing title
NORTH SASKATCHEWAN RIVER BRIDGE
BOREHOLE LOCATION PLAN

SE to W LRT
MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-1002 | REV | SHT 031

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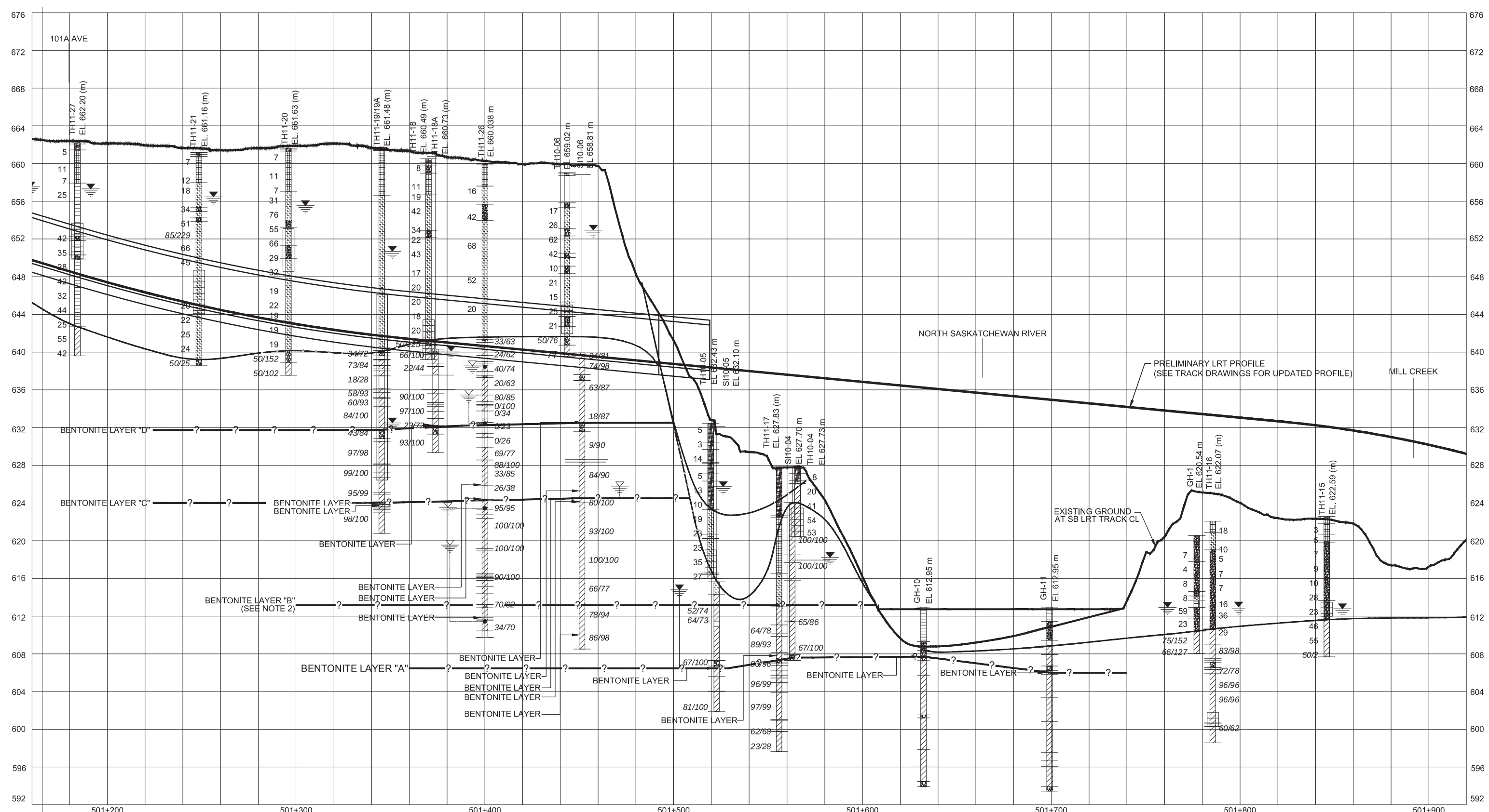

STATION (SOUTHBOUND LRT TRACK)

LEGEND

- FILL
- CLAY
- CLAY TILL
- SILT
- NO RECOVERY
- SAND, GRAVEL, BOULDERS
- CLAY SHALE, SANDSTONE, SILTSTONE
- COAL
- WATER
- GROUNDWATER LEVEL IN STANDPIPE SEPTEMBER 2012
- PIEZOMETRIC LEVEL IN PNUEMATIC PIEZOMETER SEPTEMBER 2012

17 SPT BLOW COUNT

67/100 ROCK QUALITY DESIGNATION / PERCENT RECOVERY

BENTONITE LAYER (OBSERVED)

—?— BENTONITE LAYER (ESTIMATED)

NOTES

1. REFER TO DRAWING NO. 19-5438-68-1C FOR THE SURVEYED TEST HOLE LOCATIONS.
2. THE SIMPLIFIED STRATIGRAPHIC PROFILE IS PROVIDED FOR ILLUSTRATIVE PURPOSES. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.
3. BENTONITE LAYER "B" WAS REGISTERED IN SEVERAL TEST HOLES NOT SHOWN ON THE CURRENT CROSS-SECTION.
4. FOR GEOTECHNICAL INFORMATION SEE REPORT:- EDMONTON SOUTHEAST LRT EXTENSION APPRAISAL OF GEOTECHNICAL CONDITIONS, MARCH 14 2012.

no.	description	date	appd
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issue data

no.	description	date	checked

revisions

THURBER ENGINEERING LTD. Consultant

A1 bar scale AS SHOWN

drawn by THURBER | designed by THURBER | checked by THURBER | date 28-03-13

permit

seal

consultant job no 60222337

consultant reviewed by THURBER

AECOM Prime Consultant

THE CITY OF Edmonton TRANSPORTATION SERVICES

prime consultant job no 60222337

Hatch Mott MacDonald | ISL Engineering and Land Services | DIALOG | gec architecture

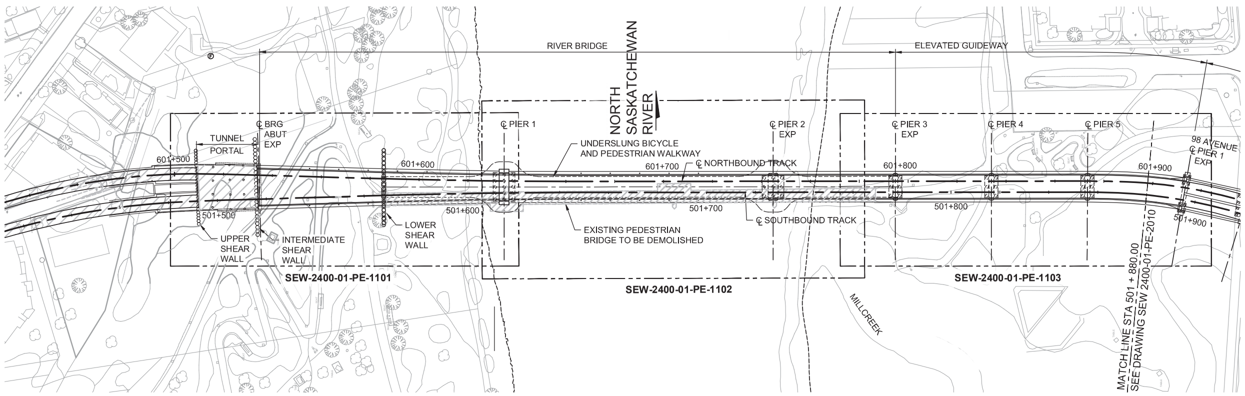
PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by THURBER

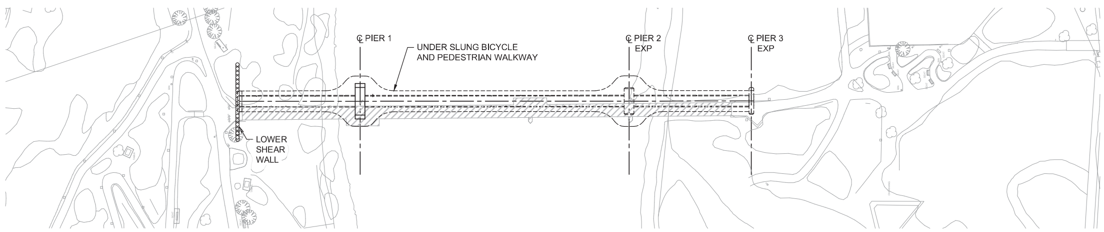
drawing title
NORTH SASKATCHEWAN RIVER BRIDGE
BOREHOLE STRATIGRAPHY

SE to W LRT
MILL WOODS TO LEWIS FARMS

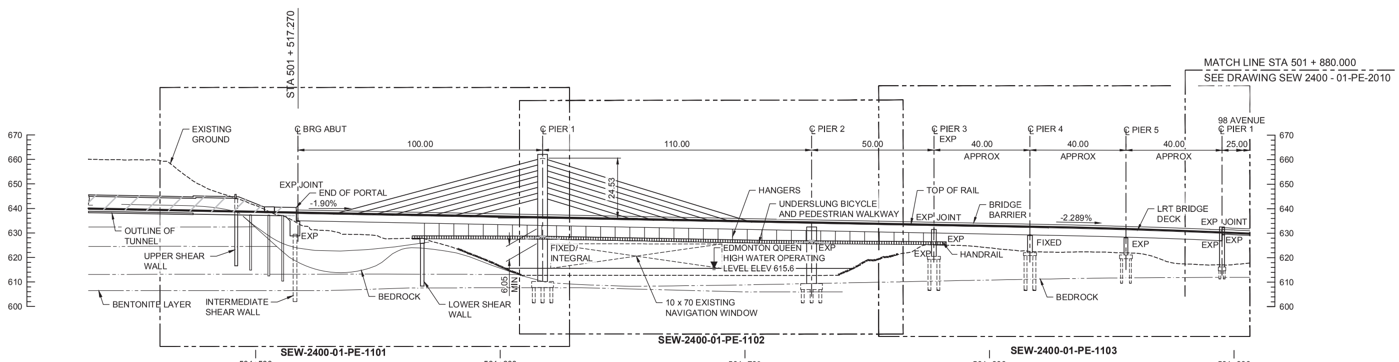
drawing no. SEW-2400-01-PE-1003 | REV | SHT 032



LRT BRIDGE PLAN



UNDERSLUNG BICYCLE AND PEDESTRIAN BRIDGE PLAN



ELEVATION

NOTES:

1. HYDRO-TECHNICAL DATA
   - HIGH WATER LEVEL = EL 622.3
   - ICE WATER LEVEL = EL 621.0
   - HIGH WATER OPERATING LEVEL = EL 615.4
2. NAVIGATION
   - NAVIGATION WINDOW SHOWN CORRESPONDS TO THE EXISTING NAVIGATION WINDOW PROVIDED BY THE EXISTING CLOVERDALE PEDESTRIAN BRIDGE.

no.	description	date	appd
C	FINAL PRELIMINARY ENGINEERING	28-03-13	R.M.
B	ISSUED FOR 90% REVIEW	07-12-12	R.M.
A	ISSUED FOR 60% REVIEW	22-06-12	R.M.

issue data

no.	description	date	checked

revisions

AECOM Consultant

A1 bar scale 1:1000m 0 10 30 50m

drawn by D. KROEKER

designed by B. HU

checked by N. SAN PEDRO

date 28-03-2013

permit

consultant job no 60222337

seal

consultant reviewed by S. ALEXANDER

AECOM Prime Consultant

THE CITY OF Edmonton TRANSPORTATION SERVICES

prime consultant job no 60222337

Hatch Mott MacDonald · ISL Engineering and Land Services · DIALOG · gec architecture

PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

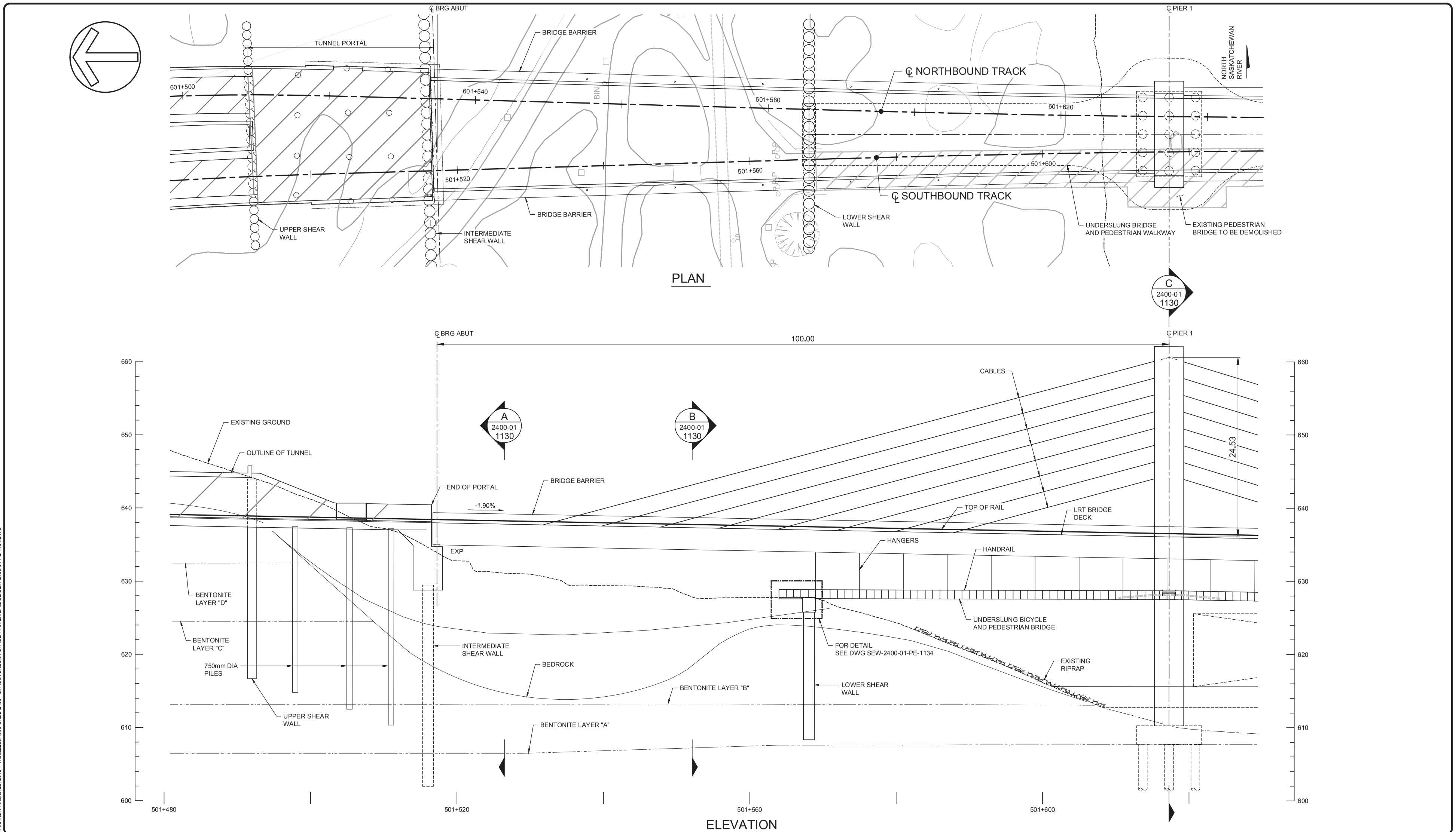
drawing title
NORTH SASKATCHEWAN RIVER BRIDGE
SINGLE TOWER EXTRADOSED OPTION
PLAN AND PROFILE

SE to W LRT
MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-1100

REV
SHT 033

ANANDA / March 28, 2013 / Y:\60222337\000-CADD\2400 - STRUCTURES\01 STAGE 1\RIVER BRIDGE\SEW-2400-01-PE-1100.DWG



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no.	description	date	appd
C	FINAL PRELIMINARY ENGINEERING	28-03-13	R.M.
B	ISSUED FOR 90% REVIEW	07-12-12	R.M.
A	N/A	-	-

issue data

no.	description	date	checked

revisions

AECOM Consultant

A1 bar scale 1:250m 0 2.5 7.5 12.5m

drawn by A. ANAND

designed by B. HU

checked by N. SAN PADRO

date 28-03-2013

permit

consultant job no 60222337

seal

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AECOM Prime Consultant

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PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

drawing title

NORTH SASKATCHEWAN RIVER BRIDGE

SINGLE TOWER EXTRADOSED OPTION
NORTH ABUTMENT – PLAN AND PROFILE
SHEET 1 OF 3

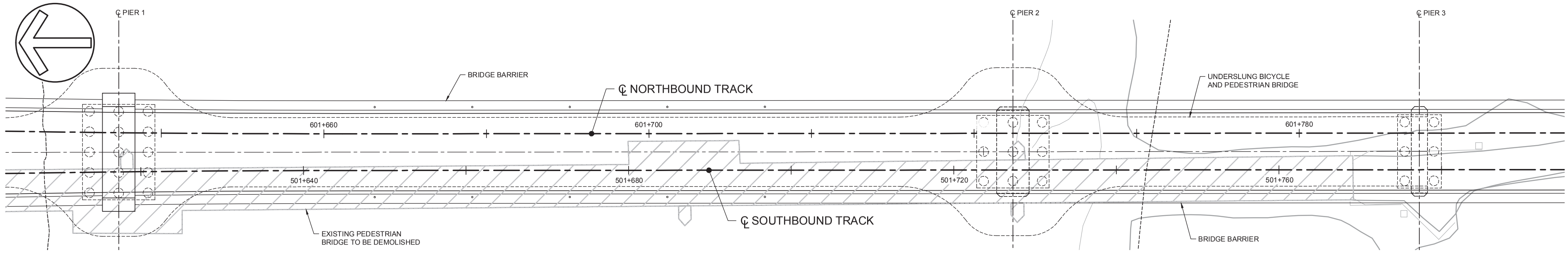
SE to W LRT

MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-1101

REV

SHT 034



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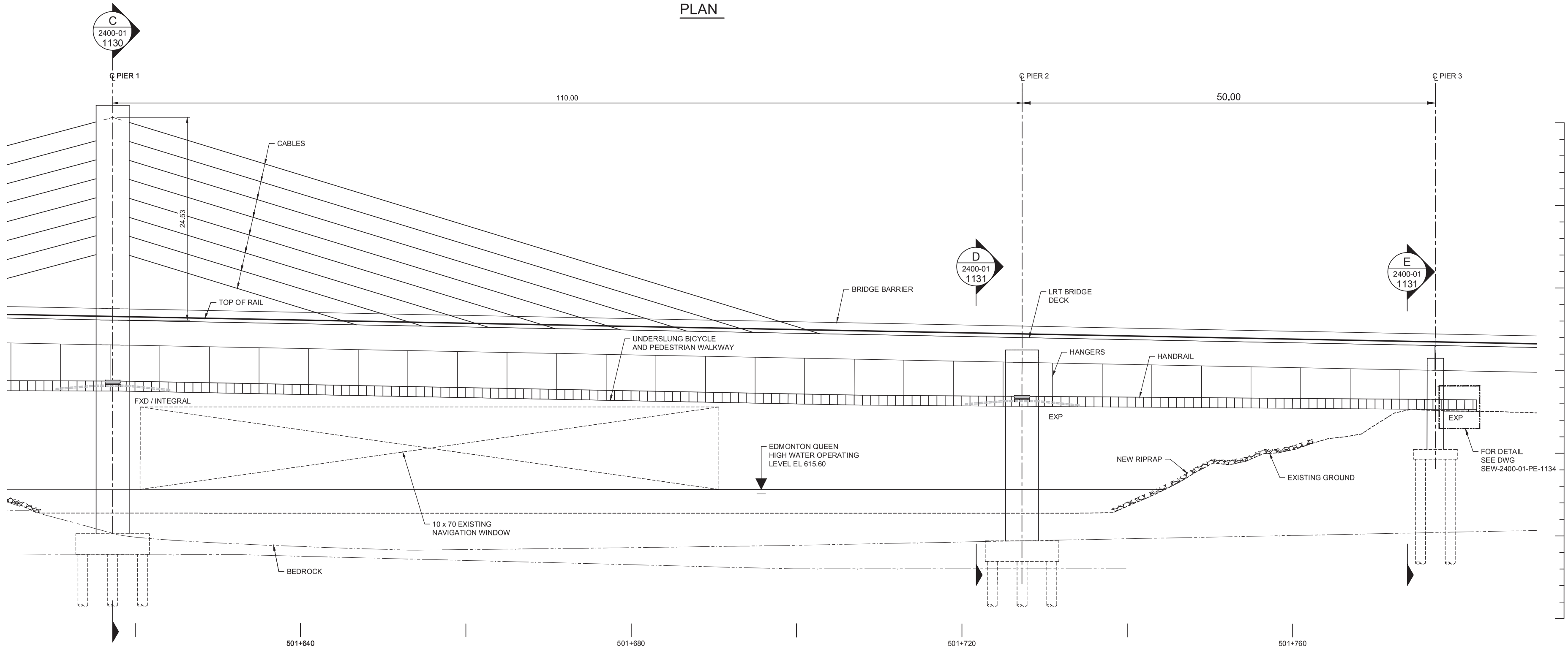

ELEVATION

ANANDA / March 28, 2013 / Y:\60222337\000-CADD\2400 - STRUCTURES\01 STAGE 1\RIVER BRIDGE\SEW-2400-01-PE-1102.DWG

no.	description	date	appd
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B	ISSUED FOR 90% REVIEW	07-12-12	R.M.
A	N/A	-	-

issue data

no.	description	date	checked

revisions

AECOM Consultant

A1 bar scale 1:250m 0 2.5 7.5 12.5m

drawn by A. ANAND

designed by B. HU

checked by N. SAN PADRO

date 28-03-2013

permit

consultant job no 60222337

seal

consultant reviewed by S. ALEXANDER

AECOM Prime Consultant

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DIALOG

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PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

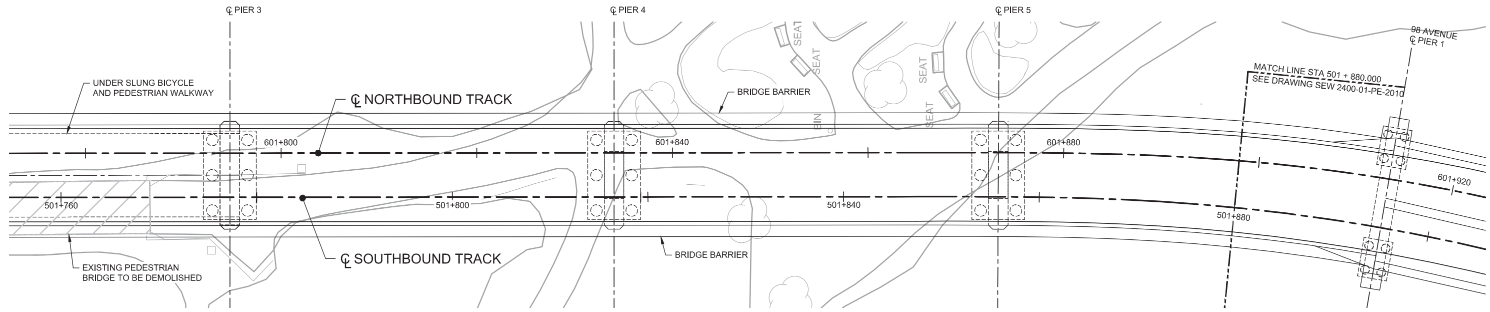
drawing title
NORTH SASKATCHEWAN RIVER BRIDGE
SINGLE TOWER EXTRADOSE OPTION
RIVER SPAN – PLAN AND PROFILE
SHEET 2 OF 3

SE to W LRT
MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-1102

REV

SHT 035



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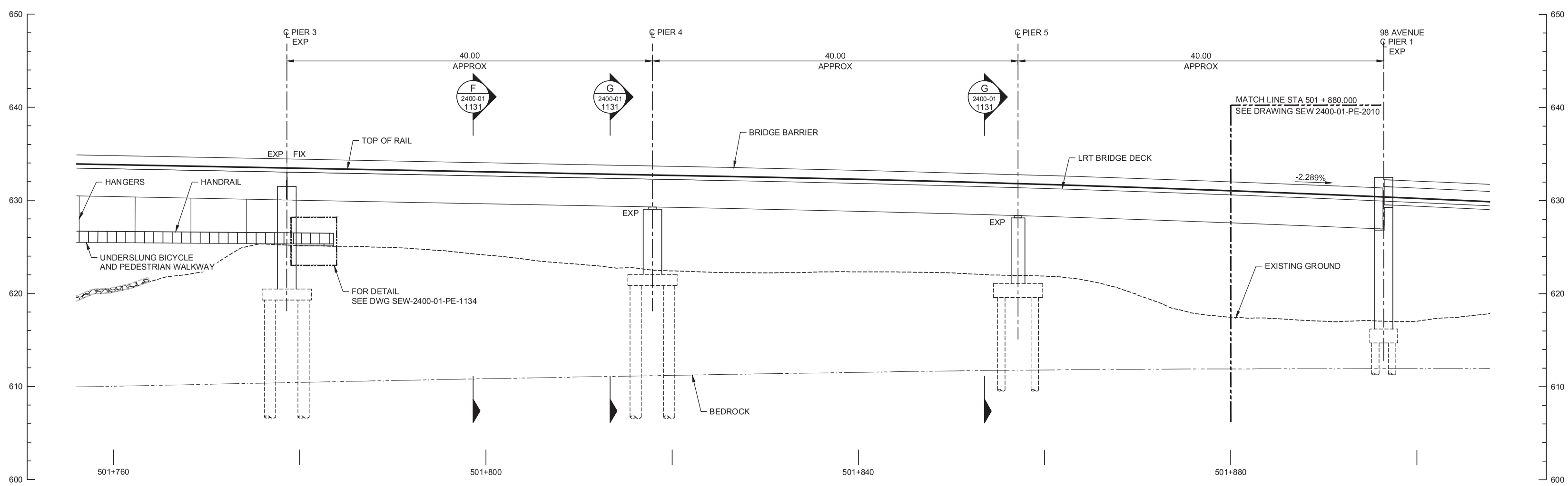

ELEVATION

ANANDA / March 28, 2013 / Y:\60222337\000-CADD\2400 - STRUCTURES\01 STAGE 1\RIVER BRIDGE\SEW-2400-01-PE-1103.DWG

no.	description	date	appd
C	FINAL PRELIMINARY ENGINEERING	28-03-13	R.M.
B	ISSUED FOR 90% REVIEW	07-12-12	R.M.
A	N/A	-	-

issue data

no.	description	date	checked

revisions

AECOM Consultant

A1 bar scale 1:250m 0 2.5 7.5 12.5m

drawn by A. ANAND

designed by R. MARZAN

checked by N. SAN PADRO

date 28-03-2013

permit

consultant job no 60222337

seal

consultant reviewed by S. ALEXANDER

AECOM Prime Consultant

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prime consultant job no 60222337

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PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

drawing title

NORTH SASKATCHEWAN RIVER BRIDGE

SINGLE TOWER EXTRADOSE OPTION
SOUTH APPROACH – PLAN AND PROFILE
SHEET 3 OF 3

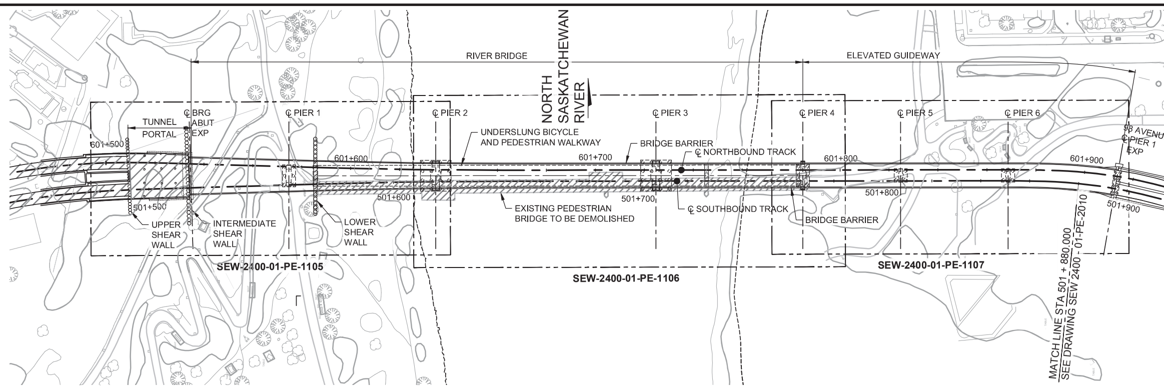
SE to W LRT

MILL WOODS TO LEWIS FARMS

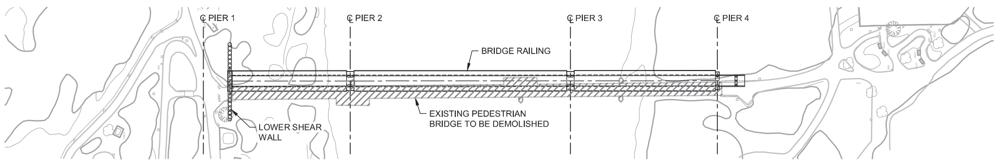
drawing no. SEW-2400-01-PE-1103

REV

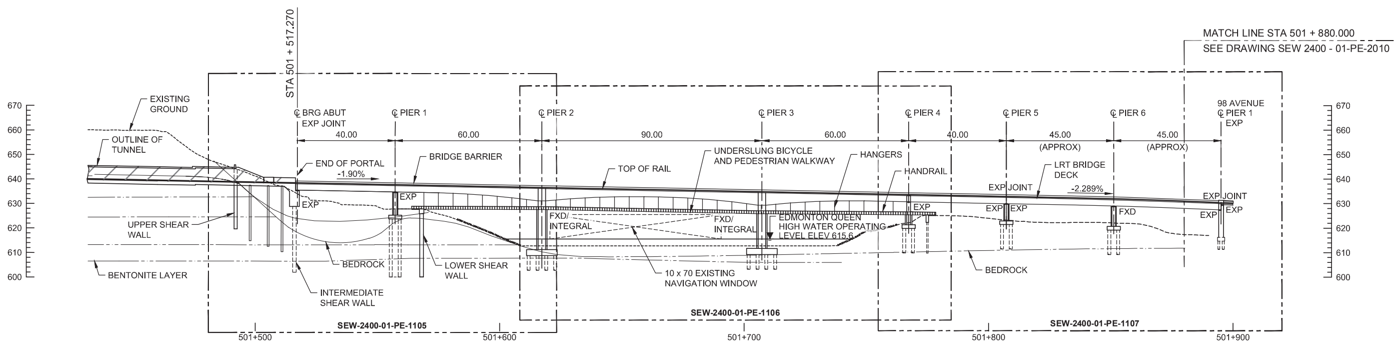
SHT 036



LRT BRIDGE PLAN



UNDERSLUNG BICYCLE AND PEDESTRIAN BRIDGE PLAN



ELEVATION
SCALE 1:1000

NOTES:

1. HYDRO-TECHNICAL DATA
   - HIGH WATER LEVEL = EL 622.3
   - ICE WATER LEVEL = EL 621.0
   - HIGH WATER OPERATING LEVEL = EL 615.4
2. NAVIGATION
   - NAVIGATION WINDOW SHOWN CORRESPONDS TO THE EXISTING NAVIGATION WINDOW PROVIDED BY THE EXISTING CLOVERDALE PEDESTRIAN BRIDGE.
3. PIER LOOKOUTS ARE NOT SHOWN ON PIER 2 AND PIER 3.

no.	description	date	appd
C	FINAL PRELIMINARY ENGINEERING	28-03-13	R.M.
B	ISSUED FOR 90% REVIEW	07-12-12	R.M.
A	ISSUED FOR 60% REVIEW	22-06-12	R.M.

