5.0 EXISTING CONDITIONS

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

5.1 Valued Ecosystem Components

5.1.1 *Geology/Geomorphology*

5.1.1.1 Methods

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

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

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

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

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

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

5.1.1.2 Description

Bedrock and Surficial Geology

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

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

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

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

Regional Geomorphological Features

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

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

Local Geomorphological Features

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

Plate 5.1. Steep slopes above the north river bank

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

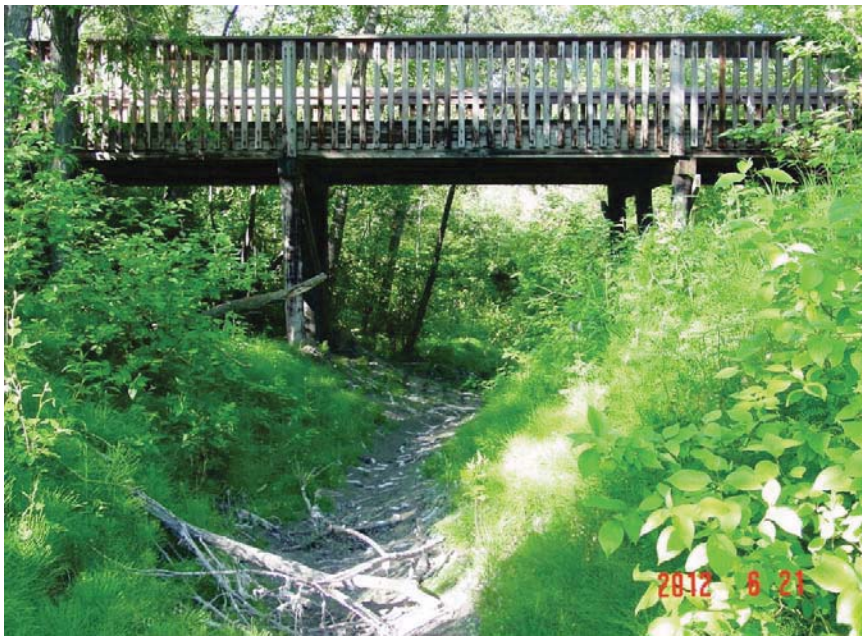


Plate 5.3. View to north along Mill Creek channel, near the junction with the NSR

Plate 5.4. Graded slopes near the base of Connors Hill

Slope Stability

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

The following summary is taken from Thurber Engineering (2012a). Slope stability on the stretch of the north bank that intersects with the LRT alignment is considered marginal as a result of several intrinsic factors, including steep slopes horizontal stresses

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

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

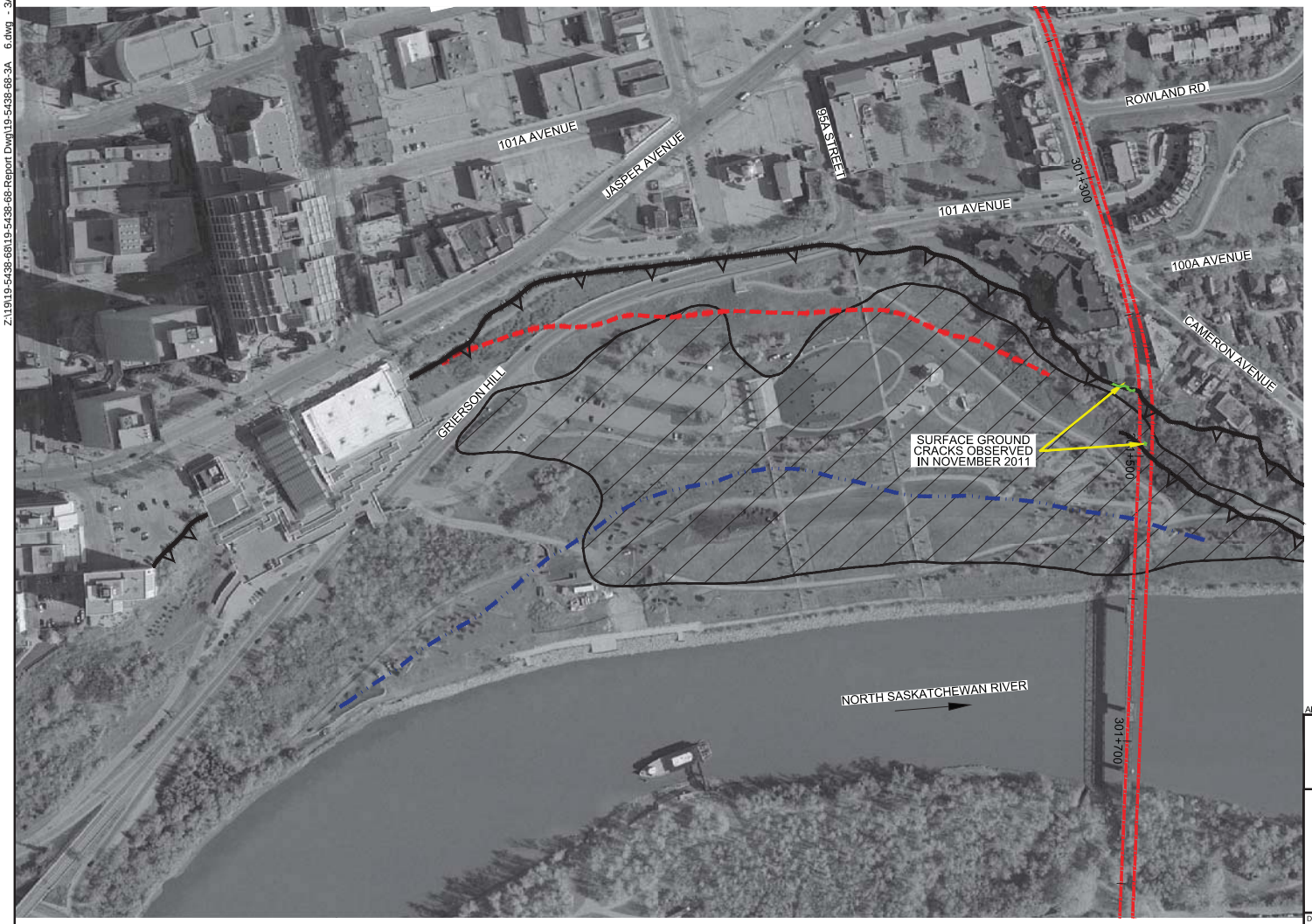
The steep slopes of the Edmonton Ski Club, north of Connors Road, contain fills that are believed to vary with respect to thickness and consistency, and to be of relatively poor quality. Thurber Engineering (2012b) speculates that some of the fills may have been placed in an uncontrolled manner. Upper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

Landfills

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

Z:\19\19-5438-68\19-5438-68-Report Dwg\19-5438-68-3A 6.dwg - 3A - Mar 14, 2012

Figure 5.1



N
W E
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LE EN

- GRIERSON HILL USED AS A WASTE DUMP FOR EDMONTON BETWEEN 1911 AND 1940
- PRESENT DAY SLOPE CREST / SCARP
- SLOPE CREST IN 1887 (BEFORE FAILURE)
- TOE OF RIVERBANK IN 1987 (BEFORE FAILURE)
- PROPOSED LRT ALIGNMENT

0 25 50 75 100 150 200 m
SCALE 1:3000

AIR PHOTO PROVIDED BY CH2M HILL CANADA LTD.

AECOM

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

RIERSON ILL SLI E - PLAN VIEW

W N 1 - 4 - - A

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

THURBER ENGINEERING LTD.

