

District of North Vancouver

# Lower Lynn Transportation Strategy



January 2011

Prepared for:



**NORTH VANCOUVER**  
DISTRICT

355 West Queens Road  
North Vancouver, BC  
V7N 4N5

Prepared by:



**FEHR & PEERS**

11410 NE 122nd Way  
Suite 320  
Kirkland, WA 98034

## TABLE OF CONTENTS

<b>Chapter 1: Existing Conditions.....</b>	<b>2</b>
Land Use Framework.....	2
Transportation Framework.....	4
Bicycle Access and Parking.....	4
Pedestrian Access .....	6
Transit Access.....	7
Freight Access .....	9
Vehicle Access.....	9
Key Plans .....	14
Key Issues.....	16
<b>Chapter 2: Traffic Analysis.....</b>	<b>18</b>
North Vancouver Data .....	19
Methodology.....	19
Neighbourhood Characteristics Included in the Adjustment.....	20
Trip Generation and Future Traffic Volume Results .....	20
Traffic Operations .....	23
<b>Chapter 3: Recommendations .....</b>	<b>25</b>
Transportation Demand Management.....	25
Pedestrians .....	25
Bicycles.....	33
Transit.....	36
Vehicles and Freight .....	41
Conclusions.....	47
<b>Appendix A: Regional Scenarios Analysis.....</b>	<b>50</b>

## TABLE OF FIGURES

<b>Figure 1: Land Use Map.....</b>	<b>3</b>
<b>Figure 2: Existing and Proposed Bikeways.....</b>	<b>5</b>
<b>Figure 3: Existing Transit Routes.....</b>	<b>8</b>
<b>Figure 4: Peak Hour Traffic Volumes .....</b>	<b>10</b>
<b>Figure 5: Mountain Highway Traffic Origin-Destination Results.....</b>	<b>12</b>
<b>Figure 6: Keith Road Traffic Origin-Destination Results.....</b>	<b>13</b>
<b>Figure 7: Lower Lynn Issues.....</b>	<b>17</b>
<b>Figure 8: 2030 Traffic Volumes with Baseline Road Network.....</b>	<b>21</b>
<b>Figure 9: 2030 Traffic Volumes with Realigned Keith Road.....</b>	<b>22</b>
<b>Figure 10: Primary Pedestrian/Bicycle Network .....</b>	<b>26</b>
<b>Figure 11: Median Extension on Mountain Highway .....</b>	<b>29</b>
<b>Figure 12: Addition of Cut Medians on Mountain Highway .....</b>	<b>30</b>
<b>Figure 13: Addition of Crosswalks and Paved Paths from Oxford Street ..</b>	<b>31</b>
<b>Figure 14: Crown Street Extension to Park and Tilford Shopping Centre.....</b>	<b>32</b>
<b>Figure 15: Bicycle Master Plan Priority Improvements .....</b>	<b>34</b>
<b>Figure 16: Primary and Secondary Transit Network.....</b>	<b>37</b>
<b>Figure 17: Transit Improvements .....</b>	<b>40</b>
<b>Figure 18: Primary Vehicle and Freight Network .....</b>	<b>44</b>
<b>Figure 19: Keith Road Options .....</b>	<b>46</b>
<b>Figure 20: Lower Lynn Transportation Strategy Capital Improvement Program...</b>	<b>48</b>
<b>Figure 21: Consolidated Network.....</b>	<b>49</b>

## Chapter 1: Existing Conditions

This chapter includes discussion of the land use, policy, and transportation contexts in the Lower Lynn neighbourhood. Its intent is to frame the transportation analysis and establish guiding principles for future recommendations. Figure 1 shows the boundaries of the study area.

### Land Use Framework

As noted in the *Lower Lynn Official Community Plan*, “nearly every category of urban land use is represented within an area only one square kilometre in size.” By design, Mountain Highway forms a firm boundary between industrial and residential uses. Retail uses line Main Street, and medium and heavy industry continue south of Main Street to Burrard Inlet.

The housing stock in the neighbourhood varies in condition, but it is largely composed of single family homes. As such, the population density is low by urban standards (around 38 people per hectare), and according to the 2006 Census, it has experienced very little growth in the recent past.

The light industrial uses west of Mountain Highway appeared after the District rezoned the land in 1957. Main Street offers a mix of retail, which is largely auto-oriented with varying setbacks from the sidewalk and large parking lots. Further west on Brooksbank Avenue, the Park and Tilford Shopping Centre offers additional retail. South of Main Street, the neighbourhood character transitions again to medium and heavy industry across the Canadian National Railway (CNR) tracks. This part of the waterfront is part of the Port Metro Vancouver, which plays a pivotal role in the local and national economies.

The neighbourhood includes land outside the District of North Vancouver, including lands within the City, under the authority of Port Metro Vancouver, roads under the jurisdiction of the Province, facilities controlled by TransLink, and lands under the jurisdiction of the Squamish Nation. Orwell Street is the eastern border between District and Squamish lands, which extend across

the Trans Canadian Highway (Highway 1) to the Seymour River.

The planning area for this study also includes Capilano University’s main campus, which is east of Lillooet Road on Purcell Way. The University serves approximately 7,200 students per term, all of whom receive a Universal Transit Pass (U-Pass) as part of their student fees. U-Pass provides unlimited, all zone access to public transit in Metro Vancouver at a reduced cost, including unlimited access to TransLink Bus, SkyTrain, SeaBus services, and the West Coast Express. Capilano University is mostly a commuter campus, and it is a major centre for education and jobs in the District.

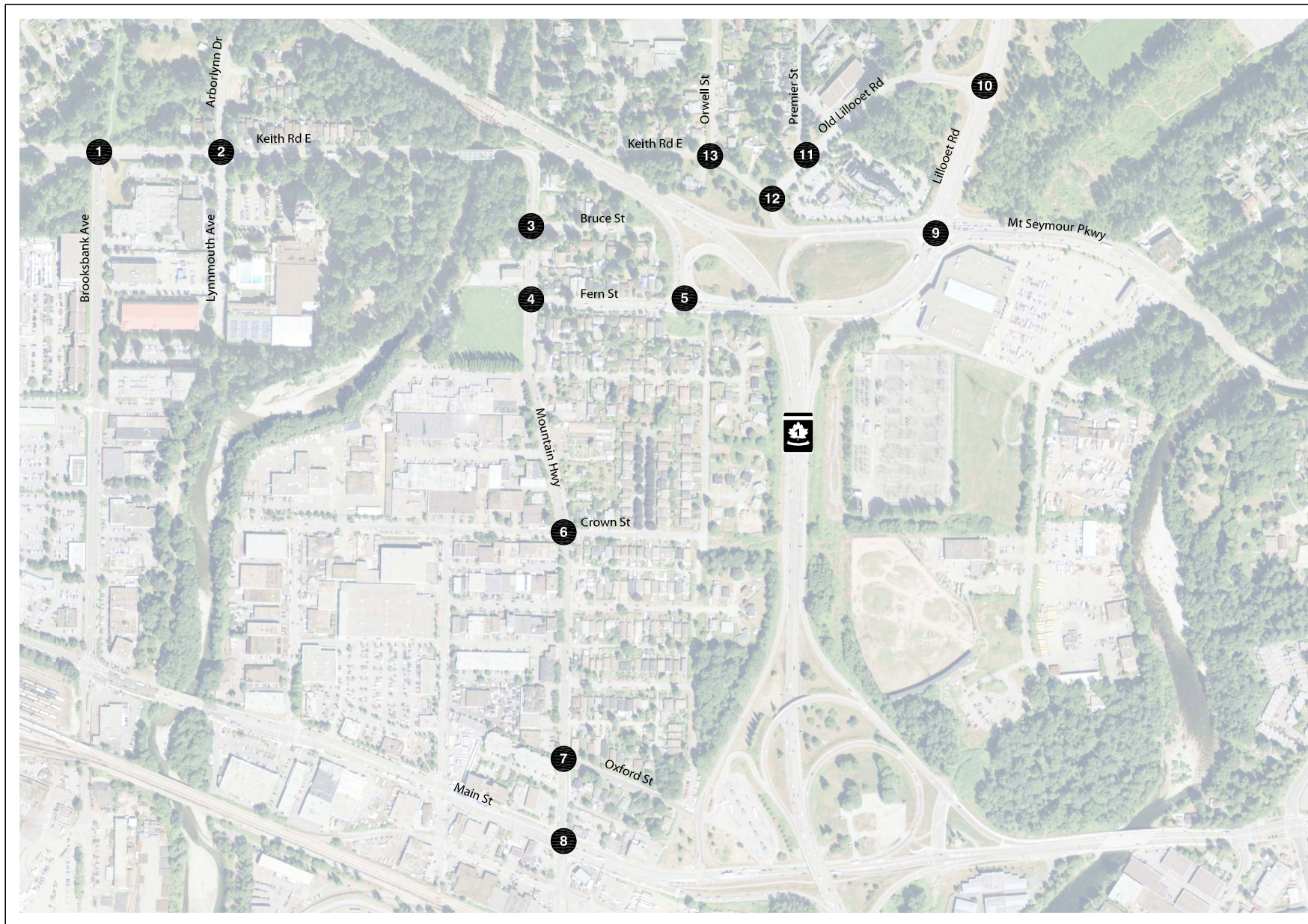
Seylynn and Bridgman Parks frame Lynn Creek, affording recreational opportunities. The trails along the Creek are well-used and valued by the community.

The stakeholders in the neighbourhood partnered in this study under the guidance of the District, recognizing the key role of partnerships and collaboration in implementing the Lower Lynn Vision.

Figure 1 summarizes the land use framework and the primary and secondary study area boundaries.

### *Lower Lynn Vision*

Lower Lynn will become a transit-oriented mixed use community comprised of a wide range of housing types for people of all stages of life, all incomes, with accessible places of work, convenient shopping and amenities. Over time it will seek to become an outstanding model of urban living in harmony with the North Shore’s natural environment.



- LEGEND**
- Turn Lane
  - AM (PM) Peak Hour Traffic Volume
  - Study Intersection

**N**  
NOT TO SCALE

<p><b>1. Keith Rd E/Brooksbank Ave</b></p>	<p><b>2. Keith Rd E/Lynnmouth Ave/Arborlynn Dr</b></p> <p>AM/PM: 11-08</p>	<p><b>3. Bruce St/Mountain Hwy</b></p> <p>AM/PM: 11-08</p>	
<p><b>4. Fern St/Mountain Hwy</b></p> <p>AM/PM: 11-08</p>	<p><b>5. Fern St/Upper Levels Hwy SB Ramps</b></p> <p>AM/PM: 11-08</p>	<p><b>6. Crown St/Mountain Hwy</b></p> <p>AM/PM: 11-08</p>	
<p><b>7. Oxford St/Mountain Hwy</b></p> <p>AM/PM: 10-07</p>	<p><b>8. Main St/Mountain Hwy</b></p> <p>AM/PM: 03-08</p>	<p><b>9. Mt Seymour Pkwy/Lillooet Rd</b></p> <p>AM/PM: ??-07</p>	
<p><b>10. Old Lillooet Rd/Lillooet Rd</b></p> <p>AM/PM: ??-07</p>	<p><b>11. Lillooet Rd/Premier St</b></p> <p>AM/PM: ??-07</p>	<p><b>12. Keith Rd E/Old Lillooet Rd/Mt Seymour Pkwy</b></p> <p>AM/PM: ??-07</p>	<p><b>13. Keith Rd E/Orwell St</b></p> <p>AM/PM: ??-07</p>

## Transportation Framework

Neighbourhood circulation contends with significant barriers, both natural and man-made. These barriers present a critical challenge to knitting Lower Lynn into the surrounding neighbourhoods. Barriers include Highway 1 to the north and east; Lynn Creek to the west, and Burrard Inlet to the south.

The neighbourhood includes two access points to the Ironworkers' Memorial Second Narrows Bridge, which is one of two vehicle connections between the North Shore and Vancouver. In order to improve neighbourhood transportation and achieve the vision of the Lower Lynn Concept Plan, this analysis must include ideas to reduce the impacts of these regional access points.