issue data

no.	description	date	checked

revisions

AECOM Consultant

A1 bar scale 1:1000m

drawn by A. ANAND
designed by R. MARZAN
checked by N. SAN PEDRO
date 28-03-2013

permit

consultant job no 60222337

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PRELIMINARY ENGINEERING DRAWINGS
NOT FOR CONSTRUCTION

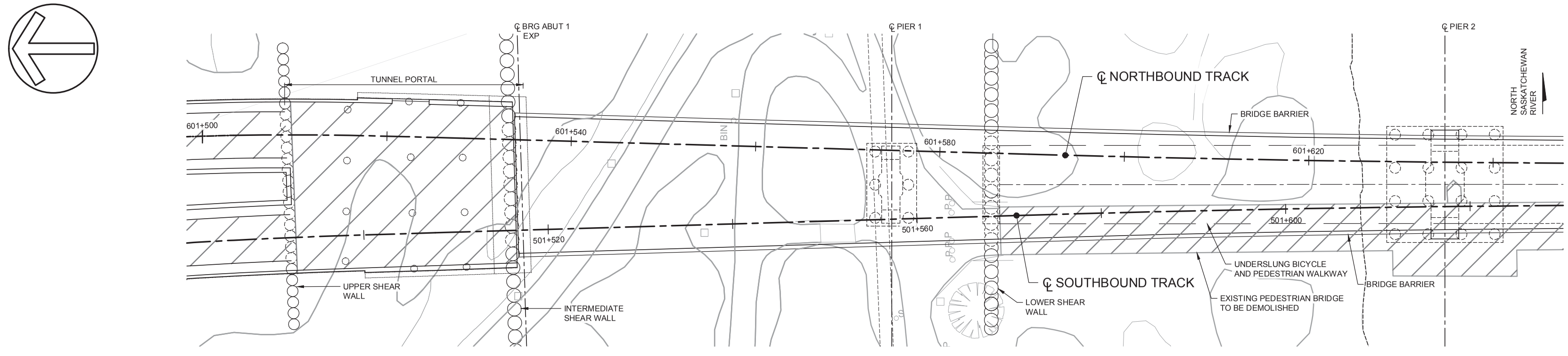
prime consultant reviewed by G. MENZIES

drawing title
NORTH SASKATCHEWAN RIVER BRIDGE
VARIABLE DEPTH CONCRETE BOX GIRDER OPTION
PLAN AND PROFILE

SE to W LRT
MILL WOODS TO LEWIS FARMS

drawing no.
SEW-2400-01-PE-1104
REV
SHT 037

ANANDA / March 28, 2013 / Y:\60222337\000-CADD\2400 - STRUCTURES\01 STAGE 1\RIVER BRIDGE\SEW-2400-01-PE-1104.DWG



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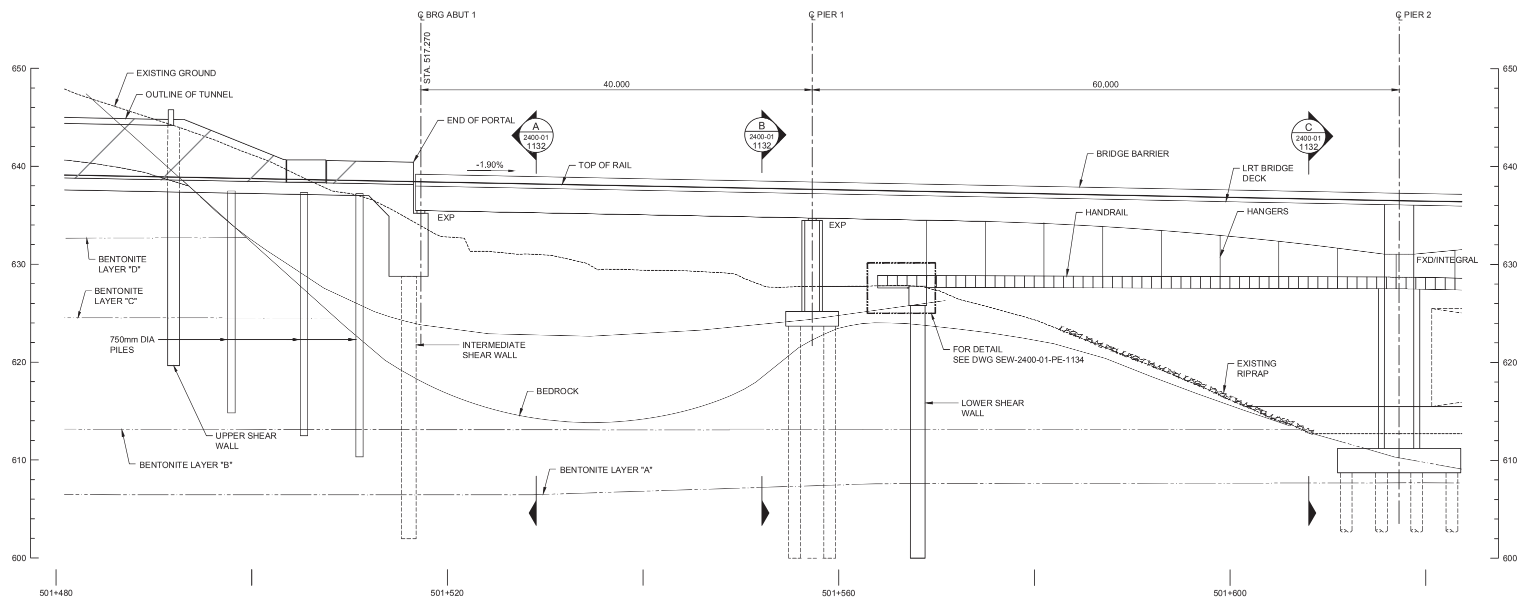

ELEVATION

ANANDA / March 28, 2013 / Y:\60222337\000-CADD\2400 - STRUCTURES\01 STAGE 1\RIVER BRIDGE\SEW-2400-01-PE-1105.DWG

no.	description	date	appd
C	FINAL PRELIMINARY ENGINEERING	28-03-13	R.M.
B	ISSUED FOR 90% REVIEW	07-12-12	R.M.
A	N/A	–	–

issue data

no.	description	date	checked

revisions

AECOM Consultant

A1 bar scale 1:250m 0 2.5 7.5 12.5m

drawn by A. ANAND

designed by R. MARZAN

checked by N. SAN PEDRO

date 28-03-13

permit

consultant job no 60222337

seal

consultant reviewed by S. ALEXANDER

AECOM Prime Consultant

The City of Edmonton TRANSPORTATION SERVICES

prime consultant job no 60222337

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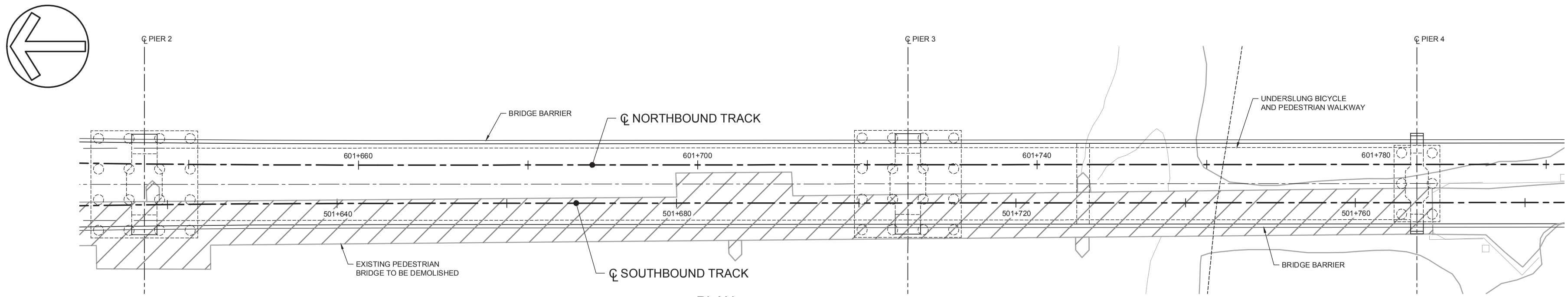
PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

drawing title
NORTH SASKATCHEWAN RIVER BRIDGE
VARIABLE DEPTH CONCRETE BOX GIRDER OPTION
NORTH ABUTMENT – PLAN AND PROFILE
SHEET 1 OF 3

SE to W LRT
MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-1105
REV
SHT 038



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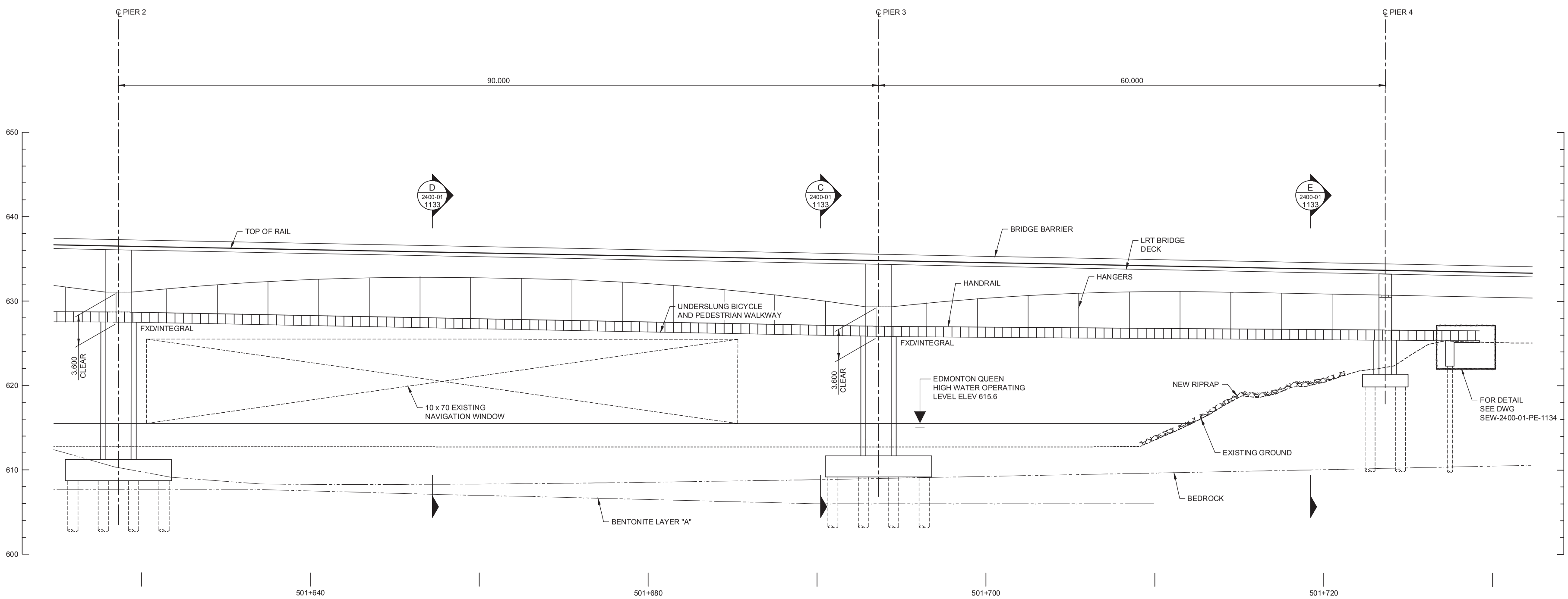

ELEVATION

no.	description	date	appd
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B	ISSUED FOR 90% REVIEW	07-12-12	R.M.
A	N/A	-	-

issue data

no.	description	date	checked

revisions

AECOM Consultant

A1 bar scale 1:250m 0 2.5 7.5 12.5m

drawn by A. ANAND

designed by R. MARZAN

checked by N. SAN PEDRO

date 28-03-2013

permit

consultant job no 60222337

seal

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prime consultant job no 60222337

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PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

drawing title

NORTH SASKATCHEWAN RIVER BRIDGE

VARIABLE DEPTH CONCRETE BOX GIRDER OPTION

PLAN AND PROFILE

SHEET 2 OF 3

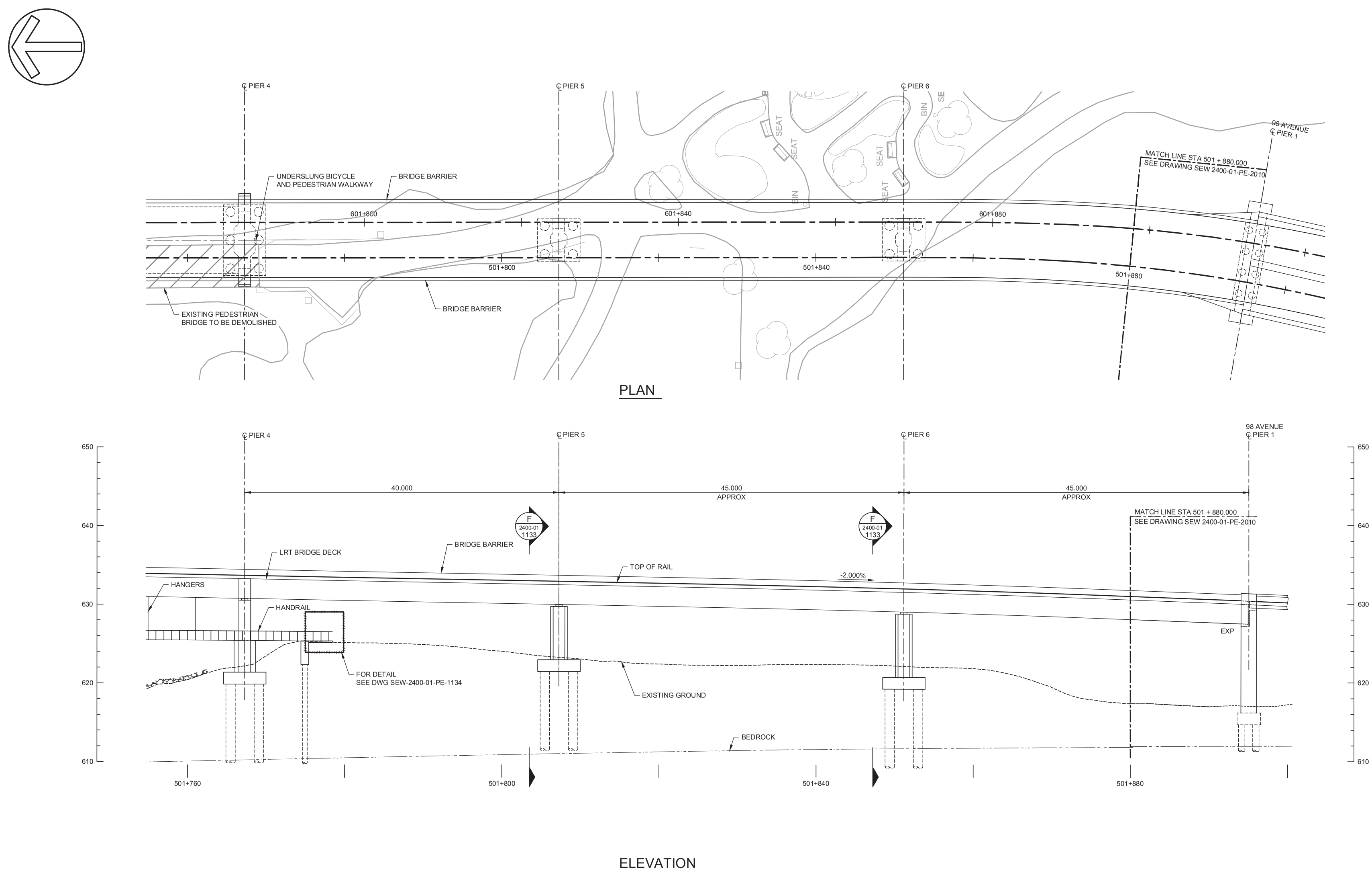
SE to W LRT

MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-1106

REV

SHT 039



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B	ISSUED FOR 90% REVIEW	07-12-12	R.M.
A	N/A	-	-

issue data

no.	description	date	checked

revisions

AECOM Consultant

A1 bar scale 1:250m 0 2.5 7.5 12.5m

drawn by A. ANAND

designed by R. MARZAN

checked by N. SAN PEDRO

date 28-03-2013

permit

consultant job no 60222337

seal

consultant reviewed by S. ALEXANDER

AECOM Prime Consultant

The City of Edmonton TRANSPORTATION SERVICES

prime consultant job no 60222337

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DIALOG

gec architecture

PRELIMINARY ENGINEERING DRAWINGS NOT FOR CONSTRUCTION

prime consultant reviewed by G. MENZIES

drawing title

NORTH SASKATCHWAN RIVER BRIDGE

VARIABLE DEPTH CONCRETE BOX GIRDER OPTION
SOUTH APPROACH – PLAN AND PROFILE
SHEET 3 OF 3

SE to W LRT

MILL WOODS TO LEWIS FARMS

drawing no. SEW-2400-01-PE-1107

REV

SHT 040

Appendix F. Vegetation Data

Valley Line-Stage 1: Full species inventory by plant community

					Plant Community[1]							
Type	**Latin name**	**Common name**	**Origin**	**G & G/S**	**C**	**P1**	**A1**	**A3**	**P3**	**A2**	**MM**	**Status** (ACIMS/*Weed Act*)
Forb	*Achillea millefolium*	Common yarrow	Native									
Forb	*Achillea sibirica*	Many-flowered yarrow	Native			R	R					
Forb	*Actaea rubra*	Red and white baneberry	Native			O	O	R	R			
Forb	*Anemone canadensis*	Canada anemone	Native			R	R					
Forb	*Anemone riparia*	Tall anemone	Native				R	O				S3S4
Forb	*Apocynum androsaemifolium*	Spreading dogbane	Native				R					
Forb	*Aralia nudicaulis*	Wild sarsaparilla	Native			F	F	F	A	O		
Forb	*Arctium* sp.	Burdock	Exotic	F		R/O						
Forb	*Arctium tomentosum*	Wooly burdock	Exotic	F/A	F	R						Noxious
Forb	*Artemisia absinthium*	Absinthe	Exotic	F								
Forb	*Artemisia biennis*	Biennial sagewort	Native			R						
Forb	*Artemisia frigida*	Pasture sage	Native	R/A								
Forb	*Artemisia ludoviciana*	Prairie sage	Native	R								
Forb	*Artemisia tilesii*	Herriot's sagewort	Native			R						S3
Forb	*Asparagus officinalis*	Asparagus	Exotic	R			R					
Forb	*Aster ciliolatus*	Lindley's aster	Native			R	R/F					
Forb	*Astragalus cicer*	Cicer milkvetch	Exotic	O		R						
Forb	*Atriplex hortensis*	Garden orache	Exotic	F								
Forb	*Brassica campestris*	Canola	Exotic	R								
Forb	*Campanula rapunculoides*	Creeping harebell	Exotic				R					Noxious
Forb	*Chenopodium album*	Lamb's quarters	Exotic	F		O						
Forb	*Chrysanthemum leucanthemum*	Ox-eye daisy	Exotic				R					Noxious
Forb	*Cirsium arvense*	Canada thistle	Exotic	F		R						Noxious

[1] Classification based on D.A. Westworth and Associates (1980), with modifications by Spencer Environmental. G=grasslands, G/S=grass/shrubland, C=caragana, A1=aspen, A2=aspen/balsam poplar, A3=Aspen/white spruce/other deciduous, P1=balsam poplar, P3=balsam poplar/aspen/birch, MM=Manitoba maple.

					Plant Community[1]							
Type	**Latin name**	**Common name**	**Origin**	**G & G/S**	**C**	**P1**	**A1**	**A3**	**P3**	**A2**	**MM**	**Status** (ACIMS/*Weed Act*)
Forb	*Corallorhiza maculata*	Spotted coralroot	Native			R						S3
Forb	*Cornus canadensis*	Bunchberry	Native				R					
Forb	*Crepis tectorum*	Narrow-leaved hawksbeard	Exotic			R						
Forb	*Cypripedium parviflorum*	Yellow lady's slipper	Native				R					S3
Forb	*Epilobium angustifolium*	Fireweed	Native	R		R	R	R			R	
Forb	*Erigeron philidelphicus*	Philidelphia fleabane	Native			R						
Forb	*Erysimum cheiranthoides*	Wormseed mustard	Native	F								
Forb	*Eurybia conspicua*	Showy aster	Native			R	A					
Forb	*Fragaria vesca*	Woodland strawberry	Native				R					
Forb	*Galeopsis tetrahit*	Hemp nettle	Exotic	R								
Forb	*Galium boreale*	Northern bedstraw	Native				R	R				
Forb	*Galium spurium*	False cleavers	Exotic	O								
Forb	*Geum aleppicum*	Yellow avens	Native				R					
Forb	*Hackelia americana*	American stickseed	Native			R/F						
Forb	*Hesperis matronalis*	Dame's rocket	Exotic	R	R							Noxious
Forb	*Hieraceum aurantiacum*	Orange hawkweed	Exotic				R					Prohibited noxious
Forb	*Hyoscyamus niger*	Black henbane	Exotic	F								Noxious
Forb	*Kochia scoparia*	Summer cypress	Exotic	O		R						
Forb	*Lathyrus venosus*	Purple peavine	Native			R						S3
Forb	*Linaria vulgaris*	Yellow toadflax	Exotic	O								Noxious
Forb	*Lotus corniculatus*	Bird's foot trefoil	Exotic	O								
Forb	*Lysimachia ciliata*	Fringed loosestrife	Native				R					
Forb	*Maianthemum canadense*	Wild lily-of-the-valley	Native			O						
Forb	*Matricaria perforata*	Scentless chamomile	Exotic									Noxious
Forb	*Medicago sativa*	Alfalfa	Exotic	O		R	O					
Forb	*Melilotus officinalis*	Sweetclover	Exotic	O								
Forb	*Oenothera biennis*	Yellow evening primrose	Native	R								

					Plant Community[1]							
Type	**Latin name**	**Common name**	**Origin**	**G & G/S**	**C**	**P1**	**A1**	**A3**	**P3**	**A2**	**MM**	**Status** (ACIMS/*Weed Act*)
Forb	*Osmorhiza longistylis*	Smooth sweet cicely	Native			O						S2
Forb	*Petasites frigidus* var. *palmatus*	Palmate-leaved coltsfoot	Native				R	R				
Forb	*Plantago major*	Common plantain	Exotic			R						
Forb	*Ranunculus macounii*	Macoun's buttercup	Native			R						
Forb	*Senecio eremophilus*	Cut-leaf ragwort	Native	R		R						
Forb	*Senecio vulgaris*	Common groundsel	Exotic			R						
Forb	*Silene pratensis*	White cockle	Exotic	O								Noxious
Forb	*Silene cucubalis*	Bladder campion	Exotic	R								
Forb	*Sisymbrium* sp.	Mustard	Unknown									
Forb	*Sisymbrium loeslii*	Tall hedge mustard	Exotic	O								
Forb	*Smilacina stellata*	Starry-flowered false Solomon's seal	Native			O/F	R/O					
Forb	*Solidago canadensis*	Canada goldenrod	Native			R	R					
Forb	*Solidago gigantea*	Late goldenrod	Native			R						
Forb	*Solidago* sp.	Goldenrod	Native			O		R				
Forb	*Sonchus oleraceus*	Annual sowthistle	Exotic	R								
Forb	*Sonchus uliginosus*	Smooth perennial sowthistle	Exotic			O	O	O				
Forb	*Symphyotricum lanceolatum* var. *hesperium*	Western willow aster	Native			R						
Forb	*Tanecetum vulgare*	Tansy	Exotic	R								Noxious
Forb	*Taraxacum officinale*	Common dandelion	Exotic	R		O	O	O	O			
Forb	*Thalictrum venulosum*	Veiny meadowrue	Native			R						
Forb	*Thlaspi arvense*	Stinkweed	Exotic	O		R						
Forb	*Tragopogon dubius*	Goatsbeard	Exotic	R								
Forb	*Trifolium hybridum*	Alsike clover	Exotic			R						
Forb	*Trifolium pratense*	Red clover	Exotic			R		R				
Forb	*Trifolium repens*	White clover	Exotic			R						

					Plant Community[1]							
Type	**Latin name**	**Common name**	**Origin**	**G & G/S**	**C**	**P1**	**A1**	**A3**	**P3**	**A2**	**MM**	**Status** (ACIMS/*Weed Act*)
Forb	*Urtica dioica*	Stinging nettle	Native			R						
Forb	*Vicia americana*	Wild vetch	Native			O	F	R				
Type	**Latin name**	**Common name**	**Origin**	**G & G/S**	**C**	**P1**	**A1**	**A3**	**P3**	**A2**	**MM**	**Status** (ACIMS/*Weed Act*)
Forb	*Vicia cracca*	Tufted vetch	Exotic	R		R	R/F					
Forb	*Viola canadensis*	Western Canada violet	Native			R	R	R				
Graminoid	*Agropyron* sp.	Wheatgrass	Unknown			O						
Graminoid	*Agropyron dasystachyum*	Northern wheatgrass	Native			R						
Graminoid	*Agropyron pectiniforme*	Crested wheatgrass	Exotic	A		R						
Graminoid	*Bromus inermis*	Smooth brome	Exotic	F/A	F/A	R/A	F					
Graminoid	*Bromus inermis* ssp. *pumpellianus*	Northern brome	Native				R	R				
Graminoid	*Carex deweyana*	Dewey's sedge	Native				R					
Graminoid	*Carex retrorsa*	Turned sedge	Native			R						S3
Graminoid	*Carex* sp.	Sedge	Unknown			R						
Graminoid	*Elytrigia repens*	Quackgrass	Exotic	A		R	O					
Graminoid	*Festuca* sp.	Fescue grass	Unknown			R						
Graminoid	*Festuca rubra*	Red fescue	Native			R						
Graminoid	*Phalaris arundinacea*	Reed canarygrass	Native	R/D		R						
Graminoid	*Poa pratensis*	Kentucky bluegrass	Native	O		O						
Graminoid	*Scirpus microcarpus*	Small-fruited bulrush	Native			R						
Graminoid	*Setaria viridis*	Green foxtail	Exotic	R								
Pteridophyte	*Equisetum arvense*	Common horsetail	Native			R/A	R					
Pteridophyte	*Equisetum hyemale*	Common scouring rush	Native			R						
Shrub	*Alnus tenuifolia*	River alder	Native			R						
Shrub	*Amelanchier alnifolia*	Saskatoon	Native			R						
Shrub	*Caragana arborescens*	Common caragana	Exotic	R/D	D	R	R	O	A		R	
Shrub	*Clematis occidentalis*	Western blue clematis	Native				O	O	R			

					Plant Community[1]							
Type	**Latin name**	**Common name**	**Origin**	**G & G/S**	**C**	**P1**	**A1**	**A3**	**P3**	**A2**	**MM**	**Status** (ACIMS/*Weed Act*)
Shrub	*Cornus stolonifera*	Red osier dogwood	Native			O/F	O/F	A	R	A	O	
Shrub	*Corylus cornuta*	Beaked hazelnut	Native			R	A	F	F	F		
Shrub	*Cotoneaster* sp.	Cotoneaster	Exotic			R	R	R	R	R	R	
Shrub	*Elaeagnus angustifolia*	Russian olive	Exotic	R								
Shrub	*Elaeagnus commutata*	Silverberry	Native	R		R	O					
Shrub	*Lonicera dioica*	Twining honeysuckle	Native			O	F	F				
Shrub	*Lonicera tartarica*	Tartarian honeysuckle	Exotic			R						
Shrub	*Lycium* sp.	Wolfberry	Exotic	R/A								
Shrub	*Prunus pennsylvanica*	Pincherry	Native			R	O/F					
Shrub	*Prunus virginiana*	Chokecherry	Native	R/A	R	A	A		A	R	O	
Shrub	*Prunus virginiana 'Schubert'*	Schubert chokecherry	Unknown			R		R				
Shrub	*Rhamnus catharticus*	Common buckthorn	Exotic			R			R			Prohibited noxious
Shrub	*Ribes americanum*	American currant	Native			R						
Shrub	*Ribes oxycanthoides*	Northern gooseberry	Native					O	O	R		
Shrub	*Ribes triste*	Swamp red currant	Native			R	R		R	R	R	
Shrub	*Rosa acicularis*	Prickly rose	Native			R	O					
Shrub	*Rosa* sp.	Rose (cultivated)	Exotic	R								
Shrub	*Rosa woodsii*	Woods rose	Native	F		R	O	O			R	
Shrub	*Rubus idaeus*	Red raspberry	Native	R		R	R					
Shrub	*Salix bebbiana*	Bebb's willow	Native				R					
Shrub	*Salix exigua*	Sandbar willow	Native			O						
Shrub	*Salix lasiandra* var. *lasiandra*	Shining willow	Native			R						
Shrub	*Salix pyrifolia*	Balsam willow	Native			R						
Shrub	*Sambucus racemosa*	Elderberry	Native			R	R		O		R	
Shrub	*Shepherdia argentea*	Thorny buffaloberry	Native	R			R					
Shrub	*Shepherdia canadensis*	Buffaloberry	Native			R	A	F				
Shrub	*Symphoricarpos albus*	Snowberry	Native			F	F	O	F			

					Plant Community[1]							
Type	**Latin name**	**Common name**	**Origin**	**G & G/S**	**C**	**P1**	**A1**	**A3**	**P3**	**A2**	**MM**	**Status** (ACIMS/*Weed Act*)
Shrub	*Symphoricarpos occidentalis*	Buckbrush	Native	R/A		O	O					
Shrub	*Viburnum edule*	Low bush cranberry	Native			O	O					
Shrub	*Viburnum opulus*	High bush cranberry	Native			R	O		R	R		S3
Tree	*Acer negundo*	Manitoba maple	Exotic	O		O/D	O	O	A	A	D	
Tree	*Betula papyrifera*	Paper birch	Native				R	O	D			
Tree	*Fraxinus pennsylvanicus*	Green ash	Exotic	R		O	R		R	O		
Tree	*Larix* sp.	Larch	Unknown	R			R					
Tree	*Picea glauca*	White spruce	Native				O	R				
Tree	*Pinus banksiana*	Jack pine	Native				R					
Tree	*Pinus contortus*	Lodgepole pine	Native	O								
Tree	*Populus balsamifera*	Balsam poplar	Native	R		D	R	A	D	D	O	
Tree	*Populus tremuloides*	Trembling aspen	Native				D	D	A	D		
Tree	*Populus* x. sp.	Hybrid poplar	Unknown				O					
Tree	*Quercus* sp.	Oak	Exotic			R			R			
Tree	*Sorbus acuparia*	European mountain ash	Exotic			O	R	R	R		R	
Tree	*Ulmus americana*	American elm	Exotic	R		R						

D=dominant, A=abundant, F=frequent, O=occasional , R=rare (locally uncommon)

Appendix G. Wildlife Species Potentially Found in the Study Area

Valley Line-Stage 1 - Wildlife Species Potentially Found in the Study Area

Common Name	Scientific Name	Provincial Status (General Status of AB Wild Species)	Wildlife Act Designation and New Species Assessed by ESCC[1]	COSEWIC Designation	SARA Designation	Species Recorded in Study Area	Potential Habitat Use for Special Status Species	Likelihood of Occurrence of Species Status Species
Birds								
Alder Flycatcher	*Empidonax alnorum*	Secure						
American Crow	*Corvus brachyrhynchos*	Secure						
American Golden Plover	*Pluvialis dominica*	Secure		LP Candidate (SSC)[2]			Migrating	Low
American Goldfinch	*Spinus tristis*	Secure						
American Kestrel	*Falco sparverius*	Sensitive		MP Candidate (SSC)[3]			Breeding/Foraging	Low
American Pipit	*Anthus rubescens*	Secure						
American Redstart	*Setophaga ruticilla*	Secure						
American Robin	*Turdus migratorius*	Secure				BBS[5]		
American Tree Sparrow	*Spizella arborea*	Secure						
American White Pelican	*Pelecanus erythrorhynchos*	Sensitive		Not at Risk			Breeding/Foraging	Low
Baird's Sandpiper	*Calidris bairdii*	Secure		Special Concern				
Bald Eagle	*Haliaeetus leucocephalus*	Sensitive		Not at Risk			Breeding/Foraging	Low
Bank Swallow	*Riparia riparia*	Secure		HP Candidate (SSC)[4]			Breeding/Foraging	Low
Barn Swallow	*Hirundo rustica*	Sensitive		Threatened			Breeding/Foraging	Low
Barred Owl	*Strix varia*	Sensitive	Special Concern				Breeding/Foraging	Low
Barrow's Goldeneye	*Bucephala islandica*	Secure						
Belted Kingfisher	*Megaceryle alcyon*	Secure		HP Candidate (SSC)			Breeding/Foraging	Moderate
Black-backed Woodpecker	*Picoides arcticus*	Sensitive					Breeding/Foraging	Low
Black-bellied Plover	*Pluvialis squatarola*	Secure						
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Undetermined					Breeding/Foraging	Low
Black-billed Magpie	*Pica hudsonia*	Secure				BBS	Breeding/Foraging	High
Black-capped Chickadee	*Poecile atricapillus*	Secure				SS[6]	Breeding/Foraging	High
Blackpoll Warbler	*Dendroica striata*	Secure						
Blue Jay	*Cyanocitta cristata*	Secure				SS		

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Blue-headed Vireo	*Vireo solitarius*	Secure						
Bohemian Waxwing	*Bombycilla garrulus*	Secure						
Bonaparte's Gull	*Chroicocephalus philadelphia*	Secure						
Boreal Owl	*Aegolius funereus*	Secure		Not at Risk				
Broad-winged Hawk	*Buteo platypterus*	Sensitive					Migrating	Low
Brown-headed Cowbird	*Molothrus ater*	Secure						
Bufflehead	*Bucephala albeola*	Secure						
California Gull	*Larus californicus*	Secure						
Canada Goose	*Branta canadensis*	Secure						
Canada Warbler	*Wilsonia canadensis*	Sensitive		Threatened	Threatened		Migrating	Low
Cape May Warbler	*Dendroica tigrina*	Sensitive	In Process				Breeding/Foraging	Low
Caspian Tern	*Hydroprogne caspia*	Sensitive		Not at Risk			Migrating	Low
Cedar Waxwing	*Bombycilla cedrorum*	Secure						
Chestnut-sided Warbler	*Dendroica pensylvanica*	Secure						
Chipping Sparrow	*Spizella passerina*	Secure				BBS	Breeding/Foraging	High
Clay-colored Sparrow	*Spizella pallida*	Secure						
Cliff Swallow	*Petrochelidon pyrrhonota*	Secure						
Common Goldeneye	*Bucephala clangula*	Secure						
Common Grackle	*Quiscalus quiscula*	Secure						
Common Merganser	*Mergus merganser*	Secure						
Common Nighthawk	*Chordeiles minor*	Sensitive		Threatened	Threatened		Breeding/Foraging	Low
Common Raven	*Corvus corax*	Secure						
Common Redpoll	*Acanthis flammea*	Secure						
Common Tern	*Sterna hirundo*	Secure		Not at Risk				