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

5.1.2 *Soils*

5.1.2.1 Methods

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

5.1.2.2 Description

Regional Context

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

Soils of the North Saskatchewan River Valley

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

Soil/Subsoil Conditions in the Study Area

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

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

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

5.1.3 *Hydrology - Surface Water/Groundwater*

5.1.3.1 Methods

Surface Water

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

Groundwater

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

5.1.3.2 Description

Surface Water

Regional Resources

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

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

Within Edmonton, Mill Creek originates at the City's eastern limits near 34 Avenue and flows northwest towards the city centre. One short section, near 75 Street is piped. In 1972, as part of bridge and interchange construction, a short reach in lower Mill Creek was backfilled to accommodate a major road interchange involving 98 Avenue and all

upstream flows were permanently diverted west by pipe to a new outfall on the NSR, upstream of the James MacDonald Bridge (Thurber Engineering 2012). The forested ravine remains intact upstream and for a short distance downstream of the diversion to the point where the ravine joins the main river valley and meets the interchange road complex.

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

Study Area

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

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

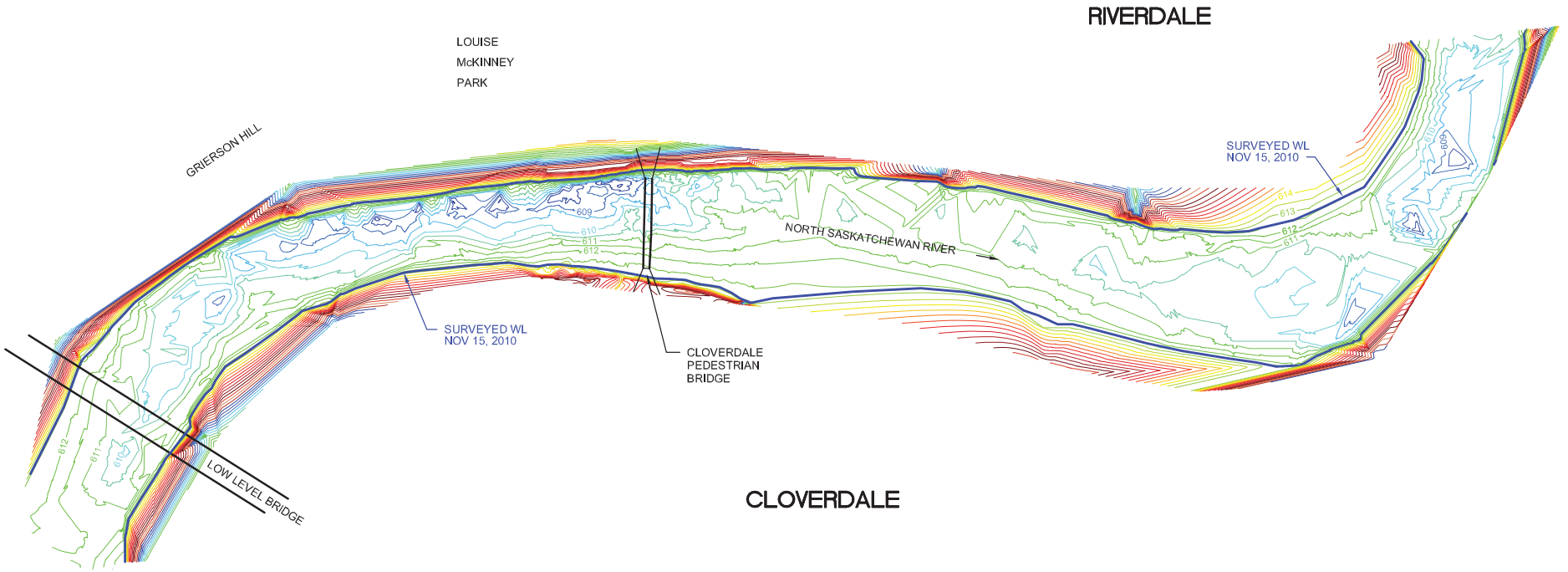
Plate 5.6. View of the armoured north bank from the Cloverdale pedestrian bridge

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

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

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

Figure 5.2



DESIGN NOTES

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

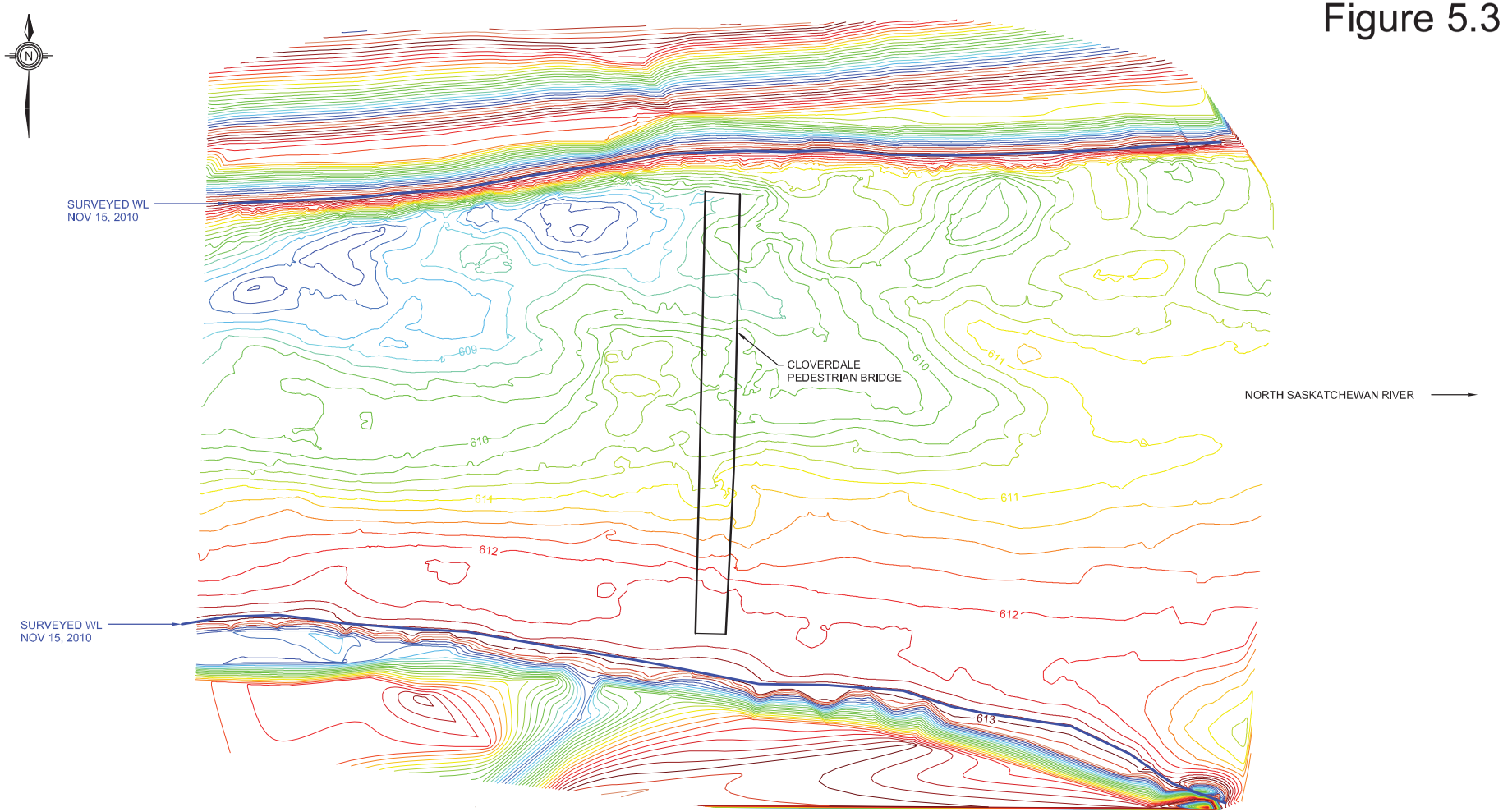
100 0 100 m

SCALE 1:5,000

nhc northwest hydraulic consultants

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

Figure 5.3



DESIGN NOTES

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

20 0 20 40 60 m

SCALE 1:1,000

nhc northwest hydraulic consultants

SPENCER ENVIRONMENTAL MANAGEMENT

LRT BRIDGE DESIGN
NORTH SASKATCHEWAN RIVER

CONTOUR PLAN

Dwg. 7575-001	20 DEC 2010	**Figure 2**

northwest hydraulic consultants ltd.