## Bicycle Access and Parking

Presently, there are limited dedicated bicycle facilities in the neighbourhood. On-street bikeways include a morning peak hour southbound diamond lane shared with transit along Mountain Highway, a bicycle lane along eastbound Main Street, shared lane markings along westbound Main Street, and signed bike routes along Barrow Street east of Harbour Avenue and Fern Street. An unpaved trail runs along Lynn Creek, which continues underneath the Keith Road and Highway 1 bridges. Support facilities are also in short supply. Phibbs Exchange offers a small number of short-term bicycle parking spaces.

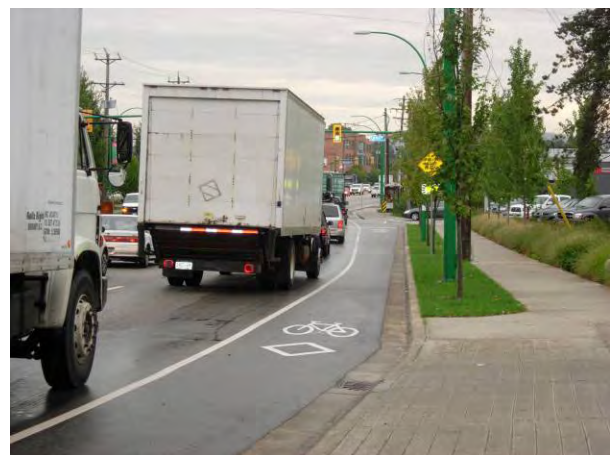
Two documents provide guidance for future plans. The *North Vancouver Bicycle Master Plan* includes a greenway along Seymour Creek and priority improvements along Mountain Highway (an upgrade to bicycle lanes), Main Street, Fern Street, and Mt. Seymour Parkway. The plan also recommends a new bridge over Mount Seymour Parkway connecting Lillooet Road and Seymour Boulevard.

The second document is the *Spirit Trail Route Planning Report*, which the District produced. The planning is coordinated among the North Shore municipalities and First Nations. The Spirit Trail would provide

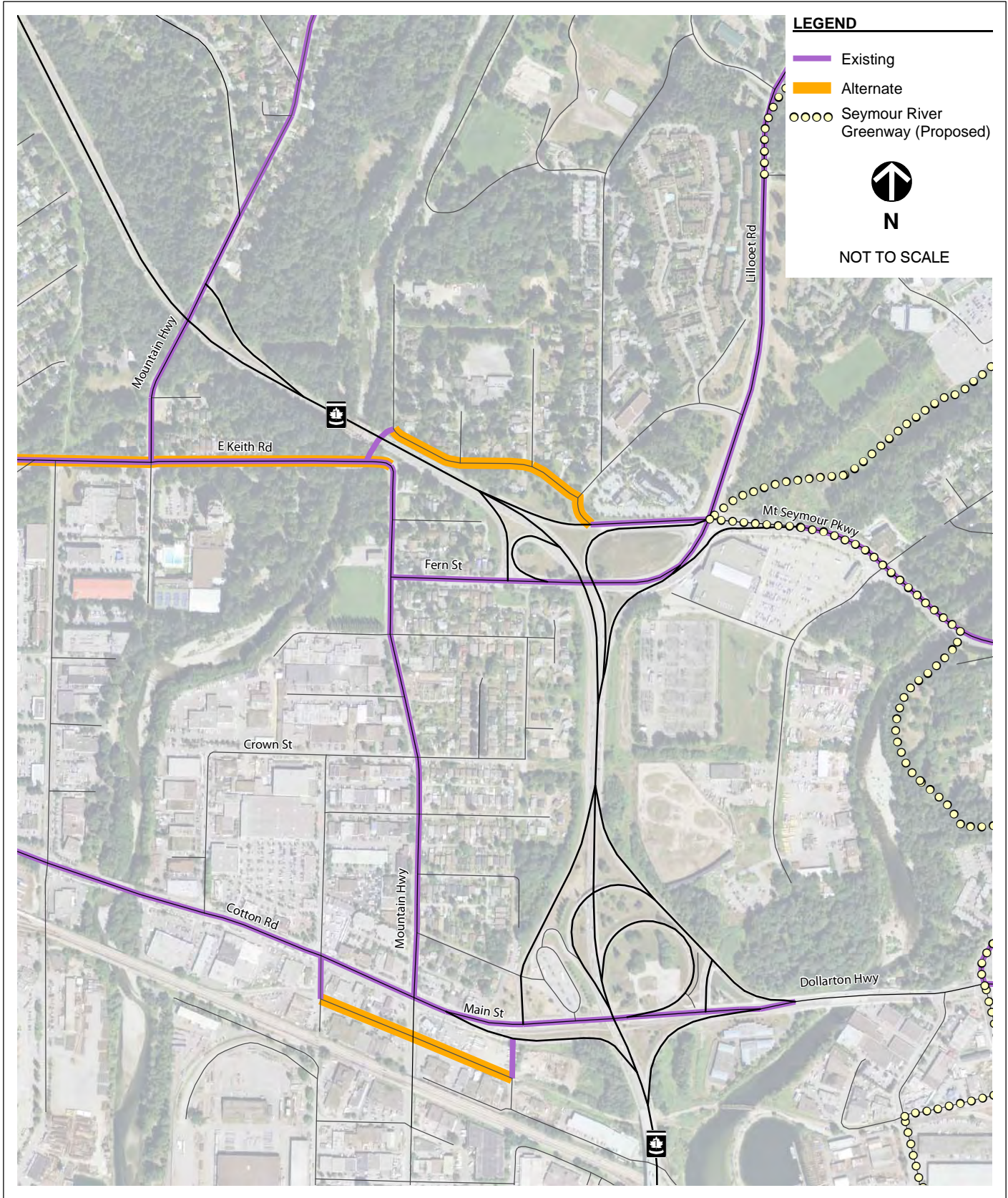
a waterfront-oriented trail to connect Horseshoe Bay to Deep Cove, although its alignment is undetermined in the vicinity of Lower Lynn.



*Short-term bicycle parking at Phibbs Exchange*



*New bicycle lane on Main Street at Harbour, where cyclists are directed to a parallel route on Barrow Street connecting to a bridge across Seymour Creek*



## Pedestrian Access

The pedestrian network in the neighbourhood consists of sidewalks, crosswalks, and trails. Presently, major pedestrian destinations include Phibbs Exchange, Main Street retail, the Park and Tilford Shopping Centre, Capilano University, and the parks along Lynn Creek (Seylynn and Bridgman). Additionally, there are two schools, the Lynnmour School and the Keith Lynn Alternative School, north of Highway 1.

Sidewalks in the neighbourhood are characteristic of older residential streets. Where they exist, they are mostly narrow, and sidewalk furniture such as street signs and mailboxes must compete for limited space. A few segments of Mountain Highway have on-street parking, which forms a buffer between the sidewalk and traffic, and there is an intermittent landscape strip along Mountain Highway south of Crown Street. A few sections of the roadway have missing sidewalks, notably Keith Road on the approach to the Keith Road Bridge, and parts of the west side of Mountain Highway south of Fern Street. Sidewalks are intermittent on the side streets in the residential and light industrial neighbourhoods, and they disappear south of Main Street in the industrial area.

The trails along Lynn Creek vary from crushed granite to dirt, and there are not good connections across the Creek. In order to cross, pedestrians climb up stairs to the Keith Road Bridge across a walkway on the north side, and then come back down to the trail.

Crosswalks are mostly at controlled intersections and almost exclusively actuated, meaning a pedestrian pushes a button to get the walk indication.

Access to the Phibbs Exchange is worthy of special consideration. Currently, the pedestrian connections to the transit center are minimal. There are unpaved paths to the east and a sidewalk on the north side of Oxford Street between Mountain Highway and the Exchange. The lighting is minimal in the parking area used by riders, and there

is no pedestrian-scale lighting at the Exchange itself.

Within the neighbourhood, the Seylynn Village project, which is on the northeast corner of the intersection of Mountain Highway and Fern Street, proposes to:

- Construct 2 metre wide sidewalks with a planting strip to provide separation from the traffic lanes on the north side of Fern Street and on the east side of Mountain Highway.
- Construct a lit, landscaped, paved walkway on the Orwell corridor between Fern Street and Phibbs Exchange.
- Improve the connections under the highway and Keith Road bridges.
- Construct a bike path between the proposed residential buildings and Highway 1, connecting Fern Street to Mountain Highway.



*Missing sidewalks at Keith Road Bridge*



*Pedestrian connection at Phibbs Exchange*

## Transit Access

Although there are multiple on-street transit stops in the area, the Phibbs Exchange provides the most frequent and extensive bus service. A key bus line (239) travels between Phibbs and Lonsdale Quay to connect to the SeaBus to Vancouver, which departs every 15 minutes.

The buses at Phibbs Exchange also provide regional connections into Vancouver and Burnaby and local connections throughout the North Shore. Currently, ten bus lines serve Phibbs Exchange. Several of them enter and exit the Ironworkers' Memorial Second Narrows Bridge at Dollarton Highway and use Oxford Street to and from Mountain Highway. For all but one of these, Phibbs Exchange is an endpoint of the route.

As noted in the bicycle and pedestrian sections, multi-modal connections are sub-standard. "Goat paths," or unofficial paths connecting to Phibbs Exchange are clearly visible, implying an unmet demand for pedestrian connections. Additionally, the small parking area to the west of the Exchange is poorly lit and under capacity, with spillover parking on Bond and Orwell Streets. There is no drop-off location, and drivers stop on Oxford Street and the Highway 1 off-ramp to drop off passengers, blocking the through lanes.

Apart from Phibbs Exchange, there are approximately 20 other on-street bus stops in the neighbourhood, which reflects a high level of both regional and local transit service. On-street stops typically provide few amenities, apart from the occasional bench or shelter.

There is a diamond lane in effect from 6:00AM to 10:00AM for transit vehicles and bicycles on southbound Mountain Highway south of Fern Street. However, there are no dedicated transit lanes apart from this, meaning that transit must wait in the same queues as vehicles along Keith Road, Main Street, and Mountain Highway most of the day. As noted, many of the buses use a short stretch of Oxford Street, which is primarily a residential street. However, there are no left turns permitted from Main Street

into the Exchange, necessitating a circuitous route along Oxford Street from Mountain Highway. This includes two constrained turns – a left turn from eastbound Main Street to northbound Mountain Highway and a right turn from northbound Mountain Highway to eastbound Oxford Street.

Figure 3 is a map of existing transit routes in the study area.



