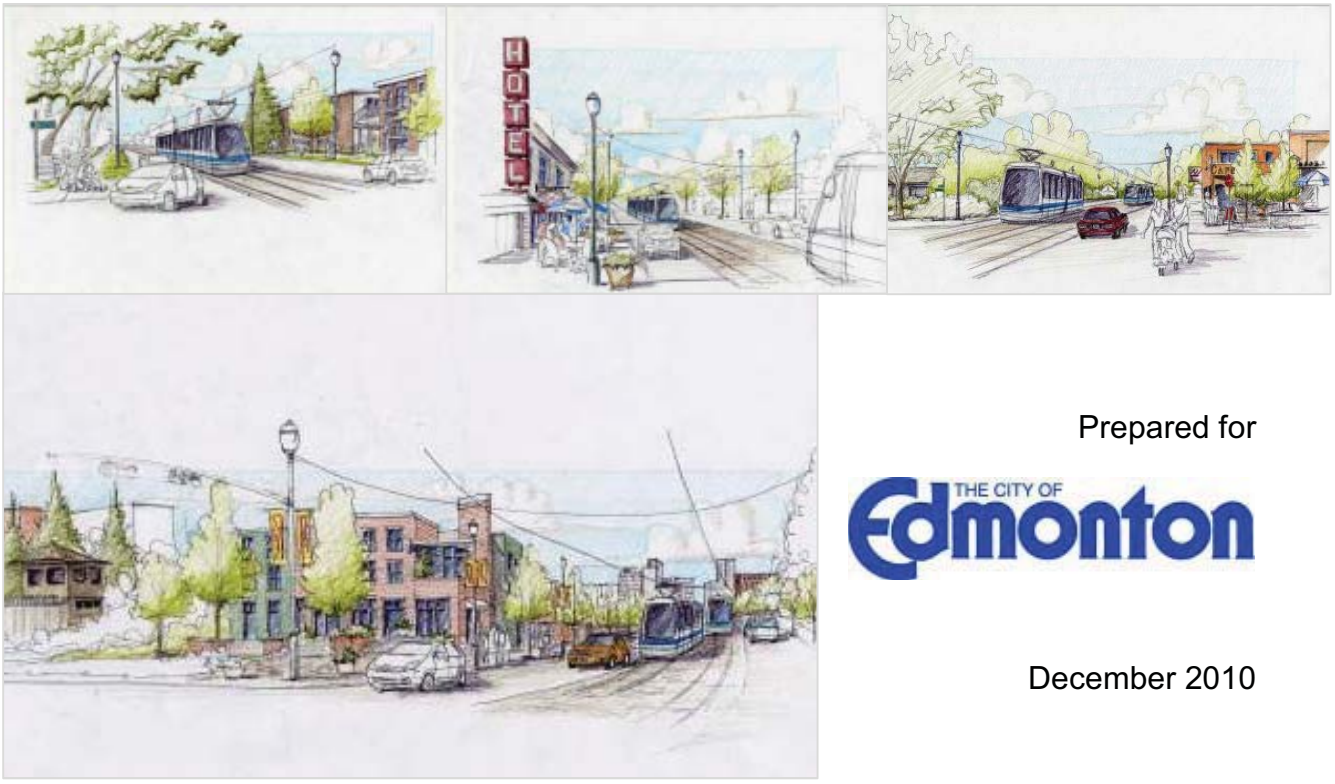
ATTACHMENT 1

West Light Rail Transit Lewis Estates to Downtown Concept Planning Report



Prepared for

THE CITY OF Edmonton

December 2010

Prepared by

CH2MHILL.

Contents

Executive Summary

1. Introduction 1-1
1.1 Purpose of the Report 1-1
1.2 Policy and Direction 1-2
2. West LRT Expansion Concept Planning Study 2-1
2.1 Alignment and Stations 2-1
2.1.1 Consistent Approach to Corridor 2-1
2.1.2 Generalized Approaches 2-2
2.1.3 Touchstones 2-4
2.1.4 Recommended Alignment Overview 2-4
2.2 LRT Operations 2-7
2.2.1 LRT Operating Protocol 2-7
2.2.2 Track Geometry 2-8
2.3 Traffic Management 2-8
2.3.1 Overall Road Network Capacity 2-9
2.3.2 Traffic Operations 2-9
2.3.3 Access Management 2-10
2.4 Utilities and Drainage 2-11
2.5 Geotechnical, Environmental, and Historical Resources 2-12
2.6 Noise and Vibration 2-12
2.7 Property Acquisition 2-12
2.8 Stakeholder Consultation 2-13
2.9 Cost Estimating 2-13
3. Special Study Areas 3-1
3.1 87 Avenue and 178 Street Intersection 3-1
3.2 87 Avenue On-street Parking and Speed Reduction 3-1
3.3 Meadowlark Road versus 156 Street 3-2
3.4 Stony Plain Road Business District 3-2
3.5 149 Street Intersection 3-3
3.6 142 Street Intersection & Stony Plain Road/102 Avenue Junction 3-3
3.7 Groat Estates Access Management 3-4

Exhibit

Exhibit2-1 West LRT Capital Cost Concept Level Estimate 2-14

Figures (located at end of report)

Figure 1 West LRT – Lewis Estates

Figure 2 West LRT – Anthony Henday Drive

Figure 3 West LRT – Aldergrove/Belmead

Figure 4 West LRT – West Edmonton Mall

Figure 5 West LRT – Misericordia

Figure 6 West LRT – Meadowlark

Figure 7 West LRT – Meadowlark Park / Sherwood

Figure 8 West LRT – Glenwood / West Jasper Place

Figure 9 West LRT – Stony Plain Road Business District

Figure 10 West LRT – Grovenor

Figure 11 West LRT – Glenora

Figure 12 West LRT – Groat Road

Figure 13 West LRT – Oliver

Figure 14 West LRT – Downtown

SECTION 1

Introduction

1.1 Purpose of the Report

This report summarizes the results of the conceptual engineering work carried out for the proposed West Light Rail Transit (W LRT) recommended alignment that connects downtown Edmonton to Lewis Estates. Via 13 km of track and 14 stations, this line traverses the west part of Edmonton by connecting the West Edmonton Mall, Misericordia Hospital, Meadowlark Mall, Stony Plain Road Business District, Vision on the Corner redevelopment, the Oliver Square Shopping District, and Grant MacEwan University.