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

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

Local surface drainage patterns elsewhere in the study area appear to be well managed. Surface drainage on the unmanicured upper north valley wall appears to follow natural patterns, flowing downslope and eventually into the river. In the manicured park, stormwater is assumed to be managed and problems have not, to our knowledge, been

identified in drainage reports. The local vicinity west of the north abutment of the Cloverdale pedestrian bridge, drains to a catchbasin and outfall that discharges on to the river bank, (E. Raszko *pers. comm.*), presumably untreated. The wooden plank deck of the existing Cloverdale Pedestrian Bridge allows precipitation to flow through and into the NSR, untreated. Flows in the Muttart area are managed as overland flow and through existing pipes. Connors and Cloverdale Hill roads both receive major drainage from a sizeable portion (31.2 ha) of the Strathearn Neighbourhood, which is handled by pipes. Once drainage has entered the City storm sewers, it is discharged into the NSR without treatment (Connected Transit Partnership 2013c). During large storm events stormwaters can result in pooling problems in two sump areas at the base of Connors Hill.

Groundwater

Project Area

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

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

Landfills

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

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

drained by the municipal storm sewer system, and 2) the presence of low permeability subsurface soils in the area (X. Wang and H. El-Ramly, *pers. comm*.).

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

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

5.1.4 *Fish and Fish Habitat*

5.1.4.1 Methods

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

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

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

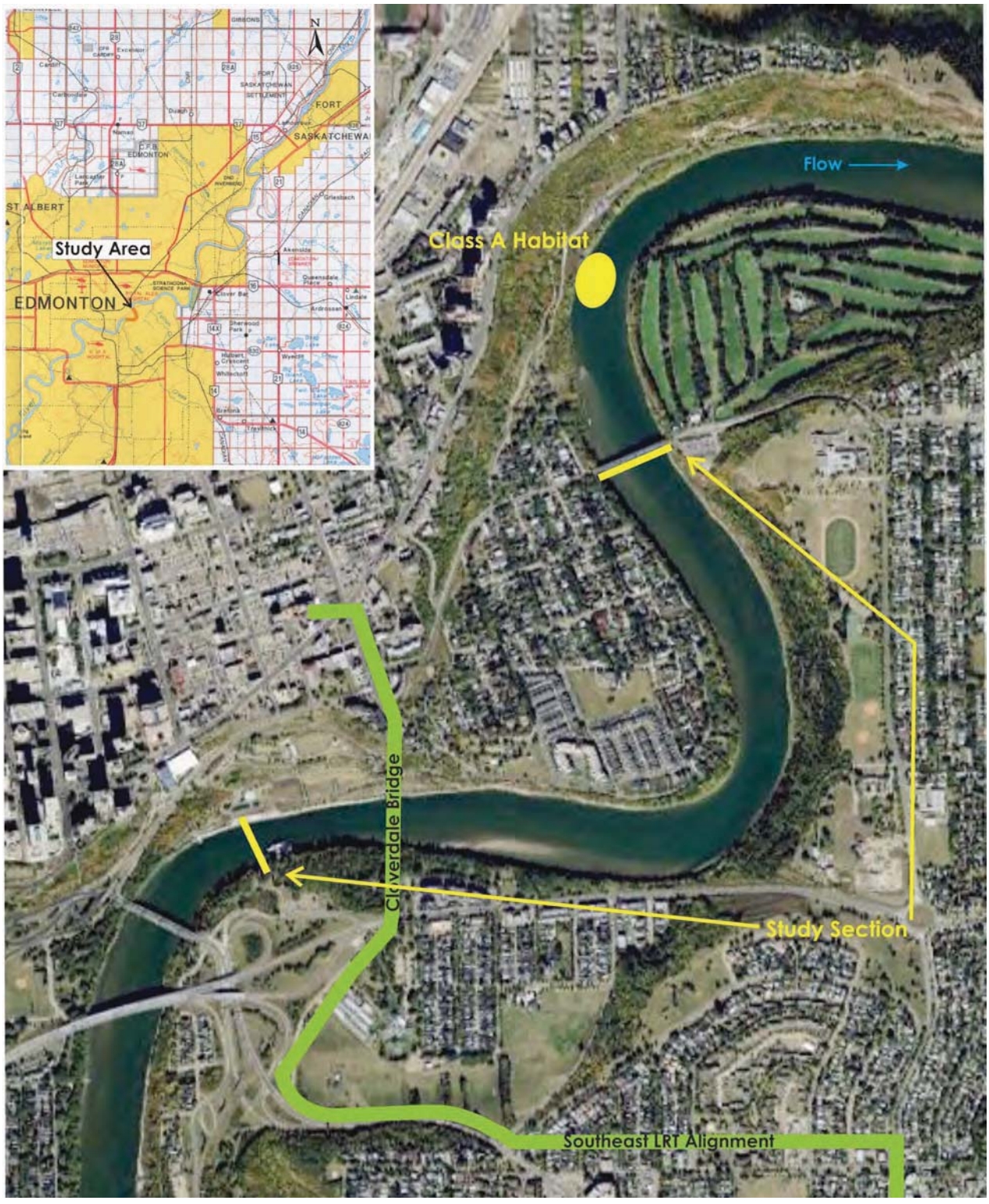


Figure 2.1. Study area location for Cloverdale LRT bridge crossing

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

Pisces Environmental Consulting Services Ltd.

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

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

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

5.1.4.2 Description

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

Fish Habitat

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

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

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

Fish Populations

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

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

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

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

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

*Scientific names are provided in Pisces 2010 (Appendix E)

[a]Pisces (2010)

[b]Pisces (2011) and Sentar (1996)

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

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

Habitat Utilization

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

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

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

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

probably used by northern pike for rearing and the deeper runs may provide overwintering habitat.

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

5.1.5 *Vegetation*

5.1.5.1 Methods

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

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

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

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

species known to occur in the province (Alberta Parks, Tourism and Recreation 2012). Species scientific nomenclature also follows ACIMS.