Valley Line-Stage 1 - Wildlife Species Potentially Found in the Study Area

Common Name	Scientific Name	Provincial Status (General Status of AB Wild Species)	Wildlife Act Designation and New Species Assessed by ESCC[1]	COSEWIC Designation	SARA Designation	Species Recorded in Study Area	Potential Habitat Use for Special Status Species	Likelihood of Occurrence of Species Status Species
Common Yellowthroat	*Geothlypis trichas*	Sensitive					Breeding/Foraging	Low
Connecticut Warbler	*Oporornis agilis*	Secure		LP Candidate (SSC)				
Cooper's Hawk	*Accipiter cooperii*	Secure		Not at Risk				
Dark-eyed Junco	*Junco hyemalis*	Secure						
Downy Woodpecker	*Picoides pubescens*	Secure						
Dunlin	*Calidris alpina*	Secure						
Eastern Kingbird	*Tyrannus tyrannus*	Secure		LP Candidate (SSC)			Breeding/Foraging	Low
Eastern Phoebe	*Sayornis phoebe*	Sensitive					Breeding/Foraging	Low
European Starling	*Sturnus vulgaris*	Exotic/Alien						
Evening Grosbeak	*Coccothraustes vespertinus*	Secure		HP Candidate (SSC)			Breeding/Foraging	Low
Fox Sparrow	*Passerella iliaca*	Secure						
Franklin's Gull	*Leucophaeus pipixcan*	Secure						
Glaucous Gull	*Larus hyperboreus*	Secure						
Golden Eagle	*Aquila chrysaetos*	Sensitive		Not at Risk			Migrating	Low
Golden-crowned Kinglet	*Regulus satrapa*	Secure						
Gray Catbird	*Dumetella carolinensis*	Secure						
Great Blue Heron	*Ardea herodias*	Sensitive					Breeding/Foraging	Low
Great Grey Owl	*Strix nebulosa*	Sensitive		Not at Risk			Breeding/Foraging	Low
Great Horned Owl	*Bubo virginianus*	Secure						
Great-crested Flycatcher	*Myiarchus crinitus*	Sensitive					Breeding/Foraging	Low
Greater Scaup	*Aythya marila*	Secure		LP Candidate (SSC)				
Greater White-fronted Goose	*Anser albifrons*	Secure						
Greater Yellowlegs	*Tringa melanoleuca*	Secure						
Green-winged Teal	*Anas crecca carolinensis*	Sensitive					Breeding/Foraging	Low

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Common Name	Scientific Name	Provincial Status (General Status of AB Wild Species)	Wildlife Act Designation and New Species Assessed by ESCC[1]	COSEWIC Designation	SARA Designation	Species Recorded in Study Area	Potential Habitat Use for Special Status Species	Likelihood of Occurrence of Species Status Species
Hairy Woodpecker	*Picoides villosus*	Secure				SS	Breeding/Foraging	High
Harris's Sparrow	*Zonotrichia querula*	Secure		HP Candidate (SSC)			Migrating	Low
Hermit Thrush	*Catharus guttatus*	Secure						
Herring Gull	*Larus argentatus*	Secure						
Hoary Redpoll	*Acanthis hornemanni*	Secure						
Hooded Merganser	*Lophodytes cucullatus*	Secure						
House Finch	*Carpodacus mexicanus*	Secure						
House Wren	*Troglodytes aedon*	Secure						
Killdeer	*Charadrius vociferus*	Secure		LP Candidate (SSC)			Breeding/Foraging	Moderate
Le Conte's Sparrow	*Ammodramus leconteii*	Secure						
Least Flycatcher	*Empidonax minimus*	Sensitive					Breeding/Foraging	Low
Least Sandpiper	*Calidris minutilla*	Secure						
Lesser Yellowlegs	*Tringa flavipes*	Secure						
Lincoln's Sparrow	*Melospiza lincolnii*	Secure						
Long-billed Dowitcher	*Limnodromus scolopaceus*	Secure						
Long-eared Owl	*Asio otus*	Secure						
Long-tailed Duck	*Clangula hyemalis*	Secure						
Magnolia Warbler	*Dendroica magnolia*	Secure						
Mallard	*Anas platyrhynchos*	Secure						
Merlin	*Falco columbarius*	Secure		Not at Risk				
Mew Gull	*Larus canus*	Secure						
Mourning Warbler	*Oporonis philadelphia*	Secure						
Northern Flicker	*Colaptes auratus*	Secure						
Northern Goshawk	*Accipiter gentilis atricapillus*	Sensitive		Not at Risk			Breeding/Foraging	Low

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Common Name	Scientific Name	Provincial Status (General Status of AB Wild Species)	Wildlife Act Designation and New Species Assessed by ESCC[1]	COSEWIC Designation	SARA Designation	Species Recorded in Study Area	Potential Habitat Use for Special Status Species	Likelihood of Occurrence of Species Status Species
Northern Waterthrush	*Parkesia noveboracensis*	Secure						
Olive-sided Flycatcher	*Contopus cooperi*	May Be At Risk		Threatened	Threatened		Breeding/Foraging	Low
Osprey	*Pandion haliaetus*	Sensitive					Breeding/Foraging	Low
Ovenbird	*Seiurus aurocapillus*	Secure						
Pectoral Sandpiper	*Calidris melanotos*	Secure						
Peregrine Falcon	*Falco peregrinus anatum*	At Risk	Threatened	Special Concern	Threatened		Foraging	Moderate
Philadelphia Vireo	*Vireo philadelphicus*	Secure						
Pileated Woodpecker	*Dryocopus pileatus*	Sensitive					Breeding/Foraging	Low
Pine Grosbeak	*Pinicola enucleator*	Secure						
Pine Siskin	*Spinus pinus*	Secure						
Purple Finch	*Carpodacus purpureus*	Secure						
Purple Martin	*Progne subis*	Sensitive					Breeding/Foraging	Low
Red Crossbill	*Loxia curvirostra*	Secure						
Red-breasted Merganser	*Mergus serrator*	Secure						
Red-breasted Nuthatch	*Sitta canadensis*	Secure				SS	Breeding/Foraging	High
Red-eyed Vireo	*Vireo olivaceus*	Secure				BBS	Breeding/Foraging	High
Redhead	*Aythya americana*	Secure						
Red-tailed Hawk	*Buteo jamaicensis*	Secure		Not at Risk				
Ring-billed Gull	*Larus delawarensis*	Secure						
Ring-necked Duck	*Aythya collaris*	Secure						
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Secure						
Ross's Goose	*Chen rossii*	Secure						
Ruby-throated Hummingbird	*Archilochus colubris*	Secure						
Ruffed Grouse	*Bonasa umbellus*	Secure						

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Sabine's Gull	*Xema sabini*	Secure						
Savannah Sparrow	*Passerculus sandwichensis*	Secure						
Say's Phoebe	*Sayornis saya*	Secure						
Semipalmated Plover	*Charadrius semipalmatus*	Secure						
Semipalmated Sandpiper	*Calidris pusilla*	Secure						
Sharp-shinned Hawk	*Accipiter striatus*	Secure		Not at Risk				
Short-eared Owl	*Asio flammeus*	May Be At Risk		Special Concern			Breeding/Foraging	Low
Snow Bunting	*Plectrophenax nivalis*	Secure						
Snow Goose	*Chen caerulescens*	Secure						
Swainson's Thrush	*Catharus ustulatus*	Secure						
Swamp Sparrow	*Melospiza georgiana*	Secure						
Tennessee Warbler	*Oreothlypis peregrina*	Secure						
Thayer's Gull	*Larus thayeri*	Secure						
Three-toed Woodpecker	*Picoides tridactylus*	Secure						
Tree Swallow	*Tachycineta bicolor*	Secure						
Tundra Swan	*Cygnus columbianus*	Secure						
Turkey Vulture	*Cathartes aura*	Sensitive					Migrating/Foraging	Low
Varied Thrush	*Ixoreus naevius*	Secure						
Veery	*Catharus fuscescens*	Secure						
Vesper Sparrow	*Pooecetes gramineus*	Secure						
Warbling Vireo	*Vireo gilvus*	Secure						
Western Sandpiper	*Calidris mauri*	Secure						
Western Tanager	*Piranga ludoviciana*	Sensitive					Breeding/Foraging	Low
Western Wood-pewee	*Contopus sordidulus*	Sensitive					Breeding/Foraging	Low
White-breasted Nuthatch	*Sitta carolinensis*	Secure						

Valley Line-Stage 1 - Wildlife Species Potentially Found in the Study Area

Common Name	Scientific Name	Provincial Status (General Status of AB Wild Species)	Wildlife Act Designation and New Species Assessed by ESCC[1]	COSEWIC Designation	SARA Designation	Species Recorded in Study Area	Potential Habitat Use for Special Status Species	Likelihood of Occurrence of Species Status Species
White-crowned Sparrow	*Zonotrichia leucophrys*	Secure						
White-throated Sparrow	*Zonotrichia albicollis*	Secure				BBS	Breeding/Foraging	High
White-winged Crossbill	*Loxia leucoptera*	Secure						
Wilson's Warbler	*Wilsonia pusilla*	Secure						
Winter Wren	*Troglodytes hiemalis*	Secure						
Yellow Warbler	*Dendroica petechia*	Secure				BBS	Breeding/Foraging	High
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Undetermined						
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Secure					Migrating	Low
Yellow-rumped Warbler	*Dendroica coronata*	Secure						
Mammals								
American Beaver	*Castor canadensis*	Secure						
Black Bear	*Ursus americanus*	Secure		Not at Risk				
Canada Lynx	*Lynx canadensis*	Sensitive		Not At Risk			Migrating	Low
Common Porcupine	*Erethizon dorsatum*	Secure				ECD[8]	Foraging	High
Coyote	*Canis latrans*	Secure				UCP[9]	Breeding/Foraging	High
Eastern Heather Vole	*Phenacomys ungava*	Secure						
Ermine	*Mustela erminea*	Secure						
Hoary Bat	*Lasiurus cinereus*	Sensitive					Breeding/Foraging	Moderate
Least Chipmunk	*Tamias minimus*	Secure				BBS	Breeding/Foraging	High
Least Weasel	*Mustela nivalis*	Secure						
Little Brown Bat	*Myotis lucifugus*	Secure		Endangered			Breeding/Foraging	Moderate
Long-tailed Weasel	*Mustela frenata*	May Be At Risk		Not at Risk			Breeding/Foraging	Moderate
Masked Shrew	*Sorex cinereus*	Secure						
Meadow Jumping Mouse	*Zapus hudsonius*	Secure						

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Common Name	Scientific Name	Provincial Status (General Status of AB Wild Species)	Wildlife Act Designation and New Species Assessed by ESCC[1]	COSEWIC Designation	SARA Designation	Species Recorded in Study Area	Potential Habitat Use for Special Status Species	Likelihood of Occurrence of Species Status Species
Meadow Vole	*Microtus pennsylvanicus*	Secure						
Mink	*Neovison vison*	Secure						
Moose	*Alces alces*	Secure						
Mountain Lion/Cougar	*Puma concolor*	Sensitive					Migrating	Low
Mule Deer	*Odocoileus hemionus*	Secure				ECD	Breeding/Foraging	High
Muskrat	*Ondatra zibethicus*	Secure						
Northern Bat	*Myotis septentrionalis*	May Be At Risk	Data Deficient	Endangered			Breeding/Foraging	Moderate
Northern Flying Squirrel	*Glaucomys sabrinus*	Secure						
Pygmy Shrew	*Sorex hoyi*	Secure						
Red Fox	*Vulpes vulpes*	Secure						
Red Squirrel	*Tamiasciurus hudsonicus*	Secure						
Silver-haired Bat	*Lasionycteris noctivagans*	Sensitive					Breeding/Foraging	Moderate
Snowshoe Hare	*Lepus americanus*	Secure						
Southern Red-backed Vole	*Clethrionomys gapperi*	Secure						
Striped Skunk	*Mephitis mephitis*	Secure				ECD	Breeding/Foraging	High
White-tailed Deer	*Odocoileus virginianus*	Secure				ECD	Breeding/Foraging	High
White-tailed Jack Rabbit	*Lepus townsendii*	Secure						
Woodchuck	*Marmota monax*	Secure						
Reptiles and Amphibians								
Tiger Salamander	*Ambystoma mavortium*	Secure		Not at Risk				
Boreal Chorus Frog	*Pseudacris maculata*	Secure		LP Candidate (SSC)			Foraging/Overwinter	Moderate
Canadian Toad	*Anaxyrus hemiophrys*	May Be At Risk	Data Deficient	MP Candidate (SSC)		FWMIS[7]	Breeding/Foraging	Moderate
Common Garter Snake	*Thamnophis sirtalis*	Sensitive	LP Candidate	LP Candidate (SSC)			Breeding/Foraging	Moderate
Plains Garter Snake	*Thamnophis radix*	Sensitive	MP Candidate	MP Candidate (SSC)			Breeding/Foraging	Moderate
Wood Frog	*Lithobates sylvaticus*	Secure		LP Candidate (SSC)			Foraging/Overwinter	Low

[1] ESCC- Alberta's Endangered Species Conservation Committee
[2] LP Candidate (SSC) - Low Priority Candidate for assessment by COSEWIC, recommended by Species Specialist Subcommittee (SSC)
[3] MP Candidate (SSC) - Moderate Priority Candidate for assessment by COSEWIC, recommended by Species Specialist Subcommittee (SSC)
[4] HP Candidate (SSC) - High Priority Candidate for assessment by COSEWIC, recommended by Species Specialist Subcommittee (SSC)
[5] Breeding Bird Survey
[6] Site Reconnaissance Survey
[7] Fish and Wildlife Management Information System
[8] City of Edmonton Wildlife-Collision Data
[9] Communication with members of the Urban Coyote Project

Appendix H. Historical Resources Reports

HISTORICAL RESOURCES IMPACT ASSESSMENT
SOUTHEAST LRT ALIGNMENT
IN LSD 15-33-52-24-W4M
IN THE CITY OF EDMONTON

FINAL REPORT ARCHAEOLOGY PERMIT 2011-249

Prepared for

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January, 2012

REPORT ABSTRACT

At the request of Art Washuta of AECOM, on behalf of the City of Edmonton, an Historical Resources Impact Assessment (HRIA) was conducted for a proposed preliminary design project for a proposed Southeast LRT alignment in LSD 15-33-52-24-W4M, in the City of Edmonton, Alberta. The fieldwork for this project was undertaken between October 5 and 25, 2011.

The HRIA survey area consists of a strip of land approximately 100 metres long by 25 metres wide extending from the sidewalk at the south end of the footbridge over the North Saskatchewan River across a gully up to the edge of 98 Avenue.

In-field investigations consisted of foot surveys and shovel testing within select parts of the gully within the proposed project area. A total of 17 shovel tests were excavated during the survey in the gully but no shovel tests were excavated on the general level beside the gully because of previous disturbances caused by paving, landscaping, or previous infrastructure emplacements.

Modern cultural items were found in the gully, but none of these was considered to be significant historic cultural items and all appear to be from the last part of the 20th century. No prehistoric cultural items or palaeontological materials, stratified layers, or buried soils were found in the shovel tests, on the ground surface, or in existing exposures. The lack of significant historic cultural materials, stratified layers, buried soils, or palaeontological artifacts in the study area suggests that no further concern for historical resources is warranted for this project area along the proposed Southeast LRT alignment in LSD 15-33-52-24-W4M.

One historic site (FjPi-166) was recorded on the north side of the North Saskatchewan River in LSD 15-33-52-24-W4M but outside the HRIA survey area by a Hydro-vac team working for Thurber Engineering Ltd. doing a geo-tech survey of the river valley for the Southeast LRT project. Cultural materials were found in a hydro-vac hole down to a depth of 8.5 feet (2.59 metres) and the artifacts were sent to Archaeology Group to determine their significance.

The cultural items appear to be from the first half of the 20th century and archival documents suggest that the hydro-vac findspot was within the old Grierson nuisance grounds/dump. The dump was used for approximately 50 years and extended for hundreds of metres along the North Saskatchewan River. It is concluded that any disturbances caused by construction of support structures for the Southeast LRT line within the dump area would be relatively small and insignificant in terms of the trash volume and large size of the old dump that could possibly be disturbed or destroyed by the LRT line project. It is concluded that no further concern for historical resources is warranted for this Grierson Dump (FjPi-166) area.

In this regard, this report recommends that further historical resource investigations are not warranted for the proposed Southeast LRT in LSD 15-33-52-24-W4M, in Edmonton, Alberta, and the project should proceed as planned. However, should any fossils be discovered during development, staff at the Royal Tyrrell Museum should be contacted immediately. This recommendation is subject to approval by the *Archaeological Survey, Historical Resources Management Branch, Alberta Culture and Community Spirit.*

PROJECT PERSONNEL

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOGRAPHS

Page

1.0 INTRODUCTION

1.1 SCOPE AND OBJECTIVES

At the request of Art Washuta of AECOM, on behalf of the City of Edmonton, an Historical Resources Impact Assessment (HRIA) was conducted for a proposed preliminary design project for a proposed Southeast LRT alignment in LSD 15-33-52-24-W4M, in the City of Edmonton, Alberta (Figures 1 and 2).

Figure 1. Map showing the general location of the HRIA survey area in LSD 15-33-52-24-W4M for the Southeast LRT alignment, in the City of Edmonton (after 1:50,000 NTS Maps 83 H/6 – Cooking Lake and 83 H/11 – Edmonton).

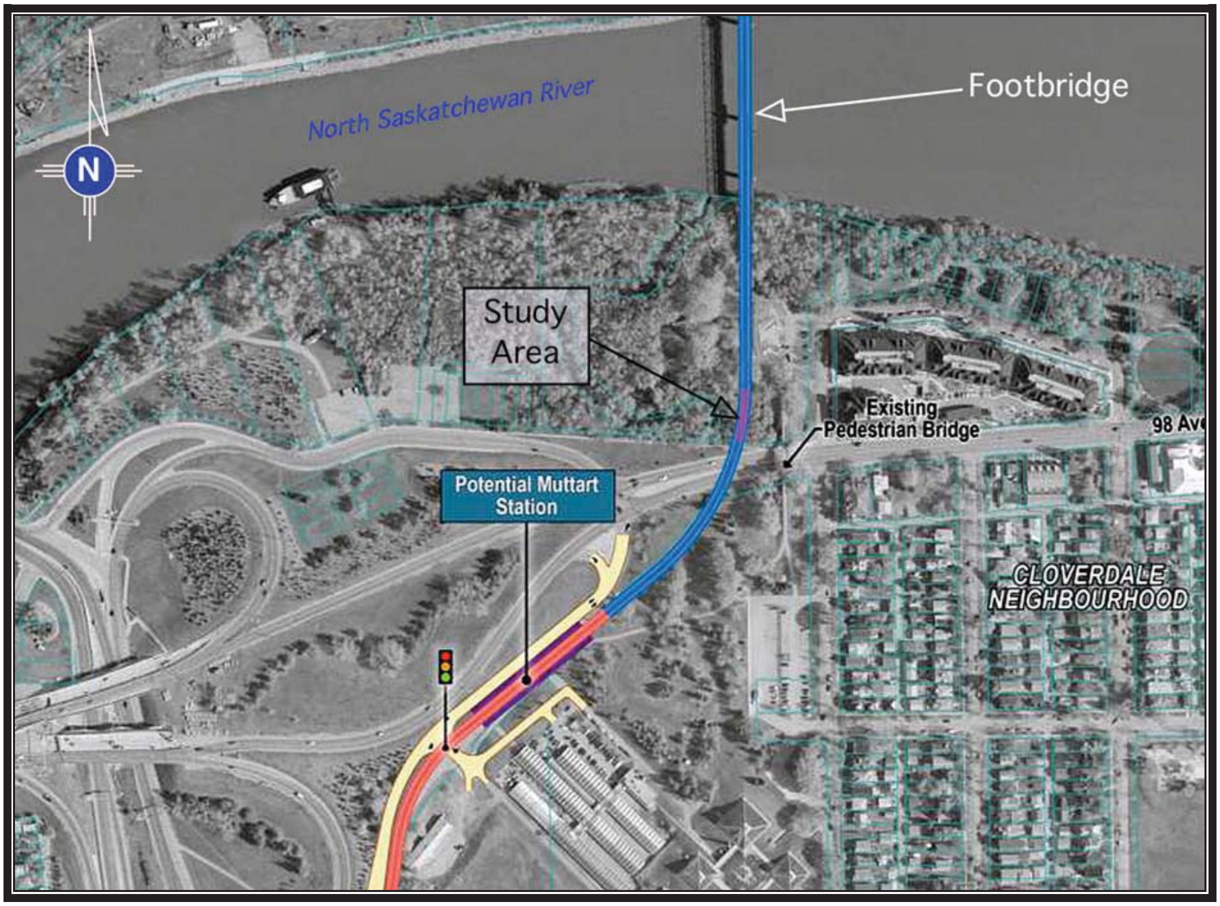


Figure 2. Photomosaic showing the location of the study area along the proposed Southeast LRT line which is highlighted in blue and coral.

The fieldwork for this project was undertaken between October 5 and 25, 2011. In-field investigations consisted of foot surveys and shovel testing within select parts of the proposed project area. A total of 17 shovel tests were excavated during the survey.

The current HRIA was undertaken because the Historical Resources Management Branch issued a Historical Resources Requirement letter on December 6, 2010 (see Appendix I) in response to an Historical Resources Overview (HRO/SOJ) conducted for CH2M Hill for the Southeast LRT Planning Study in PT. Sections 2, 11, 14, 15, 22, 23, 27, 33, and 34-52-24-W4M and Section 3-53-24-W4M in the City of Edmonton.

The HRO/SOJ recommended further assessment for only one small area on the south side of the North Saskatchewan River in LSD 15-33-52-24-W4M and that no further assessment work be done for the rest of the Planning Study area, and the Historical Resources Management Branch agreed with this recommendation. The Historical Resources Management Branch requirement letter stated that: "The HRIA is required only for the area on the south side of the North Saskatchewan River, between the river and 87th Street. More specifically on the north side of the small gully and within the gully as outlined in the SOJ."

Further, the requirement letter also indicated that a palaeontological HRIA assessment be done for two parts of the planning study area. "The HRIA shall consist of the conduct of a pre-construction impact assessment. The HRIA is required only for the area where the LRT will go underground on the Davies Road optional alignment and in the gully on the south side of the North Saskatchewan River as outlined in the SOJ." Michael Riley of Aeon Paleontological Consulting Ltd. was contacted and agreed to do the palaeontological assessment of these two parts of the planning study area, and his report will be filed separately and will not be part of the archaeological HRIA report.

The proposed Southeast LRT line will cross the North Saskatchewan River in the vicinity of an existing footbridge and will then pass over 98 Avenue. It is expected that crossing over the avenue will require support structures to be installed on both sides of 98 Avenue. On the north side of 98 Avenue there is a small gully wherein one support structure or more may need to be constructed. The gully is approximately 70 metres across (north-south) at the point where the LRT line is proposed, and is approximately 3 metres deep at its deepest point when measured from the avenue level. On the north side of the gully there is a small section of lawn approximately 6 metres wide (north-south between the gully and a paved sidewalk that extends to the footbridge). On the south side of the gully there is only a few metres of land between the gully and the side walk that runs along 98 Avenue.

It is expected that the construction of the LRT line could result in disturbance to the lands within or beside the gully, and any Historical Resources sites within any previously undisturbed areas within this new alignment area could be impacted or destroyed. Historical Resources are recognized in the Province of Alberta as non-renewable resources, subject to protective measures and defined under the Historical Resources Act (Province of Alberta 2000)[1].

This is the final report of the HRIA carried out for the proposed project in accordance with the HISTORICAL RESOURCES ACT (2000) and its respective regulations; and the Guidelines for Archaeological Permit Holders in Alberta (Archaeological Survey of Alberta 1989). This report provides relevant background material for the project and the HRIA. It describes the methods and results of the study and provides recommendations regarding further Historical Resource concerns in regard to the development proposal.

Historical resource sites are fragile and precious and easily suffer damage or destruction from such activities as road and pipeline construction, route realignments, construction activities, landscaping, soil and gravel removal, recreational activities, and landfill development. Once the context is disturbed or destroyed, the informational and interpretive value of historical resources are seriously affected and in some cases lost forever. The purpose of a Historical Resources Impact Assessment is to locate and evaluate the significance of all historical resource sites within a defined development area and to formulate

1 The Province of Alberta Historical Resources Act defines "historical resource" as ". . . any work of nature or of man that is primarily of value for its palaeontological, archaeological, prehistoric, historic, cultural, natural, scientific or aesthetic interest including but not limited to, a palaeontological, archaeological, prehistoric, historic, or natural site, structure or object . . . ".

recommendations regarding the importance of sites discovered and the necessity for mitigative action. Mitigation may involve avoidance or further study.

Management and protection of Historical Resources is the responsibility of the *Archaeological Survey, Historical Resources Management Branch, Alberta Culture and Community Spirit.* While all observations, conclusions and recommendations made in this report are the result of research undertaken by the permit holder, this work is subject to the review and acceptance or modification by *Alberta Culture and Community Spirit.* All recommendations regarding either the need for further work or that no further work is necessary must be ratified, in writing, by *Alberta Culture and Community Spirit* before they can be considered acceptable in terms of the requirements of the development.

2.0 BACKGROUND

2.1 PREDICTING HISTORICAL RESOURCE POTENTIAL

The assessment of Historical Resources potential involves the evaluation of previously recorded sites, coupled with information from models of settlement patterns (ethnography and history), local topography and biogeoclimatic features of the region. From these studies, a set of prediction variables can be selected which together are used to characterize a defined area of interest.

Predicting the occurrence of historic period sites, by comparison, is an exercise not usually undertaken because the distribution of historic sites is usually known. Historic period sites are, for the most part, visible features such as buildings, farms or cabins. In areas that have been settled for many years, sites of this type are well known, mapped and documented, and in some cases recorded as provincially designated sites.

The prediction of palaeontological resources is also different from that of archaeological sites. Palaeontological resources are associated with fossil bearing geological formations. The distributions of these formations are for the most part known. Therefore, predicting the occurrence of palaeontological resources can at times be achieved by knowing beforehand the existence of fossil bearing strata.

Another important consideration is the fact that development usually occurs on the land surface, thereby missing the fossil bearing formations found below the surface of the earth. In such cases, concern for palaeontological resources is unnecessary since no impact of potentially sensitive areas will occur. In general, any development activity that affects bedrock formations, especially in the valley breaks of any major waterway, will require a Palaeontological consultant to evaluate the area. Otherwise, developments that will not disturb the surficial geological strata that contain the fossil bearing formations are not of concern.

2.2 ARCHAEOLOGICAL PREDICTION CRITERIA

Archaeological site prediction is based upon a defined set of descriptive variables. For each development area the occurrence of these variables determines archaeological potential. These variables commonly include: cultural and biogeoclimatic zones, distinct geographic or topographic features, slope, aspect, proximity to water sources, sedimentation/drainage, elevation, proximity to open meadows, proximity to known archaeological sites, proximity to historic settlements. This section lists the prediction criteria used in this study.

As a result of the review of the known sites located in the greater study area along with information from the ethnographic and historic record, we can propose a set of variables or criteria that tend to be associated with previously located archaeological sites. With this knowledge in hand, a predictive model for the location of undiscovered archaeological sites is presented.

The environmental and ethnographic data are used to predict the type and frequency of historical resources sites for the ecozone of the project area.

While the archaeological information currently available is insufficient to accurately predict site densities in any particular environmental zone, water availability is the one overwhelming environmental predictor of archaeological site potential. Most sites have been found to be located near existing or extinct sources of water.

2.2.1 ENVIRONMENTAL SETTING

The prediction of historical resource locations, and in particular archaeological sites, is in part based on environmental descriptions of known site locations. Site locations in different regions display different environmental variables. Such environmental variables are thus important to predictive studies and for these reasons are presented herein.

2.2.2 GEOGRAPHIC VARIABLES

The geographical variables that appear to be most commonly associated with the occurrence of archaeological sites in the general region are:

1) areas immediately surrounding present-day lakes, especially flat, well-drained and South-facing terraces;
2) elevated beach ridges, strand lines and spillway channels associated with ancient glacial and post glacial lakes;
3) major river valley terraces, especially flat and well-drained landforms;
4) major river valley rims, especially high promontories along the valleys and flat, well-drained sections along the Eastern rims which hold the potential for containing stratified cliff-top dune deposits;
5) confluences of major and minor streams and rivers, especially flat and well-drained landforms in the immediate vicinity;
6) creek and stream terraces, especially flat, well-drained and South-facing sections;
7) prominences or elevated areas located away from modern water sources, especially ancient beach ridges and strand lines associated with these features, Western-facing aspects which hold the potential for containing stratified cliff-top dune deposits, and areas with quartzite pebble and cobble concentrations often used as quarries by local indigenous groups.
8) postglacial dune fields, especially flat, well-drained and South-facing sections and topographical features possibly used as natural drive lanes and animal traps;
9) known historic trails that often followed prehistoric transportation routes.

It should be noted that the pattern suggested in the above characteristics, and the limited number of sites recorded away from waterways, is prejudiced by the fact that traditional archaeological survey often focused on the examination of lakes, streams, their associated features, and easily accessible areas. This practice is particularly common in the boreal forest where access is difficult and site visibility is greatly reduced by heavily wooded areas.

Locations that exist adjacent to the specific development areas of this study that display the same biogeoclimatic character or environmental features may be considered to hold a similar level of archaeological potential.

2.2.3 PREVIOUSLY RECORDED RESOURCES

Historical Resource sites occur on the landscape in a normally predictable fashion. Cultural sites are found in areas of known settlement or resource use and, in the case of historic sites, these areas are mostly documented.

In the case of archaeological sites, the knowledge of prehistoric settlement patterns is largely based on ethnographic accounts of native settlement within a region and characteristics of previously recorded sites in the area.

Expectations of palaeontological site occurrence are based on known distributions of fossil bearing landforms.

As of November 2011, there are over 25,000 archaeological sites, over 2,000 palaeontological sites, and over 70,000 historic sites recorded within the Province of Alberta. The majority of the historic sites are standing structures found within existing settlements and are not commonly of concern to land developments that occur outside of recently or historically settled areas. Of the three historical resource site types, archaeological sites are of primary concern to land developers.

2.3 ARCHAEOLOGICAL SITE POTENTIAL

The assessment of archaeological site potential within a defined development area involves two main objectives. The first is the characterization of the development area within the context of relevant past research. The second is the evaluation of the development zone in terms of the existence of specific characteristics of site prediction.

The purpose of the first objective is to identify specific characteristics of site location. With respect to the first objective, the following questions may be asked:

1) What is known about patterns of native settlement from ethnographic research?

2) What is known about prehistoric settlement patterns from archaeological research?

3) What characteristics of the development area may be considered good indicators of past and historic cultural settlement?

The aim of the second objective is to identify the existence of these site location predictors within the proposed development area. Within a project area, there are several distinct geographical situations that can be linked to specifics of settlement pattern and resource use to determine archaeological potential (Table 1). The most commonly applied variables used to determine archaeological site potential in Alberta are listed below (Table 2).

Table 1. List of distinct geographic features used in the assessment of archaeological potential.

Feature	Potential
Stream Valley	Moderate
Stream Terrace	High
Lake Margin	High
Upland Grasslands	Low
Upland Forest	High
Glacial Terrace	Moderate
Remnant Dune	High
Prominent Hill	High
Disintegration Moraine	Moderate

Table 2. List of site prediction variables used in the assessment of archaeological potential.

Variable	Potential
Slope	None
Elevated	Moderate to High
Proximity to resources	Moderate to High
Proximity to water	Moderate to High
Proximity to known archaeological site(s)	High
Well-drained sediments	Moderate to High
Poorly -drained sediments	None
Aspect - South Facing	High
Aspect - North facing	Low
No distinct geographic or topographic features	None
Proximity to historic settlement	High
Previous/Existing disturbance	Low

Based on the sets of variables listed above, the determination of the potential of archaeological sites in a project area can result in one of two possible recommendations being selected. Either no further work is required, or the need to conduct a Historical Resources Impact Assessment is identified.

2.4 ENVIRONMENTAL SETTING

The physical environment, including geomorphological features, and resource availability, plays a role in the selection of areas that are used by animals and humans. The distribution of the remnants of the cultural and natural past follow relatively specific patterning. As environmental settings changed through time, the cultural, floral and faunal landscape also changed. An understanding of the environmental settings and changes through time allow us to predict in part where archaeological, historic and palaeontological sites are most likely to be found.

Certain landforms and geomorphological features are commonly found in association with prehistoric, historic and palaeontological sites. For example, archaeological sites are frequently found along streams and near lakes. During prehistoric times these locations provided fresh water and transportation, were focal points for wildlife, and were the source of other food resources. The beneficial attributes of these areas would be just as attractive in the past as they are today. In the same manner, flat well-drained terrain, and sunny, warm southern exposures would also be considered important criteria for the location of camping or habitation sites.

Alberta displays a wide variety of geography and one of the ways that such diversity can be described is through the use of a Land Classification system. Such systems are designed to organize and simplify the landscape so that the resulting units of description can be used for planning and management purposes. In Alberta there are two ecologically-based land classification systems that are commonly used by government and private industry: the Natural

Regions and Subregions classification (Achuff 1994) and the Ecoregions of Alberta classification (Strong and Leggat 1981; Strong 1992). There are many similarities between the two systems however, the primary difference lies in the emphasis given to climate in the latter. The Natural Regions classification " . . . emphasizes overall landscape pattern which, in some cases, reflects climate but in others, reflects the predominance of geological or soil factors" (Achuff 1994:5). Achuff goes on to note that the differences are largely a reflection of purpose. The former is used primarily in studies of agriculture, forestry and wildlife production whereas the Natural Region system is utilized more in ecosystem and biodiversity modeling. The land classification system used here to describe the physical landscape is entitled 'Natural Regions, Subregions and Natural History Themes of Alberta: a Classification For Protected Areas Management' prepared for Park Services, Alberta Environmental Protection by Peter Achuff in 1992 and updated and revised in 1994.

> Natural Regions are recognized on the basis of broad differences in landscape patterns, especially the broad vegetational, soil and physiographic features, for example grassland vs. parkland vs. forest, Chernozemic soils vs. Luvisolic soils, or mountains vs. foothills vs. plains. These features also reflect broad patterns of climate and geology. To a lesser extent, wildlife features are used, although wildlife occurrence patterns are usually not as distinctive or useful as soil, physiographic and vegetation patterns (Achuff 1994:5).

In Alberta, six Natural Regions are currently recognized (Downing and Pettapiece 2006): Grassland, Parkland, Foothills, Rocky Mountain, Boreal Forest, and Canadian Shield/Kazan Upland. The six Natural Regions are divided into Subregions based on recurring landscape patterns relative to other parts of the Natural Region. The present study area is in the Central Parkland Natural Subregion of the Parkland Natural Region (Figure 3) (Downing and Pettapiece 2006). The following description of the Central Parkland Subregion is from Downing and Pettapiece (2006).