*Parking area at Phibbs Exchange*





*Bus bench on Mountain Highway*



*Bus turnout on Main Street*

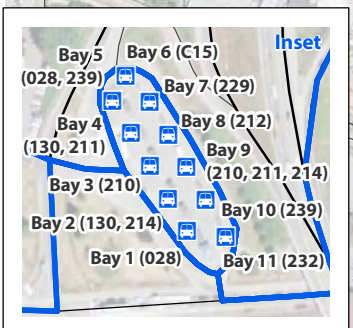
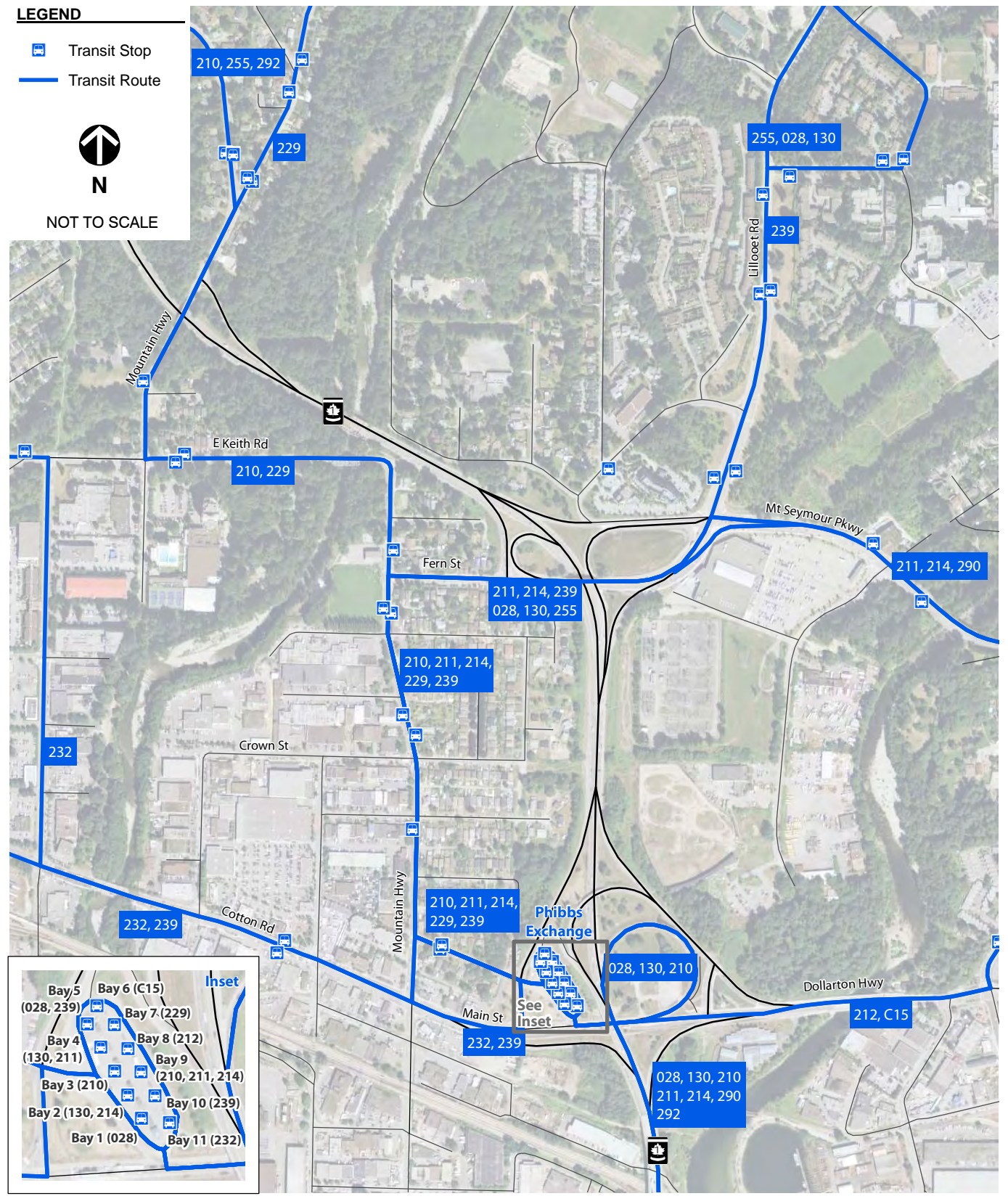


**LEGEND**

-  Transit Stop
-  Transit Route



NOT TO SCALE



**FEHR & PEERS**  
TRANSPORTATION CONSULTANTS

N:\2009Projects\SE\_Projects\SE09-0152\May2010\MXD\fig03\_transit\_studyArea4.mxd

## Freight Access

Canadian National Railway (CNR) tracks connect to a Port at the Burrard Inlet at the southern terminus of Mountain Highway. The CNR tracks continue across Burrard Inlet parallel to the Second Narrows Bridge. The primary truck and vehicle access to and from Highway 1 is at the Main Street/Dollarton Highway ramps. From Main Street, trucks turn south onto Mountain Highway, which passes under the CNR tracks.

The Vancouver Port Authority, TransLink, Transport Canada, and the BC Ministry of Transportation produced the *North Shore Trade Area Study* in the Fall of 2008. The study focused on three key areas: localized rail issues (rail yard reconfiguration), road access issues, and road/rail interface issues. Objectives of the study were to:

- Review previous studies.
- Identify issues related to capacity, efficiency, operation, safety, and access for existing and future years
- Recommend infrastructure strategies to provide benefits for all stakeholders.



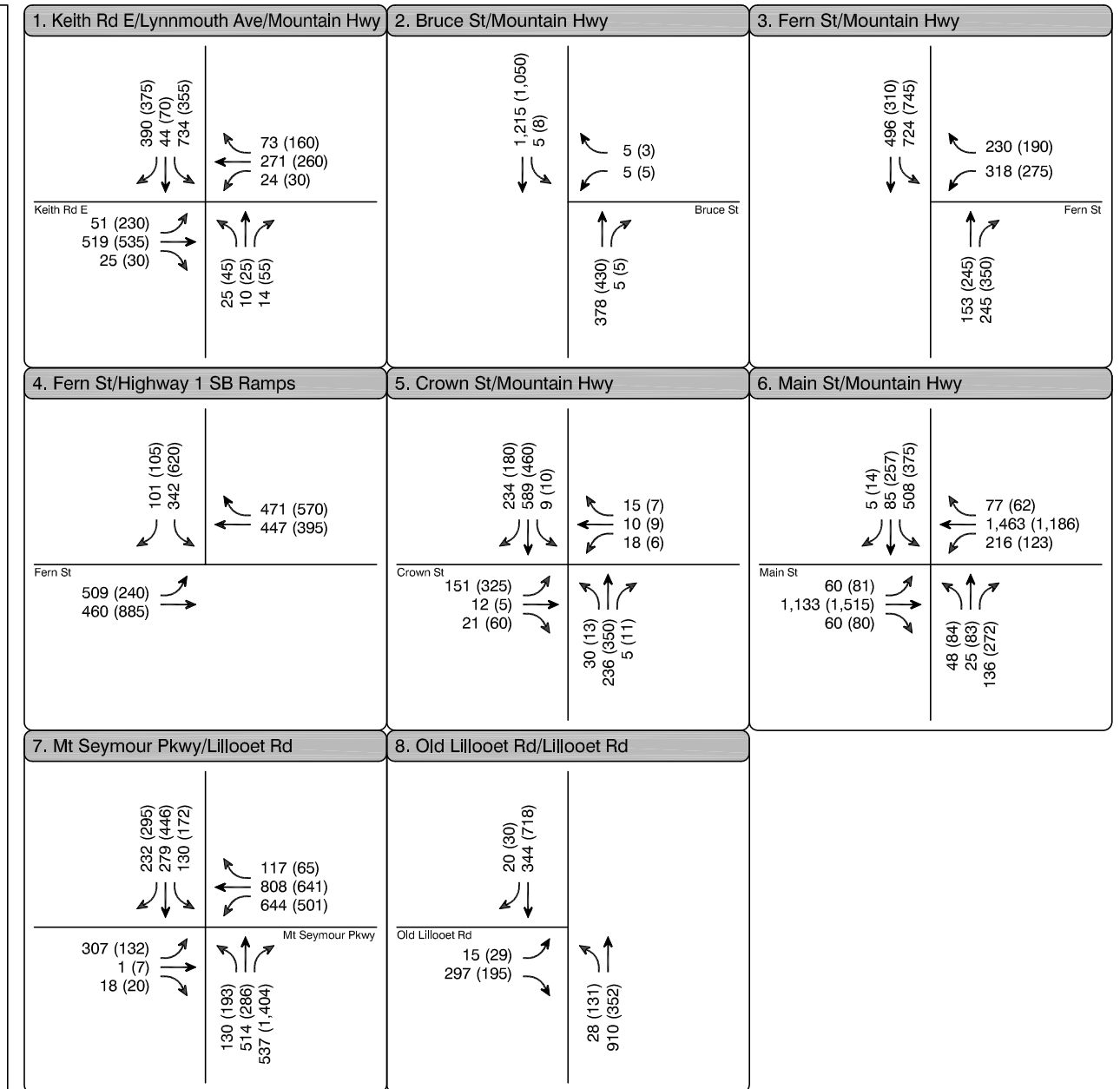
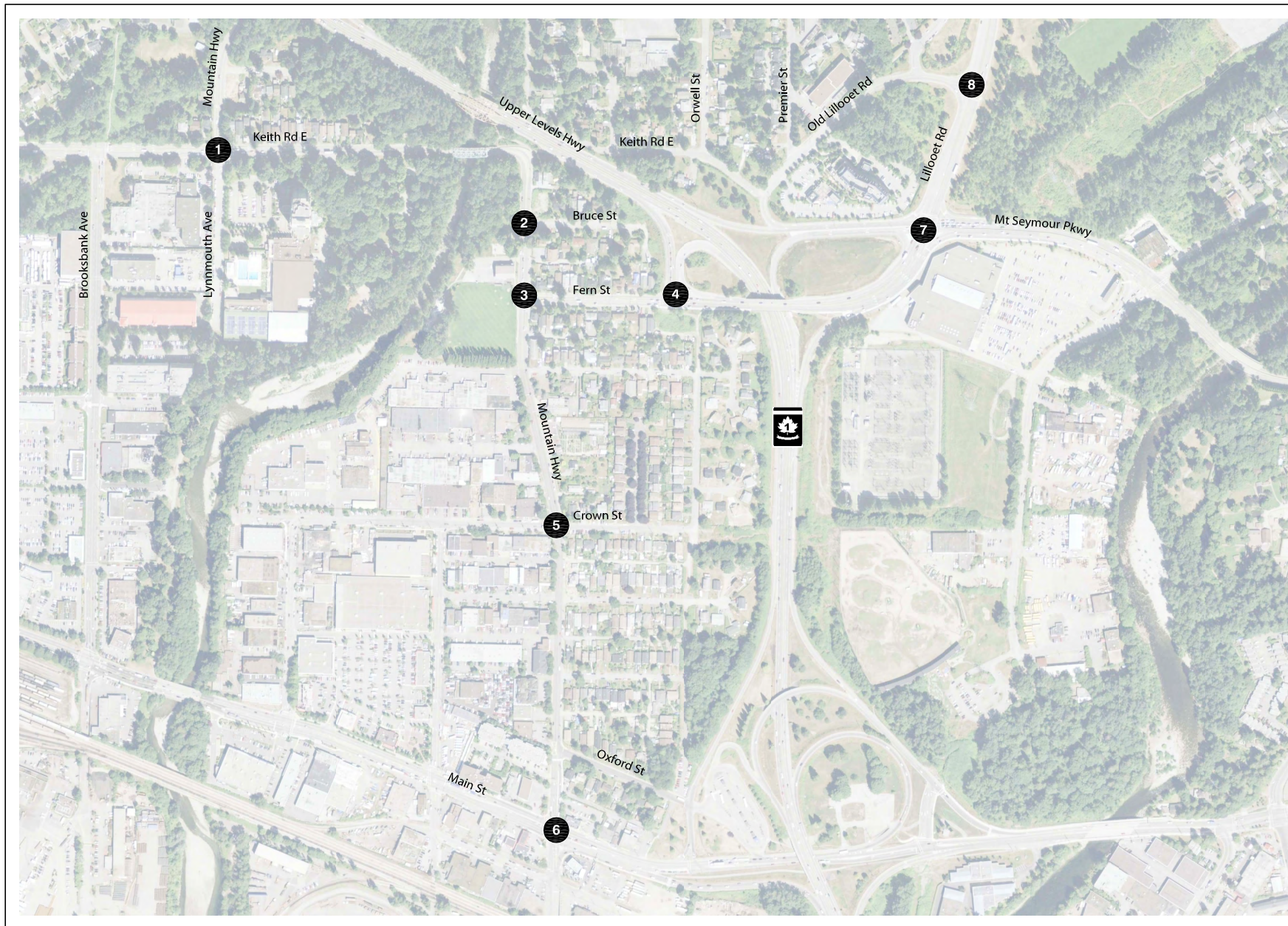
*Intersection at Mountain Highway and Oxford Street is frequently blocked.*

## Vehicle Access

Vehicle congestion and circulation patterns in the neighbourhood are directly attributable to its position as a regional hub. The transportation strategy will focus analysis on 13 study intersections, which form a primary circulation network. These intersections are:

1. Keith Road/Brooksbank Avenue
2. Keith Road/Lynnmouth Ave/Mountain Highway
3. Bruce Street/Mountain Highway
4. Fern Street/Mountain Highway
5. Fern Street/Highway 1 SB Ramps
6. Crown Street/Mountain Highway
7. Oxford Street/Mountain Highway
8. Main Street/Mountain Highway
9. Mt Seymour Parkway/Lillooet Road
10. Old Lillooet Road/Lillooet Road

Figure 4 illustrates existing counts for AM and PM peak hours.



**LEGEND**

- Turn Movement
- AM (PM) Peak Hour Traffic Volume
- Study Intersection



**N**

NOT TO SCALE

The neighbourhood is directly impacted by pass-through traffic on its way to one of the Highway 1 access points or between downtown North Vancouver and neighbourhoods to the east or Capilano University. Residents from Lynn Valley to the north and Maplewood and Seymour to the east pass through Lower Lynn, and once the Highway becomes congested, long queues form on Fern Street, Keith Road, and Mountain Highway. Drivers heading to their homes in North Vancouver intermingle with vehicles accessing the ramps at Fern Street, creating long delays which are exacerbated when there is an incident on either the Second Narrows or Lions Gate Bridges.