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

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

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

Rare Plants

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

5.1.5.2 Description

Regional Context

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

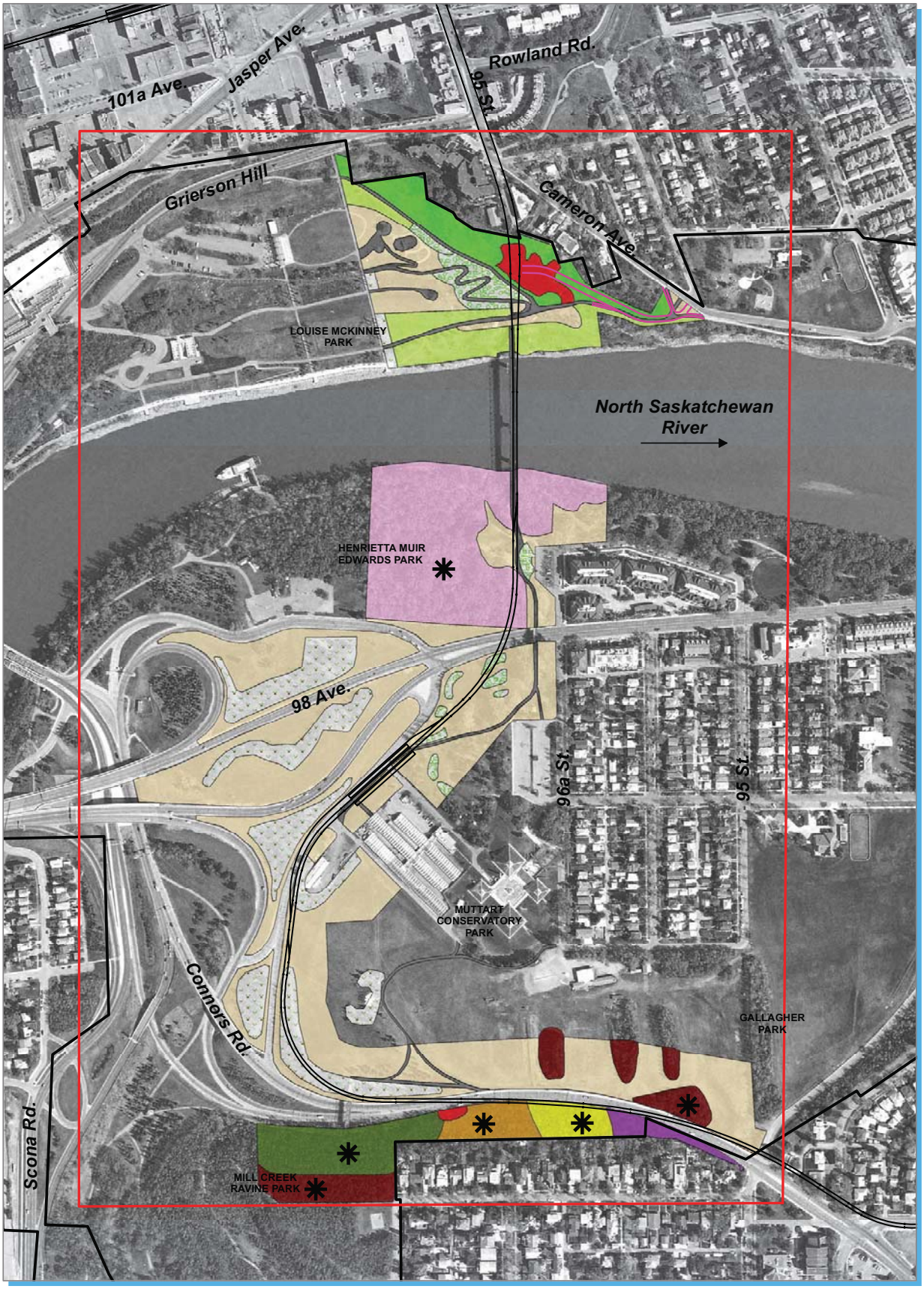
Eight plant communities were found in the study area (Figure 5.5), along with one S2 species, six S3 species, ten noxious weeds and two prohibited noxious weeds. The following sections provide detailed descriptions of these elements. Communities are divided into natural plant communities and manicured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

Natural Communities

North Valley

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

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



Legend

- Community Supports Rare Plants*
- EISA Study Area
- Proposed LRT
- Permanent Portal Access Road (Work-in-Progress/Not Yet Approved)
- Bylaw 7188 Boundary

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

Precise rare plant locations will be documented in summer 2013

0 50 100 200 Meters

1:4,250

Figure 5.5 Existing Plant Communities

City of Edmonton LRT Valley Line - Stage 1

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

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

Table 5.2. North valley plant communities

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

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

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

South Bank: HME Park

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

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

Table 5.3. HME Park plant communities

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

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

Mill Creek Ravine Park and Gallagher Park

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

Table 5.4. Mill Creek Ravine and Gallagher Park plant communities

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

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

not otherwise a significant component of the community. Common forbs included wild vetch (*Vicia americana*) and wild sarsaparilla.

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

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

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

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

The easternmost portion of Connors Hill was occupied by a Manitoba maple (MM) community. This community occupied a small strip of forest between arterial roads and residential development. Both the canopy and understorey were dominated by Manitoba maple, and the understorey was particularly poorly-developed, supporting only one forb (fireweed – *Epilobium angustifolium*) and no grasses. This community was relatively

depauperate, with only 11 species, the second lowest in the study area. The majority (64%) of species observed were native.

Manicured Areas

Louise McKinney Park

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

South bank

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

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

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

Mill Creek Ravine: Dry Pond Site

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

Rare Plants

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

Osmorhiza longistylis (Smooth sweet cicely) (S2)

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

Plate 5.10. Smooth sweet cicely plants

Plate 5.11. Fruits, showing long styles and reflexed bractlets

Anemone riparia (Tall anemone) (S3)

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

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

Artemesia tilesii (Herriot's sagewort) (S3)

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

Corallorhiza maculata (Spotted coralroot) (S3)

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

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

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

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

Lathyrus venosus (Purple peavine) (S3)

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

Carex retrorsa (Turned sedge) (S3)

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

High bush cranberry (Viburnum opulus) (S3)

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

Noxious and prohibited noxious weeds

Noxious weeds are generally those that are currently widespread in the province, and are considered difficult to eradicate. However, provincial legislation requires that these species be controlled. Prohibited noxious weeds are those that are currently uncommon or absent in the province, but which have been identified as noxious due to their potential to invade and damage natural and cultivated systems. Alberta law requires that prohibited noxious weeds be destroyed where they are found. Two prohibited noxious species and numerous noxious species were found in the study area. The *Alberta Weed Control Act* defines two categories of weeds: noxious and prohibited noxious.

Prohibited noxious species

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

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

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

Noxious weeds

Noxious weeds found in the study area include wooly burdock (*Arctium tomentosum*), creeping harebell (*Campanula rapunculoides*), ox-eye daisy (*Chrysanthemum leucanthemum*), Canada thistle (*Cirsium arvense*), dame's rocket (*Hesperis matronalis*), black henbane (*Hyoscyamus niger*), yellow toadflax (*Linaria vulgaris*), scentless chamomile (*Matricaria perforata*), white cockle (*Silene pratensis*), and tansy (*Tanecetum*

vulgare). With the possible exception of black henbane, all these species are relatively common in disturbed and waste areas in the Edmonton region. Their presence in the study area is likely reflective of its location within a densely populated city. Provincial legislation does, however, require control of these species. Surface disturbance associated with LRT construction could create ideal conditions for the spread of these and other noxious species.