An urban-style approach will be applied to this system, which will run primarily at grade and operate in a dedicated guideway adjacent to traffic. In an effort to limit property acquisition, certain sections of the corridors will have traffic lanes removed in order to accommodate the LRT. The principles of LRT operations are based on line of sight operations in the urban areas and with LRT having traffic signal priority through intersections. The speed of the LRT will be limited to roadway traffic speeds to allow the system to fit and operate safely in narrow rights-of-way and pedestrian-oriented areas.

This system will place an emphasis on aesthetics and suitability within the surrounding area; integration with transit, pedestrian, and cyclist connections; and operations that fit safely with reduced right-of-way and fewer barriers, gates, and bells in comparison with the existing Edmonton LRT system. Station infrastructure will be simple in scale and focused on integration with the neighbourhood. As this extension does not directly interline with the

existing Edmonton LRT, transfers between systems will be possible through close walking connections from the new stations to the existing stations.

1.2 Policy and Direction

The City's Strategic Vision, *The Way Ahead*, identifies strategic goals to be accomplished over a 10-year plan that provides guidance for the long term development of a sustainable City. Supplemented by the Municipal Development Plan (MDP) *The Way We Grow* and the Transportation Master Plan (TMP) *The Way We Move*, the policy documents provide the framework for developing a sustainable and livable city and outline the importance of LRT as a key tool in creating compact urban centres, offering premium transit service and promoting a mode shift to transit.

As an extension of the TMP, *The LRT Network Plan* defines the type of LRT system that best meets Edmonton's long term objectives, identifies the number and destination of LRT expansions, and suggests technology and system style. Specifically, the Network Plan recommends that low-floor technology vehicles be used for lines that do not interline with the existing system along with smaller scale stations spaced more closely: such a system enhances opportunities to serve multiple activity centres and integrates better into mature communities.

In line with these policies, the W LRT recommended corridor was approved by City Council in December 2009, with a recommendation to commence an additional concept engineering study to evaluate a preferred alignment, and assess associated costs, traffic management, and other impacts.

SECTION 2

West LRT Expansion Concept Planning Study

In February 2010, CH2M HILL Canada Limited (CH2M HILL) was directed by the City of Edmonton (the City) to undertake the planning concept engineering for the Southeast (SE) and West LRT, from downtown to Mill Woods Town Centre and from downtown to Lewis Estates, respectively, in order to identify a preferred alignment for these projects. The alignment decisions resulted from technical considerations, financial implications, public and stakeholder input, and the LRT Network Plan.

2.1 Alignment and Stations

2.1.1 Consistent Approach to Corridor

The introduction and implementation of this new LRT system into a built-up urban landscape requires that careful consideration be given when making decisions about the placement of LRT track within the selected corridor. Consistency in locating and introducing the LRT alignment is critical. Such consistency results in a new transportation mode that is understood, recognized, and, hence, completely integrated and accepted by transportation network users.

In the instance of the LRT for west Edmonton, several decision points along the corridor helped guide recommendations along the alignment. These decision points, along with several issues regarding integration into the existing urban fabric, needed to be addressed in a consistent manner. The recognition of this consistent approach allows the public to adjust to and accept the new LRT routes more easily over a short period of time.

Trade-offs

With specific direction from the City to use existing transportation corridors and minimize land-taking, the alignment, access control and station location decisions became a function of trade-offs between property, traffic lanes, and LRT right-of-way (ROW) requirements. This approach was a significant consideration in the concept engineering phase and was applied as consistently as possible through the corridors.

Existing transportation corridors ranged in width from 20 to 60 meters (m), and every effort was made to consistently balance the trade-offs. Where the ROW was limited, both the LRT and roadway minimum desired widths were applied relatively equally, with considerations given to incident management and other operational concerns. Where these minimums could not be achieved, property was identified for acquisition to accommodate the recommended alignments, station placements, and access for pedestrians, bicycles, and vehicles.

Key Stakeholder Input

During the planning process of this substantial transportation project, extensive consultation with public and key stakeholders was completed to evaluate alignment alternatives within the approved corridor. Specialists in many fields, as well as members of

the key internal city departments, were engaged through the alignment selection process to identify potential opportunities and challenges. These were evaluated and often incorporated into the alignment recommendations. Public outreach, involvement, and feedback are described in Section 2.8. The internal city department comments are summarized as follows:

- Transportation Operations: Traffic Engineering – Preservation and consistency of access control and network capacity; consideration of implications to the signaling system of an LRT priority approach; incident management; and neighbourhood short-cutting
- Transportation Operations: Roadway Maintenance – Maximizing the width of the single-lane roadway; accounting for snow and ice control, roadway repair and maintenance, and incident management
- Edmonton Transit: Light Rail Transit Operations– Ease and reliability of operations; incident management; speed of operation; interface with traffic signal systems; and rail geometry
- Edmonton Transit: Service Development – Impacts to the existing service; provision of effective and efficient transfer points associated with the new LRT service
- Capital Construction: LRT Design and Construction, LRT Expansion – Constructability and consistency in approach to the design and construction
- Planning and Development – Integration with existing and future land uses and station area planning
- Parks and Recreation– Consultative utilization of space, staging areas, and river valley; minimize impact to existing parks and green space

2.1.2 Generalized Approaches

The following section covers the general overall design concept approach for the entire length of the corridor used to determine the recommended alignment.

Centre-running

Centre-running alignment, where the LRT vehicles run in the center of the existing roadway, is a very important overall governing concept adopted as a basis for alignment selection. This concept is most appropriate to use in developed urban areas with a highly distributed road network where lanes of traffic in both directions are required. This concept is founded on accepted principles in similar applications, where LRT is placed within existing transportation corridors and provides good urban fit. Experience has shown that is that a center-running alignment balances the impacts and benefits of access control and manages the proximity of LRT to private property and amenities, rather than being on one side or the other. It also provides for a physical separation of pedestrians and train operations by providing pedestrian facilities, like sidewalks and trails, and by having vehicular traffic separate the trains from pedestrians and cyclists.