2.4.1 CENTRAL PARKLAND SUBREGION

2.4.1.1 Theme

The Central Parkland Natural Subregion occupies a broad, intensively cultivated and heavily populated fertile crescent in central Alberta. It lies between the cold, snowy northern forests and the warm, dry southern prairies, sharing the climatic and vegetation characteristics of both.

2.4.1.2 Key Features

- Mostly cultivated with mosaic of aspen and prairie vegetation on remnant native parkland areas, usually associated with hummocky till or eolian materials.
- Temperature, precipitation and growing season characteristics are intermediate between the dry, warm grasslands to the south and the cooler, moister boreal forests to the west and north.
- Black Chernozems, some Dark Gray Chernozems, significant occurrences of Solonetzic soils.

2.4.1.3 General Description

The Central Parkland Natural Subregion includes over 50,000 km^2, much of it under cultivation. It includes all or parts of Alberta's three largest cities, and arches north from Calgary through Edmonton and east to the Alberta–Saskatchewan border. It meets the Dry Mixedwood Natural Subregion to the west and north, and the Foothills Fescue, Foothills Parkland and Northern Fescue Natural Subregions to the south.

Elevations range from 500 m near the Alberta–Saskatchewan border to 1250 m near Calgary. Undulating till plains and hummocky uplands are the dominant landforms. Lacustrine and fluvial deposits are locally common in the northern and eastern parts of the Natural Subregion, and there are some significant eolian deposits. Almost all the area is cultivated, but a mosaic of aspen and prairie vegetation occupies remnant native parkland areas.

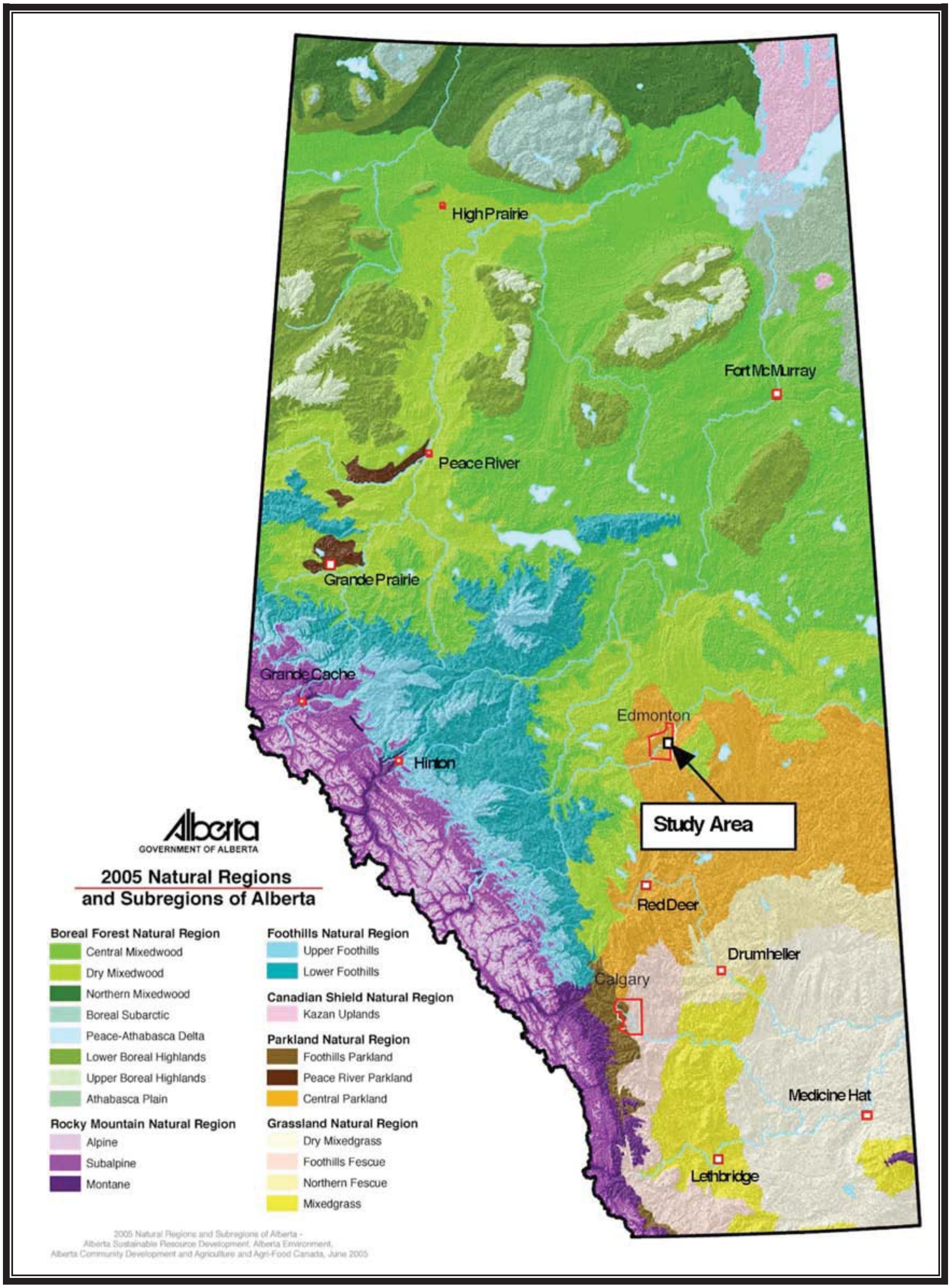


Figure 3. Map showing the location of the study area within the Central Parkland Subregion of the Parkland Natural Region in the Province of Alberta (after Downing and Pettapiece 2006).

In the southern and eastern parts of the Natural Subregion, plains rough fescue prairie is the dominant vegetation, with clumps of aspen present but restricted to moist sites. In the northern and western parts, aspen forest is dominant and grasslands are restricted to drier areas. Black Chernozems usually occur under grasslands, and Dark Gray Chernozems and Luvisols usually occur under aspen forests.

2.4.1.4 Climate

The Central Parkland Natural Subregion has a climate intermediate between the Dry Mixedwood Natural Subregion to the north and west and the Northern Fescue Natural Subregion to the south.

Monthly temperature variations are most similar to those of the Northern Fescue Natural Subregion, with slightly warmer winters and summers than the Dry Mixedwood Natural Subregion.

Monthly precipitation patterns are most similar to those of the Dry Mixedwood Natural Subregion, with a marked peak in July and significant rainfalls in June and August. The western third of the Central Parkland Natural Subregion receives more annual precipitation on average than the remainder of the area, possibly due to higher elevations and more intense summer rainfalls.

The Central Parkland Natural Subregion is highly productive for annual crops because summer precipitation is adequate, the growing season is sufficiently warm and long, and soils are suitable.

2.4.1.5 Vegetation

Estimates vary, but current information suggests that only about 5 percent of the Central Parkland Natural Subregion remains in native vegetation. The area has been intensively cultivated for over a century, and the few remaining contiguous areas of parkland vegetation occur on sites that are unsuitable for agriculture because of topography or soil constraints.

Much of the native vegetation occurring on extensive till plains within the Natural Subregion was replaced by croplands before it could be surveyed and catalogued. Consequently, the delineation of Central Parkland Natural Subregion boundaries depends heavily on soil maps.

The primary vegetation differences between the Central Parkland and Foothills Parkland Natural Subregions are the dominance of plains rough fescue in the Central Parkland and mountain rough fescue in the Foothills Parkland, and other diagnostic species. For example, beaked hazelnut, bunchberry, wild lily-of-the-valley and wild sarsaparilla commonly occur in the Central Parkland Natural Subregion, but are absent from the Foothills Parkland Natural Subregion.

The remaining native communities indicate a marked change in vegetation from southeast to northwest in response to increasing moisture. Fescue prairies dotted with aspen groves occur in the driest areas to the south and east.

Increased moisture in the central portions allows the development of true parkland, where roughly equal proportions of aspen forest and plains rough fescue grasslands occur. Higher precipitation to the north and west promotes closed aspen forests within which small grassland patches may occur.

Strong and Leggat (1992) suggest the Central Parkland Natural Subregion be subdivided into a southern grassland-dominated portion and a northern aspen-dominated portion in recognition of these climate-related changes.

Grassland communities described for the Central Parkland Natural Subregion are similar to those in the adjacent Northern Fescue Natural Subregion. Western porcupine grass, June grass, needle-and-thread, blue grama, dryland sedges and pasture sagewort occur in sparsely vegetated communities on dry, rapidly drained sandy Black and Dark Brown Chernozems or Regosols. Plains rough fescue, slender wheat grass and forb cover increase with better soil moisture conditions. Smooth brome invasion on moist, loamy soils is currently a threat to plains rough fescue communities.

Reference sites for the grassland-dominated southern portion, which are now very uncommon, occur on loamy, well drained Black Chernozems. On undisturbed sites, plains rough fescue strongly dominates in stands with few other species.

More commonly, on light to moderately grazed sites, plains rough fescue shares dominance with western porcupine grass, northern wheat grass, Hooker's oatgrass and a variety of perennial herbs (e.g., prairie crocus, prairie sagewort, wild blue flax, northern bedstraw, three-flowered avens). Dry sites in the northern part of the Natural Subregion may also be vegetated by jack pine–bearberry communities on sandy, rapidly drained Regosols and Brunisols; however, these are uncommon.

Moderately well drained sites in somewhat moister locations often support shrub communities (buckbrush, silverberry, prickly rose, chokecherry and saskatoon) on Black Chernozems. Silverberry communities are often found adjacent to saline wetlands in the southern Central Parkland Natural Subregion.

In the southeastern parts of the Central Parkland Natural Subregion, aspen communities are restricted to imperfectly drained depressions on medium to fine textured Gleysolic soils, where moisture is sufficient to support tree growth throughout the growing season. Precipitation increases to the north and west; aspen communities on Dark Gray Chernozems and Dark Gray Luvisols become dominant and are considered the reference community type for the aspen-dominated portion of the Central Parkland Natural Region.

Aspen understories throughout the Natural Subregion can be quite variable depending on parent material and moisture, but typically include saskatoon, prickly rose, beaked hazelnut, and a variety of forbs and grasses. Species such as hay sedge and creeping juniper make up the understory of aspen stands on sandy, rapidly drained sites. Balsam poplar is often present with aspen and white spruce on moist, rich sites with lush, diverse understories throughout the Natural Subregion. White spruce can occur in pure stands on moist sites where fire occurrence is infrequent, and are most commonly found on protected locations on coulee slopes.

Common cattail, sedge or bulrush marshes and willow shrublands are common on wet, poorly drained Gleysolic soils across the Central Parkland Natural Subregion. Treed fens with black and white spruce, common Labrador tea and feathermosses occur on poorly drained Gleysols or Organic soils in the aspen-dominated portion of the Natural Subregion, and particularly in the northwest section.

2.4.1.6 Geology and Geomorphology

The Central Parkland Natural Subregion lies mainly within the Eastern Alberta Plains. At higher elevations to the southwest, it also includes a small part of the Western Alberta Plains. Non-marine Upper Cretaceous sandstone and mudstone formations with minor occurrences of marine shales underlie the eastern portion. Tertiary sandstones and mudstones underlie the western portion. The dominant landform is undulating glacial till plains, with about 30 percent as hummocky, rolling and undulating uplands.

Surficial materials are dominantly medium to moderately fine textured, moderately calcareous glacial till that may be a thin (less than 2 m) blanket over bedrock in some of the low-relief plains. In the eastern part of the Natural Subregion, about 15 percent of the area is covered by glaciolacustrine and glaciofluvial sediments occurring as inclusions within the till plains.

2.4.1.7 Water and Wetlands

Many small waterbodies are scattered throughout the Central Parkland Natural Subregion, and account for about 2 percent of the area. The largest of these are Beaverhill, Gull, Buffalo and Sounding Lakes. Major watercourses include the Red Deer, Battle and North Saskatchewan Rivers.

Wetlands cover about 10 percent of the Central Parkland Natural Subregion, and are more common than in the Northern Fescue Natural Subregion because of the somewhat cooler and moister climate. Marshes, willow shrublands and seasonal ponds are typical wetland types in the southern part of the Natural Subregion, but treed fens with shallow organic soils also occur in the northwest.

2.4.1.8 Soils

Orthic Black Chernozems are typically associated with grasslands and open woodlands in the Central Parkland Natural Subregion. Solonetzic soils (Solodized Solonetz and Solod) occupy significant areas (about 15 percent) of the central low-relief plain, with a further 20 to 30 percent of soils having Solonetzic properties. Thickness of the dark surface humus layers ranges from 15 cm at the southern limits of the Natural Subregion, to about 30 cm along its northern limits.

Forested areas commonly have Orthic Dark Gray Chernozemic and Dark Gray Luvisolic soils. These soils are uncommon in the southern part of the Natural Subregion, but become increasingly common to the north and occur on about 30 percent of landscapes along the northern boundary.

Humic and Orthic Gleysols are the most common soil types associated with wetlands. Peaty subgroups are common along the Central Parkland–Dry Mixedwood Natural Subregion boundary.

2.4.1.9 Land Uses

The Central Parkland Natural Subregion is the most densely populated region in Alberta; Edmonton, Red Deer and Calgary all lie wholly or partly within it. This Natural Subregion is also the most productive agricultural region in Alberta. Cropland covers about 80 percent of the plains and about 65 percent of hummocky uplands; the remaining area is grazing land. Wheat, barley and canola are the dominant crops in the central and eastern portions with some specialty crops such as pulses and flax. At higher elevations in the southwestern part of the Natural Subregion, a shorter frost-free period limits crop production to cool-season barley and forages.

Conventional petroleum exploration and development activities occur throughout. Heavy oil, strip coal mining and gravel extraction activities occur locally.

One of the greatest threats to plains rough fescue appears to be the invasion of smooth brome. This is occurring primarily on moist sites with loamy soils. The degree of infestation varies depending on a number of factors including proximity to seed source, grazing regime, and any activity that creates bare soil.

2.5 CULTURAL SETTING

The earliest evidence for human occupation in Alberta dates to the end of the last glaciation (approximately 12,000 years BP). The Prehistoric Period spans the time from the earliest occupations up to the arrival of the first Europeans. The Prehistoric Period includes the period of time before direct contact occurred between Europeans and native peoples. That is, the time period when European culture modified native culture through trade and the introduction of new ideas, well before the first Europeans even set foot in the region.

Site classification, the general chronology of the prehistoric period, and the distribution of known archaeological sites are described below. This prehistorical overview will be used to establish a chronology and distribution pattern for archaeological sites.

Prehistoric sites in the province of Alberta are divided into various categories that reflect site function. The categories include:

1. isolated finds (generally a single artifact not found in association with any other archaeological materials or features);
2. scatters (usually small assemblages of lithic material from which it is difficult to draw conclusions about the site's original function);
3. campsites (which contain a variety of materials and possibly features);
4. stone features (without artifacts);
5. workstations (where a specific task such as butchering, plant processing, or stone tool manufacture took place);
6. kill sites;
7. quarries (where lithic material for stone tool manufacture was mined);
8. rock art;
9. human burials; and
10. ceremonial sites.

These typological classifications are commonly used by archaeologists to develop chronological understandings and sometimes even movements of ideas, materials, and peoples in prehistoric times. In addition to the small size of many of the archaeological assemblages, artifact collections are often poorly preserved, or are from poorly understood contexts which further limit the information that can be gleaned from these collections. Research to date has produced some useful information about the distribution of archaeological sites on the landscape, but there remains much to be learned about the prehistory of northwestern Alberta.

2.5.1 CLASSIFICATION OF PREHISTORIC CULTURES

In order to provide a chronological framework for the interpretation of the prehistory of a region, prehistoric time is commonly divided into a sequence of periods. This is referred to as the culture history of an area. In Alberta, culture history is generally divided into four major time periods (Figure 4).

Each of these periods displays a relatively different archaeological landscape. The periods are, for the most part, defined on the basis of environmental change, resource use, settlement patterns and artifact styles. In general, this sequence may be applied to the province as a whole, since similar artifact styles have been found in almost all areas of Alberta.

Regional differences and the clarity of the definitions remains somewhat cloudy largely due to a lack of consistent research in all areas. The theory is that each of these periods can be further divided into ever decreasing subsets of more specific groups or cultural manifestations. These cultural manifestations or theoretical archaeological constructs are known as Traditions and Complexes. Depending upon the evidence at hand these may be further divided into subsets of more specific archaeological culture types, such as “Phases”.

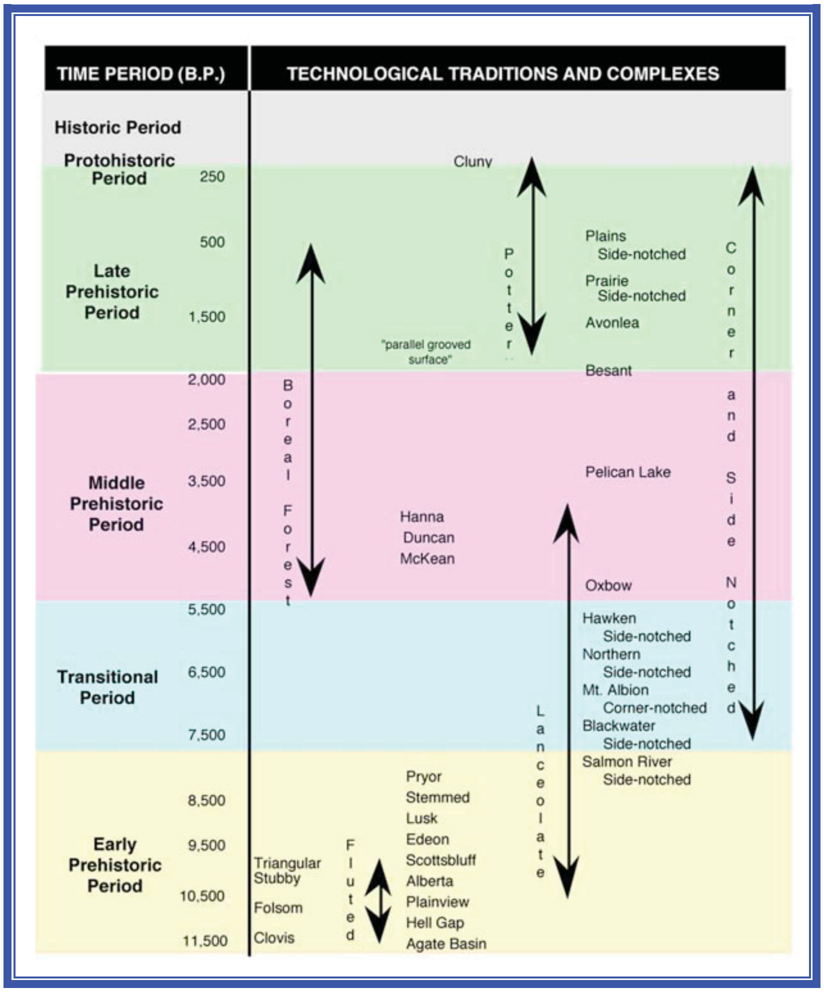


Figure 4. Culture History sequence for Alberta.

2.6 Previously Recorded Historical Resources

Archaeological sites in the Province of Alberta are recorded in the Archaeological Site Inventory Data files of the *Archaeological Survey, Historical Resources Management Branch, Alberta Culture and Community Spirit.* Site location information is maintained using a geographical system known as the Borden System[2]. All previously identified archaeological sites are geographically

[2]The Borden System relies on existing zones of longitude and latitude. Each longitude and latitudinal zone is divided into smaller areas each of which is identified by a number, called a Borden Block (e.g. GbQh). The capital letters refer to units which are two degrees of latitude by four degrees of longitude in size. These units are further divided into units which are ten minutes on a side, identified by the lower case letters. Sites found within these Block areas are given sequential numbers, such as GbQh-1, GbQh-2 and so on.

recorded using a numbered alphabetical system called the Borden System.

Each site found within an area keyed to longitude and latitudinal zones is given an identification number, called a Borden number. All sites of historic significance are also inventoried by the *Archaeological Survey, Historical Resources Management Branch, Alberta Culture and Community Spirit.* Prior to the field inspection site file searches were made of the Archaeological Site Inventory Data files and the Historic Sites Service files maintained by the *Cultural Facilities and Historical Resources Division*.

The Borden Blocks pertinent to this project are FjPi and FjPj. Of these previously located sites, 29 are located within 3 kilometres of the current project area (Figure 5). These sites consist of FiPi-03, FiPi-05, FiPi-06, FiPi-08, FiPi-12, FiPi-17, FiPi-20-23, FiPi-39, FiPi-42, FiPi-109; FjPi-33, FjPi-44, FjPi-45, FjPi-48, FjPi-72, FjPi-73, FjPi-75, FjPi-94, FjPi-98, FjPi-109; FjPj-04, FjPj-06, FjPj-26, FjPj-35, FjPj-63, FjPj-64, FjPj-125.

Of these sites, the five nearest ones (FjPi-44, FjPi-45, FjPi-48, FjPi-72, and FjPi-73) are along the North Saskatchewan River and consist of 4 historic sites and 1 archaeological site. FjPi-44 is a series of wooden pilings directly below the Low Level Bridge and has an Historic Resources Value = 0 (HRV=0). FjPi-45 is an historic cellar depression, a section of hedge and assorted modern cultural debris and has an HRV=0. FjPi-48 is a campsite consisting of a possible piece of Fire-Broken-Rock, a bison phalanx and 6 unidentified bone fragments and has an HRV=0. FjPi-72 is a grade section of old Dowlers Hill Road and has an HRV=0. FjPi-73 consist of wooden pilings related to an old ferry landing and has an HRV=4. Besides being by the North Saskatchewan River, none of these sites has a similar environmental situation as that found at the current study area location.

Previous archaeological investigation in the immediate vicinity of the proposed

Southeast LRT project area has not been comprehensive, but the fact that the proposed new alignment is by the North Saskatchewan River in a possibly undisturbed setting (an environmental situation considered to have high archaeological potential) suggested that there was potential for undisturbed Historical Resources sites to be located within the project lands.

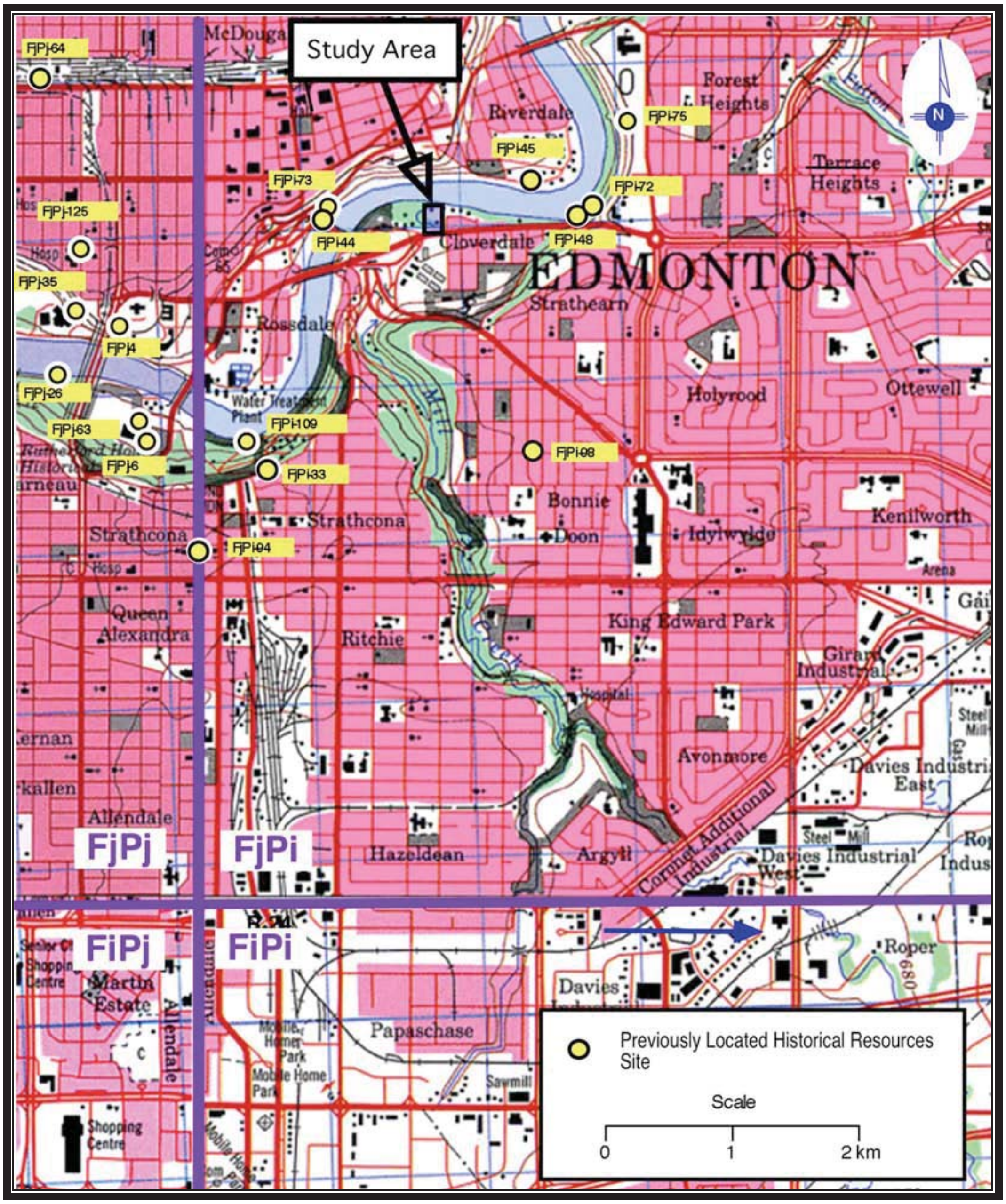


Figure 5. Map showing the location of sites in the general vicinity of the project area (after 1:50,000 NTS Maps 83 H/6 – Cooking Lake and 83 H/11 – Edmonton).

3.0 METHODOLOGY

3.1 HISTORICAL RESOURCES POTENTIAL

Searches of the Palaeontological Resources Sensitivity Zones map (Tyrrell Museum of Palaeontology 1984), the Archaeological Site Inventory Data files, and the Historic Sites Service files maintained by the *Archaeological Survey, Historical Resources Management Branch, Alberta Culture and Community Spirit,* were undertaken to determine the potential for historical resources in the Project area.

3.2 SURVEY METHODS

In-field investigations consisted of foot survey of all parts of the development area within the target area, and shovel testing of select parts of this part of the project area.

Areas for shovel testing were selected judgmentally. Subsurface examinations consisted of shovel tests ranging in size from 30 cm x 30 cm to 50 cm x 50 cm excavated to a depth of 30 - 75 cm below surface.

4.0 RESULTS

The area surveyed consists of a strip of land approximately 100 metres long by 25 metres wide extending from the sidewalk at the south end of the footbridge over the North Saskatchewan River across a gully up to the edge of 98 Avenue (Photographs 1, 2, 3 and 4). The area at the northern end of the study area (south of the end of the sidewalk up to the gully) appeared a likely candidate for deep testing using a backhoe (Photographs 5, 6, and 7). Alberta One-Call identified a buried pipeline running along the edge of the gully (Photographs 7 and 8) and it was noted that a water line and an electric line run from the metal boxes seen in Photograph 4 to a park building to the west (Photograph 7). It appears that all or almost all of the 6 or so metre wide area on the top of the north bank of the gully was disturbed by the excavations for these infrastructure installations, so no deep testing or shovel testing was undertaken between the north edge of the gully and the paved sidewalk to the north.

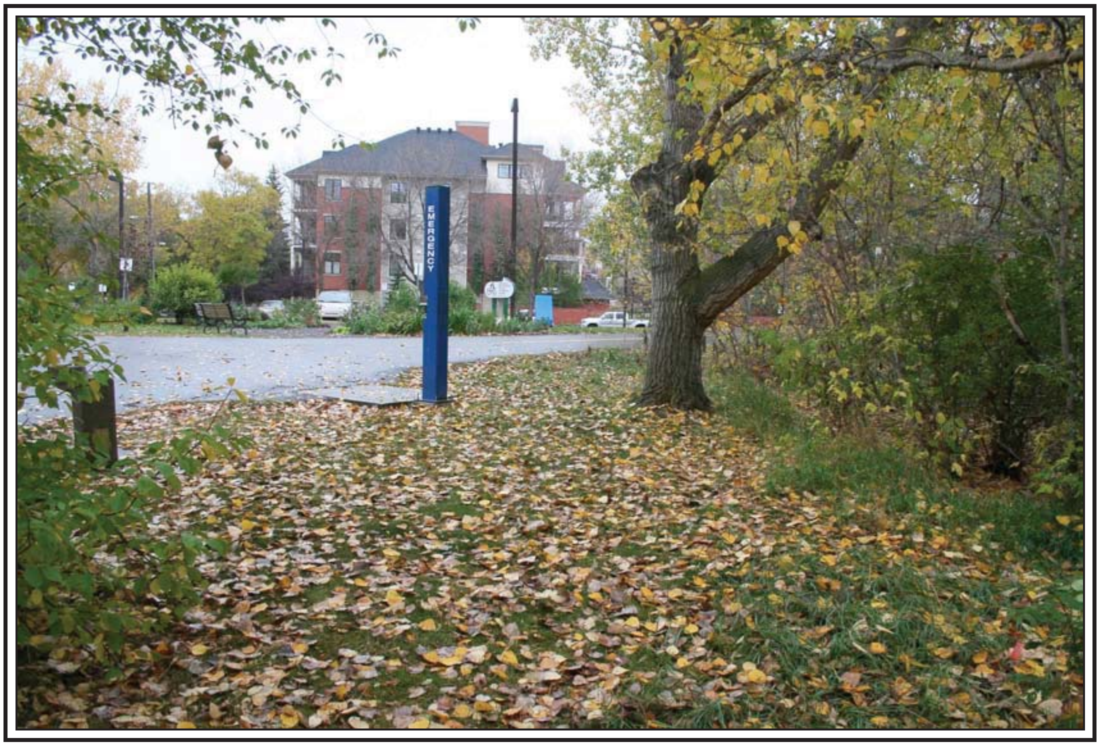
Photograph 1. View to the north across a paved area leading to the footbridge over the North Saskatchewan River.

Photograph 2. View to the south showing the location of a small gully immediately beyond the large tree and the small flat area between the paved area and the edge of the gully.

Photograph 3. View to the south-southeast across the gully bottom towards 98 Avenue.

Photograph 4. View to the south showing the side-slope up to the sidewalk which runs along 98 Avenue.

Photograph 5. View to the south-southeast showing a blue emergency post that has a disabled call button and a water fountain which lied between the edge of the paved area and the gully to the south.



Photograph 6. View to the east showing the emergency post and water fountain between the edge of the paved area and the gully to the south.

Photograph 7. View to the west showing the park building that the water line and electrical lines run towards from the emergency post and the water fountain. The intermittent orange line on the grass marks the buried pipeline identified by Alberta One-Call.

Photograph 8. View to the east showing the location of the buried pipeline that was flagged by Alberta One-Call along the edge of the gully.

Since there was only a small one or two metre area between the south edge of the gully and the sidewalk along 98 Avenue, no shovel testing was done on the top of the south bank of the gully. All shovel tests undertaken during the survey were within the gully itself.

On the northern downslope into the gully just below the buried pipeline that Alberta One-Call had flagged were a number of cultural items extending half way down the slope. These items included a wire cable, a plastic (PVC) pipe, a metal gas line pipe, concrete, and a piece of sheet metal that may have been a stove part (Photographs 9 and 10). The cable, the plastic pipe, and the gas line pipe were embedded in the side of the gully and when pulled upon they did not budge, which suggested that they were deeply embedded.

Photograph 9. View to the northeast showing the gully's northern downslope. A metal gasline pipe is visible at the bottom centre of the photograph.

Photograph 10. View to the north showing the modern cultural materials on the gully's northern downslope, some of which were embedded in the side of the gully.

The surface on the bottom of the gully was found to contain modern cultural debris that includes, concrete fragments, plastic sheeting, bricks, aluminum beer cans, plastic candy wrappers, wooden planks, a small pillow, a small backpack, pieces of paper, a piece of sheet metal, and the metal runners of an old sleigh (Photographs 11, 12, and 13).

There were a number of flat benches within the gully that extend from the bottom of the sideslope of the fill used to elevate a footbridge over 98th Avenue on the north edge of the study area. Fourteen shovel tests were placed on all of these flat benches and three shovel tests were placed on the bottom of the gully (Photographs 14 and 15). The shovel tests revealed a medium gray silt to depth (Photograph 16). No rocks, buried soils, stratigraphic layers, or cultural items were found in any of the shovel tests.

Photograph 11. Photograph showing some of the modern cultural materials found on the gully floor which include a beer can, two fragments, a plastic candy wrapper, and a large plank.

Photograph 12. Photograph showing some of the modern cultural materials found on the gully floor which include a black backpack, a pillow, and pieces of plastic packaging.

Photograph 13. Photograph showing the metal runners of an old sleigh on top of a piece of galvanized sheet metal.

Photograph 14. Photograph showing one of the shovel test locations on one of the flat benches within the gully.

Photograph 15. Photograph showing one of the shovel test locations on a flat bench near the southern side of the gully.

Photograph 16. Photograph showing the silty matrix found in the shovel tests within the gully.

Besides the modern cultural items found in the study area no significant historic cultural items and no palaeontological materials, stratified layers, or buried soils were found in the shovel tests, on the ground surface, or in existing exposures. The lack of significant historic cultural materials, stratified layers, buried soils, or palaeontological artifacts in the study area suggests that no further concern for historical resources is warranted for this project area.