The analysis included a limited origin-destination license plate survey to establish regional travel patterns through the neighbourhood in the AM peak hour.

Survey locations consisted of the following:

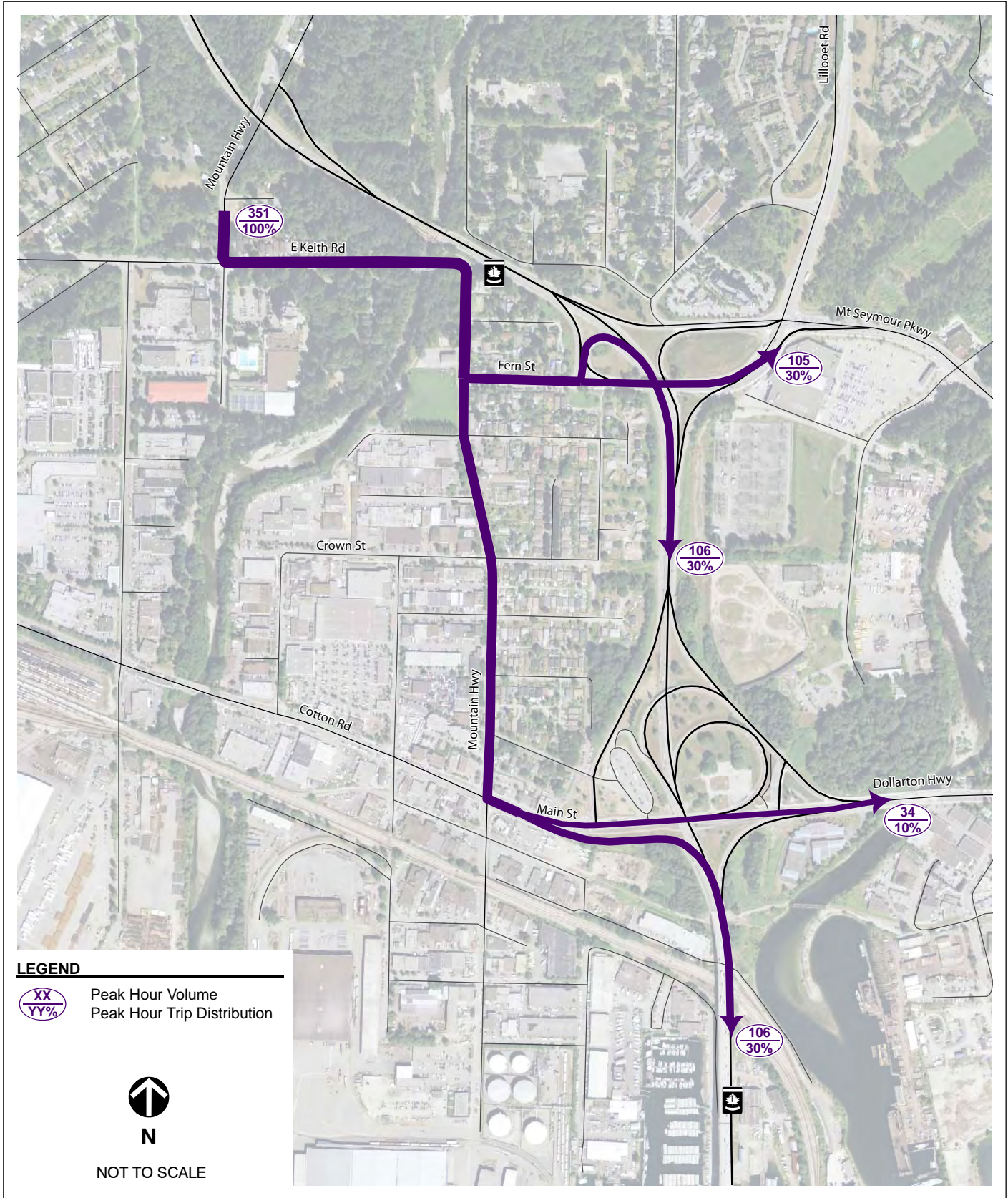
- Southbound Mountain Highway north of Keith Road
- Eastbound Keith Road west of Mountain Highway
- Northbound Fern Street south of Mt Seymour Parkway
- Highway 1 on-ramp at Fern Street
- Highway 1 on-ramp from Main Street
- Eastbound Main Street at Dollarton Highway just west of Highway 1

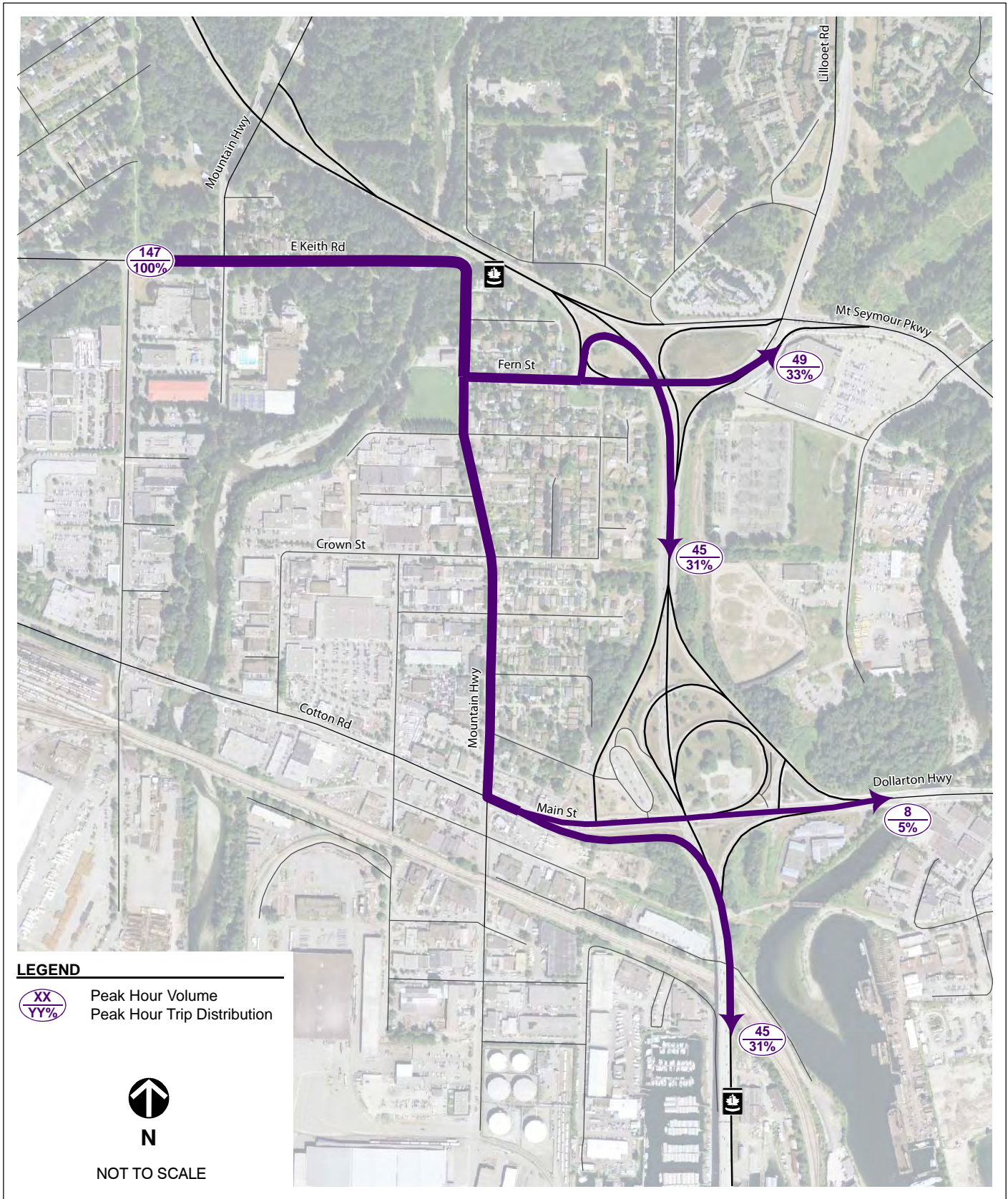
As summarized on Figures 5 and 6, the survey revealed that in the morning, 60 percent of traffic coming from north of Keith Road is headed to Highway 1, 30 percent is destined for eastbound Mt Seymour Parkway, and 10 percent heads east on Dollarton Highway.

A similar pattern emerged for traffic coming from the west along Keith Road, with 62 percent to Highway 1, 33 percent to eastbound Mt Seymour Parkway, and 8 percent to eastbound Dollarton Highway.

In both cases, traffic bound for Highway 1 in the morning splits evenly between the ramps at Fern Street and the ramps at Main Street/Dollarton Highway. This pattern confirms that a portion of the traffic on Mountain Highway cuts through Lower Lynn

to avoid queues on Highway 1. In addition, it is evident that around 40 percent of traffic on southbound Mountain Highway and eastbound Keith Road in the morning stays on the North Shore. Very little peak hour traffic is bound for Lower Lynn.





## Key Plans

The Lynnmour neighbourhood has been the subject of many local and regional planning efforts. Stakeholders in the neighbourhood include the District of North Vancouver, the City of North Vancouver, the Squamish Nation, TransLink, Port Metro Vancouver, Capilano University, North Vancouver School District #44, and the Ministry of Transportation and Infrastructure. Additionally, the Lynn Valley and Maplewood neighbourhoods have a keen interest in transportation improvements, as do the merchants along Main Street and at the Park and Tilford Shopping Centre. This section summarizes the policy context, as laid out in various plans.

The *Lower Lynn Official Community Plan* focuses mainly on land use. It was completed in 1993, and in 2008, the District completed a key update which designates the Fern Street area of North Vancouver as “Seylynn Village.” Seylynn Village is defined as “areas intended primarily for comprehensive redevelopment to a village centre with a sustainable mix of commercial, institutional, recreational and residential land uses integrated into the wider community by an effective network of pedestrian and cycling linkages.”

The *Lower Lynn Conceptual Plan* was an outgrowth of this update, rooted in a desire to revisit some of the future land use goals and form a vision for the community. Issues and opportunities identified in the Plan are as follows:

*Connectivity* – Existing pedestrian connections are generally poor due to a variety of barriers.

*Community Building* – Many public amenities and services are not conveniently accessible to Lower Lynn residents.

*Area Revitalization* – The livability of the area has been impacted by the Highway and building conditions have deteriorated in many cases.

*Housing Objectives* – Provision of affordable housing for workers, young families and

affordable rental housing are high priority housing needs in the District.

*Safety and Security* – Seylynn Park, Lynn Creek trails, and Phibbs Exchange are perceived as isolated and unsafe after dark.

*Community Identity* – Lower Lynn lacks a centre to the community.

*Highway 1 Improvements* – Options for improvements, which would reduce traffic volumes within Lower Lynn, should be protected in conceptual planning.

*Squamish Nation Development Plans* – There are opportunities for collaboration with the Squamish Nation’s development proposal for Seymour Creek Village.

Key components of the concept plan directly related to transportation include:

- New or enhanced pedestrian routes connecting Lower Lynn to Park and Tilford Shopping Centre and to the proposed Seymour Creek Village following the Crown Street alignment.
- A mid-block greenway running from Seylynn Village (Fern Street) to Oxford Street and Phibbs Exchange.
- An east-west pedestrian connection from Oxford Street to Lynn Creek (long-term).
- Increased residential density east of Mountain Highway to encourage revitalization, support the provision of additional community amenities and development of a transit node at Phibbs Exchange
- A community “heart” at Crown Street and Mountain Highway.

The Plan illustrates an underlying desire to improve opportunities to bicycle, walk, and take transit, and to reduce the impact of auto trips and reflects the District’s commitment to a sustainable transportation strategy. In the broader planning context, the District’s *Bicycle Master Plan* reinforces the twin

goals of increasing transportation choices and improving safety. The District also recently completed a 100-Year Visioning Exercise, which adhered to the desire to:

- Create a strong network of liveable, complete communities
- Support a vibrant economy
- Foster a healthy environment

Planning initiatives spearheaded by others include:

- Squamish Nation Seymour Creek Village development plans. As of the date of this report, the nature of the redevelopment of these lands is unknown
- Ministry of Transportation design concepts for Highway 1 interchange improvements
- TransLink's *North Shore Area Transit Plan*
- The Spirit Trail
- The Port Metro Vancouver's *North Shore Area Trade Study*
- City of North Vancouver *Transportation Plan*

All of these stakeholders influence travel patterns in Lower Lynn and are affected by transportation strategies that will result from this plan.