The alternative side-running approach, where the LRT vehicles run on one side of the existing street, disproportionately impacts the side of the road on which the alignment is

placed by forcing cul-de-sacs at the ends of many of the intersecting streets and requiring provision of a dedicated right-turn bay and signal in order to cross the tracks safely. The side-running LRT can best be applied in more suburban areas where the neighbourhood access is already consolidated into a few, largely spaced, signalized intersections and ROW widths are generally larger. Side-running is also preferred to provide better integration to major activity centers and transit centers.

Consistency of LRT placement within any given corridor is a major safety consideration. Meeting driver expectations regarding the location of trains within the right-of-way will best be supported by maximizing the consistent location within the ROW. Deviations are to be minimized in order to eliminate driver surprise, particularly given Edmonton's long, dark nights and inclement weather Consistent alignment also allows for easier operations and better passenger ride quality and comfort. The design challenge is to minimize the number of alignment shifts within the corridor while optimizing the alignment location for individual segments.

Station Configurations

Serving land uses along the lines and balancing overall spacing of stations was a key objective of the corridor selection phase. During concept engineering, the configuration of stations was selected to minimize property requirements and minimize impact to traffic operations. Side platforms are recommended to maintain consistent track-centre spacing in the corridor, thereby limiting or minimizing any land-taking and also permitting left-hand traffic turning-lanes in the shadow of the stations at intersections where a staggered configuration is appropriate. Centre-platform stations are generally reserved used for large activity centres, for elevated stations, and where the ROW can accommodate the required associated track flaring.

Access Management

Public input consistent identified a need for reasonable vehicular access into and out of neighbourhoods and opportunities for pedestrian crossings. Alignment, adjustments have been incorporated to improve the approach for both vehicles and pedestrians. In the more mature areas of the City, the robust road network grid system will further mitigate this issue and serve accessibility needs to most every location along the corridors selected. In the City's newer suburban areas, the generalized approach was to consolidate the curvilinear local road networks to collector roads and then to arterial road connections. This consolidated road hierarchy approach, along with ample ROW in the newer neighbourhoods, provided the design team with the room to accommodate all movements at the current intersections in these neighbourhoods, essentially having no impact on access.

Vehicular, pedestrian, and cyclist crossings of the LRT would be permitted only at signalized locations. The generalized approach was to provide right-in/right-out (RIRO) intersections at every opportunity. All directional crossings would be limited to major intersections: if these were too widely spaced in a given neighbourhood, provisions would be made for intermediate signalized crossings and left-turn-out opportunities.

Existing pedestrian/cyclist crossings were noted, and pedestrian-only crossings were established at locations that best matched the existing pedestrian/cyclist corridors.

Signalized pedestrian crossings were also permitted at the ends of station platforms where only a single traffic lane needed to be crossed.

A way-finding signage program will also be required along some segments of the corridors to address some of the access issues as they relate to businesses and neighbourhoods. The individual traveler's changes to route planning and the natural traffic redistribution are expected to settle quickly into a new access regime once the LRT is commissioned.

2.1.3 Touchstones

Several touchstone locations along the corridor provided clear starting points for the location of the alignment within the corridors. Once the touchstones were verified and firm decisions made at these locations, selection of the alignment placement between these locations was selected to ensure City-wide consistency in our approach.

In general, these touchstones are as follows:

- *Park and Ride and Transit Centre at Lewis Estates* – Integrating strongly into transit centre and park and ride facilities requiring the alignment to be on the south side of 87 Avenue
- *West Edmonton Mall* – Providing access management to major activity centre, integration into site best addressed with alignment on north side of 87 Avenue
- *170 Street* – Accounting for the grade-separation over inner ring loop goods movement corridor
- *Misericordia Hospital* – Providing access management and service to major activity centre best addressed with alignment on north side of 87 Avenue
- *Stony Plain Road (SPR) Business District* – Promoting equal benefits and impacts to businesses on both sides of ROW by placing LRT in centre of ROW
- *142 Street Traffic Movements* – Respecting the strong, bi-directional peak flows by planning alignment to be on north side of SPR
- *Significant Commercial Access Areas Near Downtown* – Promoting equal benefits and impacts to businesses on both sides of ROW by placing LRT in centre of ROW

2.1.4 Recommended Alignment Overview

The recommended West alignment as detailed in Figures1 to 14 is a continuation of the new proposed downtown LRT and SE LRT alignments that are currently under consideration.

Lewis Estates and 182 Street Communities and Stations

The West LRT line originates at the Lewis Estates subdivision, just southwest of 87 Avenue and Anthony Henday Drive (AHD). The City is currently constructing a park and ride and transit centre at this site, and it is the targeted terminus of the West LRT. The LRT alignment and the Lewis Estates Station are located just south of 87 Avenue between the transit centre and the park and ride facility. The alignment crosses the AHD signalized ramps at grade and on a new bridge, over the mainline lanes of AHD just south of the existing 87 Avenue roadway bridge.

The alignment continues east on the south side of 87 Avenue to the 182 Street Station located just west of 182 Street. The curvilinear local residential roadway layout of west Edmonton neighbourhoods was designed to combine access onto major collectors and then onto 87 Avenue at well spaced intervals. Coupled with an exceptionally wide ROW on 87 Avenue, the consolidated road network allows for side-running LRT to have minimal access impacts and design issues. Intersections at 189 Street and 182 Street would remain signalized to provide access to the bordering neighbourhoods.