5.1.6 *Wildlife*

5.1.6.1 Methods

Study Area

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

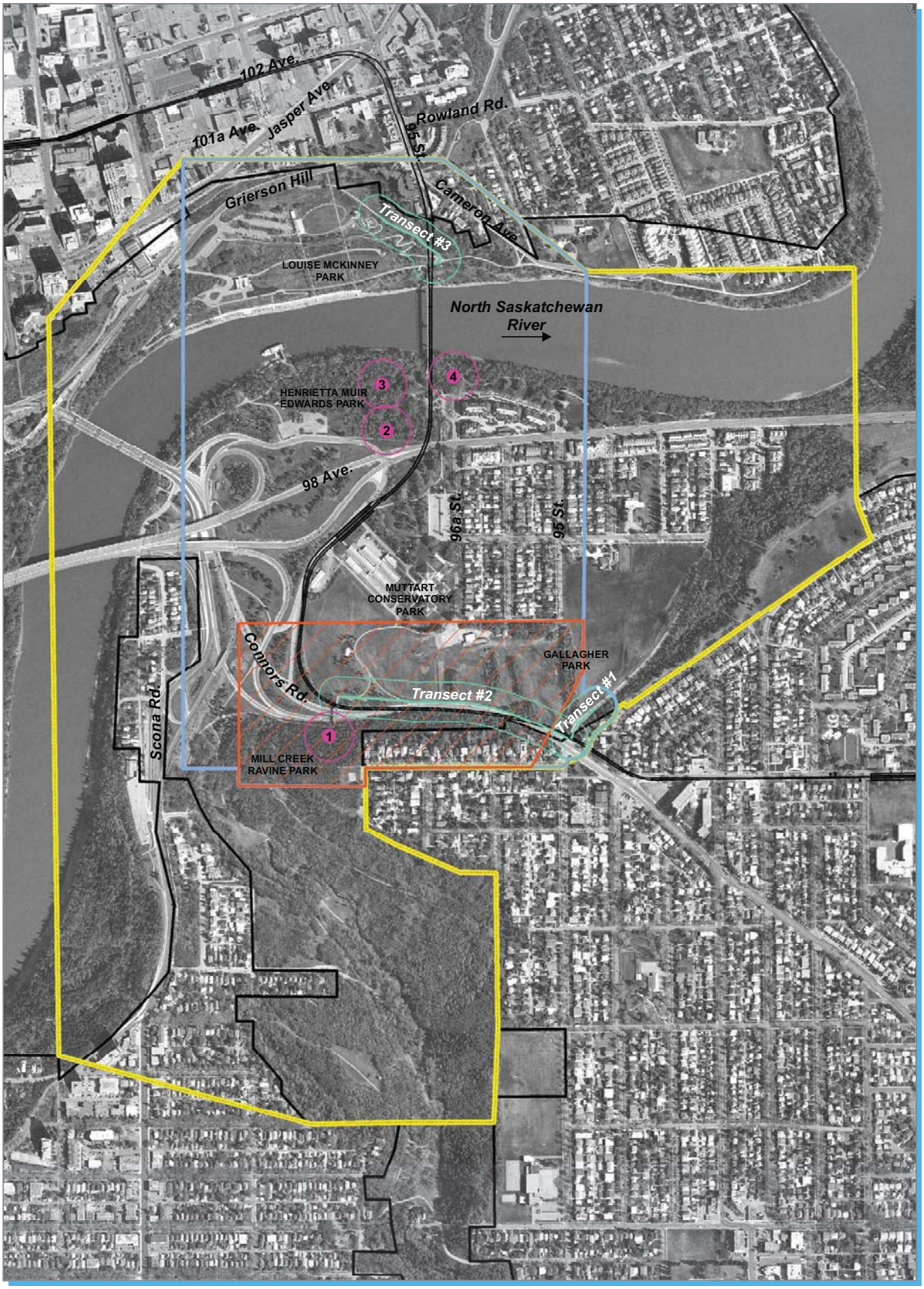
Habitat Characterization

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

Wildlife Communities

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

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



Legend

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

0 50 100 200 Meters

1:7,500

Figure 5.6 Wildlife Study Areas and Sampling Locations

City of Edmonton LRT Valley Line - Stage 1

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

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Breeding Bird Survey

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

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

Reconnaissance Winter Tracking

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

5.1.6.2 Description

Wildlife Habitat

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

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

geese nesting on the Cloverdale river bridge. The river may also be frequented by beavers and muskrats.

Wildlife - General

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

Avifauna

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

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

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

Bird abundance was greatest at point count stations 2 and 3 (16 and 10 individuals, respectively), two of the stations situate in HME park. Stations 1 (Mill Creek Ravine) and 4 (east HME Park) had the lowest bird abundance (1 and 6, respectively). Stations 2, 3 and 4 had similar species richness, likely because they are all located in an area of riparian habitat adjacent to the NSR. At the time of the breeding bird survey there was a severe caterpillar outbreak at Stations 2 and 3 which may have provided an abundant

food source for a variety of bird species. Species richness and abundance were low at point count Station 1, for no obvious reason. This station was located at the bottom of Mill Creek Ravine, south of Connors Road. There appeared to be appropriate forested habitat to accommodate a variety of bird species, but only one species (yellow warbler) was observed at that station.

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

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

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

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

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

diversity, even at the local level where native habitat patches are small and fragmented by development.

Mammals

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

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

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

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

Amphibians and Reptiles

Available amphibian breeding habitat within the regional study area is limited. All of the amphibian species that have the potential to occur in the study area based on species distributions require shallow, ponded water habitats for breeding. With the exception of the potential for such habitat along Mill Creek, in some years, the local study area was found not to have any suitable amphibian breeding habitat. The naturally vegetated areas

of the study area may provide suitable habitat for terrestrial post-breeding stages of wood frogs and boreal chorus frogs; however, considering the lack of nearby breeding habitat, the potential for the occurrence of frogs/toads is considered low.

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

Special Status Species

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

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

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

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

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

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

Peregrine Falcon

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

Mammals

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

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

Amphibians and Reptiles

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

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

5.1.7 *Habitat Connectivity*

5.1.7.1 Methods

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

5.1.7.2 Description

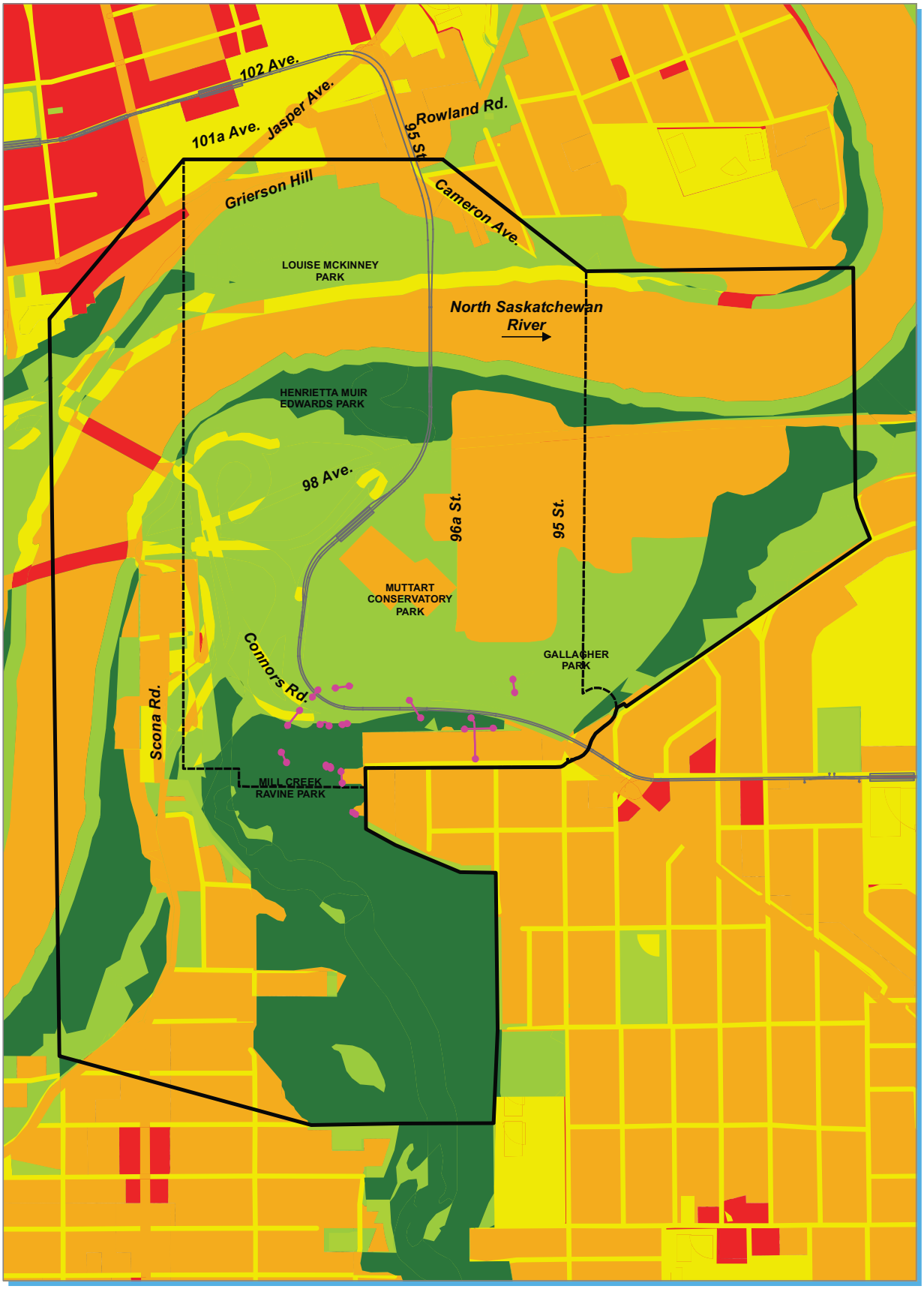
Highly developed areas such as residential, commercial and recreational regions pose barriers to wildlife movement and dispersal, when suitable habitat is present nearby. In such cases, wildlife corridors play a key role in wildlife dispersal because they serve as lineal natural or constructed links between larger habitat areas, accommodating daily, seasonal or dispersal movements that enable genetic exchange and access to other