4.1 Historic Site FjPi-166

While the Southeast LRT HRIA survey was confined to the small gully area on the south side of the North Saskatchewan River, other disciplinary surveys associated with the Southeast LRT project were being conducted for the whole project route. One of these studies was a Geotech Survey of the river valley that was conducted by Thurber Engineering Ltd, and one of their hydro-vac teams working by the north end of the footbridge over the north side of the North Saskatchewan River found sawn bone and other cultural items just east of the north end of the footbridge (hydro-vac hole location is at TH11-17 on Figure 6). The hydro-vac team abandoned the hole after wood was encountered at approximately 12 feet (3.66 metres) below surface that they could not get through.

The cultural items and bone plus a log of their depths of occurrence were sent to The Archaeology Group to determine their possible significance and to determine if there were any Historical Resources concerns. The recovered items (Table 3) consist of a white ironstone bowl fragment, a complete milk bottle, a complete red brick, a complete ink bottle with cork, and a patent medicine bottle with its cork, two butchered bone fragments (cow (Bos Taurus)), and an unidentified large mammal rib fragment (see Figures 7 to 14). None of the cultural items have any maker's marks and the bottles all are made using two piece molds, and the white bowl fragment is very generic and has no decoration, and none of these items could be dated to earlier than the beginning of the 20th century. The butchered bone was sawn and had no other butchering marks. The rib fragment was broken and had no butchering marks on it.

Table 3. Ten cultural items recovered from the hydro-vac hole at the northeast end of the footbridge over the North Saskatchewan River.

Artifact	Catalogue No.	Depth Below Surface
Cow Leg bone (radius)	FjPi-166:1	3 feet/0.91 metres
Large mammal rib fragment	FjPi-166:2	4 feet/1.22 metres
Bowl fragment	FjPi-166:3	4 feet/1.22 metres
Milk bottle	FjPi-166:4	4.5 feet/1.37 metres
Cow pelvic bone (ischium fragment)	FjPi-166:5	4.5 feet/1.37 metres
Brick	FjPi-166:6	7.5 feet/2.29 metres
Ink bottle	FjPi-166:7	8.5 feet/2.59 metres
Ink bottle cork	FjPi-166:8	8.5 feet/2.59 metres
Patent medicine bottle	FjPi-166:9	8.5 feet/2.59 metres
Patent medicine bottle cork	FjPi-166:10	8.5 feet/2.59 metres

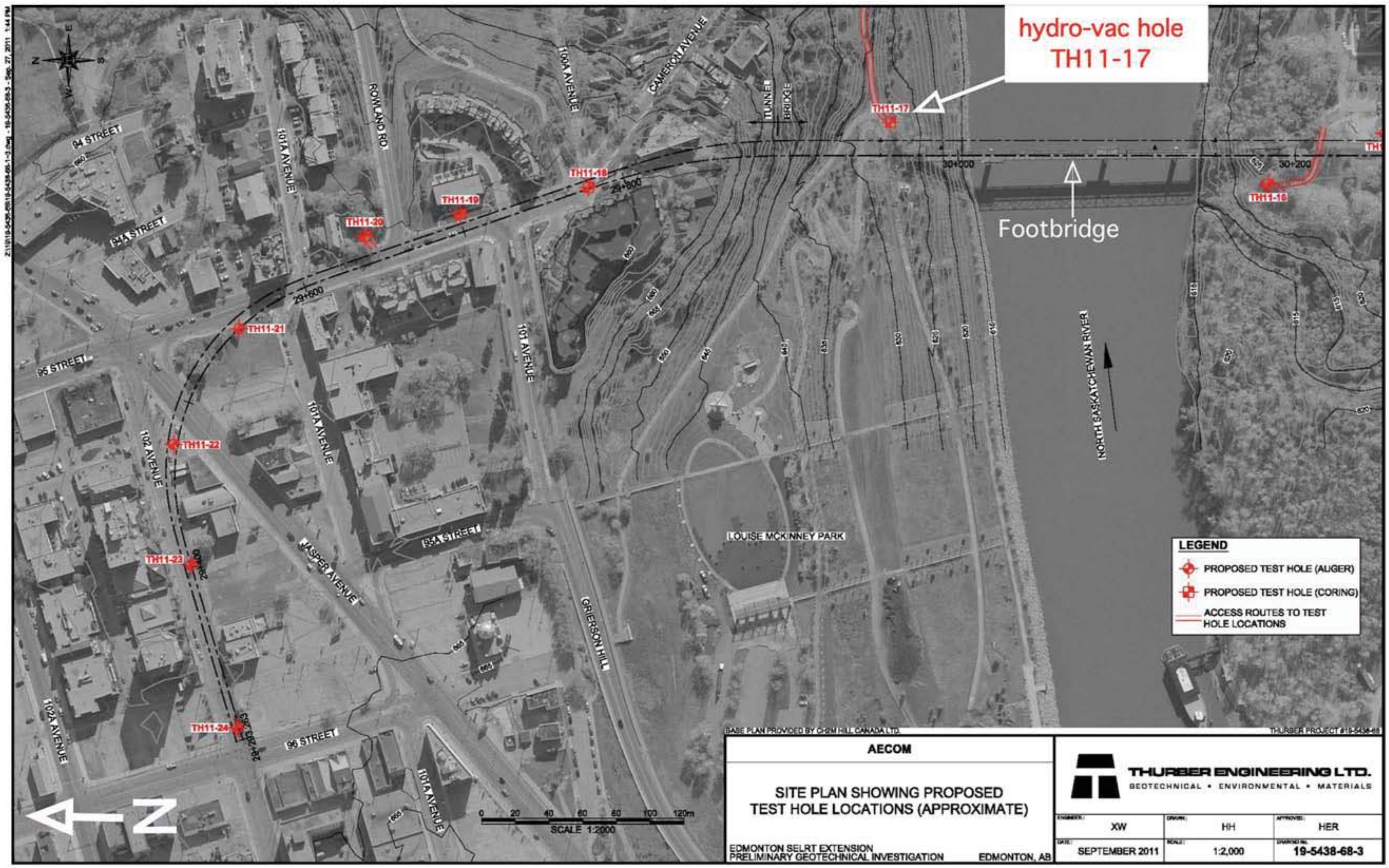


Figure 6. Photomosaic showing the location of Hydro-vac hole TH11-17 at the northeast end of the footbridge over the North Saskatchewan River.

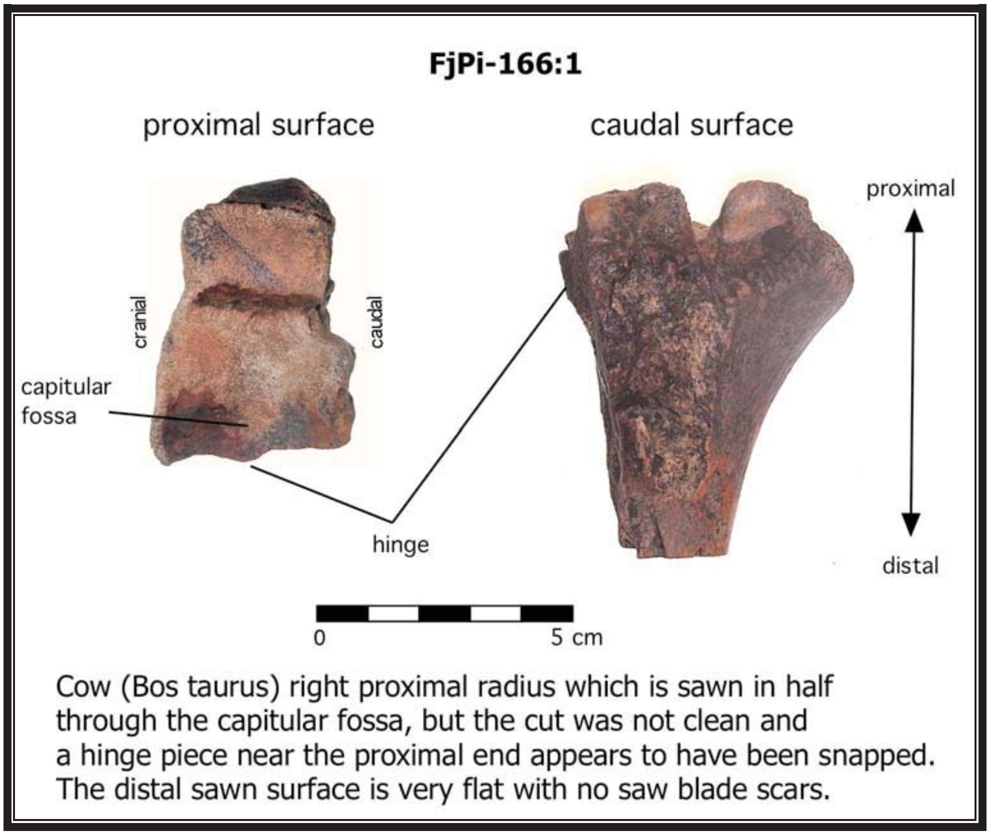


Figure 7. Butchered immature cow (Bos taurus) proximal right radius fragment found in Hydro-vac hole TH11-17.

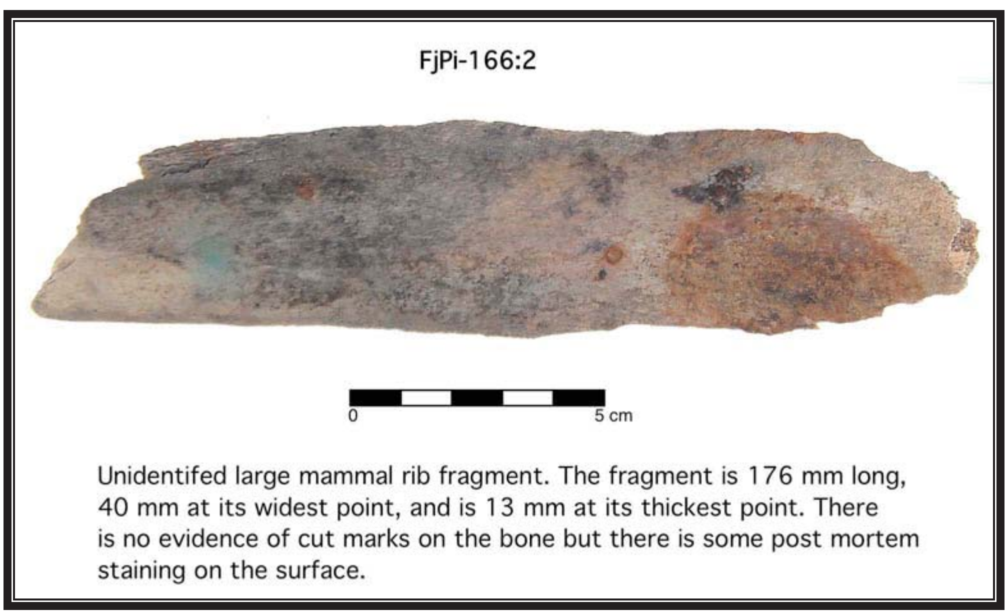


Figure 8. Unidentified large mammal rib fragment found in Hydro-vac hole TH11-17.

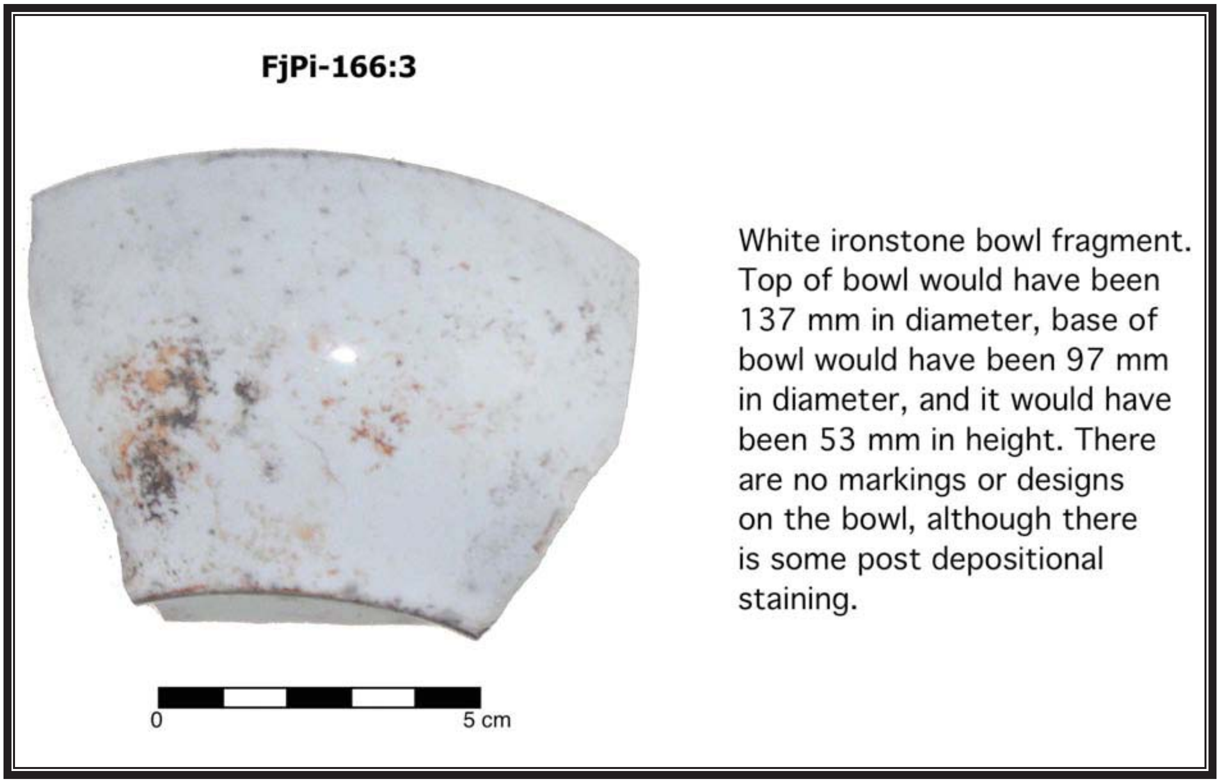


Figure 9. White ironstone bowl fragment found in Hydro-vac hole TH11-17.

FjPi-166:4

Clear glass milk bottle with a purple hue. The bottle is 200 mm tall, the top is 47 mm in diameter, the neck is 43.5 mm in diameter, while the body and base are 75 mm in diameter. The body and neck of the bottle were made using a two piece mold which has left strong side seams and the top rings and the base were fused to the main part of the bottle. The top consists of two rings separated by a thin indented line. While the bottom ring has fusion lines indicating that it was made in two pieces, the topmost ring has no fusion lines. The base has a circular post mold scar in the center that is slightly raised above the central part of the base, and so is the lateral edge which allows the bottle to sit flat, which it could not do otherwise since the post mold scar is not flat. There are no markings on the bottle.

Figure 10. Milk bottle found in Hydro-vac hole TH11-17.

FjPi-166:5

Immature cow (Bos taurus) right proximal ischium fragment which is broken and there is no evidence of butchering.

Figure 11. Butchered immature cow (Bos taurus) right proximal ischium fragment found in Hydro-vac hole TH11-17.

FjPi-166:6

Complete red brick with mortar attached. While the sides and top of the brick are flat, the bottom of the brick is pitted and slightly irregular. This suggests that the brick was made in a mold sitting on sand. The central part of the top of the brick is concave with sloped sides and there raised linear bumps near the four corners of the bottom of the concavity. The brick is 210 mm long, 95 mm wide, and 63 mm thick. The concavity on the top of the brick is 19 mm deep, 142 mm long at the top and 120 mm long at the bottom of the concavity, and it is 52 mm wide at the top and 30 mm wide at the bottom of the concavity. There is no maker's mark on the brick.

Figure 12. Red brick found in Hydro-vac hole TH11-17.

FjPi-166-7 is a clear glass ink bottle. The bottle is 69 mm tall, the base is 51.5 mm in diameter, the body is 50 mm in diameter, the neck is 26 mm in diameter, and the top is 29.5 mm in diameter. The bottle was made using a two piece mold and the side seam extends from the base to the top. The top has a rounded ring which sits on a neck 10 mm in length. The neck sits on a small ring that sits on the rounded shoulder which extends to a raised ring at the top of the body. The body is 30 mm tall and it rests on a basal ring. The bottom of the bottle is depressed so that the bottle can sit on the basal ring. In the center of the base is an embossed triangle with the letter C in the center.

FjPi-166:8 is the cork for the ink bottle.
The cork has shrunk through drying so that it loosely fits in the top of the bottle, and the top of the cork has been broken off. The cork is 17 mm in diameter at its base and the body of the cork is 14 mm l ong, while the remaining part of the top of the cork is 20 mm in diameter.

Figure 13. Ink bottle with its cork found in Hydro-vac hole TH11-17.

FjPi-166:9 is a clear glass rectangular graduated patent medicine bottle. The bottle is 186 mm tall, the top is 29 mm in diameter, the neck is 23 mm in diameter, while the body and base are 63 mm wide and 40 mm thick. The bottle was made using a two piece mold which has left strong side seams that are tranversely positioned on the sides of the bottle and are not centered on the sides. The bottle is sligtly concave on the front and slightly convex on the back. The front has embossed graduated scales on either side. The left side scale is numbered 1 to 7 while the right side has 50, 100, and 200 cc. In the center of the top of the body just below the start of the shoulder is an embossed 3 VIII. The shoulder and neck are fluted or scalloped. The top ring is rounded and sits on a parallel sided part of the neck that is separated from the fluted part of the neck with an incised line. The base is slightly indented and a circular post mold scar extends to the edges of the front and back parts of the base. There is not maker's mark on the bottle.

FjPi-166:10 is a cork that was found in the top of the bottle. The cork is dry and it may have shrunk in size, but it still fits snuggly in the top. The cork is 23 mm high, and is approximately 16 mm in diameter at the top. The bottom portion of the cork is approximately 9 mm in diameter.

Figure 14. Patent medicine bottle with its cork found in Hydro-vac hole TH11-17.

Dr. Heinz Pyszczyk of Alberta Culture and Community Spirit was contacted and informed of the artifact discovery and the depths at which the items were found. He concluded that shovel testing or deep testing would be impractical given the depth of the deepest items, so he asked that we do an historic archival and library search to see if there were any records that could shed light on the possible origin of the deeply buried materials.

The archival search revealed that the Hydro-vac hole TH11-17 was within the bounds of the old Grierson nuisance grounds or dump (assigned site number FjPi-166, see Site Form in Appendix II). Garbage dumping at the Grierson nuisance grounds began around 1894 and it continued until the mid-1940's. One letter to the editor (Edmonton Bulletin March 1, 1912) indicates that by 1912 the dump was well-used, and residents in the immediate vicinity of the dump were referring to this as the City Dump, and that some if not all of these residents were not happy with the dump's location due to strong odors emanating from the dump and the fact that flies attracted to the dump were plaguing the residences in the summer time. Significant slumping occurred between McDougall Hill and what is now 95 Street during the last part of the second decade of the century, and around 1922 stabilization of the bank began in earnest. Part of the stabilization plan was to use garbage to help in-fill above the toe and foot of the slump. In this regard controlled or directed dumping under City control was used to build up the lower terrace. Approximately 30,000 cubic yards of rubbish were being dumped at the dump by 1932 which consisted of house and trade refuse including paper, scrap wood, broken glass, grass cuttings from city lawns, manure from stables, plaster and concrete from new or old buildings, vehicles and vehicle parts, and clothing (Edmonton Civic Town Planning newsletter July 15, 1932).

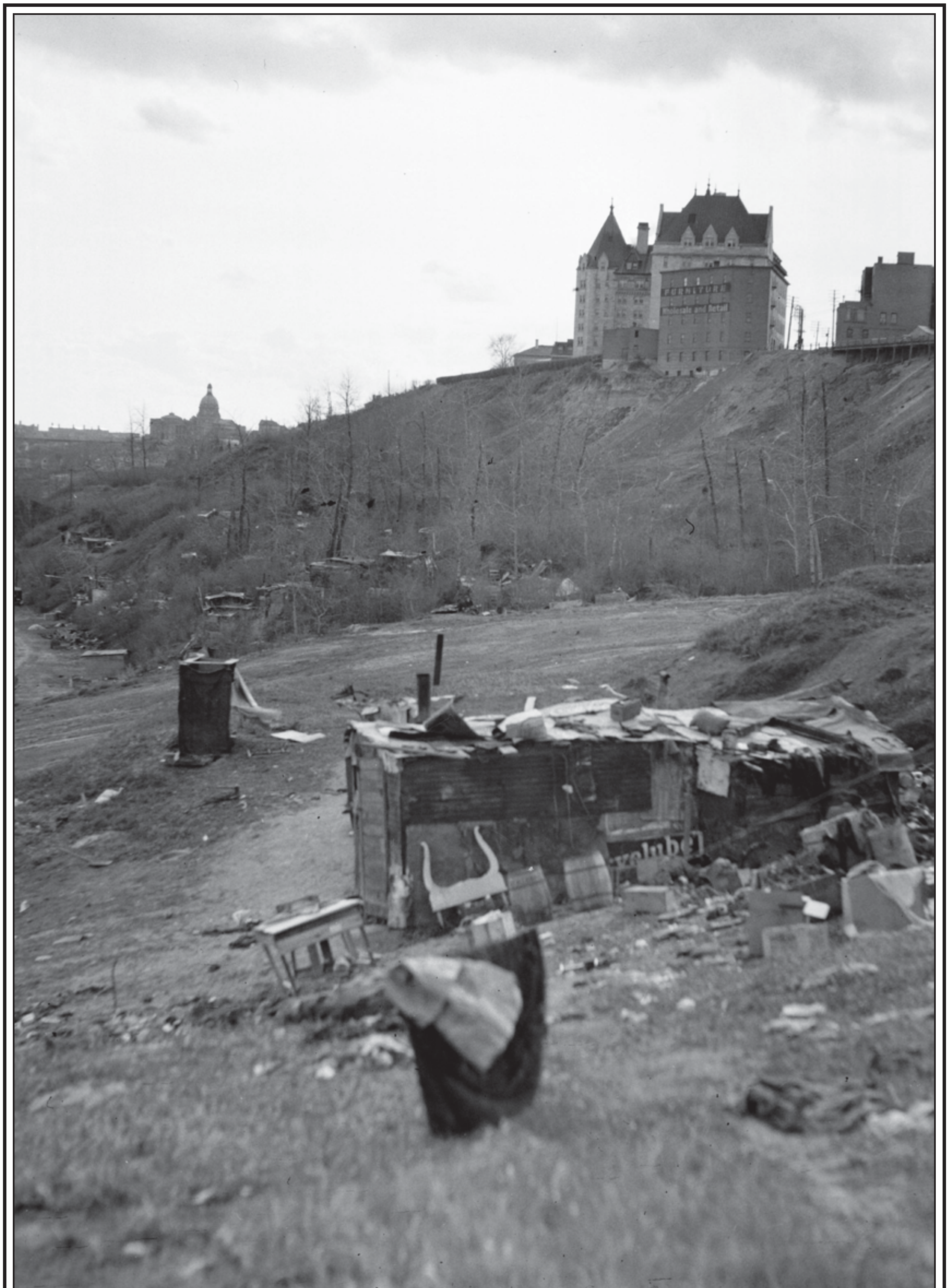
During the Great Depression squatters began setting up shacks on or by the dump. These squatters were able to build their shacks from dumped material, but they also sorted through and collected salvageable items which they sold. A letter to R. B. Jenkins of the City Health Department (April 2, 1937) indicates that the City tried to have these people moved from the dump, and over time several of the shacks were covered up. The letter offers some insight about the land reclamation progress at the dump wherein it states “as our dump progresses along the toe of the bank we have covered up the shacks and several have been removed in this way” (Haddow 1937). This statement suggests that the in-filling at the dump was being done in a deliberate manner. By the late 1940’s it appears that dumping at the Grierson dump was discontinued and the Rundle Park area on the eastern City limits became the main City of Edmonton dumping grounds. The Grierson dumpsite was covered with soil matrix, was landscaped, and now sits under Louise McKinney Park.

Since no archaeological excavations were undertaken at the dumpsite area, the exact limits and depths of the Grierson Dump were not established, but photographs of the dump area (Photographs 17 to 19) suggest that the bulk of the Grierson Dump lies between the North Saskatchewan River and the mid-slope up to the top of the northern river valley edge (Figure 15). The historic photographs of the dump show that the Grierson Dump extended for approximately 700 metres along the river and approximately 100 metres or more from the river’s edge. The road shown in Photograph 17 appears to be at the approximate location of the modern Grierson Hill road and if this is the case, Hydro-vac hole TH11-17 appears to be near the eastern end of the Grierson Dump (Figure 15). Although hole TH11-17 was only taken down to around 12 feet below surface, the actual depth of the garbage may be significantly deeper at this location.

The fact that the dump area was very large (possibly more than 50 hectares) suggests that any disturbance that will be caused by the Southeast LRT project will only impact an extremely tiny fraction of the whole dump area and therefore these impacts should not be considered significant since the vast majority of the dumpsite will not be impacted and will remain buried.

Photograph 17. View to the east showing the extent of the Grierson Dump in 1931 (Photograph # EA-217-3 courtesy of the City of Edmonton Archives).

Photograph 18. View to the west showing men working at the Grierson Dump site on May 8, 1931 (Photograph # EA-217-2 courtesy of the City of Edmonton Archives).



Photograph 19. View to the west showing some of the squatter's cabins on the Grierson Dump site in 1938 (Photograph # EA-160-325 courtesy of the City of Edmonton Archives).

Figure 15. Satellite photo showing the estimated extent of the Grierson Dump based on the approximate dumping area as existed in Photographs 17 and 18, though the continued dumping at the site after this date could mean that the actual dump site is much larger.

While all of the cultural materials recovered from the hydro-vac hole could date to the period from 1900 to 1940, none can definitely be attributed to the period before 1900, but materials buried below 12 feet may be from the earlier historic period. But, given the huge volume of material dumped at the site, the disturbance or destruction of a tiny fraction of the cultural materials at the dump from the late 19th or early to mid 20th century should not be considered significant since more than 99.9% of the dump will remain undisturbed. It is recommended that the proposed Southeast LRT construction through this site area should be allowed to proceed.

5.0 RECOMMENDATIONS

The HRIA survey area consists of a strip of land approximately 100 metres long by 25 metres wide extending from the sidewalk at the south end of the footbridge over the North Saskatchewan River across a gully up to the edge of 98 Avenue.

In-field investigations consisted of foot surveys and shovel testing within select parts of the gully within the proposed project area. A total of 17 shovel tests were excavated during the survey in the gully but no shovel tests were excavated on the general level beside the gully because of previous disturbances caused by paving, landscaping, or previous infrastructure emplacements.

Modern cultural items were found in the gully, but none of these was considered to be significant historic cultural items and all appear to be from the last part of the 20th century. No prehistoric cultural items or palaeontological materials, stratified layers, or buried soils were found in the shovel tests, on the ground surface, or in existing exposures. The lack of significant historic cultural materials, stratified layers, buried soils, or palaeontological artifacts in the study area suggests that no further concern for historical resources is warranted for this project area along the proposed Southeast LRT alignment in LSD 15-33-52-24-W4M.

One historic site (FjPi-166) was recorded on the north side of the North Saskatchewan River in LSD 15-33-52-24-W4M but outside the HRIA survey area by a Hydro-vac team working for Thurber Engineering Ltd. doing a geo-tech survey of the river valley for the Southeast LRT project. Cultural materials were found in a hydro-vac hole down to a depth of 8.5 feet (2.59 metres) and the artifacts were sent to Archaeology Group to determine their significance.

The cultural items appear to be from the first half of the 20th century and archival documents suggest that the hydro-vac findspot was within the old Grierson nuisance grounds/dump. The dump was used for approximately 50 years and extended for hundreds of metres along the North Saskatchewan River. It is concluded that any disturbances caused by construction of support structures for the Southeast LRT line within the dump area would be relatively small and insignificant in terms of the trash volume and large size of the old dump that could possibly be disturbed or destroyed by the LRT line project. It is concluded that no further concern for historical resources is warranted for this Grierson Dump (FjPi-166) area.

In this regard, this report recommends that further historical resource investigations are not warranted for the proposed Southeast LRT in LSD 15-33-52-24-W4M, in Edmonton, Alberta, and the project should proceed as planned. However, should any fossils be discovered during development, staff at the Royal Tyrrell Museum should be contacted immediately. This recommendation is subject to approval by the *Archaeological Survey, Historical Resources Management Branch, Alberta Culture and Community Spirit.*

6.0 REFERENCES

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APPENDIX I: REQUIREMENT LETTER FROM ALBERTA CULTURE AND COMMUNITY SPIRIT

Government of Alberta
Culture and Community Spirit

Historic Resources Managemer
Old St. Stephen's College
8820 – 112 Street
Edmonton, Alberta T6G 2P8
Canada
Telephone: 780-431-2300
www.culture.alberta.ca/hrm

December 6, 2010 Project File: 4715-10-042

Mr. James Hnatiuk
CH2M Hill
Suite 800, Highfield Place
10010 – 106th Street
Edmonton, Alberta
T5J 3L8

Dear Mr. Hnatiuk:

SUBJECT: CITY OF EDMONTON
SOUTHEAST LRT PLANNING STUDY
PART SECTIONS 2, 11, 14, 15, 22, 23, 27, 33 & 34-52-24-W4M; 3-53-24-W4M
HISTORIC RESOURCES STATEMENT OF JUSTIFICATION

The Archaeology Group has provided the Historic Resources Management Branch (HRMB) of Alberta Culture and Community Spirit with an Historic Resources Statement of Justification (SOJ) package for the captioned project. Staff of the HRMB have reviewed the potential for the proposed development to impact historic resources and have concluded that an Historic Resources Impact Assessment (HRIA) is required. Staff of the Royal Tyrrell Museum of Palaeontology have also reviewed this information and have indicated that an HRIA for palaeontological resources is also required.

HISTORIC RESOURCES IMPACT ASSESSMENT

Pursuant to Section 37(2) of the *Historical Resources Act*, an HRIA report is required for both archaeology and palaeontology for the proposed project. The HRIAs are to be prepared in accordance with the instructions outlined in the attached Schedule "A". In addition, if it is determined that historic structures will be affected by this project, staff of the HRMB are to be notified, additional studies may be required prior to development proceeding.

Should you require additional information or have any questions concerning the above, please contact Barry Newton at (780) 431-2330 or by e-mail at barry.newton@gov.ab.ca.

…cont.

Alberta
Freedom To Create. Spirit To Achieve.

Mr. James Hnatiuk
December 6, 2010
Page 2

On behalf of Alberta Culture and Community Spirit, I would like to thank you and officials of the City of Edmonton for your cooperation in our endeavour to conserve Alberta's past.

Sincerely,

David Link, PhD
Assistant Deputy Minister

Attachment

cc: Walt Kowal, The Archaeology Group
Dan Spivak, RTMP (3948-83H-6)

SCHEDULE "A"
***HISTORICAL RESOURCES ACT* REQUIREMENTS**
CITY OF EDMONTON
SOUTHEAST LRT PLANNING STUDY
PART SECTIONS 2, 11, 14, 15, 22, 23, 27, 33 & 34-52-24-W4M; 3-53-24-W4M
(PROJECT FILE: 4715-10-042)

1. HISTORIC RESOURCES IMPACT ASSESSMENT - ARCHAEOLOGICAL RESOURCES

Pursuant to Section 37(2) of the *Historical Resources Act*, an Historic Resources Impact Assessment (HRIA) and any work resulting from this assessment is to be conducted on behalf of the City of Edmonton by an archaeologist qualified to hold an Archaeological Research Permit within the Province of Alberta. In order to conduct the HRIA, the archaeological consultant must submit "An Application for an Archaeological Research Permit - Mitigative Research Project" to the Historic Resources Management Branch. Please allow up to ten working days for the permit to be processed.

Timing: The HRIA shall consist of the conduct of a pre-construction impact assessment carried out under snow-free, unfrozen ground conditions. The HRIA is required only for the area on the south side of the North Saskatchewan River, between the river and 87th Street. More specifically on the north side of the small gully and within the gully as outlined in the SOJ.

Deep Testing: A deep testing program may be required in areas of significant sedimentation, at the discretion of the consulting archaeologist.

Additional measures: Depending upon the results of the HRIA, additional salvage, protection or preservative measures may be required

2. FINAL REPORT

A copy of the HRIA final report for archaeological resources and any Interim reports are to be sent to the Historic Resources Management Branch, 8820 - 112 Street, Edmonton, Alberta, T6G 2P8.

3. HISTORIC RESOURCES IMPACT ASSESSMENT - PALAEONTOLOGICAL RESOURCES

Pursuant to Section 37(2) of the *Historical Resources Act*, an Historic Resources Impact Assessment (HRIA) and any work resulting from this assessment is to be conducted on behalf of the City of Edmonton by a palaeontological consultant qualified to hold a Permit to Excavate Palaeontological Resources (Mitigative) within the Province of Alberta.

…cont.

SCHEDULE "A" – PAGE 2

Timing: The HRIA shall consist of the conduct of a pre-construction impact assessment. The HRIA is required only for the area where the LRT will go underground on the Davies Road optional alignment and in the gully on the south side of the North Saskatchewan River as outlined in the SOJ.

Additional measures: Depending upon the results of the HRIA, additional salvage, protection or preservative measures may be required.

4. FINAL REPORT

A copy of the final report for palaeontological resources and any Interim reports are to be submitted directly to Dan Spivak, Royal Tyrrell Museum of Palaeontology Box 7500, Drumheller, Alberta, T0J 0Y0.

