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

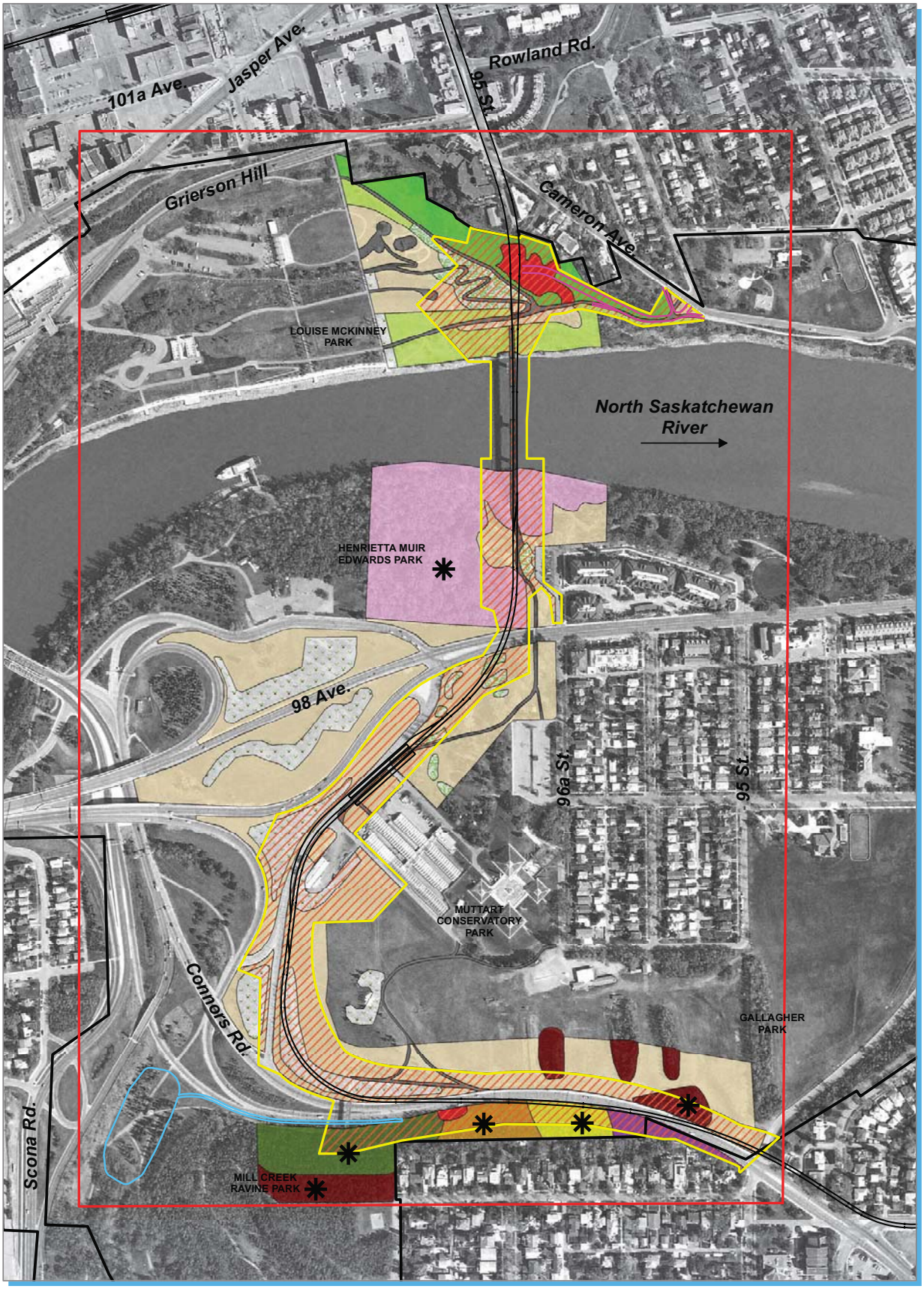
Examined potential impacts related to vegetation include the following:

- 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



Legend

- Community Supports Rare Plants*
- EISA Study Area
- Project Area
- Proposed LRT
- Permanent Portal Access Road (Work-in-Progress/Not Yet Approved)
- Proposed Dry Pond and Vegetated Swale (Conceptual)
- Bylaw 7188 Boundary
- Impacted Features

*Precise rare plant locations will be documented in summer 2013

Natural Communities

- Aspen (A1)
- Aspen/Balsam Poplar (A2)
- Aspen/White Spruce/ Other Deciduous (A3)
- Balsam Poplar (P1)
- Balsam Poplar/Aspen/Birch (P3)
- Manitoba Maple (MM)
- Caragana (C)
- Grassland/Shrub (G/S)
- Grassland (G)

- Pathway/Structure

Manicured Communities

- Lawn
- Garden
- Planted Bed

0 50 100 200 Meters

1:4,250

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

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

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

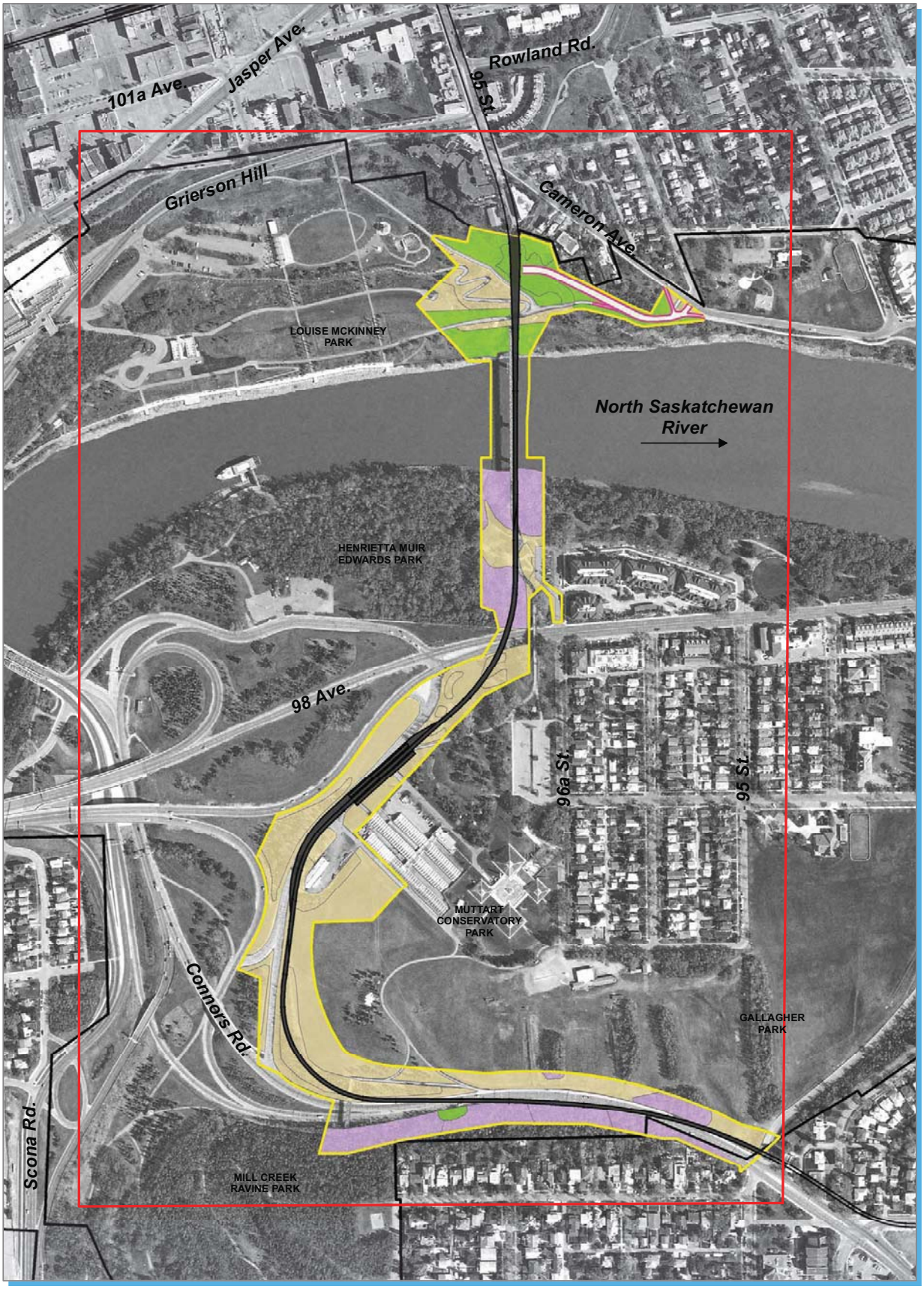
There are two overarching objectives of mitigation for vegetation losses:

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

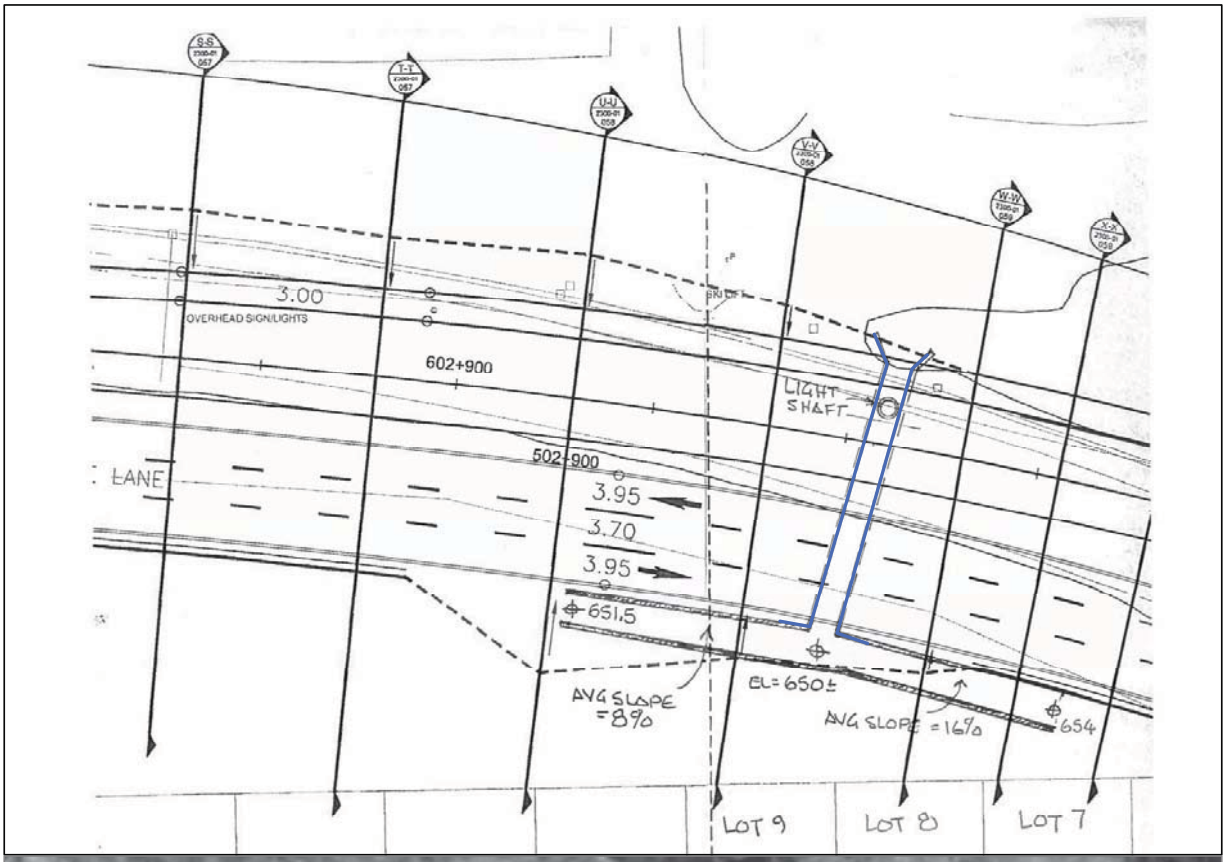
6.2.1 *Land Disposition and Land Use Zoning*