West Edmonton Mall and Misericordia Stations

Due to the requirement for a grade-separation at 170 Street to respect its special designation in the Transportation Bylaw as the Inner Ring Road (IRR) and a heavy goods movement corridor, special consideration was given to the West Edmonton Mall (WEM) and Misericordia stations. The WEM site is easily recognized as one of the most significant activity centres in the City and as a result providing direct pedestrian access and close integration with the transit centre while maintaining vehicle access to the facility was vital. In order to manage access control and protect all of the existing traffic movements that currently occur along 87 Avenue, the elevated segment over 170 Street was extended to include the West Edmonton Mall station. This treatment benefits both the transportation system users and patrons of the mall. Similarly, the proximity of the 170 Street grade-separation to Misericordia Hospital provides an opportunity to extend the elevated segment and to implement better pedestrian integration with the activity centre through an elevated station while maintaining unimpeded access to the health facility.

The alignment remains on the south side of 87 Avenue and crosses 178 Street at grade. Just east of this intersection, the LRT ramps up onto an elevated structure and crosses to the north side of 87 Avenue to stop at an elevated station directly over the existing West Edmonton Mall Transit Centre. The LRT continues on an elevated structure over 170 Street to an elevated Misericordia Station. All intersections between 178 Street and 170 Street remain as per the existing arrangement. The main access to the hospital is relocated and signalized to align with the 169 Street intersection with the LRT elevated above it, while the existing access is maintained but only with right-in and right-out (RIRO) turn provisions. The 165 Street intersection is also downgraded to a RIRO access due to sightline challenges as the elevated structure crosses from the north side of 87 Avenue to its centre.

The alignment proceeds to descend on a ramp to grade just west of 164 Street and continues east through a signalized intersection at 163 Street and Meadowlark Road. The service roads along 87 Avenue from 165 Street to 156 Street are removed in order to limit property impacts and maintain the two lanes of traffic in each direction. On-street parking is provided in certain stretches along this segment to accommodate additional parking activity. The posted speed will be reduced to 50 kilometers per hour (km/h) from the current 60 km/h to accommodate safe on-street parking practices.

Meadowlark Station, 156 Street, and 95 Avenue Station

At the corridor approval phase in December 2009, the Transportation Bylaw 15101 defined the W LRT corridor as running along 87Avenue, turning north onto Meadowlark Road, and connecting with 156 Street. Further study and consultation with the public stakeholders suggested that there is a strong rationale for the alignment to run further east on 87 Avenue and turn north directly onto 156 Street. The higher density land uses around 156 Street,

easier pedestrian access to station and more desirable LRT operations with only one softer radius turn all influenced the revised recommendation. The transit centre on Meadowlark Road will likely be decommissioned and did not factor into the evaluation.

Thus, the recommended alignment continues along the centre of 87 Avenue and transitions to the west side of 156 Street to the Meadowlark Station just south of 89 Avenue. To simplify intersection operations and minimize property impacts, the segment of 156 Street between 87 Avenue and 89 Avenue is reduced to one southbound lane of traffic. As the alignment moves north of 89 Avenue along 156 Street, the constrained ROW requires that the four-lane arterial road is reduced to two lanes all the way to Stony Plain Road in order to limit property impacts.

The 95 Avenue Station has staggered platforms on the north and south sides of 95 Avenue to permit left-hand traffic turn-lanes in the shadow of the stations at the intersection. Property acquisition is required around the station. Signalized intersections are provided at 92 Avenue and 97 Avenue to maintain community connectivity.

Stony Plain Road Business District and Stations

The W LRT alignment next crosses diagonally from the centre of 156 Street to the centre of SPR through the properties at the southeast corner of the intersection of 156 Street and SPR. This diagonal alignment provides more optimal track geometry for LRT operations, simpler traffic interactions in the intersection of 156 Street and SPR, and reasonable integration with (and transfer to) the Jasper Place Transit Centre. This alignment and station location are envisioned as significant catalyst for future TOD in this area.

The alignment then proceeds east in the centre of Stony Plain Road, whose ROW on SPR is constrained to 20 m for its entire length into the downtown. To accommodate the LRT, it was recommended to preserve one wide lane of traffic in each direction with some special provisions. The current SPR arterial roadway status and function as a commuter route will be reduced to major collector-like status once the LRT is implemented.

In conjunction with the Stony Plain Road Revitalization Project, more space in the SPR Business District may be acquired to enhance the public realm such as sidewalks, landscaping, or provide on-street parking. Signalized intersections will be provided at 155 Street, 153 Street, and 151 Street to allow vehicles to cross the tracks; however, these intersections cannot accommodate left-hand turns due to the amount of property that this would require.

Grovenor and Glenora Communities and Stations

Continuing east, the 149 Street Station which is located between 151 Street and 150 Street and is intended to serve the business district and the surrounding mature neighbourhood. The LRT then continues through the centre of 149 Street intersection and proceeds east towards 150 and 151 Streets where the alignment transitions from centre-running to north side-running. This transition is required to permit the LRT to address issues with the strong west-to-south and north-to-east traffic flow prominence at the 142 Street intersection. The alignment crosses 142 Street on the north side of the intersection to the 142 Street Station to serve the existing mature neighbourhoods and the redevelopment Vision on the Corner.

As the alignment leaves the station, it transitions back into the centre of SPR at 139 Street and continues centre-running to the Glenora Station where the station platforms are staggered about the 133 Street intersection. Signalized intersections are provided at 136 Street, 134 Street, and 132 Street to maintain community connectivity and accessibility for vehicles, pedestrians, and cyclists. Proceeding east, the alignment crosses Groat Road and Groat Ravine on a new bridge that is combined with one lane of traffic on either side of the LRT.

A special area of note exists east of the Groat Bridge, where the Groat Estates properties on the south side of SPR are provided no alternative roadway network options to accommodate reasonable accesses into and out of their properties. Therefore, signals and road improvements are provided at 129 Street, 127 Street, and 126 Street in order to permit U-turns on SPR so as to provide these properties reasonable access and egress.

104 Avenue and Stations to Downtown

Next, as the W LRT alignment continues east, it approaches the 124 Street Station where the station platforms are staggered about the 124 Street intersection. This configuration allows for left-hand turn movements for the westbound traffic. However, ROW constraints do not permit eastbound left-hand turns onto 124 Street. This movement will be accommodated with a limited jug-handle east of the intersection at 123 Street and a full jug-handle east of the intersection at 121 Street.