## Key Issues

The following is a summary of issues raised in the Lower Lynn concept plan consultation, as well as those raised in other plans or observed in the neighbourhood. Each set of issues has an accompanying set of ideas worth exploring. It is meant to capture key issues that have not been raised in earlier sections. Figure 6 summarizes the issues.

### *Major Improvements/Highway 1 Access Issues*

- The Second Narrows bridge is a constraint, and capacity is fixed. While stakeholders acknowledge that there will be a queue to the bridge, it should shift as much as possible off neighbourhood streets and onto the Highway.
- Residents from neighbourhoods to the north and west often pass through Lower Lynn to access the freeway, which creates queues.
- Southbound traffic on the Highway comes down the grade at high speeds towards slowed or stopped traffic approaching the bridge.
- When there is an incident on the Second Narrows or Lions Gate Bridges, traffic can back up for blocks along Keith Road, Mountain Highway, and Main Street.

### Ideas

- A new interchange at Brooksbank - a new ramp that would complete the movements at the interchange and allow traffic to get directly onto Highway 1 rather than going through the neighbourhood.
- An Inter-River (north of Lower Lynn) frontage road to connect neighborhoods.
- A flyover connecting Mt. Seymour Parkway to Keith Road.
- A Fern Street extension through Bridgman and Seylynn Parks to straighten the 90-turn at Keith Road and Mountain Highway.

### *Phibbs Exchange*

#### Issues:

- Bus bays and parking area are over capacity.
- Pedestrian and bicycle connections are minimal.
- Buses must take a circuitous route along Oxford Street because of limited turns into the Exchange.
- Located far from Capilano University.
- Passenger waiting experience is poor.
- Perceived personal safety issues.

#### Ideas:

- Move Phibbs to a location where it is more comfortable to wait and where it is closer to higher density residential uses.
- Provide transit and bypass routes to get around the North Shore – an east-west Crown Street extension could provide dedicated transit lanes.
- Provide pedestrian-scale lighting, wayfinding signs, and stronger connections to the neighbourhood.
- Provide long-term bicycle parking.
- Provide transit-serving retail (coffee stand, dry cleaners, etc.) as an amenity that could provide increased security.

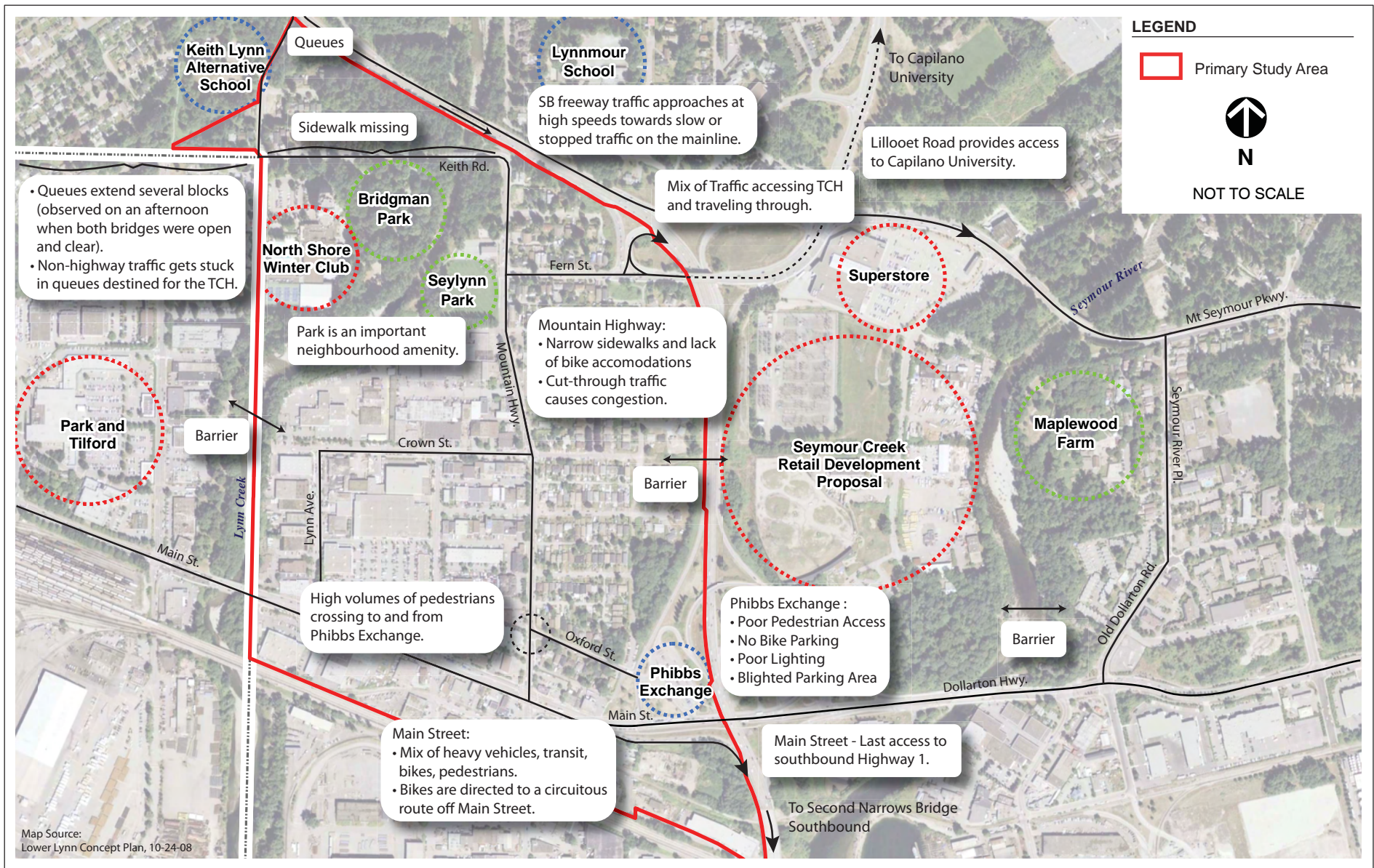
### *Other Circulation Issues*

#### Issues

- Truck traffic on Main Street conflicts with bicycles and pedestrians and gets delayed accessing the Port.
- Emergency access and traffic local to the North Shore mixes with Highway-bound queues, which creates delays.

#### Ideas:

- Improve Barrow Street and connections to the Main Street/Dollarton Highway ramps.
- Extend Crown Street across Lynn Creek and Highway 1 as a bicycle/pedestrian bridge that could be opened during emergencies for one-way vehicle access or consider providing transit lanes.



## Chapter 2: Traffic Analysis

The proposed future development in Lower Lynn will consist of a number of design features that could influence travel characteristics at the site, compared to lower density development with less access to transit. Our analysis quantifies the effects that design, density, and mixed-use features have on the trip-making characteristics of future development in Lower Lynn. It also provides 2030 PM peak hour traffic volumes and Level of Service at key intersections with and without a realignment of Keith Road.

The unique nature of this site, in terms of its design, the transportation features it will offer, and its setting in the midst of North Vancouver, renders traditional methods of estimating vehicle traffic generation ineffective. Traditional methods, which are based on extremely suburban average rates, may not be relevant to Lower Lynn because:

- Mixed land uses in close proximity will encourage internalization of many trips.
- High frequency transit service, focused at Phibbs Exchange, will reduce auto trips during commute periods; additionally, transit-oriented residents are likely to self-select this transit-oriented development.
- A substantial increase in density over current levels, and a move away from single family homes to multi-family units, including the demolition of up to 190 homes will result in both smaller households and a greater transit mode share.
- Strong bicycle and pedestrian connections, including a new crossing of Lynn Creek would encourage bicycling and walking, particularly walk to transit, walk to school, and bike to work trips.

These site and travel characteristics are essential elements of a walkable, livable community, but are often disregarded in transportation analysis. Conventional practice conservatively analyzes the trip generation potential for new development in

isolation, and under the assumption that such development is a typical suburban and generally auto-oriented project. The extent and combination of high density development; a pedestrian, transit, and bicycle-oriented circulation network; mixing of uses; and the proximity of the project site and proposed transit service to major destinations are unlike suburban development.

The methodology adjusts trip generation based on the unique characteristics of a project site. This methodology, in combination an estimate of mode split, was used to derive a trip generation for the Lower Lynn buildout.

## North Vancouver Data

In order to provide a basis for mode split assumptions, we reviewed several local data sources. According to TransLink's 2004 Trip Diary Survey, the North Shore presently has a 6.2% daily transit share, and a combined 11.4% daily bike/walk share. The 2006 Census for the District of North Vancouver shows a 20% transit commute share and 11% bike/walk commute share. Recently, the Seylynn Village Traffic Impact Study assumed a transit mode share of 36% in the AM peak period, a bike mode share of 10%, and a walk mode share of 2%. These assumptions included no reduction for Transportation Demand Measures, which could result in greater incentives for non-auto travel.

	2006 Census Journey to Work for DNV	Seylynn Village Traffic Impact Study AM Peak Period
<i>Transit</i>	20%	36%
<i>Bicycle</i>	11%	10%
<i>Walk</i>		2%

## Methodology

To establish a reasonable trip generation for Lower Lynn, we took the following steps:

1. Established base trip generation rates from ITE.
2. Adjusted for pass-by retail trips
3. Removed trips from 190 single family homes.
4. Adjusted for transit use based on the 2006 Census for the District of North Vancouver.
5. Adjusted for walking and bicycling trips using the "D's" described below.

The origin of the methodology lies in the research of University of California at Berkeley professor Robert Cervero.<sup>1</sup> This research found that certain characteristics of the neighbourhood a household lived in affected the number of vehicle trips generated and vehicle-miles traveled by that household. This effect was independent of the household characteristics (income, household size, number of workers, etc.) typically used in trip generation equations. Where study areas vary significantly in character from the conventional trip generation site (typically a suburban, low-density site), trip generation should therefore include an adjustment of household-based trip-generation rates to reflect the characteristics of the area surrounding the household. The *ITE Trip Generation Handbook (2001)*, provides some guidance on adjustments for trip internalization (or interaction between uses) at multi-use sites, but adjustments are based on a small number of studies in Florida that may not be applicable to a more urban setting such as Lower Lynn.

<sup>1</sup> Cervero, R. and K. Kockelman (1997) "Travel Demand and the 3Ds: Density, Diversity, and Design," *Transportation Research D*, Vol. 2, pp. 199-219

## Neighbourhood Characteristics Included in the Adjustment

The methodology includes adjustments for several neighbourhood characteristics.

These characteristics, often referred to as the “Ds”, are:

1. Net Residential and Employment Density – This variable is measured in units of dwelling units per acre for residential density and total jobs per acre for employment density.
2. Jobs/Housing and Job Mix Diversity – Research suggests that having residences and jobs in close proximity will reduce the vehicle-trips generated by each by allowing some trips to be made on foot or by bicycle.
3. Walkable Design – Many pedestrian and bicycle improvement projects are based on the assumption that improving the walking/biking environment will result in more non-auto trips and a reduction in auto travel.
4. Distance from Transit (Residential): The distance from a person's place of residence to a transit station has a significant effect on the number of vehicle miles traveled per day and on transportation mode choice (e.g., whether to drive or take transit) for both work and total trips. Recent research suggests this is partially explained by a self selection process, wherein transit riders select to live in transit-oriented locations.