resources (Paquet et al. 2004). The viability of an area as a wildlife corridor is a function of the continuity in its vegetation structure, its width, the amount and type of surrounding disturbance and the quality of the habitat it connects. Major wildlife corridors provide cover and resources, connecting large areas of habitat at a regional scale. River valleys and their associated riparian strips in particular are widely recognized as important wildlife corridors (Vermont Agency of Natural Resources 2005).

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

Louise McKinney

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



Legend

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

Landscape Permeability Model Output*

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

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

0 50 100 200 Meters

1:7,500

Figure 5.7 Landscape Permeability

City of Edmonton LRT Valley Line - Stage 1

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

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

Henrietta Muir Edwards Park

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

Mill Creek Ravine and Gallagher Park

The other potentially significant wildlife movement corridor present in the local study area is on the south side of the river through Mill Creek Ravine, across Connors Road, into Gallagher Park to the Cloverdale Road Ravine and back to the main river valley (Figure 5.7). Mill Creek Ravine provides a large patch of natural habitat suitable to support a high diversity of native wildlife species. The City has recognized the value of Mill Creek Ravine through its designation as a Biodiversity Core Area within the City's ecological network (City of Edmonton 2008). Mill Creek Ravine also functions as a wildlife movement corridor, extending in a linear fashion for approximately 3kms to the south. The natural habitat of Mill Creek Ravine effectively terminates at Connors Road. As a result, wildlife moving beyond the ravine (or approaching the ravine) must either cross over Connors Road and enter Gallagher Park, or traverse Scona Road to access other natural areas of the NSRV near the Old Timers Cabin. Snow tracking observations made in November 2012 provided evidence that some wildlife do cross over Connors Road into Gallagher Park. Deer tracks, in particular, were observed in abundance just south of Connors Road. Two sets of tracks were seen to cross over Connors Road; one

set of tracks approached the road before turning back. Some tracks were also noted moving through a forested slope parallel to Connors Road, particularly along the back edge of the residential lots south of the road. The number of animals and frequency of use cannot be determined from this one survey event. Existing records of animal-vehicle collisions on Connors Road are patchy and not site specific, but do not suggest one concentrated corridor or a chronic collision problem. Nonetheless, despite the presence of Connors Road, a three-lane arterial roadway, the connection between Mill Creek Ravine and Gallagher Park appears to be functional for larger bodied wildlife species such as deer and coyotes. The width of Connors Road and traffic volumes may provide a more significant barrier to smaller wildlife species such as porcupines, skunks or squirrels; however, even individuals of those species are still expected to cross occasionally. From Gallagher Park, highly permeable, natural habitat connections exist to the northeast along the wooded valley slopes above Cloverdale Road (Figure 5.7). Several small round and linear woodland patches in Gallagher Park are expected to act as stepping stones between Connors Road and Cloverdale Ravine, providing protective cover for animals moving through the manicured park. Cloverdale Ravine, in turn, connects to the wooded riparian area along the river north of 98th Avenue, looping into the corridor available in HME Park, although 98 Avenue separate the two features.

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

5.2 Valued Socio-Economic Components

5.2.1 *Land Disposition and Land Use Zoning*

5.2.1.1 Methods

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

5.2.1.2 Description

Land Disposition

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

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

Land Use Zoning

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

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

5.2.1 *Residential Land Use*

5.2.1.1 Methods

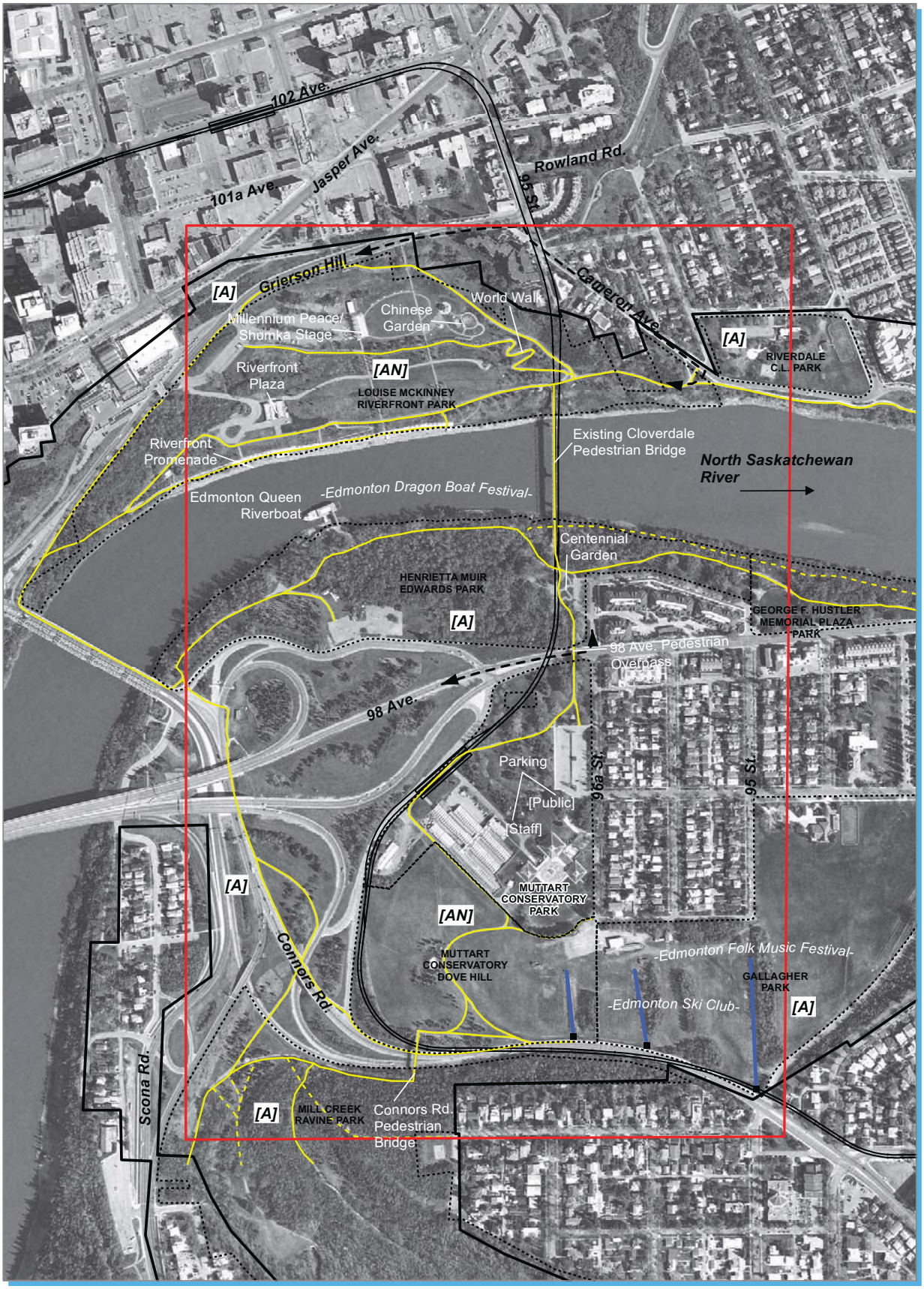
Several residential areas are within or border the EISA study area, necessitating a description of residential land use from the perspective of potential project interactions. Key project issues prompted investigation of four fundamental aspects of residential areas: identification of neighbourhood areas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