The balance of this LRT route continues as a centre-running alignment along 104 Avenue, where the ROW widens out considerably to provide ample space for two lanes of traffic in each direction. Access to the commercial and high-density developments along this stretch of the corridor are provided at signalized intersections at 121 Street, 116 Street, 114 Street, and 112 Street. A station is located just east of 121 Street, and two more are staggered about the 116 Street and 112 Street intersections. The alignment remains on 104 Avenue through to 109 Street, which is the limit of this study.

2.2 LRT Operations

2.2.1 LRT Operating Protocol

In any LRT system involving trains running at-grade through signalized intersections, the degree of priority given to the trains compared to that given vehicular traffic is critical in determining how the intersections will operate, measured by the level of service and amount of delay experienced by each mode. Efficiently accommodating competing needs (those of LRT trains and passengers with those of vehicular traffic and its passengers and goods), is not a simple matter. Some factors that come into play when considering the various trade-offs in this matter include the following:

- *Vehicle operating characteristics of LRT vehicles:* Greater deceleration and acceleration distances than other vehicle.
- *Schedule reliability:* Efficient operation of an LRT system requires more service reliability and schedule/travel time consistency than other vehicles using the road network.
- *Signal control technology:* The need to efficiently deal with frequent passage of LRT trains through or adjacent to busy, urban signalized Will require use of one of the newer

generations of traffic signal controllers with capability to accommodate the interaction between LRT movement and vehicular traffic. More sophisticated interaction capability between traffic signal and rail signal systems is also becoming more common.

- *Environmental and sustainability perspectives:* A number of environmental and societal factors are considered pertinent to balance increased vehicle emissions associated with delays to traffic against the need to provide significant priority to LRT vehicles.

The recommended protocol for the W LRT uses an integrated traffic signal control system for both the train and vehicular traffic. The signal concept for LRT priority involves operating the trains as close as possible to the traffic signal system green phase to minimize the delay to trains while minimizing impacts on movement of vehicular traffic. Such a system would seek to have peak direction trains (for example, downtown-bound in the morning peak period) travel through key intersections during the green phase for the parallel traffic flow. To accomplish this, it is envisioned that a communication system between the LRT trains and the traffic signals at major intersections will provide feedback to Light Rail Vehicle (LRV) operators to either extend or truncate their dwell times at stations in order to best hit the green signal phase at the critical intersection(s) in the next segment of track. Trains travelling in the non-peak direction may not receive as much priority as peak direction trains, and this must be accounted for in the system's operational planning. This will generally require upgrades or replacement of the existing traffic signal control system.

2.2.2 Track Geometry

The trackway geometry was developed for both operator and passenger comfort,, minimizing and flattening curves to manage travel times and noise, and reduce wear and tear .The trade-off between these objectives and property requirements was considered carefully.

2.3 Traffic Management

This project represents a substantial length of new LRT to be implemented, most of it running at-grade within or alongside existing roadways. There will inevitably be traffic-related impacts, including the following:

- *Overall road network impacts*: Roadway capacity reduced where traffic lanes are to be removed, and "off route" impacts to roads in the general vicinity of the new LRT resulting from traffic that will divert away from the LRT route.
- *Traffic operations impacts*: At intersections where trains pass through, as well as at some "off route" intersections that will be affected by diverted traffic
- *Neighbourhood accessibility impacts*: Resulting from the necessary full or partial closure of some intersections along the LRT corridor

This section provides a conceptual overview of each of these traffic management issues. Further analysis is required during preliminary and detailed design stages to fully address these issues, as well as traffic management during construction. Following construction, there will be a need for ongoing monitoring of traffic conditions, to identify and implement solutions to traffic-related concerns. This may include accommodating diverted traffic along parallel arterial routes, or addressing neighbourhood shortcutting concerns.

2.3.1 Overall Road Network Capacity

A basic premise of development of the W LRT project to date has been the Council directive that elimination of travel lanes can be considered as a way to create space within a road ROW to accommodate LRT, in order to reduce or eliminate property acquisition. However, reduction of lanes inevitably raises concerns about displacement of traffic. The existing road network within the W LRT study area is relatively "robust" with, in most cases, a number of routes being available for drivers to choose from, particularly in the peak commuter flow directions. This network resiliency is a vital factor in the implementation of the W LRT system as currently proposed.

In the W LRT study area, the key issues with respect to diversion of traffic relate to the proposed reduction of lanes on 156 Street between 87 Avenue and SPR, and on SPR/104 Avenue between 156 Street and the downtown. In terms of 156 Street capacity reduction, parallel routes with some capacity available to handle diverted traffic (depending, of course, on the origin and destination of individual trips) include 170 Street (a portion of the inner ring road [IRR]), 163 Street, 149 Street, and 142 Street. In the east-west direction, with lost capacity on SPR/104 Avenue, alternative routes primarily include 107 Avenue, 111 Avenue, 118 Avenue, and Yellowhead Trail. Localized checks of capacity at several key intersections along 107 Avenue have confirmed that there is sufficient residual capacity available based on 2041 horizon traffic projections which include the LRT system.

Analysis to the traffic redistribution data indicates that the existing roadway network can accommodate the change in traffic pattern. Further analysis will be carried out in the next phase to determine improvement requirements at adjacent roadways.

2.3.2 Traffic Operations

With the "urban-style" LRT technology proposed for the new SE line, trains will be more integrated into the traffic realm (compared to the existing LRT in Edmonton). They will still operate in a dedicated ROW, typically in the centre of the road, with small curbs between trains and adjacent traffic lanes, and with no crossing gates and bells at intersections (except where needed to address specific safety concerns). As discussed in Section 2.2.1, from a traffic control perspective, the intent is that an integrated signal system will control both vehicle traffic and LRT, with special signal displays for the LRT. There will be two different scenarios with respect to train-vehicle priority:

- At select locations, trains will receive full priority when approaching a signalized intersection, with the signal phasing/timing being adjusted as necessary to accommodate the passage of the train with no reduction in speed. This mode of operation is desirable from an LRT operations perspective, and is generally appropriate at intersections with relatively minor side streets, and where traffic capacity conditions allow for the resultant overall decrease in intersection capacity.