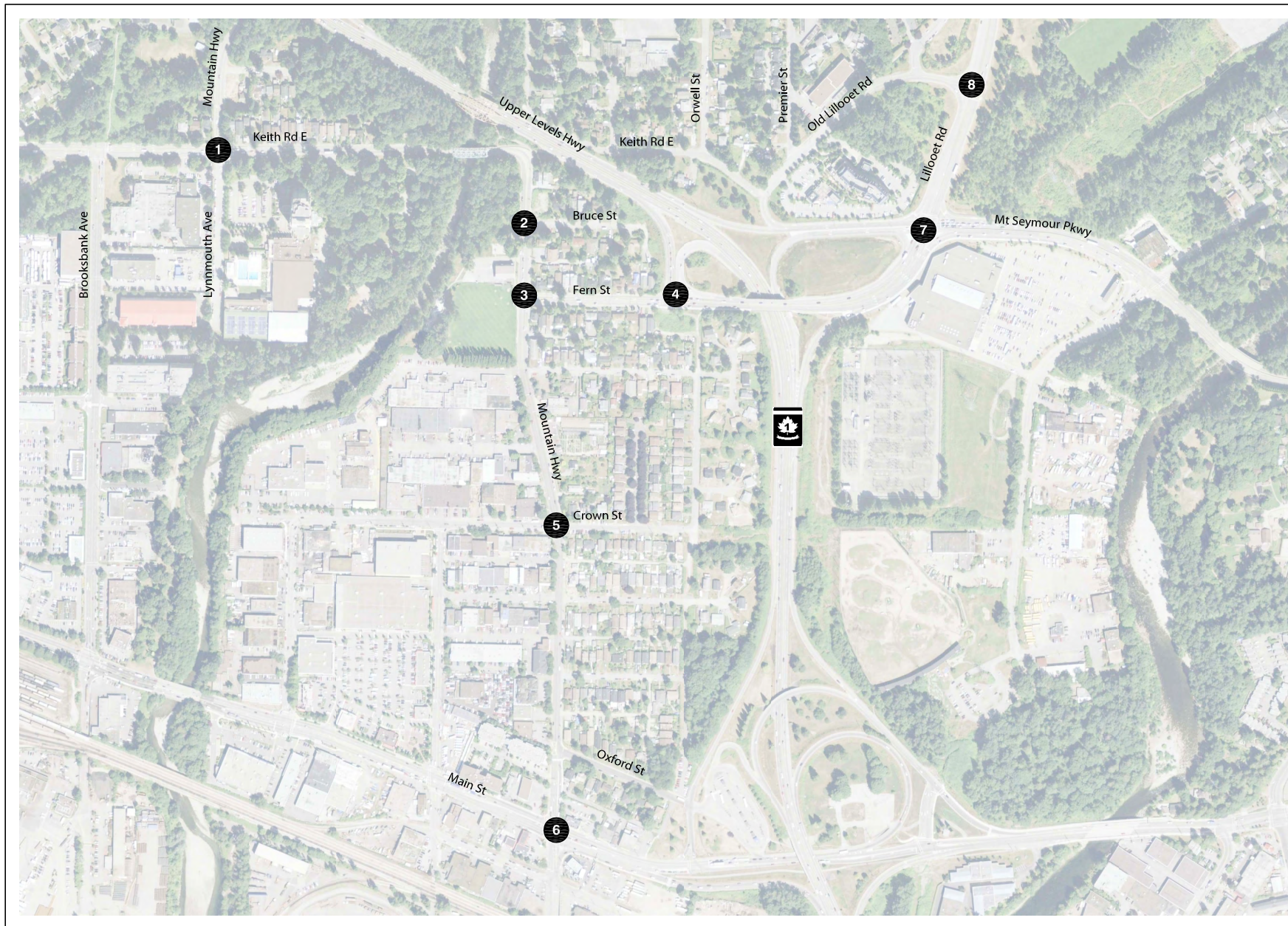
The list of variables is expected to evolve over time. As the preceding list shows, the methodology has proceeded beyond Cervero's original four D's and may ultimately include as many as ten variables.

## Trip Generation and Future Traffic Volume Results

The table on the following page summarizes the results of the trip generation exercise. The planned development in Lower Lynn is expected to result in 1,100 new vehicle trips during the PM peak hour, approximately 150 new transit trips, and 110 new walking and bicycling trips. In checking with both the 2006 Census and TransLink's 2004 *Trip Survey*, these estimates are well within reasonable ranges and likely to be somewhat conservative.

The next step was to distribute the trips from Lower Lynn through the network, taking into account the growth in background traffic traveling through the neighbourhood. In order to derive the background traffic volumes, we used a combination of the District of North Vancouver's travel demand forecasting model (in EMME/2) and the trip generation estimates described on the previous page. We used the District's model to determine the growth in background traffic from surrounding areas, and we manually applied the trips from Lower Lynn. The roadway network in the model includes the extension of Seymour Boulevard, a new roadway connection through the Seymour Creek development which connects with Highway 1.

Figures 8 and 9 describe the traffic volumes at key intersections in the study area, including existing traffic volumes, traffic volumes with the roadway improvements described in the Seylynn Village Report, and traffic volumes with the realignment of Keith Road and the introduction of additional left-turn lanes at the Fern Street on-ramps to Highway 1. All numbers are for the PM peak hour.



1. Keith Rd E/Lynnmouth Ave/Mountain Hwy	2. Bruce St/Mountain Hwy	3. Fern St/Mountain Hwy												
<table border="1"> <tr> <td>410 80 470</td> <td>210 370 40</td> </tr> <tr> <td>Keith Rd E 260 790 40</td> <td>50 30 80</td> </tr> </table>	410 80 470	210 370 40	Keith Rd E 260 790 40	50 30 80	<table border="1"> <tr> <td>1,270 120</td> <td>70 110</td> </tr> <tr> <td></td> <td>Bruce St 530 60</td> </tr> </table>	1,270 120	70 110		Bruce St 530 60	<table border="1"> <tr> <td>570 840</td> <td>220 480</td> </tr> <tr> <td></td> <td>Fern St 380 500</td> </tr> </table>	570 840	220 480		Fern St 380 500
410 80 470	210 370 40													
Keith Rd E 260 790 40	50 30 80													
1,270 120	70 110													
	Bruce St 530 60													
570 840	220 480													
	Fern St 380 500													
4. Fern St/Highway 1 SB Ramps	5. Crown St/Mountain Hwy	6. Main St/Mountain Hwy												
<table border="1"> <tr> <td>170 740</td> <td>610 580</td> </tr> <tr> <td>Fern St 300 1,040</td> <td></td> </tr> </table>	170 740	610 580	Fern St 300 1,040		<table border="1"> <tr> <td>240 730 70</td> <td>35 30 40</td> </tr> <tr> <td>Crown St 390 30 80</td> <td>30 480 45</td> </tr> </table>	240 730 70	35 30 40	Crown St 390 30 80	30 480 45	<table border="1"> <tr> <td>40 370 520</td> <td>110 1,260 140</td> </tr> <tr> <td>Main St 150 1,780 100</td> <td>110 110 320</td> </tr> </table>	40 370 520	110 1,260 140	Main St 150 1,780 100	110 110 320
170 740	610 580													
Fern St 300 1,040														
240 730 70	35 30 40													
Crown St 390 30 80	30 480 45													
40 370 520	110 1,260 140													
Main St 150 1,780 100	110 110 320													
7. Mt Seymour Pkwy/Lillooet Rd	8. Old Lillooet Rd/Lillooet Rd													
<table border="1"> <tr> <td>320 550 190</td> <td>80 690 610</td> </tr> <tr> <td>140 10 30</td> <td>Mt Seymour Pkwy 220 350 1,620</td> </tr> </table>	320 550 190	80 690 610	140 10 30	Mt Seymour Pkwy 220 350 1,620	<table border="1"> <tr> <td>40 840</td> <td></td> </tr> <tr> <td>Old Lillooet Rd 40 220</td> <td>150 420</td> </tr> </table>	40 840		Old Lillooet Rd 40 220	150 420					
320 550 190	80 690 610													
140 10 30	Mt Seymour Pkwy 220 350 1,620													
40 840														
Old Lillooet Rd 40 220	150 420													