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

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

5.2.1.1 Description

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



Legend

- EISA Study Area
- Proposed LRT
- Construction Access
- Bylaw 7188 Boundary
- Park Boundaries
- Ski Lift

Zoning

- **[A]** Metropolitan Recreation Area
- **[AN]** River Valley Activity Node

Pathway

- Shared Use Pathway
- Granular Pathway

0 50 100 200 Meters

1:5,000

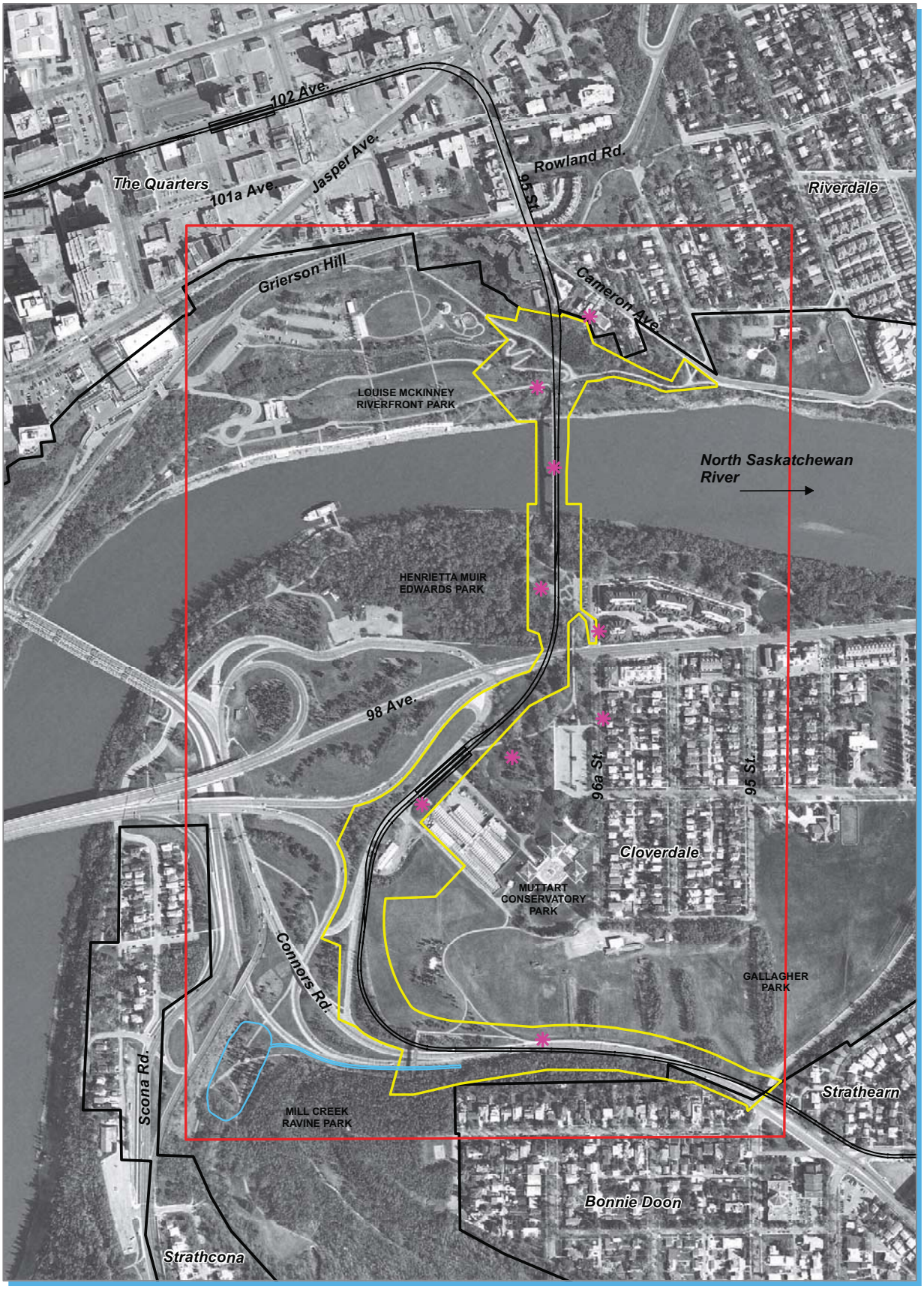
*Muttart garden beds not shown
**Land use zoning source: City of Edmonton Planning and Development (2013)

Figure 5.8 Existing Recreational Amenities

City of Edmonton LRT Valley Line - Stage 1

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

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.



Legend

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

0 50 100 200 Meters

1:5,000

Figure 5.9 Neighborhoods and Key Short-Distance Viewpoints

City of Edmonton LRT Valley Line - Stage 1

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

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

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

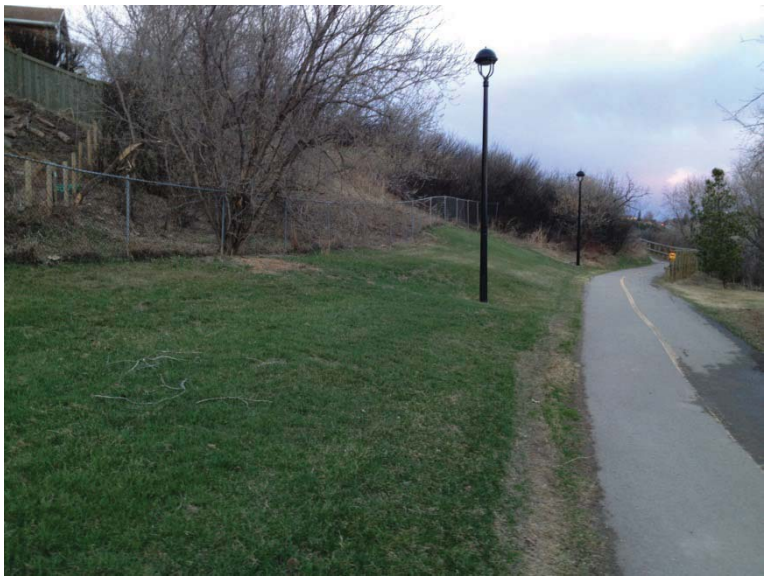


Plate 5.14. Houses located along Cameron Avenue backing onto Louise McKinney.

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

Within Cloverdale, 98th Avenue is a four-lane roadway that begins at the Low Level Bridge and travels east/west. The road carries downtown commuter traffic but also services Cloverdale Neighbourhood. Traffic on local roads within the neighbourhood is

assumed to be relatively low and primarily residential. The Muttart Conservatory parking lot is accessed from 96 A Street serves and may experience slightly higher traffic than other local roads in the neighbourhood. During the Edmonton Folk Music Festival, traffic and parking in Cloverdale is limited to residents and Folk Festival workers only; however, this represents increased traffic and noise and may limit visitor parking and is, therefore, likely experienced as an inconvenience to Cloverdale residents.

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

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

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

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

5.2.2 *Recreational Land Use*

5.2.2.1 Methods

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

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

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

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

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

5.2.2.2 Description

North River Bank and Louise McKinney Park

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

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

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

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

Important park features and amenities include:

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

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

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

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

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

Future Park Plans

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

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

North Saskatchewan River

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

Rafter's Landing is the only boat launch within the study area. It is licensed to the Edmonton Queen Riverboat, and not available for public use; however, the City has an agreement with Riverboat Inc. to allow access to the launch for certain special events, including hand launching for the dragon boats. A public floating dock is available on the

north side of the river. This dock is not a launching point for boaters, but can be used to access Louise McKinney Park from the river.