- At certain critical intersections (in terms of cross street classification, and/or intersection capacity conditions), it will be desirable and necessary to use the traffic/train signal control system(s) to adjust the timing of arrival of trains at the intersection so as to minimize the impacts of the train passage on traffic operations. Rather than holding trains at stations, the system would also have the option of rearranging the order in which the various signal phases are displayed, to either advance or delay the display of

the "main street green" signal phase to allow the train to pass through, while still ensuring that the signal phases serving other movements are also displayed during the signal cycle.

In addition to the signalized intersections along the W LRT route, a number of "off route" locations have been identified as sites where traffic signals may be required to address the shifting of traffic away from the LRT route roads. For the most part, these new sets of traffic signals need not be installed prior to or concurrent with construction of the LRT. It is recommended that such locations be monitored after LRT construction, with signals installed only when warrants are met. At some key locations, where traffic diversion related to the LRT is expected to be significant, it is recommended that signals be installed as part of the LRT construction. There may also be locations at which signalization will be required primarily as a part of the traffic management planning for accommodating traffic during construction. Construction related impacts and mitigation measures are not addressed in this study.

2.3.3 Access Management

The "access management" required for this project focuses primarily on addressing neighbourhood accessibility needs along the new LRT routes. Implementation of an at-grade LRT system will result in full or partial closure of some accesses that currently connect with roads forming the LRT route. Such closures impact the movement of vehicles into and out of adjacent neighbourhoods and other types of development along the corridor. Also impacted are locations at which pedestrians can cross the LRT route.

The corridor selection and conceptual engineering work to date provides a comprehensive approach to access management focused on traffic safety and operational requirements, built upon the following key assumptions:

- All vehicle movements crossing LRT tracks must occur under signal control. In most cases, full signalization of an intersection is desirable, allowing for all vehicle movements and for pedestrian crossings.
- In some situations, such as driveways accommodating only right-in/right-out movements with side-running LRT, signal control is still required to manage the movement of the vehicles across the tracks, but in these cases the signals will not need to control the through movements on the main street.
- All left-turn movements crossing the LRT tracks must occur with "protective" signal phasing, i.e. with a left-turn arrow phase controlling the movement (left turns move only when the arrow is displayed). To avoid situations where a queue of vehicles waiting for their left-turn arrow phase blocks through vehicles from being able to proceed through the intersection, all left-turn movements crossing the tracks are provided with dedicated left-turn storage bays. This is a critical criterion, as there are some locations at which traffic signals are required but ROW restrictions limit the ability to provide for left-turn storage bays for the turns crossing the tracks from the main street.

- Pedestrian crossings of the LRT can be dealt with in several different ways, with specific details to be determined during the preliminary and detailed design stages of the project. Examples include the following:
  - Pedestrian movements are accommodated at a normal, signal-controlled intersection.
  - A partial set of pedestrian-activated traffic signals, linked to the traffic/LRT control system, either at an intersection (with limited vehicular movements) or at a midblock location, are provided solely for the purpose of accommodating pedestrian crossings of the LRT alignment. These would be configured to ensure that a "Walk" signal is displayed only when there is no train coming and when traffic can be interrupted without significantly impacting vehicle flow.
  - Uncontrolled pedestrian crossings of the LRT can be provided in some circumstances. Options include what are referred to as "Z" crossings (in which the path provided for pedestrians' forces them to be looking in the direction of an approaching train as they cross each side of the tracks). Other forms of pedestrian crossing can also be considered, employing a variety of different signage and/or train-actuated warning devices.

In establishing the recommended access management plans, provision of direct neighbourhood connections to and from the LRT alignment was the primary objective. In some cases, however, indirect routing of vehicles will be required because of the need to limit the number of signalized intersections along the LRT route. For example, in situations where left-turn movements into a neighbourhood are not accommodated, drivers may need to make three right turns to get to a signalized intersection where they will be able to make a through movement across the tracks.

Provision of indirect access for residential areas was considered to be more acceptable than it would be for access to and from a commercial area. This recognizes the high degree of familiarity that residents would have with access options for their neighbourhood. Conversely, commercial developments rely on easy and direct access for patrons.

2.4 Utilities and Drainage

The proposed W LRT project will generate numerous wide-ranging impacts to the existing utilities. Existing municipal services within the corridor include major trunk sewers and watermains, local sewers and watermains, telecommunication duct banks, and oil and gas pipelines. Together with associated service and access manholes, individual building services and surface catchbasins and leads.

Storm water runoff and the increased impervious areas along the corridor, as well as in the tunnel sections in the Quarters and Wagner areas, will impact drainage system capacity, storage, and discharge. Existing drainage systems will have to be assessed for these effects.

At this level of study, some utilities and service locations require further investigation. Verifying locations and identifying mitigations in the next stage of engineering will help optimize the construction cost and identify schedule implications.

2.5 Geotechnical, Environmental, and Historical Resources

During the corridor selection and alignment selection phases, geotechnical, environmental and historical impact assessments were conducted in order to establish any fatal flaws within the corridor or the alignment. The assessments were limited to a desktop evaluation of previously published data and reports. No geotechnical drilling investigation of the recommended alignment was performed.

The geotechnical review identified that the majority of subsurface along the W corridor consists of glaciolacustrine deposits of bedded sands, silts, and clays; and glacial till, consisting of a silty clay matrix containing sand layers, cobbles, and boulders. Clay shale and sandstone bedrock, containing coal seams and bentonite layers, can be found at various depths along the alignment. There were no major geotechnical constraints identified with the West track alignment, with the siting of an overpass at West Edmonton Mall and Misericordia Hospital, or at the Groat Road bridge location.

A Phase I Environmental Site Assessment (ESA) was not carried out for this level of engineering. However, a desk-top environmental review was undertaken and identified several locations which have the potential to impact the quality of soil and groundwater of sites along the corridor.

A Historical Resources Overview (HRO) of the W LRT alignment included primarily archaeological and palaeontological sites, Aboriginal traditional use sites of a historic resource nature, and historic structures. Approximately 11 historical sites have been identified along SPR and 104 Avenue adjacent to the alignment.