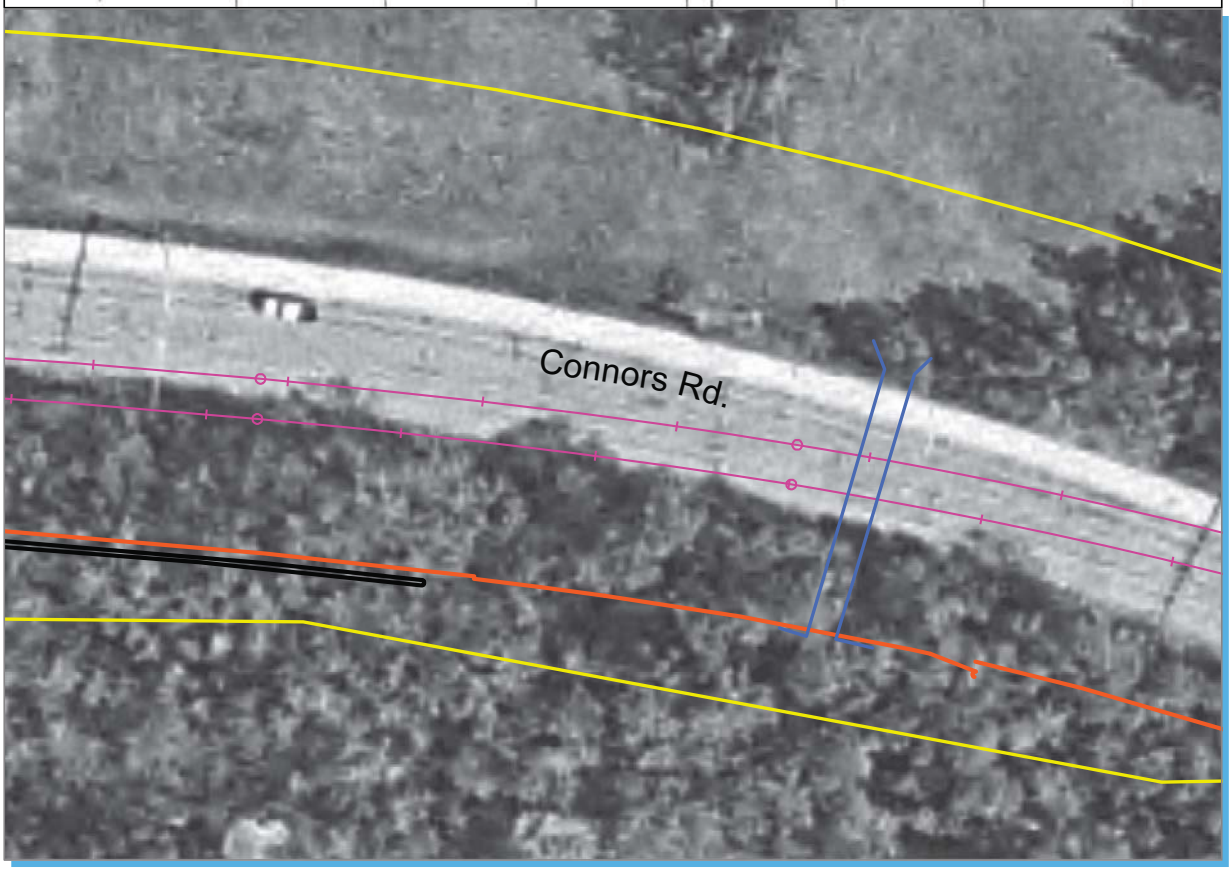
We examined the following potential impacts of the proposed project on land disposition and land use zoning:

- 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:

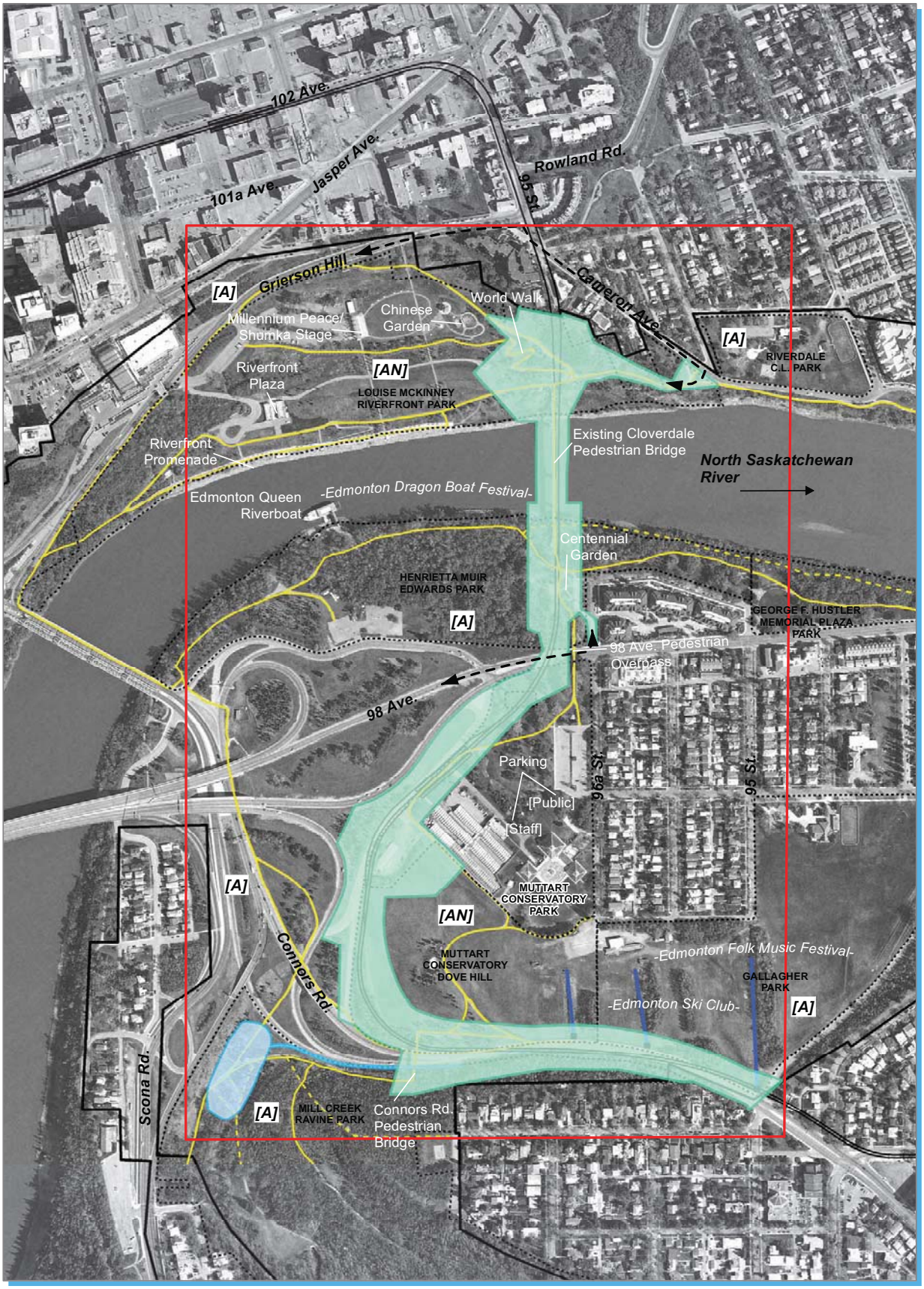
- impacts to the trail network,
- closure or relocation of other recreational infrastructure,
- disruptions to river navigation (boating) during construction,
- disruptions to special events (festivals, etc.),
- relocation of socially-important amenities, including gardens, donor benches and trees, the 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

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

0 50 100 200 Meters

1:5,000

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.