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

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

Plate 5.20. Cloverdale pedestrian bridge

South River Bank and Henrietta Muir Edwards Park

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

Plate 5.21. Picnic shelter at HME Park

Plate 5.22. Centennial Garden

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

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

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

The Muttart Conservatory/Dove Hill

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

Plate 5.23. The Muttart Conservatory

Indoors, the facility features:

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

A non-public greenhouse complex that supports the conservatory's horticultural activities is located west of the pyramids (Plate 5.24). A storage building and maintenance yard

support volunteer gardening activities and provide storage for Muttart's display props (Plate 5.25). Staff parking is located in this area. Vehicular access to this area is provided by the Muttart access road, a narrow road that connects with 98th Avenue and Connors Road.

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

Plate 5.25. Muttart storage facility

The Muttart Conservatory grounds, located to the north of the greenhouse pyramids, provide multiple recreational activities and support the Muttart's horticultural

programming, including important community partnering programs. Outdoor amenities and activities include:

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

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

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

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

The open park space situated southwest of the Muttart site is known as Dove Hill, and is mainly unprogrammed. A piece of public artwork, "Dove of Peace", is located on a high

point in this area adjacent to an SUP. The "Dove of Peace" is a white steel sculpture designed to commemorate Pope John Paul II's visit to Edmonton in the 1980s, and is visible from various viewpoints within the river valley. The pathway that passes by the sculpture connects the Muttart Conservatory and HME Park to Connors Road, the Connors Road pedestrian bridge and neighbouring communities (Figure 5.8).

Gallagher Park

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

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

Plate 5.27. Edmonton Ski Club slopes and lodge

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

Mill Creek Ravine

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

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

Valley Pathway Network

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

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

Other trails in the study area include:

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

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

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

Plate 5.28. Connors Road pedestrian bridge

Summary – Recreational Amenities

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

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

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

5.2.3 *Visual Resources*

5.2.3.1 Methods

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

attractive qualities, consideration of winter views, when deciduous tree foliage is absent, allows assessment of conditions when vegetation screening is least effective.

5.2.4 *Description*

North River Bank and Louise McKinney Park

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

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

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

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

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

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

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

North Saskatchewan River

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

South River Bank and Henrietta Muir Edwards Park

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

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

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

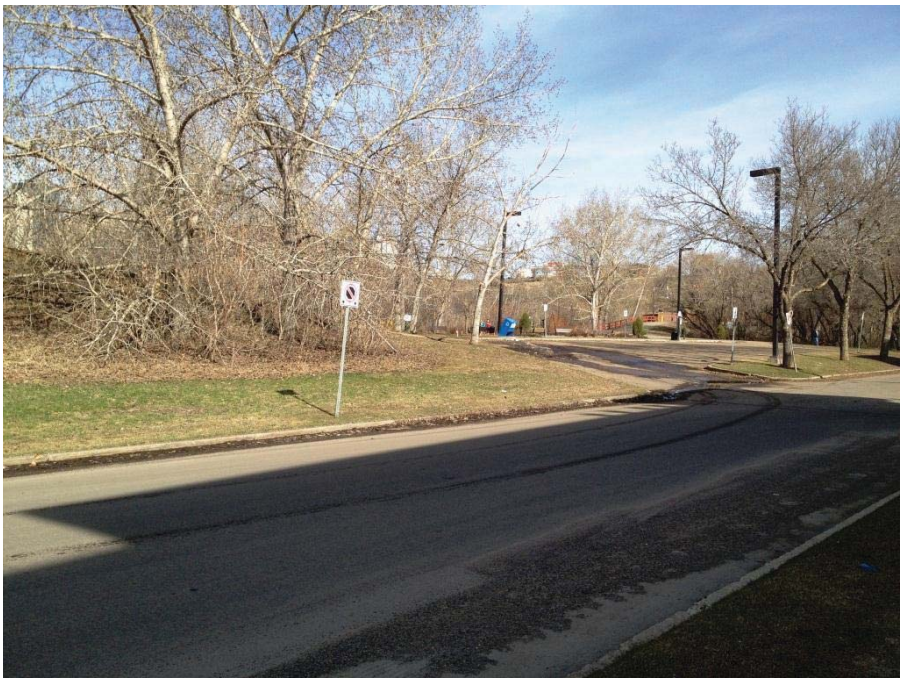


Plate 5.35. View northwest into HME Park from the corner of 98th Avenue and 96A Street

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

98th Avenue Views

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

Muttart Conservatory

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

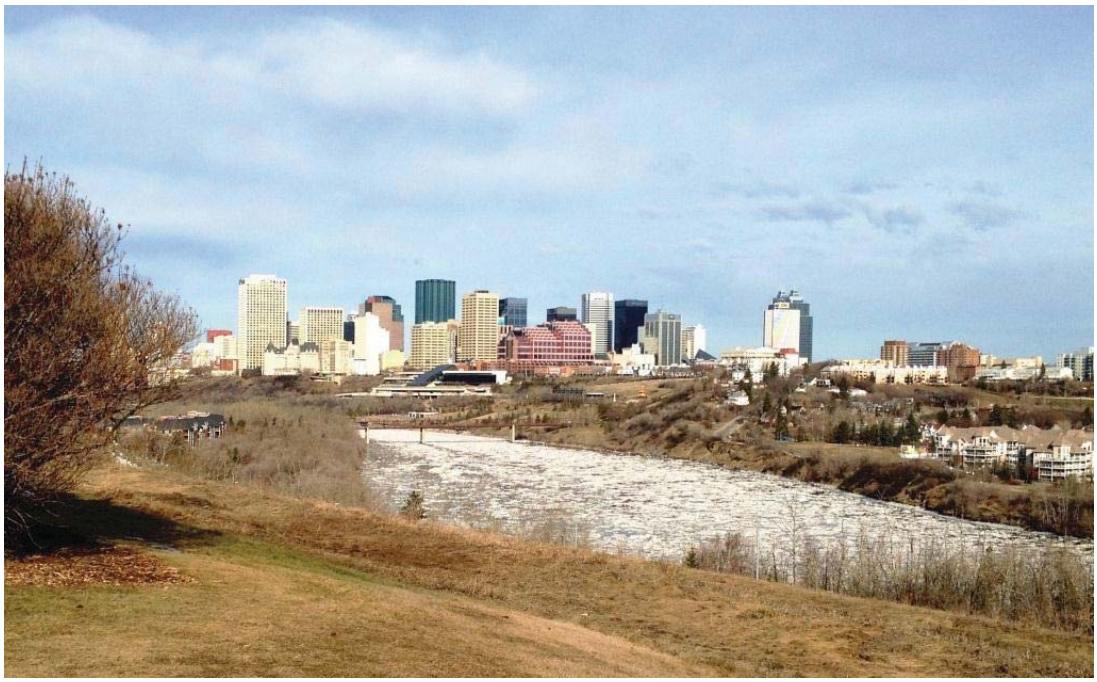


Plate 5.36. View from the top-of-bank at Strathearn

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

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

condition and utilitarian uses, this area is relatively unattractive and negatively impacts the image of the Muttart area.

Connors Road Viewshed

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

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

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

Plate 5.39. View west from Connors Road pedestrian bridge

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

5.2.5 *Utilities*

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

5.2.6 *Worker and Public Safety*

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

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

5.3 Valued Historic Components

5.3.1 *Historical Resources*

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

5.3.1.1 Methods

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

Archaeological Resources

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

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

Paleontological Resources

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

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

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

5.3.1.2 Description

Archaeological Resources

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

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

Paleontological Resources

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

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

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

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