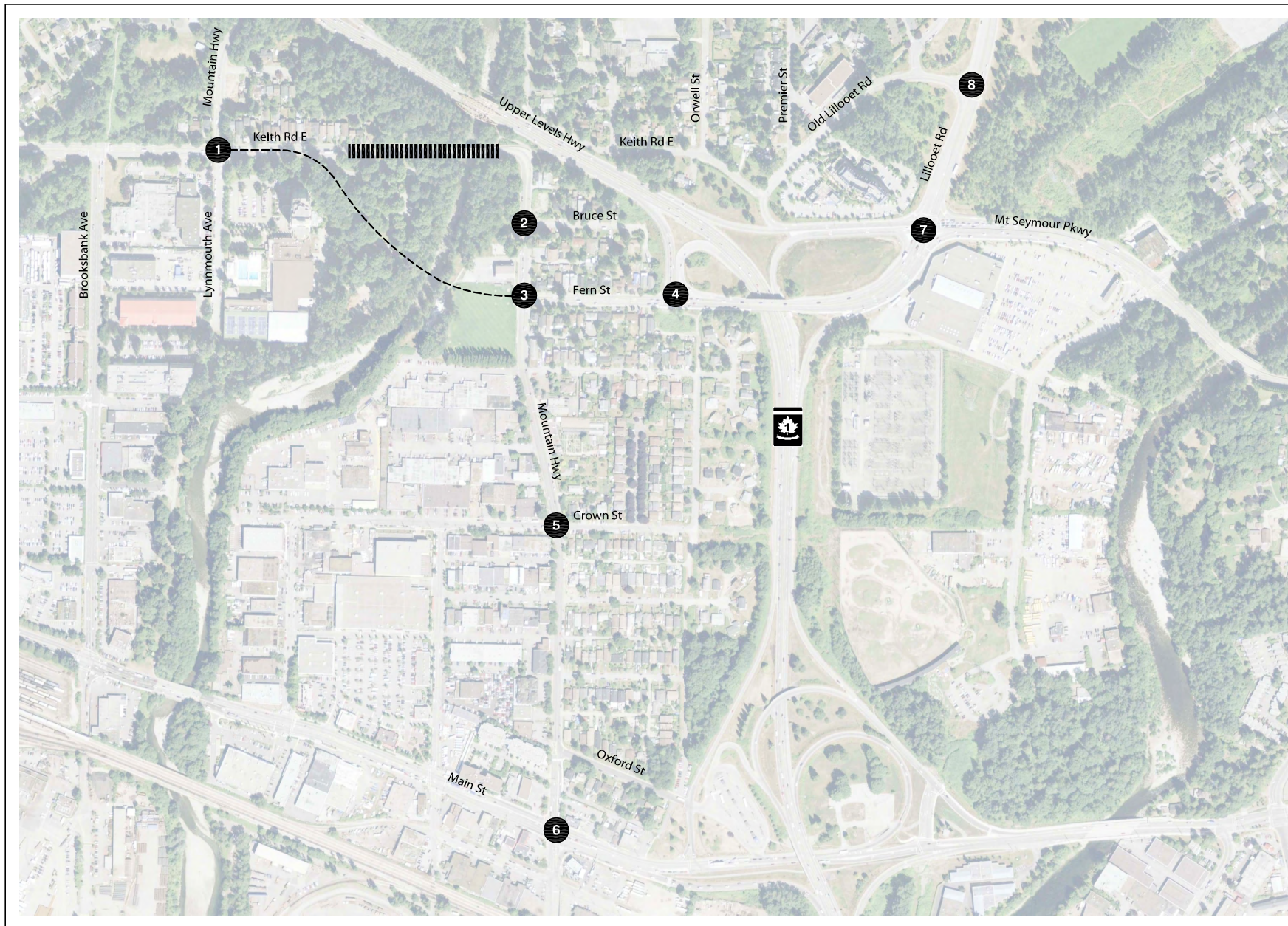
**LEGEND**

- Turn Movement
- PM Peak Hour Traffic Volume
- Study Intersection



**N**

NOT TO SCALE



1. Keith Rd E/Lynmouth Ave/Mountain Hwy	2. Bruce St/Mountain Hwy	3. Fern St/Mountain Hwy														
<table border="1"> <tr> <td>410 80 470</td> <td>210 370 40</td> </tr> <tr> <td>Keith Rd E 260 790 40</td> <td>50 30 80</td> </tr> </table>	410 80 470	210 370 40	Keith Rd E 260 790 40	50 30 80	<table border="1"> <tr> <td>20 1</td> <td>1 180</td> </tr> <tr> <td></td> <td>Bruce St 10 180</td> </tr> </table>	20 1	1 180		Bruce St 10 180	<table border="1"> <tr> <td>70 80 90</td> <td>30 190 480</td> </tr> <tr> <td></td> <td>Fern St 130 750 510</td> </tr> <tr> <td></td> <td>340 40 500</td> </tr> </table>	70 80 90	30 190 480		Fern St 130 750 510		340 40 500
410 80 470	210 370 40															
Keith Rd E 260 790 40	50 30 80															
20 1	1 180															
	Bruce St 10 180															
70 80 90	30 190 480															
	Fern St 130 750 510															
	340 40 500															
4. Fern St/Highway 1 SB Ramps	5. Crown St/Mountain Hwy	6. Main St/Mountain Hwy														
<table border="1"> <tr> <td>170 740</td> <td>610 580</td> </tr> <tr> <td>Fern St 300 1,040</td> <td></td> </tr> </table>	170 740	610 580	Fern St 300 1,040		<table border="1"> <tr> <td>240 730 70</td> <td>35 30 40</td> </tr> <tr> <td>Crown St 390 30 80</td> <td>30 480 45</td> </tr> </table>	240 730 70	35 30 40	Crown St 390 30 80	30 480 45	<table border="1"> <tr> <td>40 370 520</td> <td>110 1,260 140</td> </tr> <tr> <td>Main St 150 1,780 100</td> <td>110 110 320</td> </tr> </table>	40 370 520	110 1,260 140	Main St 150 1,780 100	110 110 320		
170 740	610 580															
Fern St 300 1,040																
240 730 70	35 30 40															
Crown St 390 30 80	30 480 45															
40 370 520	110 1,260 140															
Main St 150 1,780 100	110 110 320															
7. Mt Seymour Pkwy/Lillooet Rd	8. Old Lillooet Rd/Lillooet Rd															
<table border="1"> <tr> <td>320 550 190</td> <td>80 690 610</td> </tr> <tr> <td>140 10 30</td> <td>Mt Seymour Pkwy 220 350 1,620</td> </tr> </table>	320 550 190	80 690 610	140 10 30	Mt Seymour Pkwy 220 350 1,620	<table border="1"> <tr> <td>40 840</td> <td></td> </tr> <tr> <td>Old Lillooet Rd 40 220</td> <td>150 420</td> </tr> </table>	40 840		Old Lillooet Rd 40 220	150 420							
320 550 190	80 690 610															
140 10 30	Mt Seymour Pkwy 220 350 1,620															
40 840																
Old Lillooet Rd 40 220	150 420															

**LEGEND**

- Turn Movement
- PM Peak Hour Traffic Volume
- Study Intersection
- New Keith Rd E Bridge
- To Be Removed



**N**

NOT TO SCALE

## Traffic Operations

Once we estimated the trip generation for the Lower Lynn Concept Plan and applied it to future year traffic estimates, we used the District's traffic operations model (in Synchro) to calculate PM peak hour Level of Service at key intersections. Our analysis included two different roadway networks – one which includes all the improvements planned by the Seylynn Development, and one that includes those improvements as well as a realignment of Keith Road. Appendix A includes a robust discussion of this project, and Figure 18 shows the improvement options in more detail. It includes widening the Keith Road Bridge, re-routing the street south through Lynn Park, and adding an eastbound left-turn lane to the Fern Street on-ramps at Highway 1.

The 2008 existing traffic volumes are generally lower and the study intersections perform better during the AM peak hour compared to the PM peak hour as shown on the tables on the following page. Therefore, rather than review AM peak hour data for the entire network, we focused on the movements and locations that are most important during the AM peak for more detailed evaluation:

- Traffic traveling eastbound on Keith Road to the Highway 1 southbound on-ramp at Fern Street.
- Vehicles traveling southbound on Mountain Highway to Main Street.

During the existing AM peak hour, eastbound vehicles on Keith Road traveling to the Highway 1 southbound on-ramp at Fern Street experience significant delays and queuing. Either the improvements proposed by the Seylynn Village or the realigned Keith Road Scenario would improve eastbound travel time to the Highway 1 southbound on-ramp compared to the existing roadway configuration. The realigned Keith Road Scenario would reduce travel time by approximately 20 seconds compared to the Seylynn Village improvements. This travel time improvement is due to a more direct route reducing the travel distance and improved

signal phasing at the Mountain Highway/Fern Street intersection by having the primary eastbound and westbound movements occur at the same time.

Both the Seylynn Village improvements and the realigned Keith Road Scenario could be further improved by adding a second eastbound left-turn lane at the Fern Street/Southbound Highway 1 Ramps intersection. The 2008 existing eastbound left turn from Fern Street to the Highway 1 southbound on-ramp is over 500 vehicles during the AM peak hour and we forecast this movement will increase to over 600 vehicles during the 2030 AM peak hour. A second eastbound left-turn lane would improve the operations of the intersection and provide more storage space for vehicles waiting to enter southbound Highway 1.

The southbound direction of Mountain Highway experiences higher traffic volumes during the AM peak than the PM peak. Southbound Mountain Highway has two lanes from Fern Street to Oxford Street. From 6:00 to 10:00 AM, one of the southbound lanes from Crown Street to Oxford Street is designated as a transit only lane. We project that southbound Mountain Highway between Fern Street and Oxford Street will continue to operate satisfactorily with transit only designation during the 2030 AM peak period.



### Lower Lynn Neighbourhood - PM Peak Hour Intersection Level of Service

ID	East/West Street	North/South Street	2008 Existing	2030 Base Network <sup>1</sup>	2030 Realigned Keith Road
1	Keith Road E	Mountain Highway	C (32 secs)	D (43 secs)	D (43 secs)
2	Bruce Street	Mountain Highway	C (19) secs)	B (16 secs)	B (10 secs)
3	Fern Street	Mountain Highway	C (31 secs)	D (41 secs)	C (31 secs)
4	Fern Street	Highway 1 Southbound Ramps	B (17 secs)	C (30 secs)	C (23 secs)
5	Crown Street	Mountain Highway	B (13 secs)	C ( 25 secs)	C ( 25 secs)
6	Main Street	Mountain Highway	D (42 secs)	E (58 secs) <sup>2</sup>	E (58 secs) <sup>2</sup>
7	Mt Seymour Pkwy	Lillooet Road	D (38 secs)	E (56 secs)	E (56 secs)
8	Old Lillooet Road	Lillooet Road	A (7 secs)	A (9 secs)	A (9 secs)

Source: 2000 Highway Capacity Manual

1. Base network assumes Seylynn Village roadway improvements: a new signal at Bruce Street/Mountain Highway as well as a second southbound left-turn lane and a second westbound left-turn lane at Fern Street/Mountain Highway
2. SimTraffic was used to estimate the delay at this intersection in order to account for effects of adjacent signals

### Lower Lynn Neighbourhood – 2008 AM Peak Hour Intersection Level of Service

ID	East/West Street	North/South Street	2008 Existing
1	Keith Road E	Mountain Highway	C (35 secs)
2	Bruce Street	Mountain Highway	C (17 secs)
3	Fern Street	Mountain Highway	C (23 secs)
4	Fern Street	Highway 1 Southbound Ramps	C (22 secs)
5	Crown Street	Mountain Highway	A (8 secs)
6	Main Street	Mountain Highway	D (36) secs)
7	Mt Seymour Pkwy	Lillooet Road	D (43 secs)
8	Old Lillooet Road	Lillooet Road	A (6 secs)

Source: 2000 Highway Capacity Manual

## Chapter 3: Recommendations

This section is divided into proposed recommendations for each mode of travel. For every mode, we identified a recommended “primary” network of streets. While all streets should include basic amenities for all users, each street has a primary function that can help guide decision-making. For instance, Main Street’s potential emphasis is goods movement and traffic, while Mountain Highway’s emphasis would be bicycle, pedestrian, and transit. Within the primary network for each mode, there are specific proposed capital projects. These projects are divided into short-term, medium-term, and long-term projects:

*Short-Term:* Less expensive, not contingent on development, or urgently needed to address a safety concern.

*Medium-Term:* Feasible but contingent on other projects or development.

*Long-Term:* High degree of complexity or coordination, contingent on other projects, developments, or agreement with partners.

### Transportation Demand Management

Many of the strategies in this document are capital engineering projects. However, there is a wide range of programs that could reduce vehicle demand and mitigate congestion. This menu of strategies, known as Transportation Demand Management or Best Management Practices, can achieve meaningful reductions in vehicle miles generated by new development. Initial ideas could include:

- Require new residential development to assess homeowner dues that would contribute to one transit pass per household.
- Locate a car-sharing node near Phibbs Exchange or requiring new development to reserve 2-3 parking spaces for a car-sharing node.

- Provide reserved spaces for carpools in new commercial development.
- Require new commercial development to partially fund a TDM coordinator position responsible for ride-matching and providing information about alternative mode options.

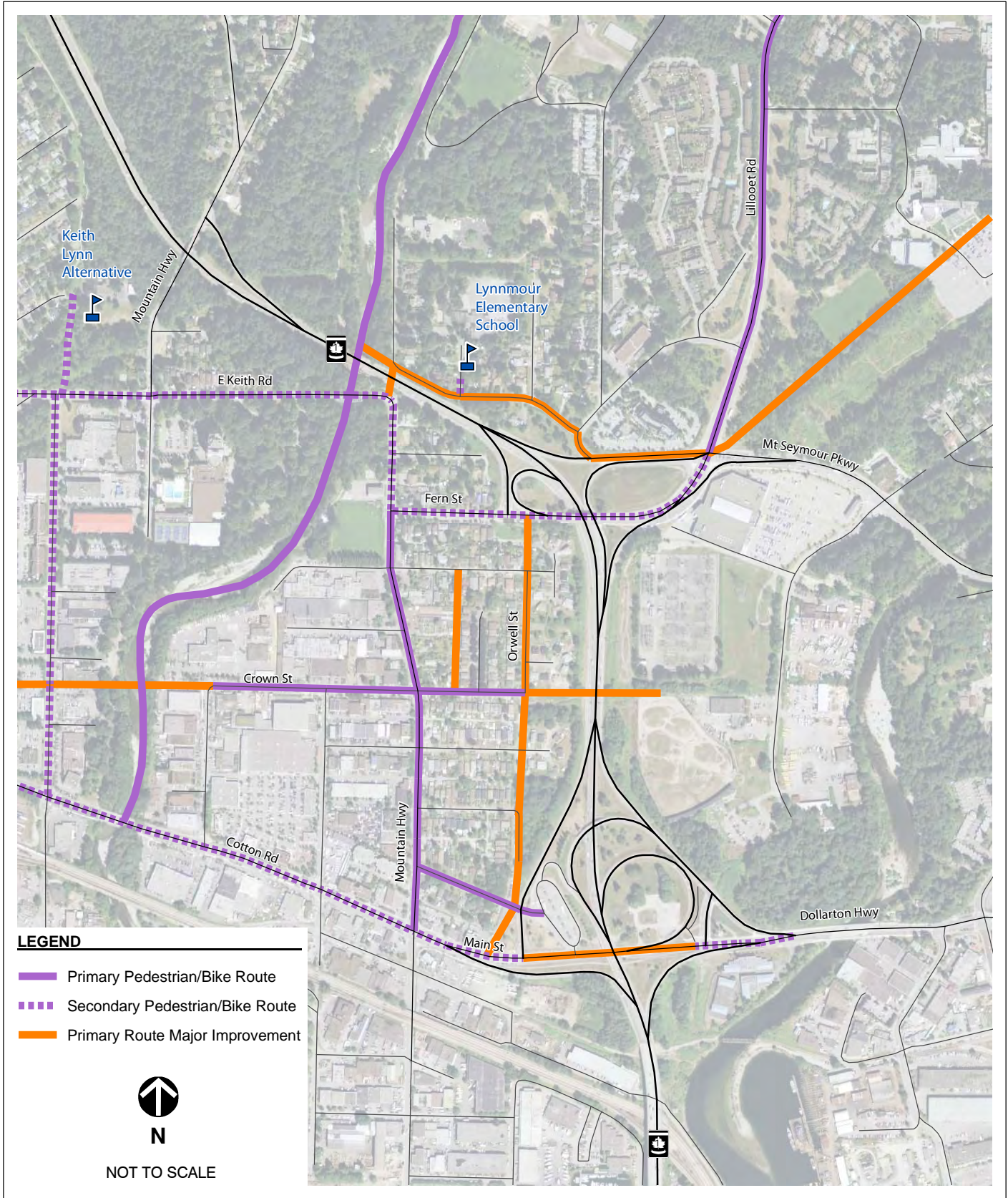
When implemented on a district-wide or neighbourhood-wide basis, TDM measures can achieve vehicle trip reductions averaging 10% for residential uses and 30% for commercial uses. The District could develop a menu of TDM measures and associated trip reductions as an optional program for developers to reduce vehicle impacts.