APPENDIX II: ARCHAEOLOGICAL SITE INVENTORY DATA FORM

Alberta
Culture and Community Spirit

ARCHAEOLOGICAL SITE INVENTORY DATA

Borden No. FjPi-166
Permit No. 11-249

Return to: Historic Resources Management, Archaeological Survey
8820 - 112 Street, Edmonton, Alberta T6G 2P8

Revisit Date:

1. Site Name: Grierson Dump
2. Field No.: Grierson Dump
3. Elevation (m): 610
4. N.T.S. 1:50,000 Map No.: 83 H/11
5. Legal Description: LSD 14,15;2,3 Section 33;4 Township 52;53 Range 24 W of 4 M
6. UTM NAD83 Zone 12 Easting Centre 335692 Northing Centre 5935331
7. Land Owner: [ ] Government of Canada [ ] Government of Alberta [x] Municipal Government [ ] Freehold

Land Owner Name/Address: City of Edmonton

8. Access (refer to highway, road number, trail, cardinal directions, landmarks, nearest settlement, distances)

From the west end of the Low Level Bridge in the City of Edmonton go northeast up Grierson Hill road 375 metres to the access road and parking lot on the southeast side of Grierson Hill road. Proceed southeast 120 metres into Louise McKinney Park. The site occupies the first terrace above the river and extends approximately 700 metres to the northeast along the North Saskatchewan River.

9. Site Environment/Setting (describe in terms of drainage, slope, aspect, vegetation, soil type, landforms)

The site area has been totally landscaped and there are numerous trails throughout the old dump site area.

10. Site Class
- [ ] prehistoric
- [ ] indigenous historic
- [x] historic
- [ ] contemporary
- [ ] undetermined

11. Site Context
- [ ] surface
- [x] subsurface
- [ ] underwater
- [ ] stratified
- [ ] undetermined

12. Component
- [x] single
- [ ] multi
- [ ] undetermined

1 # components

13. Site Type
- [ ] isolated find
- [ ] scatter <10
- [ ] scatter >10
- [ ] campsite
- [ ] stone feature
- [ ] killsite
- [ ] workshop
- [ ] quarry
- [ ] rock art
- [ ] burial
- [ ] palaeoenvironmental
- [ ] settlement
- [ ] homestead
- [ ] farm
- [ ] ranch
- [ ] dwelling
- [ ] trading post
- [ ] police post
- [ ] mine
- [ ] trail
- [ ] mission
- [ ] school
- [ ] urban
- [ ] ceremonial/religious
- [ ] industrial
- [ ] transportation

other, specify: historic feature

14. Features (frequencies if possible)

___ stone circle	___ medicine wheel	___ pit	___ structure	other, specify
___ cairn	___ effigy	___ mound	___ foundation	1 dump
___ stone arc	___ pictograph	___ depression	___ cellar	
___ stone line	___ petroglyph	___ cabin	___ dump	___
___ drive lane	___ hearth	___ house	___ fence	

Borden No. FjPi-166

Permit No. 11-249

15. Description (spatial extent, patterning, density and variety of remains, diagnostics and exotic material, for historic archaeological sites provide details regarding site ownership, origins, function and context)

10 historic items were recovered from one hydro-vac hole near the northeast end of the estimated limits of the old Grierson Dump. The 10 items are a white ironstone bowl fragment, a complete milk bottle, a complete red brick, a complete ink bottle with cork, and a patent medicine bottle with its cork, two butchered bone fragments (cow (Bos Taurus)), and an unidentified large mammal rib fragment.

16. Materials Observed ☒ yes ☐ no Materials Collected ☒ yes ☐ no

Materials observed/collected (frequencies if possible).

observed	collected		observed	collected		observed	collected	
		projectile points	3	3	faunal remains			wood
		lithic tools			human remains			shell
		lithic cores			metal points			metal
		lithic debitage			floral remains	3	3	glass
		bone tools			tephra			beads
		pottery			soil samples	1	1	ceramics (historic)
		fire cracked rock			macrofossils	3	3	other, specify 2 corks, 1 red brick
		charcoal						

17. Collection Remarks (formed tools, raw materials, etc. that were collected)

The 10 items collected are a white ironstone bowl fragment, a complete milk bottle, a complete red brick, a complete ink bottle with cork, and a patent medicine bottle with its cork, two butchered bone fragments (cow (Bos Taurus)), and an unidentified large mammal rib fragment. All of the cultural items appear to be from the first half of the 20th century.

18. Collection Repository ☒ Royal Alberta Museum ☐ Private collection ☐ Other…

19. Photo/Images ☒ yes ☐ no Repository Archaeology Group Inc.

20. Culture ☐ Early Prehistoric ☐ Late Prehistoric ☒ Historic other, specify
☐ Middle Prehistoric ☐ Fur Trade/Contact ☐ undetermined

Cultural Affiliation (Complexes, phases, traditions, projectile point types, ethnographic & ethnic groups)

Culture Remarks

21. Calendar Date (A.D./B.C.) 1894-mid 1940's

22. Radiocarbon Dates

Borden No. FjPi-166

Permit No. 11-249

23. Dimensions Length (m) 700 Width (m) 100 Orientation E/W Depth Below Surface (m) >4 metres

24. Estimated Portion Intact (%) 0

25. Assessment Methods
- ☐ surface inspection
- ☐ erosion exposure
- ☐ shovel tests
- ☐ backhoe tests
- ☐ excavation
- ☐ auger tests
- ☐ mapping
- ☐ monitor

other, specify: hydro-vac hole

shovel tests ____ # positive shovel tests ____

backhoe tests ____ # positive backhoe tests ____

auger tests ____ # positive auger tests ____

excavation units ____ length (m) ____ width (m) ____ # excavated square meters ____

26. Disturbance Factors (natural, human, current, potential)

Type of Disturbance
- ☐ agriculture
- ☐ pipeline
- ☐ wellsite
- ☐ road/highway
- ☐ gravel/sand pit
- ☐ residential area
- ☐ coal mine
- ☐ oil sands
- ☐ forestry
- ☐ transmission line
- ☐ reservoir
- ☐ recreation area
- ☐ industrial area
- ☐ vandalism
- ☐ erosion

other, specify: LRT line

Will current development impact site? ☒ yes ☐ no ☐ unknown

Disturbance Factors Remarks

The site area has been covered with sediment and has been landscaped.

27. Permit Holder/Researcher Walt Kowal

28. Observed by Thurber Engineering Ltd. Date (YYYYMMDD) November 8, 2011

29. Collected by Thurber Engineering Ltd. Date (YYYYMMDD) November 8, 2011

30. Tested by ____ Date (YYYYMMDD) ____

31. Excavated by ____ Date (YYYYMMDD) ____

32. Form completed by Walt Kowal Date (YYYYMMDD) January 4, 2012

33. Report Title/Project Name Southeast LRT Alignment in LSD 15-33-52-24-W4M, in the City of edmonton

34. Site Significance/Recommendations Remarks

The site is considered to be significant since it contains millions of pieces of cultural material from the first half of the 20th Century and these items may be of historic interest in the future. The possible impact on this huge dump area by the proposed Southeast LRT project is considered to be insignificant and no further work is recommended for this dump site in regards to the Southeast LRT project, but further investigation should be undertaken if wholesale disturbance of the buried materials is to take place in the future.

35. Additional Remarks

The site was not tested or visited and the dump dimensions are estimates based on 1931 photographs like the one below, and it may in fact be larger than estimated.

Borden No. FjPi-166

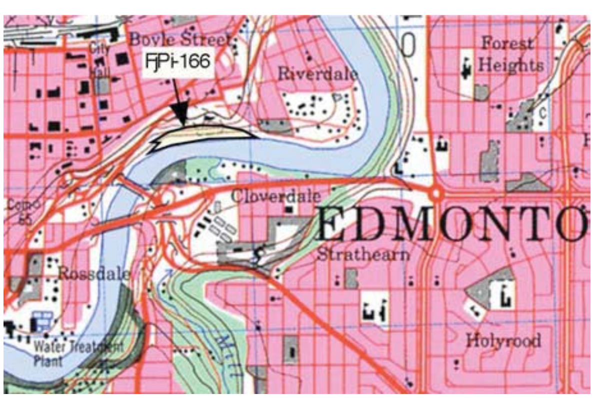
Permit No. 11-249

36. Site Map

Photograph courtesy of the City of Edmonton Archives

N.T.S. 1:50,000 Map Inset

Map No.: 83 H/11



Legend

Extent of Site
Positive Shovel Test
Negative Shovel Test
Road
Trail
Fence
Railway
River
Steep Rise

Additional Legend

N

Scale :___ cm = ___ m

HISTORIC RESOURCES IMPACT ASSESSMENT (PALEONTOLOGICAL REPORT)

Southeast LRT Planning Study Route

Prepared for
City of Edmonton
by
Michael G. Riley, M.Sc.
of
AEON Paleontological Consulting Ltd

ACCS Project File: 4715-10-042; RTMP Permit No.: 11-022

This document contains sensitive information regarding Historic Resources that are protected under provisions of the Alberta Historical Resources Act. This information is to be used to assist in planning for the proposed project only. It is not to be disseminated, and no copies of this document are to be made without written permission of Historic Resources Management Branch, Alberta Culture and Community Services.

169, 51042 RR204 Sherwood Park, AB T8G 1E5 • Phone: 780.662.3277 • Fax: 780.662-3282
www.paleoconsulting.com

Table of Contents

List of Tables

Paleontological Historic Resources Impact Assessment

PROJECT NAME	Southeast LRT Planning Study

Introduction

In response to a request by The Archaeology Group Inc. on behalf of the City of Edmonton - LRT Design and Construction, Aeon Paleontological Consulting Ltd. (Aeon) was retained to complete a paleontological Historic Resources Impact Assessment of the proposed southeast extension of the City of Edmonton's Light Rapid Transit (LRT) line and associated facilities (ACCS File: 4715-10-042 - Schedule "A" requirements for paleontology have been issued).

The proposed SE LRT line extension project will connect the potential Grey Nuns LRT station at 66 Street and 31 Avenue in Mill Woods to the potential Quarter LRT station at 96 Street and 102 Avenue in downtown Edmonton. Along the proposed LRT route alignment, two areas of paleontological interest were noted: the slopes of the North Saskatchewan River Valley and the Wagner Park ravine (Mill Creek Ravine system). These two drainage systems were of paleontological interest as they are associated with incised watercourse crossings that have downcut and may have exposed fossil resources and/or bedrock from the underlying Empress and Horseshoe Canyon formations. Fossil resources have been recorded along the slopes and floodplains of both the North Saskatchewan and Mill Creek drainage systems.

A pre-construction Historic Resources Impact Assessment for paleontology was completed in October 2011, according to the Schedule A requirements issued for paleontology. Based on background research and the author's past work in the Edmonton area, the two high potential crossings along the proposed route (North Saskatchewan River Valley and Wagner Park) were surveyed using pedestrian reconnaissance.

After review of the field survey data, geotechnical reports, and proposed design/construction plans, it is suggested that bedrock from the Horseshoe Canyon Formation is likely to be disturbed during development of the SE LRT expansion. The disturbance will likely occur during specific phases of construction at three areas along of the north and south slopes of the North Saskatchewan River Valley (River Valley). The three areas included the underground LRT tunnel excavation (sequential excavation), the north slope development around the tunnel portal, and the south slope (mid-slope) roadway/railway development along Conners Road.

Note: Due to the paleontological sensitivity of the North Saskatchewan River Valley slopes, any changes to the current plan (e.g. project boundaries, routing, bridge construction techniques, etc.) may require a reevaluation of the paleontological program and scope of work required.

The objective of this report is to:

- provide a brief review of the known paleontological resources, geologic formations and areas of high paleontological potential within and around the proposed SE LRT Expansion project;
- document any paleontological sites, resources and/or high potential zones within and around the proposed SE LRT project noted during the impact assessment;
- assess the proposed project's potential during development activities to disturb any documented or known paleontological sites, resources, high paleontological potential zones and/or bedrock (e.g. Horseshoe Canyon Formation and Empress Formation);
- and, if appropriate, suggest areas within the proposed project area that may require a paleontological post-impact assessment (monitoring program), once the final route alignments are completed.

Key Contacts

Report Prepared by	Aeon Paleontological Consulting Ltd.			
Address:	169, 51042 Range Road 204			
	Sherwood Park, AB T8G 1E5			
Contact Person:	Michael G. Riley, M.Sc.		Title:	Principal Paleontologist
	Tel:	780.662.3277	email:	mriley@paleoconsulting.com
	Fax:	780.662.3282	File:	Aeon-11-0162

Proponent	City of Edmonton - LRT Design and Construction			
Address:	14th Floor, Century Place, 9803 102A Avenue			
	Edmonton, AB T5J 3A3			
Contact Person:	Jeff Ward, P. Eng.		Title:	Senior Engineer
	Tel:	780.495.9976	email:	jeff.ward@edmonton.ca
	Fax:	780.496.2803	File:	Not available

Contracting Client	The Archaeology Group Inc.			
Address:	2526 Bell Court S.W.			
	Edmonton, AB T6W 1J8			
Contact Person:	Walt Kowal		Title:	Principal Archaeologist
	Tel:	780.438.4262	email:	w.kowal@shaw.ca
	Fax:	780.439.4285	File:	Not available

Heritage Contact	Heritage Resources Branch, Land Use Planning Section			
Address:	Old St Stephen's College, 8820-112 St			
	Edmonton, AB T6G 2P8			
Contact Person:	Rebecca Traquair		Title:	Administrative Coordinator
	Tel:	780.431.2300	Email:	rebecca.traquair@gov.ab.ca
	Fax:	780.431.2301	File #:	4715-10-042

Museum Contact	Royal Tyrrell Museum, Resource Management Program (RMP)			
Address:	Box 7500			
	Drumheller, AB T0J 0Y0			
Contact Person:	Dan Spivak		Title:	Head, RMP
	Tel:	403.823.7707	Email:	dan.spivak@gov.ab.ca
	Fax:	403.823.7131	File #:	3948-83H-6

Project Details

Table 1							
Nature of Project	Rail system, bridge construction (foundations, abutments, piles, new single span bridge), construction/realignment of roadways, intersections and pedestrian pathways.						
Legal Description:	LSD*	Sec	Twp	Rge	Mer	HRV	Category
	6,11,14	2	52	24	4	---	---
	3,4,5,12,13	11	52	24	4	---	---
	4,5,12,13	14	52	24	4	---	---
	1,8,9,16	15	52	24	4	---	---
	1,2,7,8,10,11,14,15	22	52	24	4	---	---
	4,5	23	52	24	4	---	---
	2,3,6,7,10,11,14,15	27	52	24	4	---	---
	6-8,10,11,15	33	52	24	4	**5**	**p**
	3,5,6	34	52	24	4	---	---
	2,3,5, 6,7	4	53	24	4	**5**	**p**
* - if LSD is **RED** then it has been notated in the *Listing of Historic Resources* with a Historic Resource Value (HRV) of 5p = High Palaeontological Resource Sensitivity Zone							
Project Size:	~10 hectares (13 km long railway)			Nearest Town:	Edmonton		
NTS Map Sheet:	83 H/6 Cooking Lk. & H/11 Edm.			Area/County:	City of Edmonton		

Natural Region	Central Parkland
Surficial Covering*:	Forested valley slope and terraces, landscaped parkland with grasses and trees, roadways and industrial/commercial sites.
Depth of Cover:**:	Up to ~10 m - test holes indicate floodplain deposits are up to 10 m thick on the lower alluvial terrace; slopes unknown but variable.
Outcrop***:	Visible along cutbanks and slopes of North Saskatchewan River.
Relation to Slope:	Floodplain, terraces and valley slope

* **Surficial Covering** = any vegetation, sediments, or water bodies/channels that overlie the bedrock in the proposed project area (e.g. forest, creek, pasture, glacial sands).

** **Depth of Cover** = the estimated depth of the sediments (e.g. soil, glacial drift, fill) overlying the bedrock deposits on average, throughout the proposed project lands.

*** **Outcrop/Exposure** = any bedrock outcropped or exposed in and around the proposed project area ROW.

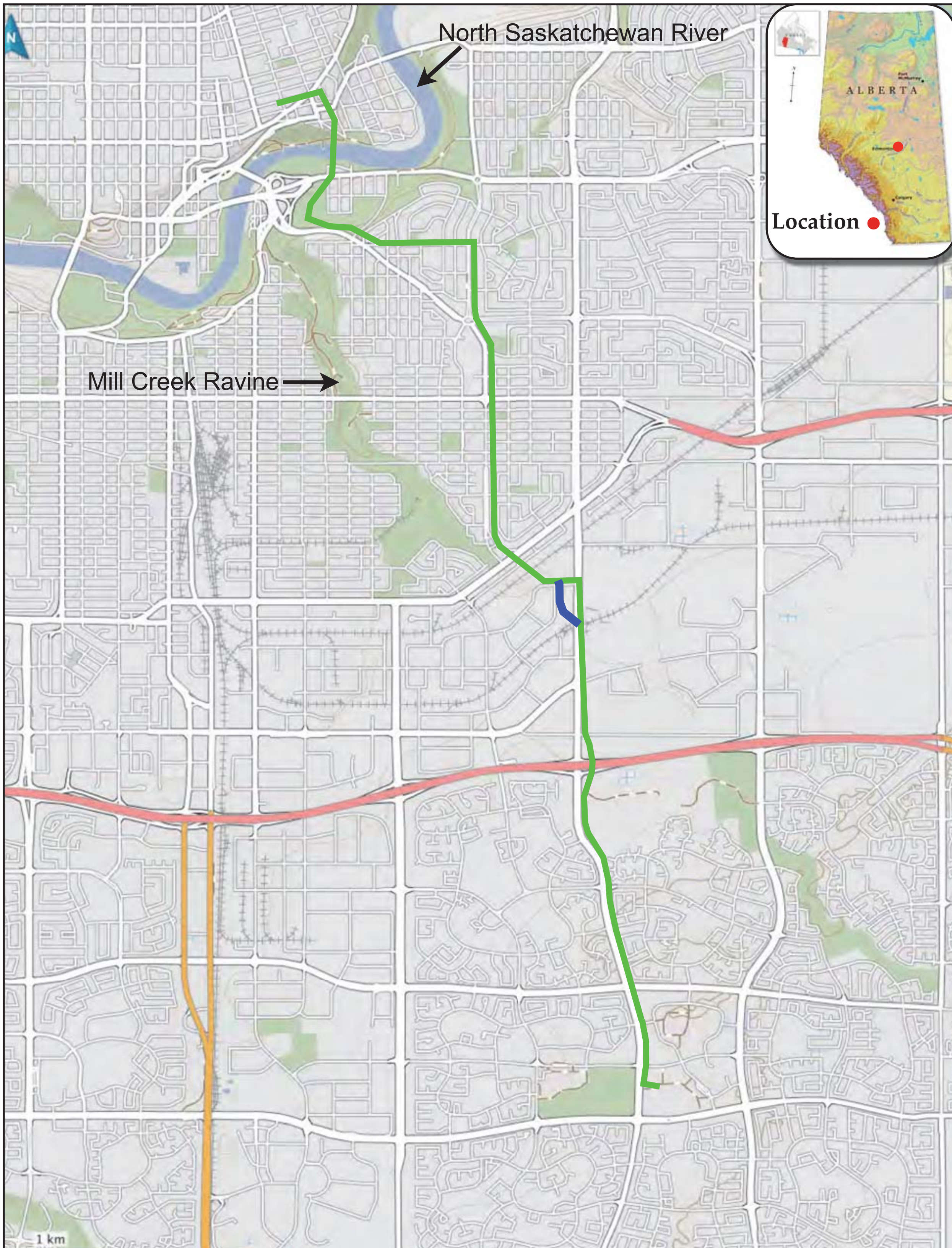


Figure 1. Topographical map with roadway overlay showing proposed Southeast LRT route (and optional Davies Road alignment (from downtown to Mill Woods.

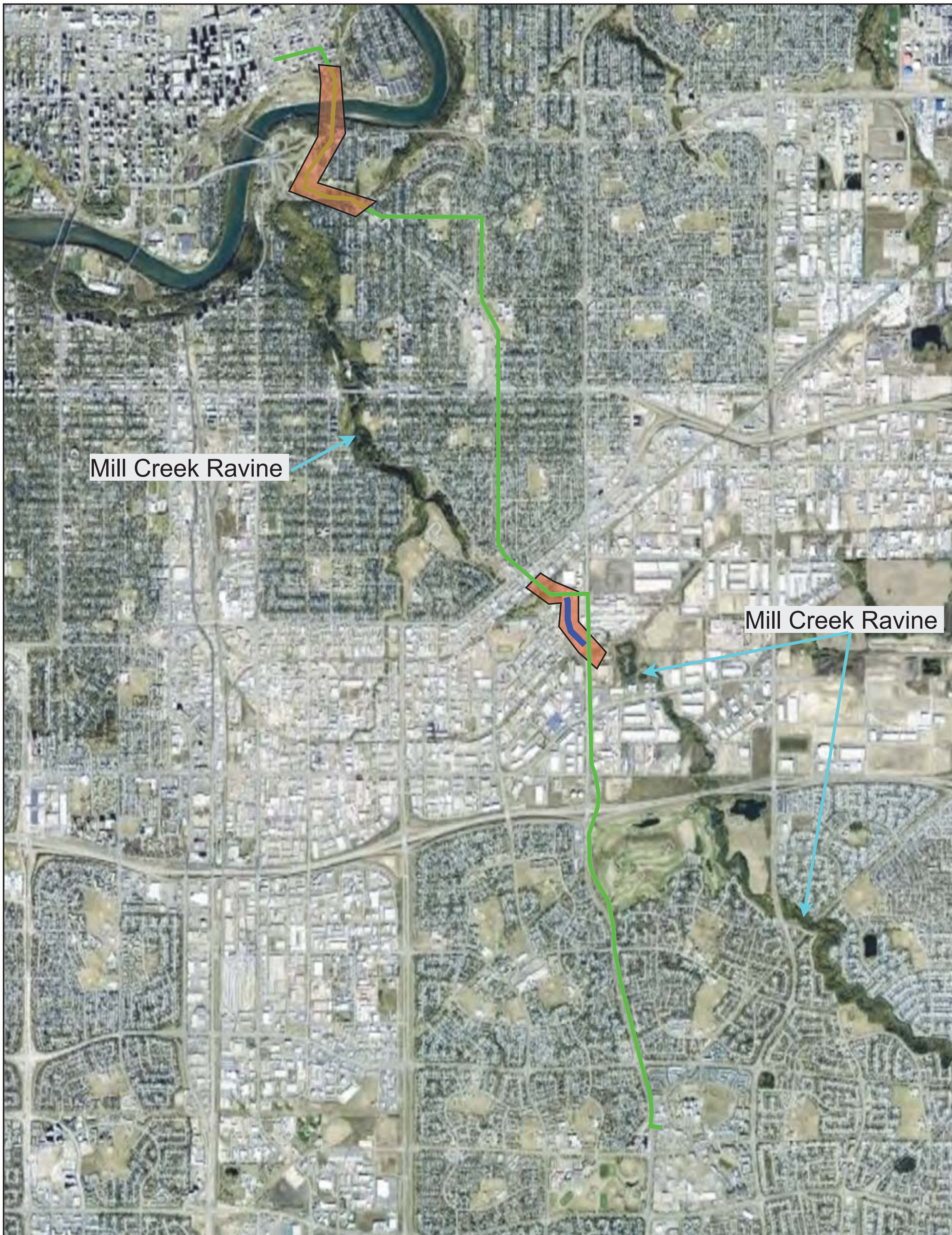


Figure 2. Satellite image showing proposed Southeast LRT route (and Davies Road optional alignment ( ) from downtown core to Mill Woods.
Red areas ( ) are assessed as areas of paleontological interest. Google 2010.

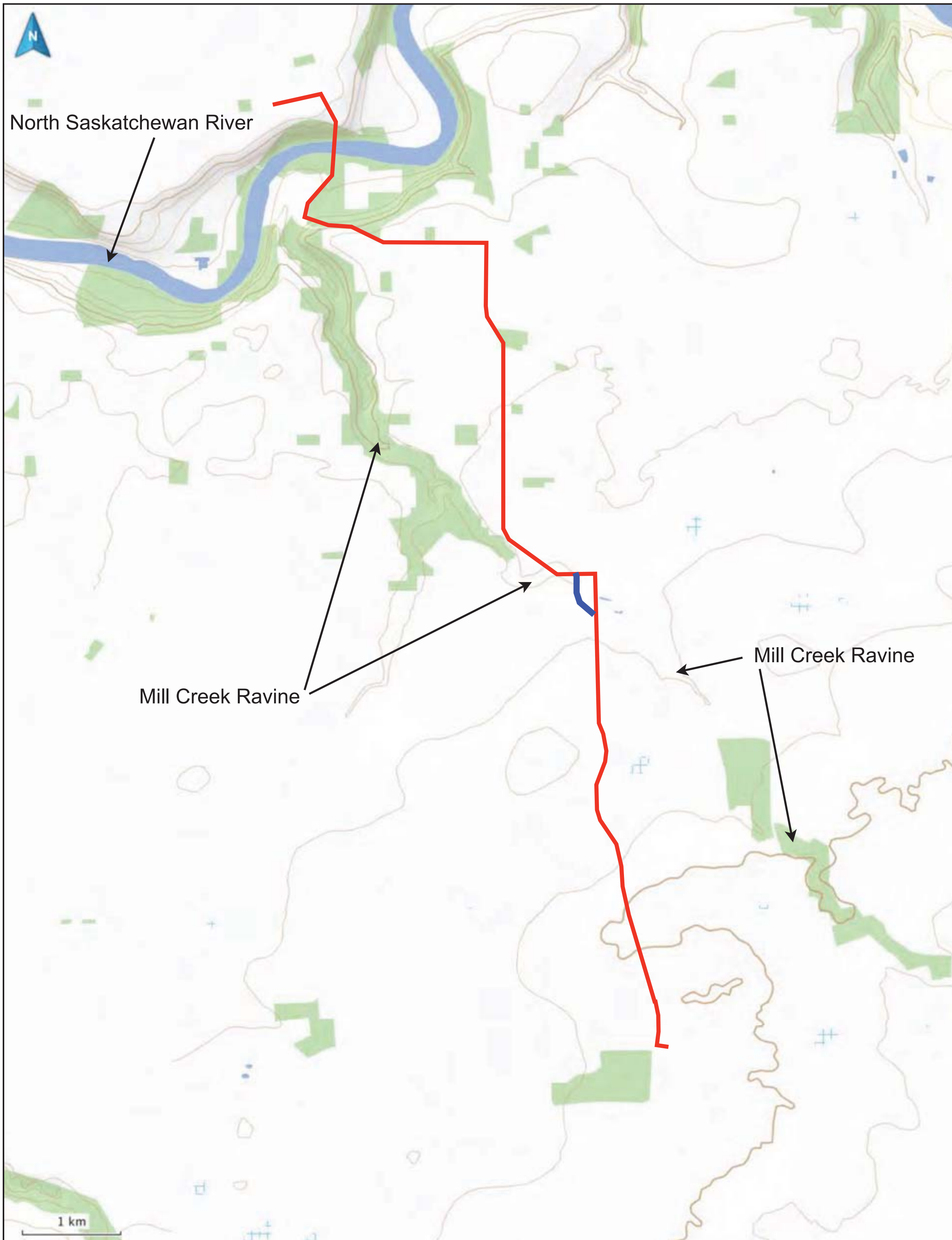


Figure 3. Shaded topographical map showing proposed Southeast LRT route (and Davies Road optional alignment (from downtown to Mill Woods. Contour = 10 m.

Paleontological Resources and Stratigraphic Information

Table 2			
In *Listing of Historic Resources* :	**Yes**	**HRV Value:**	**5p**
Designated Lands:	6-8,10,11,15 33-52-24 & 2,3,7-4-53-24 W4M March 1, 2011 *Listing*		
Site Name:	High Palaeontological Resource Sensitivity Zone		
Comments:	The project will impact the valley slope, terraces and floodplain of the North Saskatchewan River (NSR). Outcrop from the Horseshoe Canyon Fm. is present along river cut-banks, valley slopes and tributary walls near the project. Significant paleontological resources (vertebrate remains - dinosaur) have been recovered along the valley slopes and tributaries of the NSR up and downstream of the project.		
Stratigraphic Information			
Group:	Edmonton		
Formation:	Horseshoe Canyon		
Member:	Unknown		
Epoch:	Upper Cretaceous		
Age:	late Campanian to early Maastrichtian (69-72 Ma)		
Comments:	Based upon past studies by the author in the area, the strata underlying the project are likely associated with the informally named Unit 1 complex of the Horseshoe Canyon Formation. It is considered to be an aggradational, coastal to alluvial system. The age of the sediments is considered to be late Campanian (~69-72 Ma) and the unit is composed primarily of grey to brown siltstone/mudstone, sandstone, and thick black coal seams with minor isolated channel deposits.		

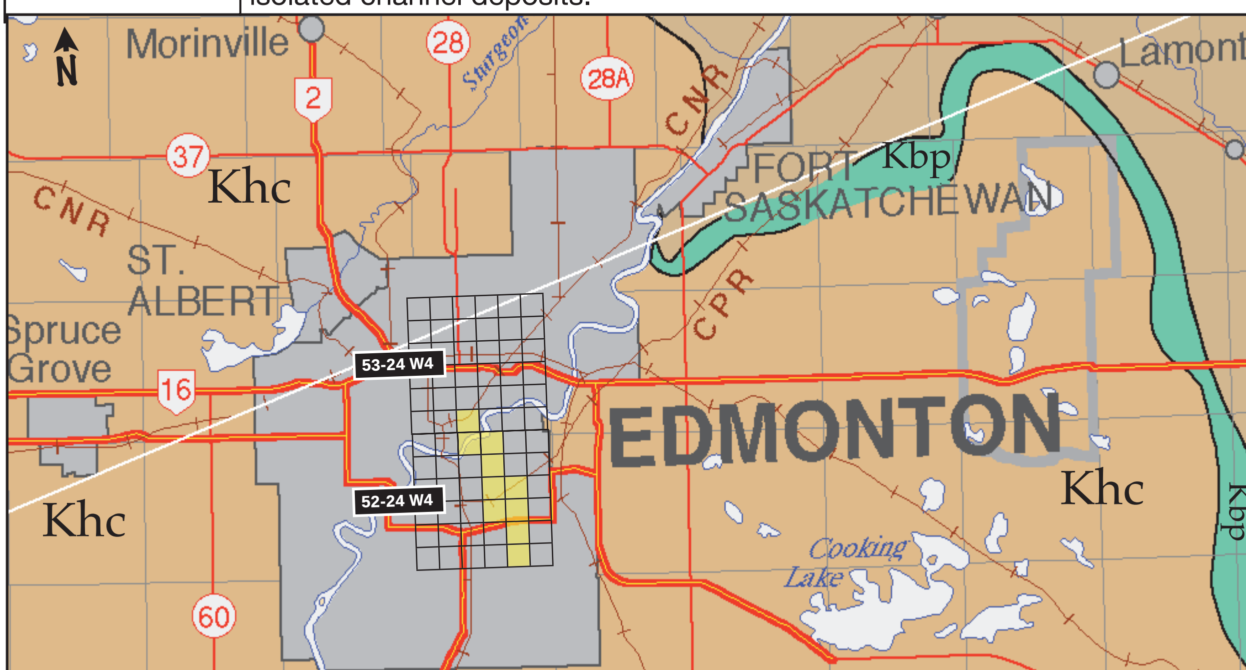


Figure 4. Portion of Geological Map of Alberta showing surficial bedrock. Proposed SE LRT located within Alberta Township Grid sections highlighted in yellow ( ). Khc = Horseshoe Canyon Formation; Kbp = Bearpaw Formation. AB Geologic Survey 1999.

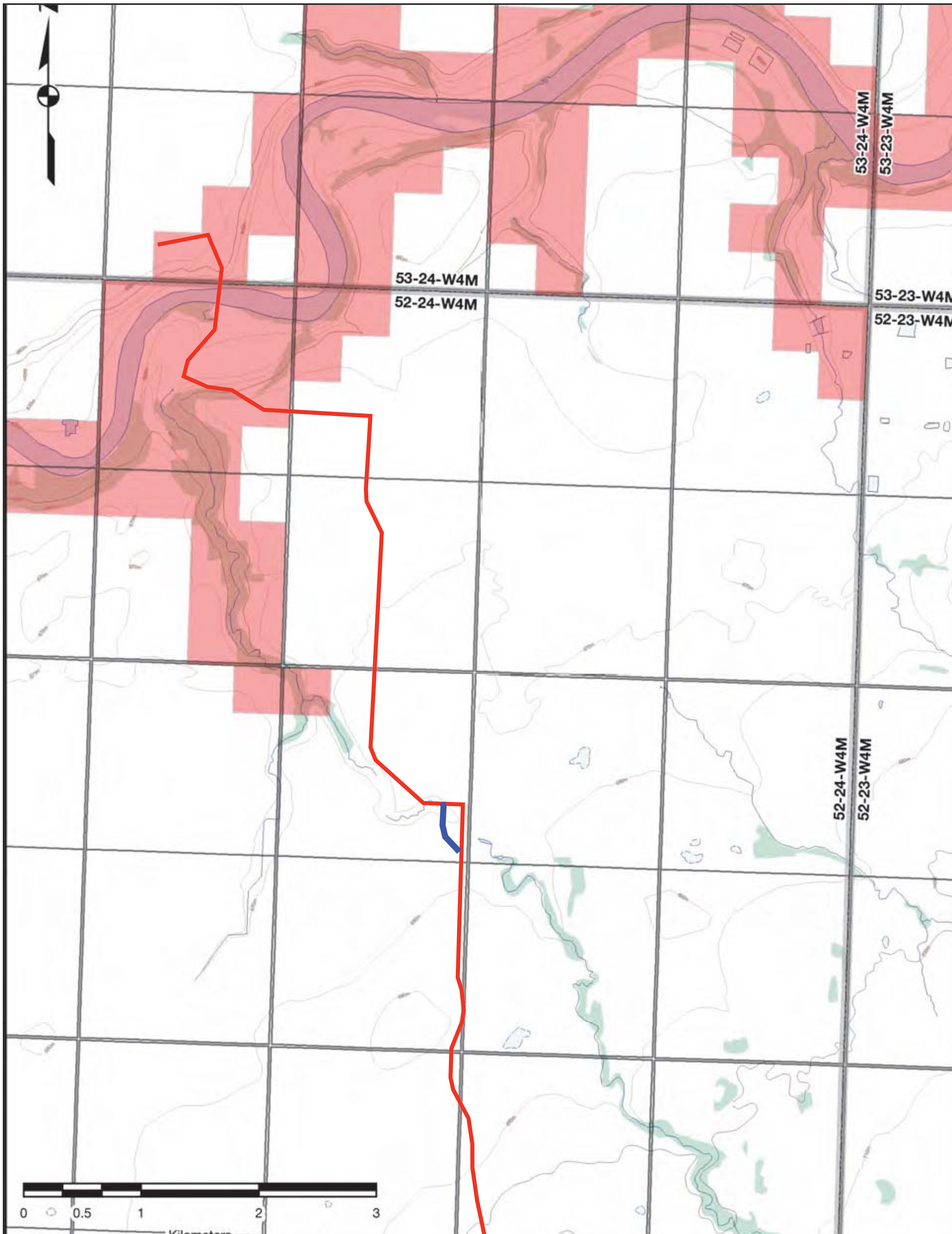


Figure 5. Topographical map showing lands with HRV 5P designation (■) along proposed Southeast LRT route (—) and Davies Road optional alignment (—).