2.6 Noise and Vibration

In the process of consultation with the public, noise and vibration impacts were raised as a concern for residences and businesses located along the transportation corridors traversed by the W LRT alignment. In an effort to address these issues, noise monitoring measured the existing noise levels; these levels were then compared with levels projected for the year 2041 traffic volumes and LRT combined. The results of the baseline noise monitoring indicated sound levels ranging from 57.0 to 64.9 dBA $_{Leq24}$ as measured in the rear outdoor amenity area. At all locations, the noise climate was dominated by either local traffic on the main or adjacent roads. The monitoring indicated that the noise climate was generally broadband in nature, with no tonal components and no dominant stationary sources.

There are no segments of the alignment that were found to require noise attenuation as per the City Urban Noise Policy.

The vibration study for W LRT will be undertaken in the next stage of design.

2.7 Property Acquisition

As expressed earlier in this report, minimizing land-taking was one of the guiding principles for the design of the urban LRT system. However, there were several instances where, despite this guiding principle, land had to be acquired to fit the system into the urban fabric. Typically, land would be required to help accommodate the following:

- insufficient ROW available to fit the critical elements
- insufficient space at station locations
- turning movements at intersections
- smoothed curvature of the track at tight turns
- systems infrastructure such as sub-stations and maintenance facilities

The approach used in handling property acquisition, wherever property was required, first examined the potential for a partial taking or sliver as opposed to taking the entire property. Where it was determined that the sliver required was large or that the building on the property was impacted, the entire parcel was identified for taking. Additionally, when land-taking was confirmed to be necessary for the project, construction lay-down or staging-area opportunities were contemplated for those parcels to assist in the construction of the adjacent segment. The potential property requirements are indentified in the red shading in Figures 1 to 14.

2.8 Stakeholder Consultation

Building on consultation and outreach carried out at the earlier corridor planning phase, the City conducted a comprehensive public consultation process through concept engineering. Public input shaped the outcome of the project as alignment, station and access alternatives were identified, evaluated and incorporated into the final concept recommendation.

The public consultation process included individual stakeholder surveys, on-line comment opportunities, public workshops, public open houses and public information sessions. Public input provided was a key consideration by the project team when developing their recommendation.

2.9 Cost Estimating

A cost estimate has been prepared for the conceptual plan. Cost estimating techniques, commensurate with the level of engineering design to date, were used to develop the estimate. The cost estimate is based on the following:

- Recent costs for similar, competitively tendered work carried out in the City (such as structures, tunneling, and roadworks)
- Industry rates for comparable projects from multiple sources, including LRT projects elsewhere in North America
- Unit rate-based build-up of costs

To this total estimated capital cost is applied an “Incremental Risk Pricing Adjustment”, to harmonize the parametric-based capital cost estimate with the risk-adjusted estimate developed as part of the probabilistic risk analysis undertaken by the project’s Financial Advisor. On this basis, and at this level of conceptual design development, total estimated capital cost is $1.06 billion (2010 dollars). Exhibit 2-1 provides a breakdown of the cost by major cost elements.

EXHIBIT2-1
West LRT Capital Cost Concept Level Estimate

Capital Cost Category		Millions
Construction		$635
Roadwork & Trackwork	*$335*	
Structures	*$ 105*	
Signals & Systems	*$ 135*	
Stations	*$ 60*	
Vehicles		$ 225
Land		$ 100
Engineering & Construction Administration		$ 100
Total 2010/11 Real Dollars (Billions)		**$ 1.06**
Total Inflated to 2016 Dollars (Billions)		**$ 1.24**

SECTION 3

Special Study Areas

Consultation has been an essential part of the Concept Planning for the recommended alignment of the W LRT. Throughout this year, the general public, business groups, special interest groups, community associations, and City Stakeholder groups have been engaged through various workshops, meetings, events, and online surveys and questionnaires. The collected input has been influential in shaping the alignment recommendation.

Through the consultation process, a few areas were identified to be of particular interest, importance, and concern. These areas are discussed as follows.

3.1 87 Avenue and 178 Street Intersection

This intersection serves high volumes of both north-south and east-west traffic, including a mix of commuter traffic and West Edmonton Mall (WEM) traffic. Given the size and nature of the mall, this intersection is subject to more fluctuation in daily and peak-hour traffic volumes than a typical intersection along the W LRT route. Based on this, the LRT grade-separation proposed across the southern face of the WEM site was considered for continuation over 178 Street before returning to grade. However, providing this grade separation would be inconsistent with one of the basic premises of the new LRT line: specifically, that grade-separations would be provided only at railway crossings, crossings of the Inner Ring Road, and crossings of access-controlled freeways, or where technically required to achieve the required vertical profile. The recommended alignment configuration calls for an at-grade crossing of 178 Street, on the south side of 87 Avenue. Based on 2041 weekday AM and PM peak hour traffic projections, this intersection will operate close to capacity. In addition, roadways surrounding large retail centres can experience regular weekend peaks in traffic demand which exceed the weekday peaks. Therefore, it is recommended that the arrival pattern of the train at this location be controlled to minimize impacts on traffic flow (as discussed in Section 2.3.2).

3.2 87 Avenue On-street Parking and Speed Reduction

Several sections of 87 Avenue currently benefit from parallel service roads which provide for on-street parking, as well as a slower traffic environment directly in front of homes. In order to fit in the LRT along this route, while respecting the key objective of minimizing property acquisition, removal of the service roads is proposed. Where feasible, on-street parking will be maintained, though it will become part of the 87 Avenue cross section and will have no separation from east-west through traffic on 87 Avenue. This will require a reduction in the posted speed limit on 87 Avenue, from 60 to 50 km/h, from 170 Street to 156 Street. An alternative solution, featuring retention of service roads plus LRT, is not feasible without significant property acquisition.