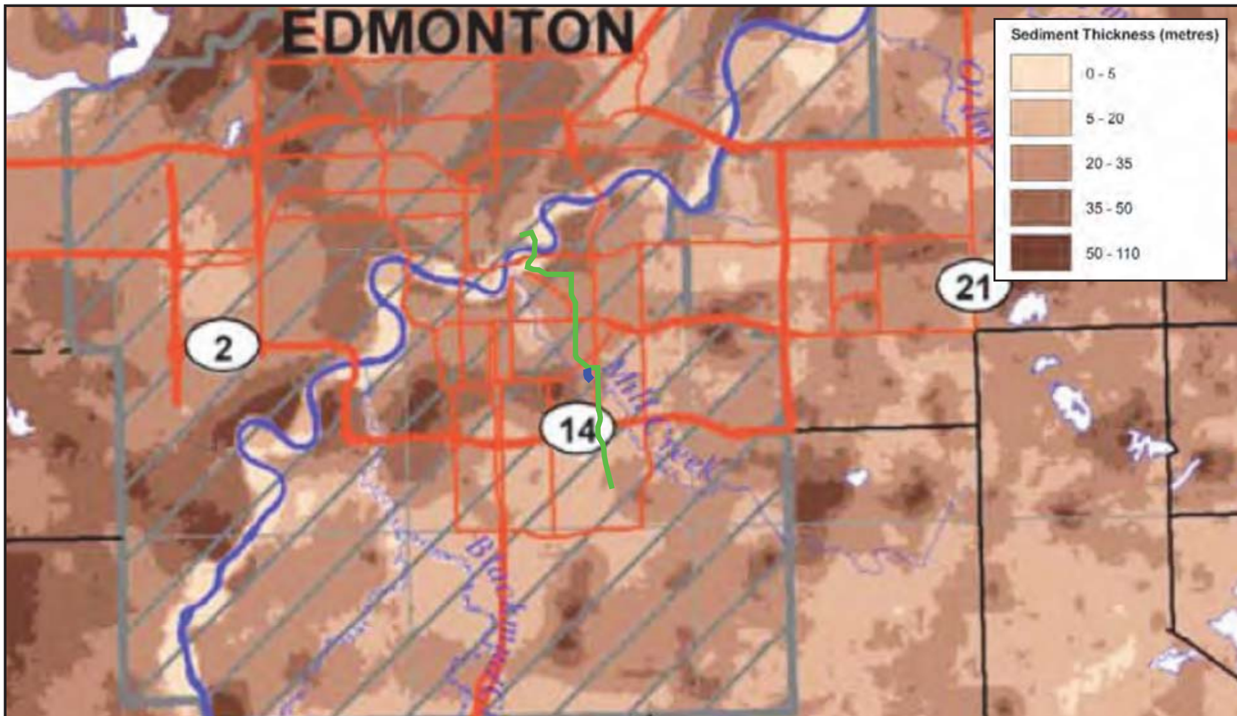


Figure 6. Drift thickness map showing proposed Southeast LRT route (—) and Davies Road optional alignment (—). Scale 1:500,000. Slattery & Barker 2010.

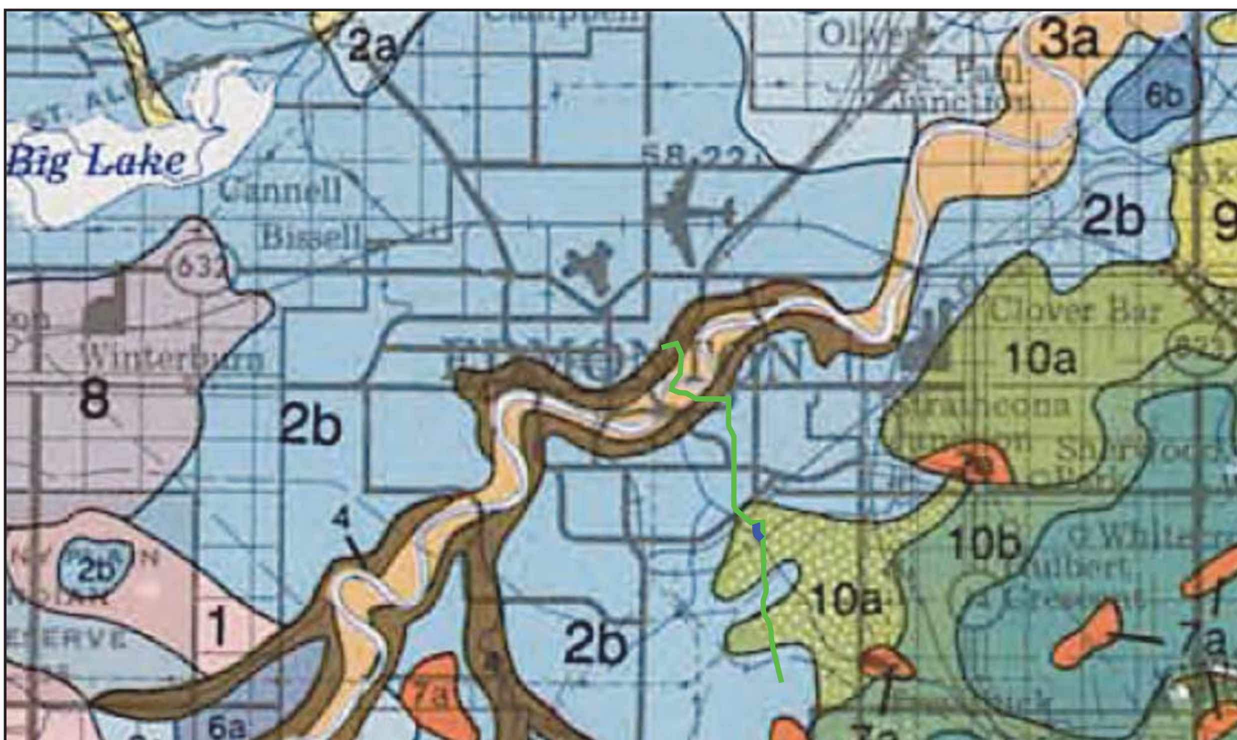


Figure 7. Quaternary geology map. Map legend: Lacustrine Deposit (2) - 2b = fine sediment (silt & clay); Fluvial Deposit (3) - 3a = coarse sediment (gravel, sand, & minor silt); Stream and Slopewash Eroded Deposit - 4 = exposed till and bedrock; Stagnation Moraine (10) - 10a = undulating topography with local relief generally less than 3 m. Shetson 1990.

Evaluation

North Saskatchewan River Valley

Churchhill Station to LRT Tunnel /North Slope

The City of Edmonton proposes the expansion of the LRT system from the downtown core into the southeast section of the City (Figs. 2, 8).

Figure 8. Approved corridor for the West and SE LRT expansion projects. SE LRT corridor (Areas 1 to 4) is the proposed line assessed in this report. City of Edmonton 2012.

Beginning at the proposed ground-level Churchill station, an at-grade track system will be developed, running east-west down 102 Avenue. The LRT line will be excavated below-grade east of 96 Street and continue to slope downward along 102 Avenue until it enters the proposed LRT tunnel. The tunnel will run below 102 Avenue then turn south at 95 Street. The tunnel will continue south, below the existing city infrastructure, until the tunnel portal emerges, approximately midway down the bank of the north slope of the River Valley below 95 Street (Figs. 9-12). The proposed alignment of the tunnel below ground level suggests that a portion of the tunnel will be excavated through bedrock from the Horseshoe Canyon Formation (Figs. 4, 10).

The LRT tunnel will likely be developed using the sequential excavation method (New Austrian Tunnelling method - NATM). It is likely that a backhoe-like excavator will excavate and advance small sections of the tunnel. The excavated material (spoil) will be loaded onto muck-trucks (hopper cars?) for removal. Shotcrete (concrete/mortar sprayed on at high pressure) will be applied (as the tunnel advances) to support and stabilize the newly excavated section of the tunnel.

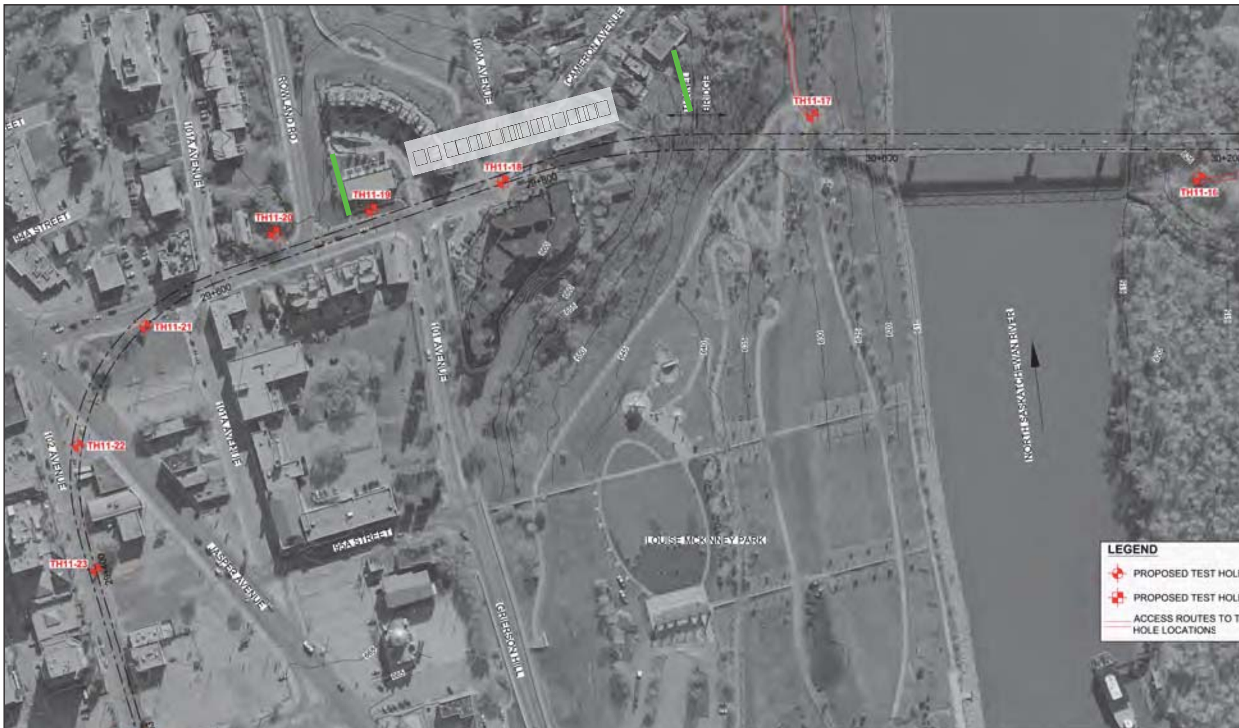


Figure 9. Geotechnical Test Hole Drilling Program. Green lines (—) bound section of proposed tunnel that will likely impact bedrock. Courtesy AECOM. Modified by Aeon.

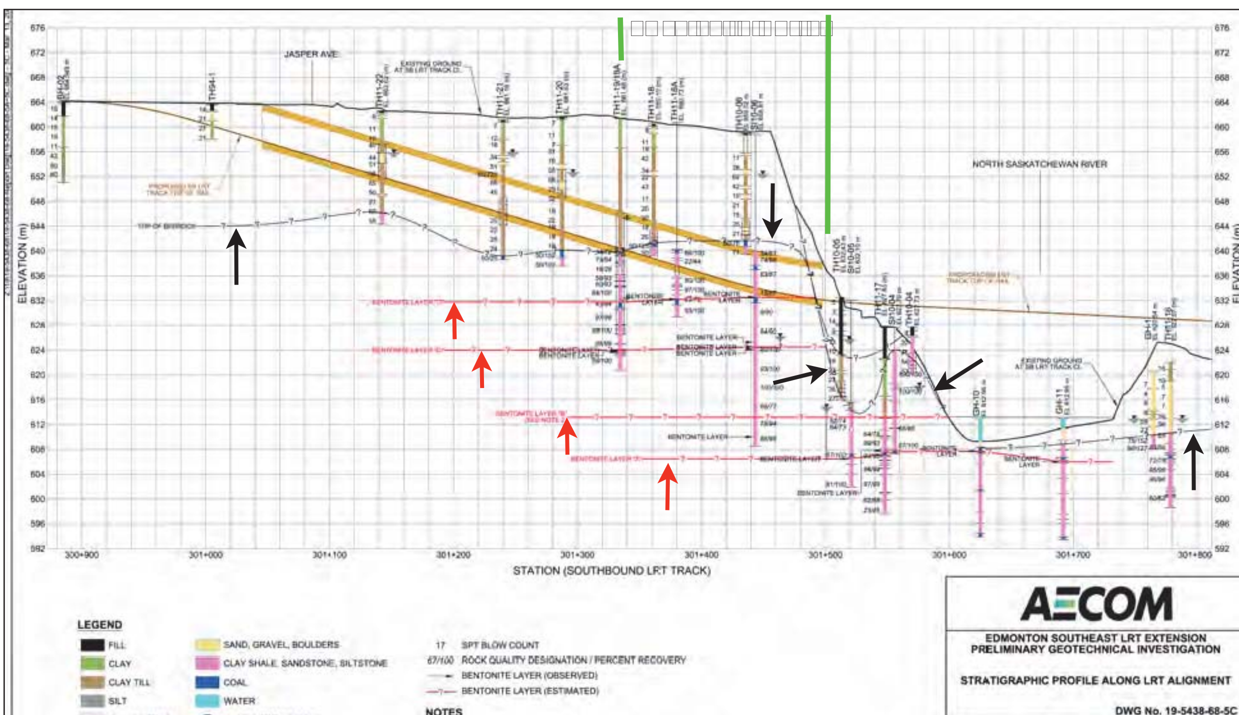


Figure 10. Stratigraphic profile along section of proposed LRT alignment. Drill/bore hole locations TH-11-16 to -22 shown. Note estimated top of bedrock (—?—)(→) and bentonite layers (—?—)(→). Green lines (—) bound section of proposed tunnel that will impact bedrock. Courtesy AECOM. Modified by Aeon.

Figure 11. View facing north from pedestrian walkway on north bank of North Saskatchewan River Valley showing approximate LRT tunnel portal (●) placement.

Figure 12. View facing north from south bank of North Saskatchewan River showing existing footbridge and approximate location of proposed LRT tunnel portal (●) on north valley slope. Note: bedrock likely near surface below thin vegetative/colluvial or lanscaped cover (areas bounded by — lines). 1= reference point (see house in Fig. 13)

Based upon the stratigraphic profile provided by AECOM (Fig. 10; Appendix A) along the proposed LRT alignment, it is likely the tunnel will be excavated through bedrock from the Horseshoe Canyon Formation (Figs. 4, 10). If the sequential type of excavation is utilized, then the exposed bedrock face and spoil/excavated sediments could expose (and leave intact/recoverable) significant fossil vertebrate resources from the Horseshoe Canyon Formation.

Figure 13. View facing northeast from footbridge of exposed bedrock face (bounded within — lines) along northside cutbank of North Saskatchewan River. 1= reference point (see house in Fig. 12) proposed LRT alignment .

The survey noted that bedrock from the Horseshoe Canyon Formation outcrops immediately to the east (downstream) of the proposed LRT alignment (Figs. 12, 13). The light-grey coloured bedrock deposits are exposed at an active cut-bank on the north side of the river (Fig. 13). Observations of the exposed bedrock face indicate the deposits are primarily comprised of interbedded mudstone/siltstone layers. Silty sandstone layers and thin ironstone layers were also noted, but were a minor component of the exposures in this area (Figs. 14, 15). This exposed bedrock is *in situ* and does not appear to be an isolated slump block associated with the Grierson Hill landslide in 1901. Several, small poorly preserved fragments of fossil plant material were observed in the slope debris/talus. No fossil vertebrate material was noted.

Historical note: the landslide was likely caused by a combination of coal mining operations targeting the coal seams within the Horseshoe Canyon Formation at Grierson Hill and extremely heavy rainfall. The mining operation likely caused fracturing and subsidence while the rainfall resulted in extreme bank erosion and ground saturation eventually leading to slippage along one or more of the bentonite layers (montmorillonite - mineral clay) (Godfrey, 1993).

Figure 14. View looking east along north valley wall of North Saskatchewan River showing exposed bedrock from the Horseshoe Canyon Formation. Slide scar (→).

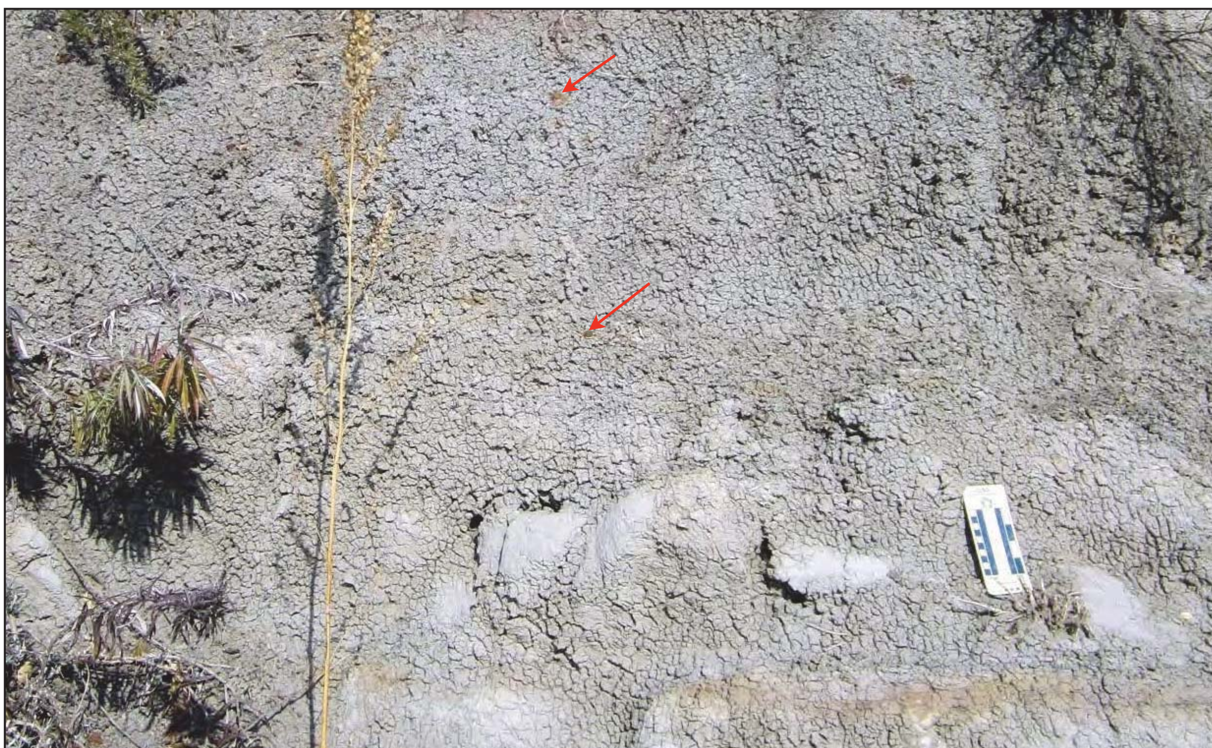


Figure 15. Close-up of weathered bedrock face in Fig. 14 showing interbedded layers of siltstone/mudstone, silty sandstone and ironstone fragments (→) in slopewash .

North Saskatchewan River Valley

LRT Bridge

The proposed LRT bridge-elevated trackway will span the North Saskatchewan River from the tunnel portal on the north valley slope to the proposed Muttart Station on the south side floodplain. The tracks will remain elevated across 98 Avenue then drop to grade before the proposed Muttart Station (Fig. 16). The line will continue south and ascend Connors Road to the north of the existing road, utilizing the existing disturbed and landscaped road right-of-way. Just beyond the top of the south valley slope, the line will head east at grade level down 95 Avenue to 85 Street. At 85 Street, the line turns south and heads south toward Bonnie Doon Shopping Centre.

Figure 16. Satellite image of North Saskatchewan River Valley showing section of proposed SE LRT alignment (—) from existing footbridge to 85 Street. Inset shows photomosaic of proposed alignment from 2010 workshop sessions (City of Edmonton).

The vertical clearance of the LRT bridge over the North Saskatchewan River has not been determined. The vertical clearance, however, will be set to meet the federal *Navigable Waters Protection Act* (Figs. 10, 19). On the south side of the North Saskatchewan River channel, the bridge-trackway will remain elevated across the pedestrian path and 98 Avenue, then continue to descend in elevation to near grade level at the proposed Muttart Station (Figs. 17, 19).

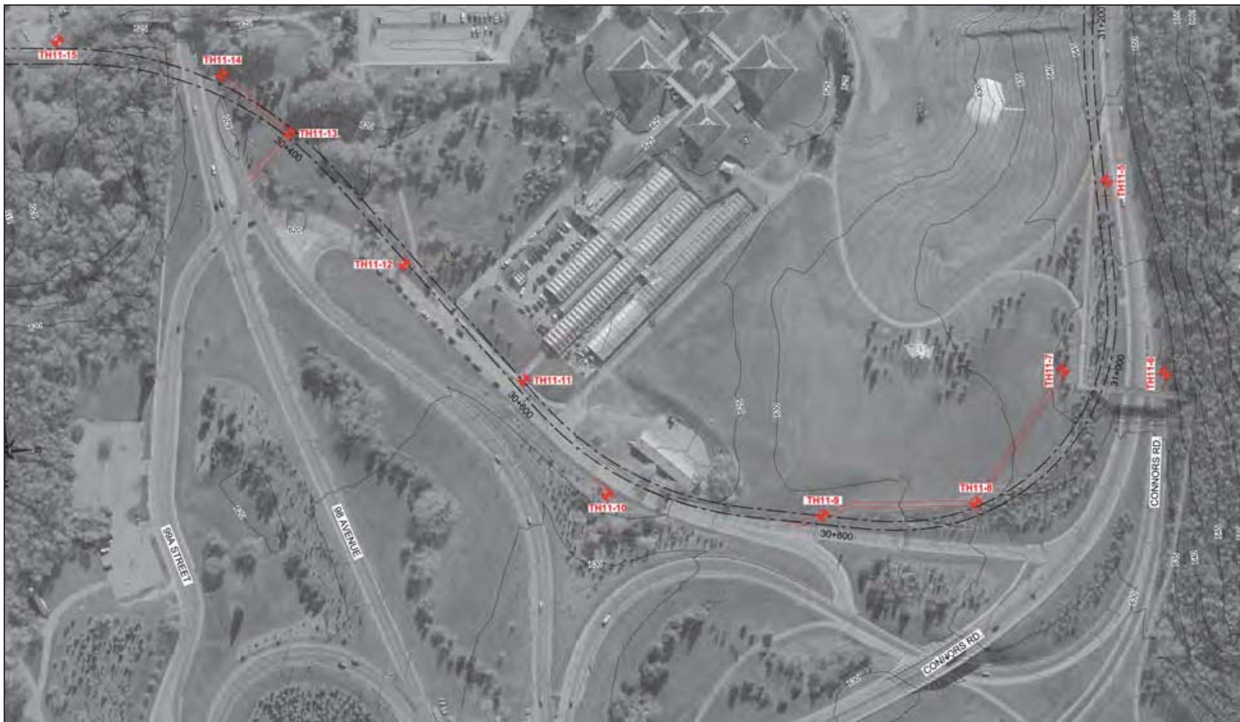


Figure 17. Geotechnical test hole drilling program locations showing south floodplain around Muttart Conservatory and topography of south valley slope along Connors Road. Courtesy AECOM.

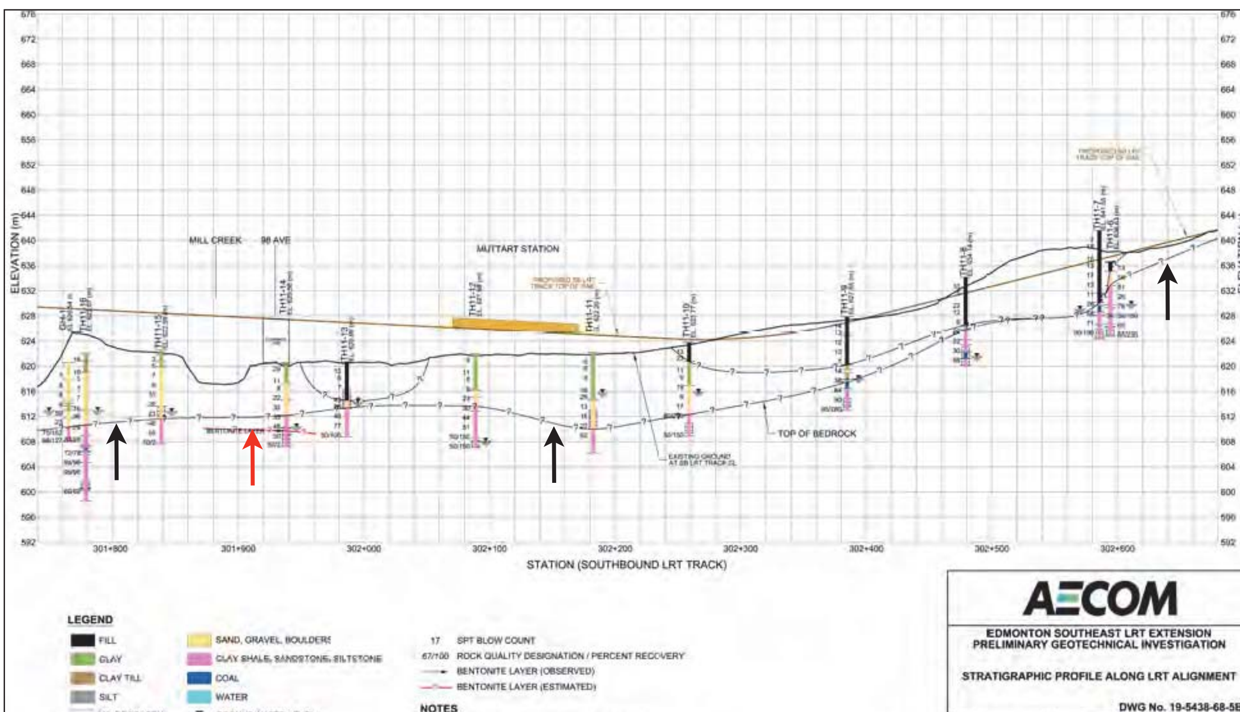


Figure 18. Stratigraphic profile along North Saskatchewan River and base of Connors Hill section of proposed LRT alignment. Drill hole locations TH11-7 to -16 shown. Note estimated top of bedrock (—?—)(→) and bentonite layers (—?—) (→). Courtesy AECOM.

Figure 19. View facing south along proposed alignment (—) near tunnel portal on upper north slope of North Saskatchewan River Valley. View shows footbridge, gulley on south bank (→), Muttart Conservatory pyramids (→) and Connors Road (→) in background.

Figure 20. View looking southeast from footbridge observation deck showing exposed right (south) bank of North Saskatchewan River. Note thick floodplain deposits along bank (→) and reworked coal (inset) and bedrock fragments (→) along exposed river bed.

Figure 21. View facing southwest from footbridge showing gulley (→) incised into thick floodplain deposits on the right bank (south side bank) of the river.

Figure 22. View of right bank from river level showing thick floodplain deposits of silt and sand next to mouth of gulley (→) in Figure 21. White scale bar sheet = 15 cm high.

The field survey noted that the north bank had previously been landscaped and the slope stabilized. The bank development appears to have included grading, rip-rap emplacement, and replacement of vegetative cover. Consequently, if bridge development is minimal along the bank, then there is a low potential to impact bedrock along the bank. However, if excavation work for temporary access roads and bridge support structures on this lower slope/bank is required, it will likely disturb bedrock (Fig. 10). Therefore, due to the uncertain nature of the bridge construction plans (piers, bank development) and the amount of bedrock that will likely be disturbed, there is a low or high potential that significant paleontological resources will be disturbed - a high potential if development activities require excavation on the north bank.

Note: Along the north slope, bedrock is close to the surface at two areas likely slated for development during bridge construction: the tunnel portal and the north river bank (Figs. 10, 12). Paleontological monitoring has been previously suggested for the tunnel and tunnel portal development.

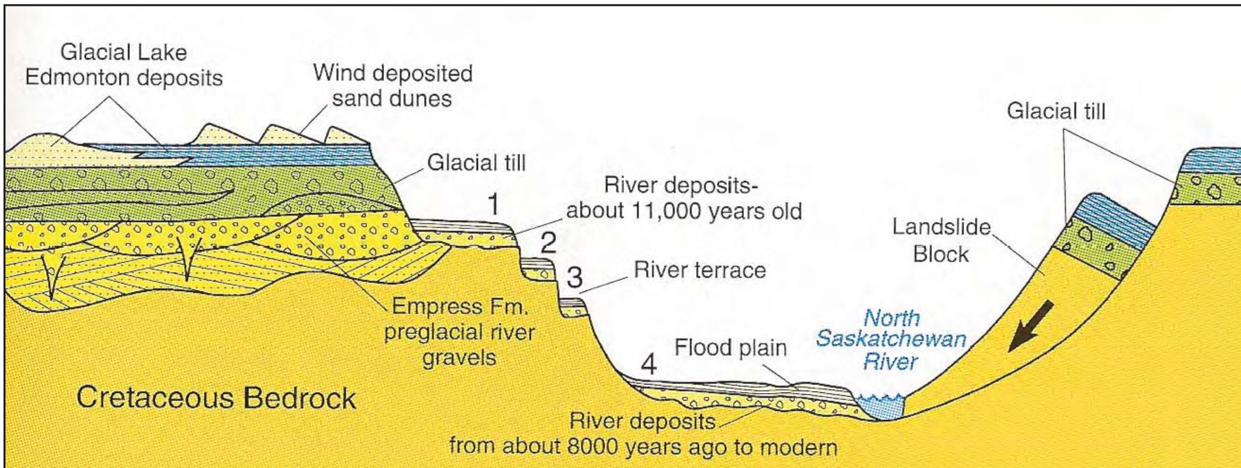


Figure 23. Idealized geological cross section of the North Saskatchewan River Valley. Edmonton Geological Society 1993.

The pedestrian survey (at low water levels in the fall season) of the right (south) bank of the river, noted thick floodplain deposits of silt and fine-grained sands (Figs. 20-22). Due to low water levels in the fall, the river bed and gravel bar were also exposed and accessible. Numerous coal and reworked bedrock fragments from the Horseshoe Canyon Formation were noted among the coarse gravel deposits of the exposed river bed (Fig. 20). The stratigraphic cross sections provided indicate that the underlying bedrock lies close to the ground surface - anywhere from 0.5 to 2 m below the river bed (Fig. 10). Therefore, any pit excavations (open caisson - retaining, water-tight structures) in the river channel will have a potential to impact bedrock.

The author has no direct experience with open caissons, however, it is suggested that there is a moderate to high potential to impact fossil resources if open pit excavation work will impact bedrock. However, due to water table penetration and saturation of the uppermost layers of bedrock beneath the river bed, the upper 0.5 m of bedrock is often 'weathered', reducing the potential to recover fossil resources. If pit excavation is to impact bedrock to a depth greater than 0.5 m below the bedrock contact, then monitoring of the open pit excavation (if accessible) and spoil material is suggested.

Bridge construction also requires deep foundations to support the abutment(s) and bridge piers that cross the river channel and the piers that support the elevated trackway. The bridge piers will likely use drilled, belled cast-in-place concrete piles socketed into the bedrock (Fig. 24C) and pre-drilled and/or driven piles (Figs. 24A, 24B). Open caissons (retaining, water-tight structures), if used to develop the channel crossing piers, will likely encounter bedrock during excavation. This is due to the shallow depth of bedrock below the river bed (Fig. 10). Deep foundations (likely cast-in-place concrete piles socketed into the bedrock) will also be required to support the piers of the bridge-elevated trackway leading to the proposed Muttart Station.

Typically, there is no potential of recovering paleontological resources from driven piles. However, there is a low to moderate potential of recovering intact paleontological resources from borehole drillings/spoil material. Generally, the larger the bore hole auger, the higher the potential to recover fossil resources. This conclusion is based upon the author's previous experience with large-diameter bore hole projects (including the Quesnell Bridge Widening Project (RTMP File: 3948-83H-5)). During paleontological monitoring of the north bank bore hole drills

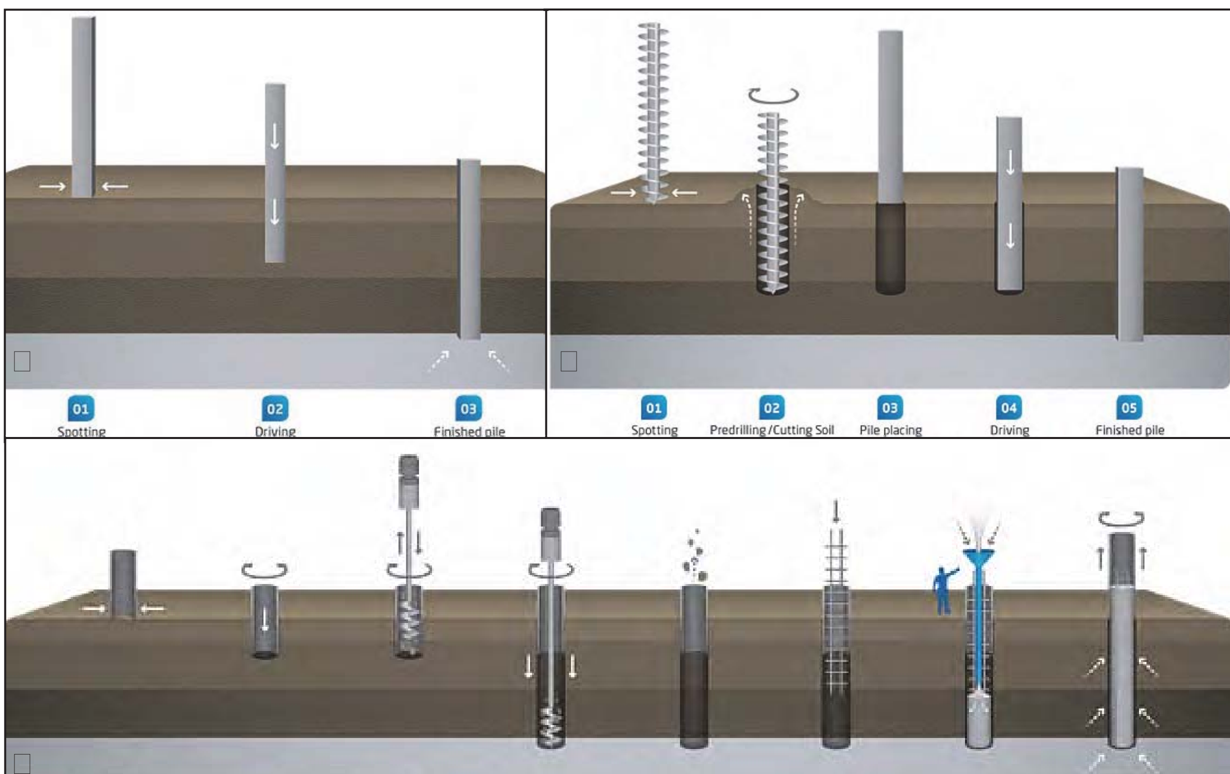


Figure 24. Diagrams of typical construction of three types of piles that may be used in bridge and trackway construction. A) Pre-fabricated driven pile. B) Pre-drilled driven pile. C) Large-diameter bore, cast-in-place, concrete pile into bedrock. Junttan 2011.

during the Quesnell Bridge project, fossil resources were recovered from the auger spoil piles.

As the proposed elevated trackway continues south from the right river bank and associated levee to the proposed Muttart Station, it crosses the alluvial terrace (active floodplain/river-built terrace) (Fig. 23). The unconsolidated deposits on the alluvial terraces average 10 m in thickness, with the deposits thinning to approximately 5 m along the dry stream bed of the gully (gully = original Mill Creek Ravine outlet channel) that has incised into the floodplain (Figs. 18, 19). Based upon the site survey and utilizing information from a 2008 Thurber geotechnical report (North Western Utilities project), the alluvial deposits are comprised of clay-silt, sand and gravel deposits (in descending order) (Figs. 21, 22).

Based upon the overall thickness of alluvial sediments and the likely use of pre-drilled or driven piles for structural supports, there is a low potential that construction activities will expose bedrock or provide recoverable fossil material from the south bank to the proposed Muttart Station.

North Saskatchewan River Valley

Proposed Muttart Station to top of the South Valley Slope (along Connors Road)

South of the proposed Muttart Station, the line begins to ascend the south valley slope, remaining north of the existing paved roadway (Connors Road). The alluvial sediments and fill remain relatively thick along the lower valley slope - approximately 5-10 m thick (Figs. 25, 26). At the midpoint of the slope (for approximately a 300 m stretch) the bedrock lies close to the surface - 0.5-2 m below the ground surface (Figs. 25-28). The upper part of the valley slope sees a thickening of alluvial deposits and fill to greater than 8 m in depth (Figs. 25, 26).

Foundation support structures for the trackway along the south valley slope will likely be pre-drilled and/or driven piles. Therefore, there is a low potential that grading, ground surface preparation and construction of foundation supports will impact bedrock along the lower or upper portions of the valley slope. There is a moderate potential that grading and ground surface preparation and construction of foundation supports will expose bedrock or provide recoverable fossil material along the middle portion of the valley slope.

However, there is also the possibility that the roadway may be relocated to the south, further into the valley slope, allowing the trackway to utilize the existing road bed. This would require a realignment of Connors Road and likely require the development of retaining walls. Roadway realignment and slope grading along the middle to upper slopes and terraces could require substantial excavation into the valley slope and upper terraces. It is suggested that if a realignment of the roadway is required, that there is a high potential to impact bedrock during construction of the roadway.

Figure 25. Geotechnical test hole drilling program locations showing topography of south valley slope along Connors Road. Courtesy AECOM.

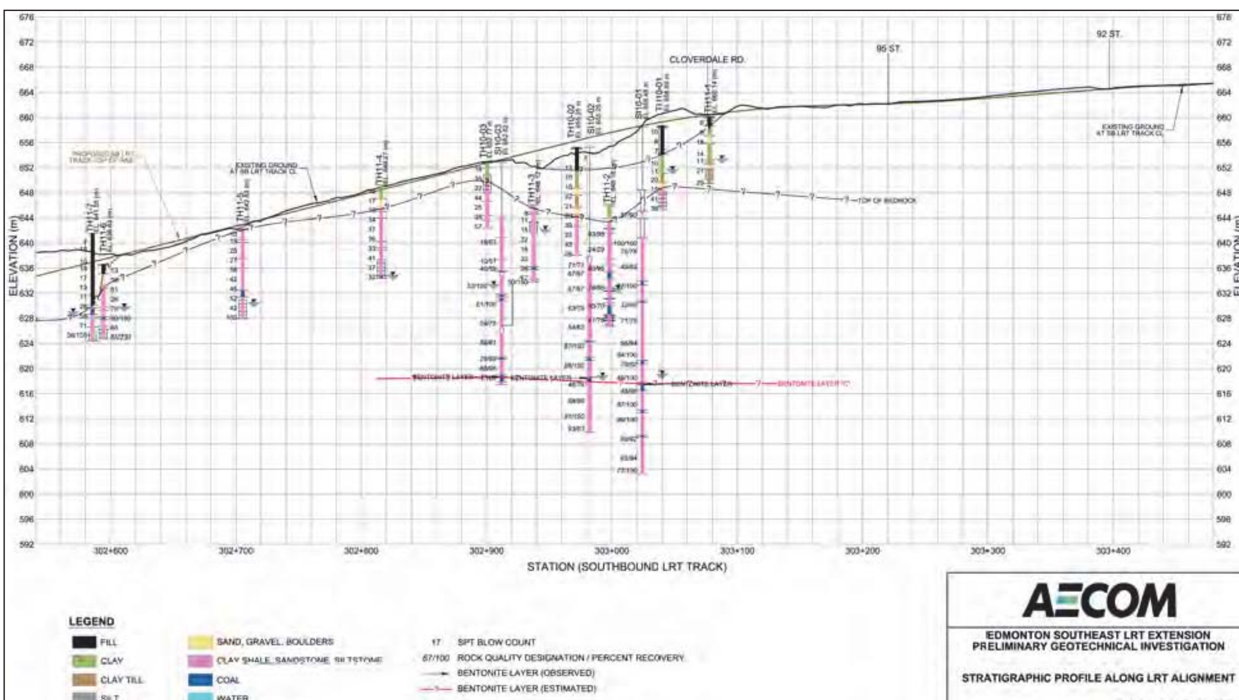


Figure 26. Stratigraphic profile along Connors Hill section of proposed LRT alignment. Drill hole locations TH11-1 to -7 shown. Note estimated top of bedrock (—?—)(→) and bentonite layers (—?—) (→). Courtesy AECOM.

Figure 27. View looking south from top of north valley slope showing Muttart Conservatory pyramids (→), Connors Road (→) and proposed LRT alignment (—).
Area between orange arrows (→) is area that bedrock is close to the surface.

Figure 28. View looking southeast below Connors Road showing moderate to steep landscaped slopes along the middle valley slope. Area of thin cover over bedrock.

Wagner Road Alignment

The author noted that the proposed SE LRT alignment called for an elevated trackway across Argyll Road, Wagner Park and along Wagner Road. The optional Davies Road alignment along with the below ground tunnel have been removed as a potential option (Figs. 29-31). Although there were no HRV notations for paleontology assigned to the area (Fig. 5), a brief pedestrian survey of the dry creek bed and banks within Wagner Park was undertaken. The survey was undertaken as the creek in Wagner Park is part of the original Mill Creek Ravine drainage system (Figs. 2, 3).

Today, the isolated section of Mill Creek in Wagner Park is bounded by city infrastructure (roads and commercial development) (Fig. 30). The park has been landscaped along the proposed ROW except at the crossing. The creek channel and a small riparian buffer around the channel remains intact and is vegetated with shrubs and trees (Fig. 34).

A pedestrian survey followed the dry creek bed through the park to assess if any bedrock or fossil resources may have been exposed along the creek bed and banks (Fig. 35). The creek channel appears to have downcut 6-8 m into the surrounding terrain. Underlying the thin soil and organic debris layer, the banks and creek bed appear to be comprised of glaciolacustrine deposits of silts and very fine-grained sands. No bedrock or fossil resources were observed.

A review of drift thickness and surficial Quaternary geology maps for the region (Figs. 6, 7) and the drill test hole logs provided by AECOM/Thurber (Figs. 32, 33), indicate that bedrock from the Horseshoe Canyon Formation (referred to as ‘clay shale’ in the logs) is present in this area, but is a significant distance below the ground surface. In the drill hole logs provided, 13 m at the creek crossing, is the closest to the ground surface that bedrock is first encountered (Fig. 32). The depth of bedrock impact varies, put appears to range from 19-22 m north of the creek to greater than 25 m or more south of the creek along 75 Street. Several logs south of the creek along Wagner Road were terminated at 15 m and no bedrock was impacted at this point.

The logs suggest that the Quaternary deposits are primarily comprised of clay tills (clay, silts, sands, and minor gravels). Some silty, fine-grained sand and thin ‘coal’ layers were noted. It is likely these sediments represent glacial tills and Glacial Lake Edmonton-derived deposits. It does not appear that any preglacial Empress Formation gravels are present in this area of the the proposed LRT line.

The proposed trackway will be elevated over Argyll Road and Wagner Park and return to grade near the intersection of Wagner Road and Davies Road (Fig. 29). Foundation support structures for the elevated trackway along this corridor will likely be pre-drilled and/or driven piles. The possible maximum pile length will be 26 m. Typically, there is no potential of recovering paleontological resources from driven piles. However, there is a low to moderate potential of recovering intact paleontological resources from borehole drillings/spoil material (see page 21). Overall, there is a low potential that grading, ground surface preparation and construction of foundation supports will disturb bedrock due to the depth that bedrock lies below ground surface (greater than 13 m).

Figure 29. Photomosaic of proposed Argyll Road-Wagner Road alignment showing elevated trackway crossing Argyll Road, CN railway, and Wagner Park. City of Edmonton.

Figure 30. Satellite image of Wagner Park showing drill hole locations. Courtesy AECOM.

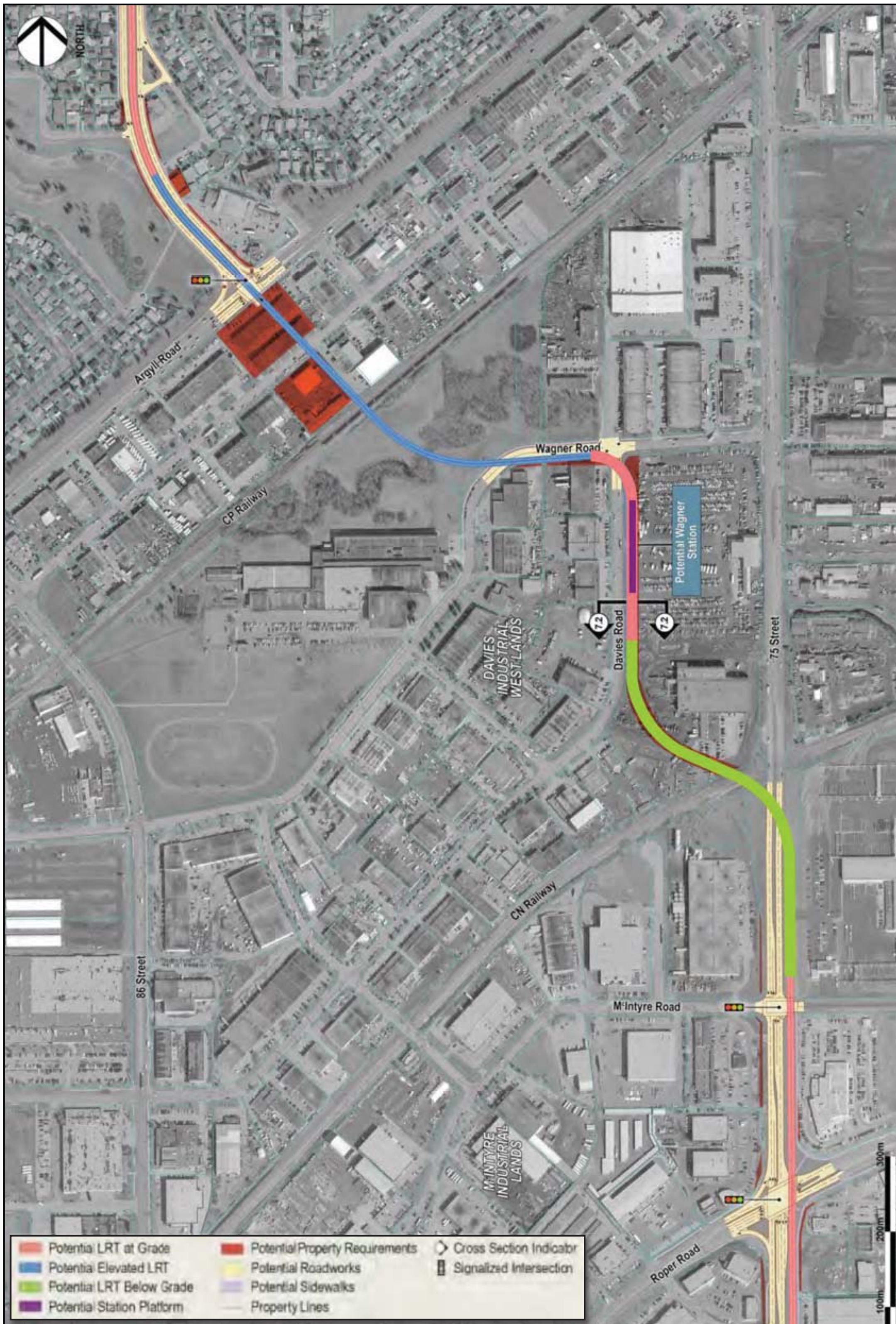


Figure 31. Photomosaic of proposed Argyll Road-Wagner Road alignment showing optional Davies Road alignment and associated tunnel under CN railway and 75 Street.

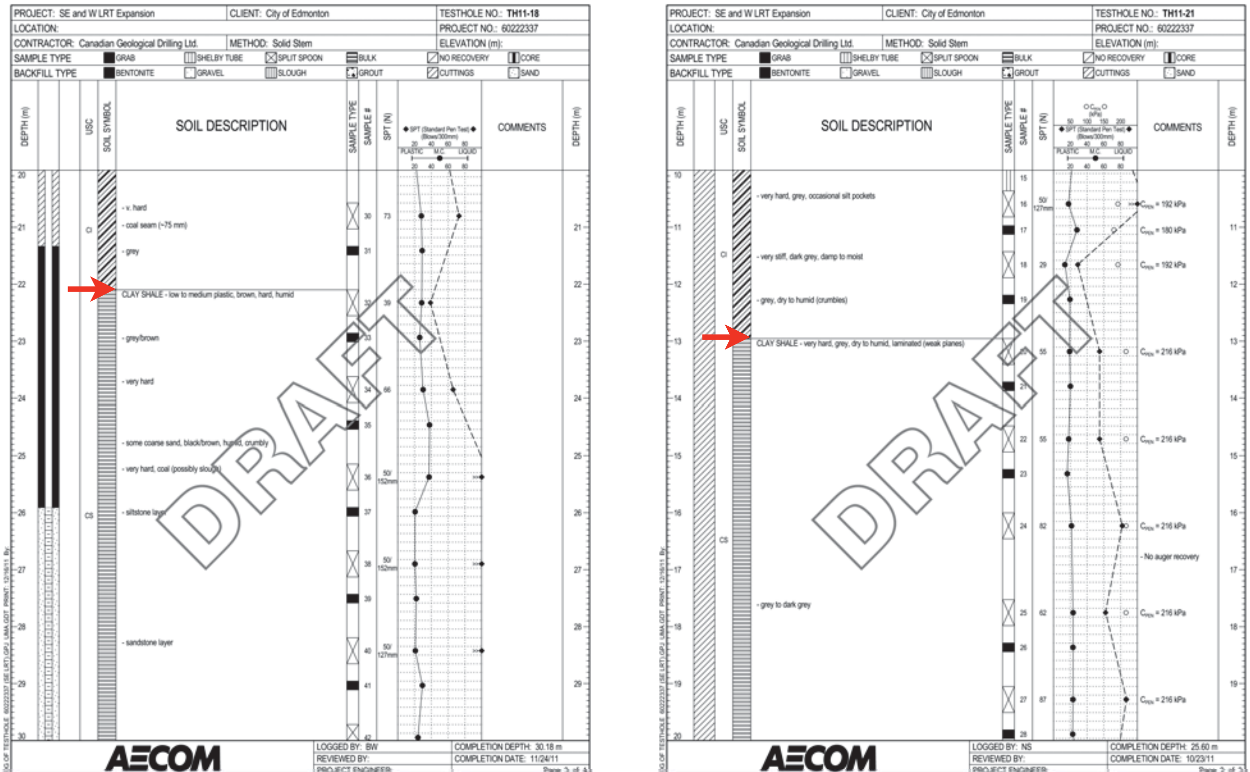


Figure 32. Portion of drill test hole logs from TH11-18 and 21 (see Fig. 30) showing bedrock contact (→ = start of clay shales from Horseshoe Canyon Fm.). Courtesy AECOM.

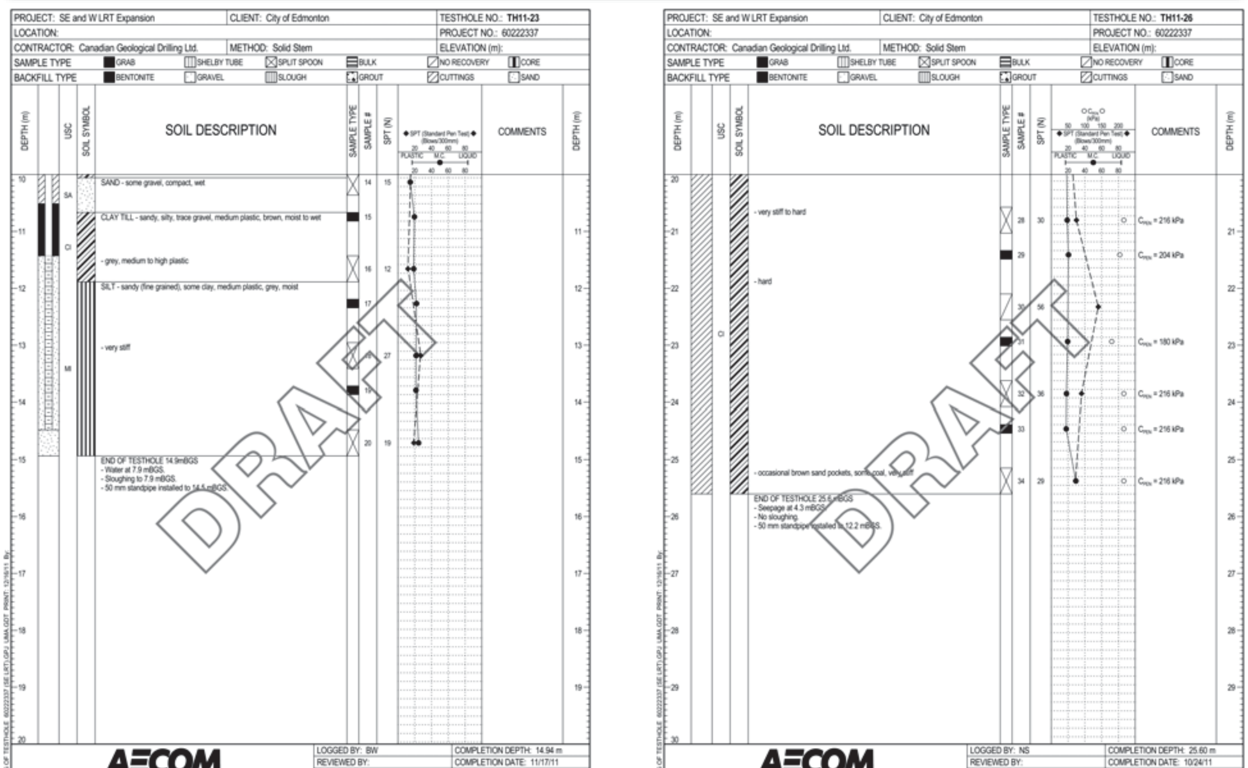


Figure 33. Portion of drill test hole logs from TH11-23 and 26 showing (see Fig. 30) end of test hole in 'Quaternary' deposits. No bedrock contact logged. Courtesy AECOM.

Figure 34. View facing northwest from south side of Wagner Park along proposed alignment showing thick vegetation surrounding dry drainage. The drainage is an isolated section of the original Mill Creek drainage system maintained within the park.

Figure 35. View facing north from dry creek bed in Wagner Park. Inset shows thick deposits of clay till (silt and silty sand) along banks of dry creek bed (aka Mill Creek).

Recommendations

The Historic Resources Management Branch of Alberta Culture and Community Spirit issued a Schedule A requirement for paleontology for the Southeast LRT Planning Study (ACCS File: 4715-10-042). After completing the pre-construction Historic Resources Impact Assessment for paleontology, background research, discussions with staff at AECOM and Thurber Engineering, and a review of the drill hole logs and stratigraphic cross sections, three areas of high paleontological potential were noted for the currently proposed SE LRT alignment (**Fig. 36**).

Figure 36. Areas that have a high paleontological potential to impact bedrock during development activities of the proposed Southeast LRT development.

Based primarily upon the bedrock geology, stratigraphic cross sections and construction techniques likely to be utilized during development, it is suggested that these three areas (Fig. 36) require a paleontological monitoring program (Table 3), as there is a high potential to disturb significant fossil resources from the Horseshoe Canyon Formation. Horseshoe Canyon Formation deposits in this area are known to contain the well-preserved fossil remains of large vertebrates (primarily dinosaurs) - both dinosaur bone beds and isolated remains have been recovered from the slopes and the floodplains of the North Saskatchewan River Valley and its major tributaries within the City of Edmonton. This includes dinosaur bone fragments from Mill Creek Ravine and the valley slope at the Quesnell Bridge. Therefore, any significant amount of disturbance of these bedrock sediments is considered to have a high potential to disturb fossil resources.

Table 3 - Areas of High Paleontological Potential Along SE LRT Alignment	
Areas of High Paleontological Potential	Monitoring Program Suggested*
Area A - southern portion of LRT tunnel to be excavated through bedrock and associated development of tunnel portal/ north valley slope around tunnel portal.	**Yes** - monitor spoil during bedrock excavation portion of LRT tunnel development and associated slope/ bridge abutment development around tunnel portal.
Area B - North Saskatchewan River LRT bridge abutments and piers. If construction technique utilizes open caissons, this may allow inspection of exposed bedrock or survey of excavated sediments.	**Yes** - monitor excavation pits **only if** open cassions/pier pits used and accessible for monitoring and if excavation will impact in situ bedrock to a depth greater than 0.5 m (so, monitoring contingent on accessibility and construction techniques).
Area C - middle slope of Connors Road. If existing roadway requires realignment, then grading and retaining wall development may require development of south valley slope.	**Yes** - monitor **only if** existing roadway requires realignment, requiring excavation and grading of valley slope (e.g. to install retaining walls).
* As design and construction plans are finalized, then impact to fossil resources/bedrock in the three suggested monitoring areas above may need to be re-assessed. If construction techniques or design plans suggest that impact to bedrock will be minimal or monitoring is unlikely to recover fossil resources, then the Royal Tyrrell Museum and Heritage Resources Management Branch can be advised and the suggested monitoring program adjusted accordingly.	

It is suggested that all remaining areas of the the proposed SE LRT alignment have a low potential to impact bedrock and/or recover significant fossil resources. This includes the Wagner Park elevated trackway and water course crossing. This recommendation is primarily based upon the thickness of the overlying drift cover and the construction techniques employed to develop the proposed support structure for the trackway.

Therefore, it is suggested that if the proposed SE LRT alignment plan reviewed in this report is adopted, that a **paleontological post-impact assessment (monitoring program) be required** for three areas (Fig. 36: Areas A-C) within the North Saskatchewan River Valley. Due to the low potential to impact paleontological resources during construction activities throughout the remainder of the proposed alignment and optional alignments, it is suggested that no further paleontological assessment/action is required for these areas if the applicant complies with Section 31 of the *Historical Resources Act* – " a person who discovers an historic resource in the course of making an excavation for a purpose other than for the purpose of seeking historic resources shall forthwith notify the Minister of the discovery."

Notes

Note 1: Due to the paleontological sensitivity of the North Saskatchewan River Valley slopes, any changes to the current alignment plan, (e.g. project boundaries, trackway routing, bridge construction techniques, etc.) may require a re-evaluation of the paleontological potential and scope of work required.

Note 2: There is a high potential for recovery of significant Pleistocene (ice-age) fossil vertebrate remains from the Empress Formation gravels, but drill hole logs suggest the gravels are not present along the proposed SE LRT alignment.)

Acknowledgements

The author would like to thank Walt Kowal of The Archaeology Group and Lynn Maslen and staff of Spencer Environmental Management Services for assistance in answering general project related questions and providing project specific reports. Thanks also to Scott Alexander (AECOM), Karan Jalota (AECOM), and Hassan El-Ramly (Thurber Engineering) for their cooperation and assistance in providing geotechnical data and answering technical questions concerning this project.

Report Authorization

Please contact the report author if you have any further questions in regards to the paleontological component and evaluation of this project.

Report Author:

Michael G. Riley, M.Sc.
Professional Paleontologist (AB)
Aeon Paleontological Consulting Ltd.

*Disclaimer required by Alberta Culture and Community Spirit:
"Any recommendations made in this report are not necessarily consistent with the requirements of the *Historical Resources Act."*

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Appendix A

Select Pages of Geotechnical Report Referenced for Test Hole Locations and Stratigraphic Cross Section

THURBER ENGINEERING LTD.

Table 1 Tentative Test Hole Depths and Approximate Drilling Time Required

Test Hole No.	Approximate Station	Location	Drilling (Coring) Depth (m)	Standpipe Depth (m)	Drilling Time (hours)	Traffic Lane Closure
TH11-1	31+480	Cloverdale Hill Rd.	10	10	3	One lane on Cloverdale Hill Rd.
TH11-2	-	Edmonton Ski Club	15 (10)	15	6	-
TH11-3	-	Edmonton Ski Club	15	15	4	-
TH11-4	31+260	Edmonton Ski Club	15	15	4	-
TH11-5	31+100	Muttart Conservatory	10	10	3	-
TH11-6	31+000	Pedestrian bridge over Connors Rd.	20	20	8	One lane on Connors Rd.
TH11-7	31+000	Pedestrian bridge over Connors Rd.	20	20	8	-
TH11-8	30+880	Muttart Conservatory	10	10	3	-
TH11-9	30+800	Muttart Conservatory	10	10	3	-
TH11-10	30+670	Muttart Conservatory	15	15	4	-
TH11-11	30+600	Muttart Conservatory	15	15	4	-
TH11-12	30+500	Muttart Conservatory	15	15	4	-

Client: AECOM
File: 19-5438-68
e-file: 0819\15438-68 let

Date: September 27, 2011
Page 5 of 6

A1. Locations of geotechnical test holes for proposed SE LRT Extension at the North Saskatchewan River Valley crossing. Table shows locations and tentative depths for test holes TH11-1 to TH11-12 (see locations Figs. 9, 17, 25). Courtesy AECOM, Sept 27, 2011.

THURBER ENGINEERING LTD.

Table 1 Tentative Test Hole Depths and Approximate Drilling Time Required (Continued)

Test Hole No.	Approximate Station	Location	Drilling (Coring) Depth (m)	Standpipe Depth (m)	Drilling Time (hours)	Traffic Lane Closure
TH11-13	30+400	Muttart Conservatory	15	15	4	-
TH11-14	30+350	Pedestrian bridge over 98 Ave.	20	20	8	-
TH11-15	30+230	Pedestrian bridge over 98 Ave.	20	20	8	-
TH11-16	30+180	Bridge over N. Sask. River	20 (15)	15	10	-
TH11-17(1)	29+960	Louise McKinney Park	25 (20)	15	12	-
TH11-18	30+000	95 Str. & Cameron Ave.	30 (10)	20	16	One lane on 95 Str.
TH11-19(2)	29+780	Condominium Building at 95 Str.	30 (10)	16	16	-
TH11-20(2)	29+700	Vacant land area at 95 Str. & Rolland Rd.	25(5)	16	12	-
TH11-21	29+560	Parking lot	20	20	7	-
TH11-22	29+470	Parking lot	18	10	6	-
TH11-23	29+400	102 Ave.	18	10	6	One lane on 102 Ave.
TH11-24	29+300	102 Ave.	10	10	3	One lane on 102 Ave.

(1) Slope indicator will be installed in test hole TH11-17.
(2) Test holes TH11-19 and TH11-20 are located on private properties.

Client: AECOM
File: 19-5438-68
e-file: 08\19\5438-68 let

Date: September 27, 2011
Page 6 of 6

A2. Locations of geotechnical test holes for proposed SE LRT Extension at the North Saskatchewan River Valley crossing. Table shows locations and tentative depths for test holes TH11-13 to TH11-24 (see locations Figs. 9, 17, 25). Courtesy AECOM, Sept 27, 2011.

Appendix B

Paleontological Permit

Government of Alberta
Culture and Community Spirit

Royal Tyrrell Museum of Palaeontology
P.O. Box 7500
Drumheller, Alberta T0J 0Y0
Telephone 403/823-7707 Fax 403/823-7131

PERMIT TO EXCAVATE PALAEONTOLOGICAL RESOURCES 11-022

NAME:	Riley, Michael
ADDRESS:	#169, 51042 Range Road 204, Sherwood Park, AB T8G1E5
AFFILIATION:	Aeon Paleontological Consulting Ltd.

Is hereby authorized to conduct the palaeontological investigations described on the applicant's Application dated Oct 13, 2011 subject to the conditions of the *Historical Resources Act* and the Regulations passed pursuant to that Act, the *Occupational Health and Safety Act* and Regulations passed pursuant to that Act and any other relevant Provincial legislation. It is the permit holder's responsibility to ensure that all necessary permits and permissions are in place prior to the commencement of fieldwork.

PERMIT SUMMARY AND SCHEDULE

1. Purpose of investigations: Mitigative, Historical Resources Impact Assessment
   City of Edmonton, LRT Expansion Branch, Capital Construction Dept.
   Southeast LRT Planning Study
   West LRT Planning Study
2. Location of investigations: Edmonton
   City of Edmonton
   W4 R24 T53 S3 L2,5-7
   W4 R24 T52 S2 L6,11,14
   W4 R24 T52 S15 L1,8,9,16
   W4 R24 T52 S11,14 L4,5,12,13
   W4 R24 T52 S23 L4,5
   W4 R24 T52 S27 L2,3,10,11,14,1
   W4 R24 T52 S22 L1,7,8,10,11,14
   W4 R24 T52 S33 L6-8,10,11,15
   W4 R24 T52 S34 L2,3,5,6
   W4 R25 T52 S35 L4,5,12,13,14
   W4 R25 T52 S26 L13
   W4 R25 T52 S28 L8-12
   W4 R24 T53 S6 L5-8
   W4 R25 T53 S1 L3,4,6-8
   W4 R25 T53 S2 L1-4
   W4 R25 T52 S30 L9,10,15,16
   W4 R25 T52 S34 L1,8,9,16
   W4 R25 T52 S27 L5-12,16
   W4 R24 T53 S5 L5,6
   W4 R25 T52 S29 L9-12
3. Types of palaeontological resources sought: Cretaceous vertebrate, invertebrate & fossil plants. Pleistocene fauna
4. Geological Ages: Cretaceous, Quaternary
5. Formations: Horseshoe Canyon
6. Date two paper copies of final report and digital data are due: Jun 08, 2012
7. Institution in which palaeontological specimens and records are to be deposited: Royal Tyrrell Museum of Palaeontology - P.O. Box 7500, Drumheller, Alberta, T0J 0Y0

PERMIT NO. 11-022 Page 1 of 2

8. Date palaeontological specimens and records are to be deposited: Dec 10, 2012
9. Permit is valid from date of issue to: Dec 11, 2011

APPROVED	
Andrew Neuman Acting Assistant Deputy Minister	Oct 13, 2011 Date

PERMIT NO. 11-022 Page 2 of 2