3.3 Meadowlark Road versus 156 Street

At the corridor planning level for the West LRT, the turn required to shift the LRT from 87 Avenue to 156 Street was proposed to occur at Meadowlark Road, along the back side of the shopping centre. However, a more detailed review of operational impacts has reflected the important role of Meadowlark Road as a connection to Whitemud Drive; accordingly, the route was adjusted to make a 90 degree turn from 87 Avenue directly onto 156 Street and to run along the east side of the retail centre. This design reduces the impact on the 87 Avenue / Meadowlark Road intersection and results in less disruption to traffic heading south on 159 Street to Whitemud Drive.

The 156 Street alignment also provides more direct service to the higher density residential neighbourhoods located south and east of Meadowlark Mall and allows for more optimal station placement. From an LRT operations perspective, the 87 Avenue to 156 Street alignment results in fewer turns than the Meadowlark Road alignment, which in turn will help minimize noise and maintenance costs. The 87 Avenue to 156 Street alignment follows the curve of Meadowlark Road around the west side of the mall, then turns onto 156 Street at the north end of the mall.

Further review from a traffic and LRT operations perspective led to the conversion of 156 Street between 87 Avenue and 89 Avenue to one-way northbound.

3.4 Stony Plain Road Business District

As described in the alignment walkthrough, SPR Business District is a historical commercial area that is based around a narrow, four-lane arterial roadway, with some on-street and off–peak parking. The Stony Plain Road and Area Business Revitalization Zone has been working on enhancements to the commercial strip through streetscape improvements, economic development initiatives, and facade improvement programs. In conjunction with the revitalization initiatives, the LRT is envisioned as a significant catalyst for renewal of the area and future transit-oriented development (TOD).

Through the consultation process, the business community has expressed concerns about the impact on parking, access, and traffic in the area once the LRT is implemented. The roadway between 156 Street and 149 Street is very constrained with only 20 m of public ROW available. In order to accommodate the LRT, only one wide lane of traffic in each direction can be maintained with limited on-street parking potential. It is proposed that parking on the side streets can be converted to diagonal parking to make up the loss of on street parking and alley way improvements can effectively give the businesses two business fronts and back-lane access for their customers. Also, as a part of the Stony Plain Road Revitalization Project, there is a direction to acquire 3 m of private property to enhance the public realm including such upgrades as sidewalks and landscaping and to provide on-street parking in certain segments.

In regards to traffic access, negative impacts to business activity in the area are feared as a result of changing the current SPR arterial roadway to a road more resembling a collector. The tight ROW precludes the opportunity of creating left-hand turns leaving SPR, as providing them would require substantial property acquisition. Intermediate block

signaling is planned in the business area to allow jug-handle-type movements to gain access across the tracks. A way-finding signage program will also work to address circulation.

Businesses have also expressed that snow removal is a significant concern in this area. Provisions for this activity will require specialty treatment and handling. The road width proposed will provide a wide enough travel lane to allow some on-street snow storage, as well as some utilization of side street snow storage capacity.

3.5 149 Street Intersection

The design of the SPR/149 Street intersection is premised on a reduction in traffic volumes. This decrease is caused by the reduction in east-west capacity along SPR resulting from the removal of one through lane in each. A north-running LRT alignment option through this intersection was considered but not recommended, because the tracks would have to remain on the north side through the Grovenor neighbourhood to 142 Street. A side-running alignment in a narrow ROW requires a wider cross section in order to provide a safety buffer between the track and the sidewalks. This would require property acquisition through the Grovenor neighborhood. This alignment arrangement would also create access constraints on the north side of SPR.

2041 horizon forecast traffic volumes continue to show a heavy northbound-to-eastbound right turn in the morning and a corresponding heavy westbound-to-southbound left turn in the afternoon. There are also significant north-south traffic flows through this intersection, presumably caused by the reduction in north-south capacity on 156 Street and diversion to 107 Avenue due to the reduction in east-west capacity on SPR. Based on the 2041 forecasts, this intersection will be operating at or close to capacity during peak hours. It is recommended that a second westbound lane through the intersection be investigated in later stages of design to help alleviate capacity and queuing concerns.

3.6 142 Street Intersection & Stony Plain Road/102 Avenue Junction

The intersection of 142 Street and SPR combined with the junction where 102 Avenue merges into Stony Plain Road, 230 m to the east, is an area of complex traffic operations.

A north running LRT alignment to the north side of Stony Plain Road is proposed through this area specifically to minimize operational impacts on the heavy left-turn movement from Stony Plain Road to 142 Street southbound in the afternoon peak period. Multiple laning configurations for the SPR/102 Ave junction, the 142 Street intersection, and the short segment of Stony Plain Road in between were reviewed. The ultimate goal in this review was to provide sufficient capacity, while keeping the operation as close as possible to how the various movements interact currently, to minimize the potential for driver confusion. The lane arrangement reflected in the recommended plan accomplishes this goal. It is recommended that a second westbound lane through the intersection be investigated in later stages of design to help alleviate capacity and queuing concerns.

The north running alignment also has the benefit of closely integrating the 142 Street Station with the Vision on the Corner redevelopment site.

3.7 Groat Estates Access Management

Access concerns have been raised by the property owners in Groat Estates, which is located on the south side of Stony Plain Road immediately east of the bridge crossing Groat Road. Approximately 18 properties in this vicinity are only accessible from SPR with no internal road circulation between these properties, and no alternate routes are available for them to access their properties. The City has recognized this area as a special case, where due to lack of a supporting roadway network, a number of options were examined to preserve reasonable access from all directions onto SPR.

The property owners have requested that a north-running option in this location be investigated as it would allow their access to essentially stay exactly as it stands today, with left hand turns possible from SPR. After a thorough investigation this option was dismissed as the drawbacks outweighed the fore mentioned benefits. It was concluded that in comparison to the centre running option, this alignment resulted in more property impacts, affected property access on the north side of SPR; was inconsistent with overall design philosophy; required that the roadway crossed the tracks twice in a short area; introduced additional turns into the alignments which result in potential for higher maintenance costs and noise impacts.

In contrast, the recommended center running alignment provides an overall balance of LRT and motor vehicle interface safety, as well as minimizes operational challenges and land requirements. Special u-turn type movement intersections were provided just east of the bridge over Groat Road and at 127 Street, to accommodate access into the Groat Estates properties.