### Pedestrians

As outlined in the Existing Conditions chapter, there are four key issues for pedestrians:

- Missing and narrow sidewalks
- Infrequent marked crosswalks. Marked crosswalks at Fern Street, Crown Street, and Oxford Street are approximately 250 metres apart.
- High-volume streets such as Main Street and Mt Seymour Parkway that create wide crossings.
- Minimal lighting and wayfinding to Phibbs Exchange

The primary pedestrian network includes Mountain Highway, Oxford Street, Orwell Street, Crown Street, and the Lynn Creek Trail. Main Street and Mount Seymour Parkway are also critical streets for pedestrians as they serve key destinations and include transit lines. Figure 10 shows the proposed primary and secondary pedestrian networks.



The following recommendations are intended to create safe, frequent crossing opportunities and a comfortable environment for walking. Opportunities to improve the quality of the pedestrian experience by widening sidewalks or installing landscape strips along Mountain Highway are encouraged as development occurs.

### **Short Term**

*Establish a set of design guidelines for Mountain Highway that includes wide sidewalks, a boulevard strip to provide a buffer from traffic, and frequent crosswalks.*

*Install pedestrian-scale lighting and wayfinding along Oxford Street.* The Seylynn Village project will improve pedestrian conditions along Orwell Street. Lighting on Oxford Street should match the lighting along Orwell Street.

*Improve the pedestrian connections to Phibbs Exchange:*

- Mark crosswalks at Oxford Street/Highway 1 ramp and install a continuous pathway between the bus boarding area and the entrance at Oxford Street (Figure 13).
- Provide lighting along at the Main Street/Dollarton Highway undercrossing of Highway 1 and pave the dirt path.
- Improve the dirt paths between the boarding area and Main Street (Figure 13).

*Install pedestrian countdown signals along Main Street.* Due to the large amount of heavy truck traffic, particularly near Mountain Highway and Harbour Avenue, pedestrian refuge islands are likely difficult to install; however, countdown signals provide a benefit, particularly for wide crossings such as Main Street.

### **Medium Term**

*Install improvements along Mountain Highway for all modes.* Provide a cross section for Mountain Highway that includes medians, on-street parking, dedicated

bikeways, and bus turnouts. The Lower Lynn planning envisions a concentration of residential and retail clustered near the Seylynn Village development, which transitions to light industrial and auto-oriented retail as the corridor heads south to Main Street. The cross section includes parking near the heart of the neighbourhood both to provide access to businesses and to buffer pedestrians from traffic. South of Crown Street, Mountain Highway would have a median island to facilitate pedestrian crossings. Specific improvements attached to this project include the following:

- *Install crossing improvements at Crown Street/Mountain Highway.* Install curb extensions on the east side of Mountain Highway at Crown Street/Mountain Highway (Figure 12) and pedestrian refuge islands on Mountain Highway.
- *Improve the frequency of marked crosswalks along Mountain Highway.* Consider Rupert Road, Charlotte Drive, or other locations adjacent to transit stops or destinations such as Dykhof Nurseries as development intensifies along Mountain Highway.

*Improve the connection between the Lynn Creek Trail and Lynnmour School and the connection to the Keithlynn neighbourhood from Keith Road (Figure 10).*

*Create Safe Routes to School plans for Lynnmour School.*

*Install Overhead Flashing Beacons across Mountain Highway at the Oxford Street Crosswalk (Figure 11).* Currently, TransLink buses traveling north on Mountain Highway turn right onto Oxford Street to access Phibbs Exchange, and the path of their turning movement prohibits a median at this location. If improvements are made to the Main Street entrances to Phibbs Exchange, buses will no longer use the Oxford Street route, and a median may be feasible in addition to the beacons.

## **Long Term**

the parking lot (example at the McDonald's at Main Street/Lynn Ave).

*Install sidewalks on the south side of Oxford Street.* As the neighbourhood redevelops, include sidewalks on the south side as part of any new projects.

*Extend Crown Street across Lynn Creek to the west* (Figure 14). The Crown Street extension across Lynn Creek should connect directly to the Park and Tilford Shopping Centre. Include a marked crosswalk across Brooksbank Avenue at 4<sup>th</sup> Street East and a pedestrian pathway through the Park and Tilford Shopping Centre. The design of the extension should be wide enough to allow emergency vehicle access during times when Keith Road is congested.

*Extend Crown Street across Highway 1 to the east as the Seymour Creek development proceeds* (Figure 13). The Crown Street extension to the east across Highway 1 should be considered as the Squamish Nation creates land use plans for Seymour Creek. The bridge would require coordination among the District, the Squamish Nation, and the Ministry of Transportation.

The engineering challenge of creating an overpass could be overcome in one of a few ways:

1. Create a circular ramp or a system of stairs with regular landings to provide a fully accessible climb for bicyclists and pedestrians of all abilities.
2. Depending on where the bridge lands, it could be appropriate to provide an elevator on the Seymour Creek side, particularly if the bridge aligns with a shopping centre or other retail use.

*Work with business owners to install clearly-marked, direct pedestrian connections from sidewalk to building entrances along Main Street.* These can be marked with special pavers, contrasting colors, or slightly raised pathways that function like speed tables in



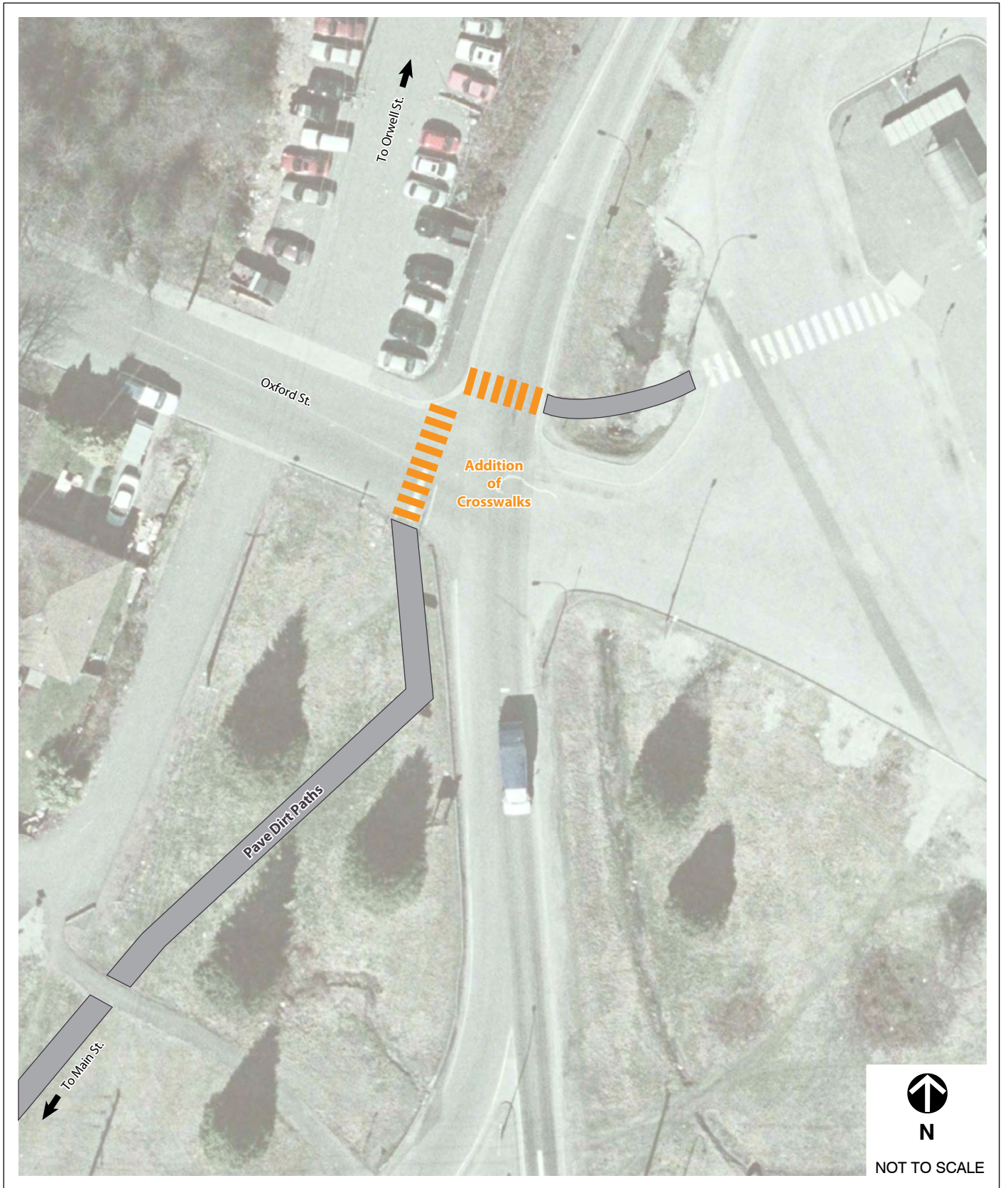


**FEHR & PEERS**  
 TRANSPORTATION CONSULTANTS

**ADDITION OF CUT MEDIANS ON MOUNTAIN HIGHWAY**

N:\Projects\SE09-0152\_N.Vancouver Lower Lynn\Graphics\Draft\AI\April2010\fig12\_mountain\_crown2.ai

**FIGURE 12**







## Bicycles

Issues for cyclists include:

- Gaps in the existing bicycle network.
- Lack of support facilities such as short- or long-term bicycle parking
- Missing and inconsistent signs and markings

According to the District's *Bicycle Master Plan*, the following streets are a high priority for on-street bicycle lanes:

- Mount Seymour Parkway
- Mountain Highway
- Main Street/Dollarton Highway
- Fern Street.

Lillooet Road, Keith Road, and the Dollarton Highway Bridge are lower priority streets in the *Plan*. The *Plan* also calls for a route along Orwell Street and a route connecting Barrow Street to Old Dollarton Highway via a new bridge across the Seymour River. Other new bicycle/pedestrian bridges include an extension of Crown Street across Lynn Creek, an overpass of Highway 1 at Keith Road, and an overpass over Mount Seymour Parkway connecting Lillooet Road and Seymour Boulevard. Figure 15 shows many of the improvements called for in the District's *Plan*. Figure 10 shows the primary and secondary bicycle routes recommended in the Lower Lynn Transportation Strategy.

Although the *Bicycle Master Plan* recommends bicycle lanes along Main Street and Mount Seymour Parkway, it is unclear whether the recommendation was based on a feasibility analysis. While both of these streets would benefit from bicycle provisions, each would require substantial reconfiguration to include on-street bicycle lanes. Both projects require interagency coordination – with the Ministry of Transportation for Mount Seymour Parkway and with both the Ministry of Transportation and the City of North Vancouver for Main Street.

Mount Seymour Parkway, which is a four-to-six-lane road with a center median, could include bicycle lanes within the current right-of-way, if vehicle lanes were narrowed and the median were narrowed or removed.

However, the street includes free-right turn lanes and freeway off- and on-ramps, making five-foot bicycle lanes less ideal and calling for special design treatments such as colored bicycle lanes.

Main Street, which is a five-lane road with a striped center median, already has narrow lanes and a few interim bicycle improvements. As development occurs, the District could require a re-design of the roadway to include bicycle lanes on both sides, but without widening the roadway or reducing the number of travel lanes, bicycle lanes are not feasible in the existing pavement.

The District's toolbox of bicycle facilities includes on-street bicycle lanes, shared lanes, and off-street paths to plan for cyclists of all levels. While experienced cyclists are likely more comfortable on streets such as Main Street, research shows that casual and less experienced cyclists will ride out of their way to avoid arterial streets. In order to provide a network for all cyclists, the following list of projects includes interim improvements, such as sharrows, as well as another type of bicycle facility, the bicycle boulevard. Bicycle Boulevards are "bicycle priority streets," typically located on lower volume, lower speed collector and residential streets. Aspects include special pavement markings and signs, as well as traffic calming devices such as traffic circles to discourage cut-through traffic.



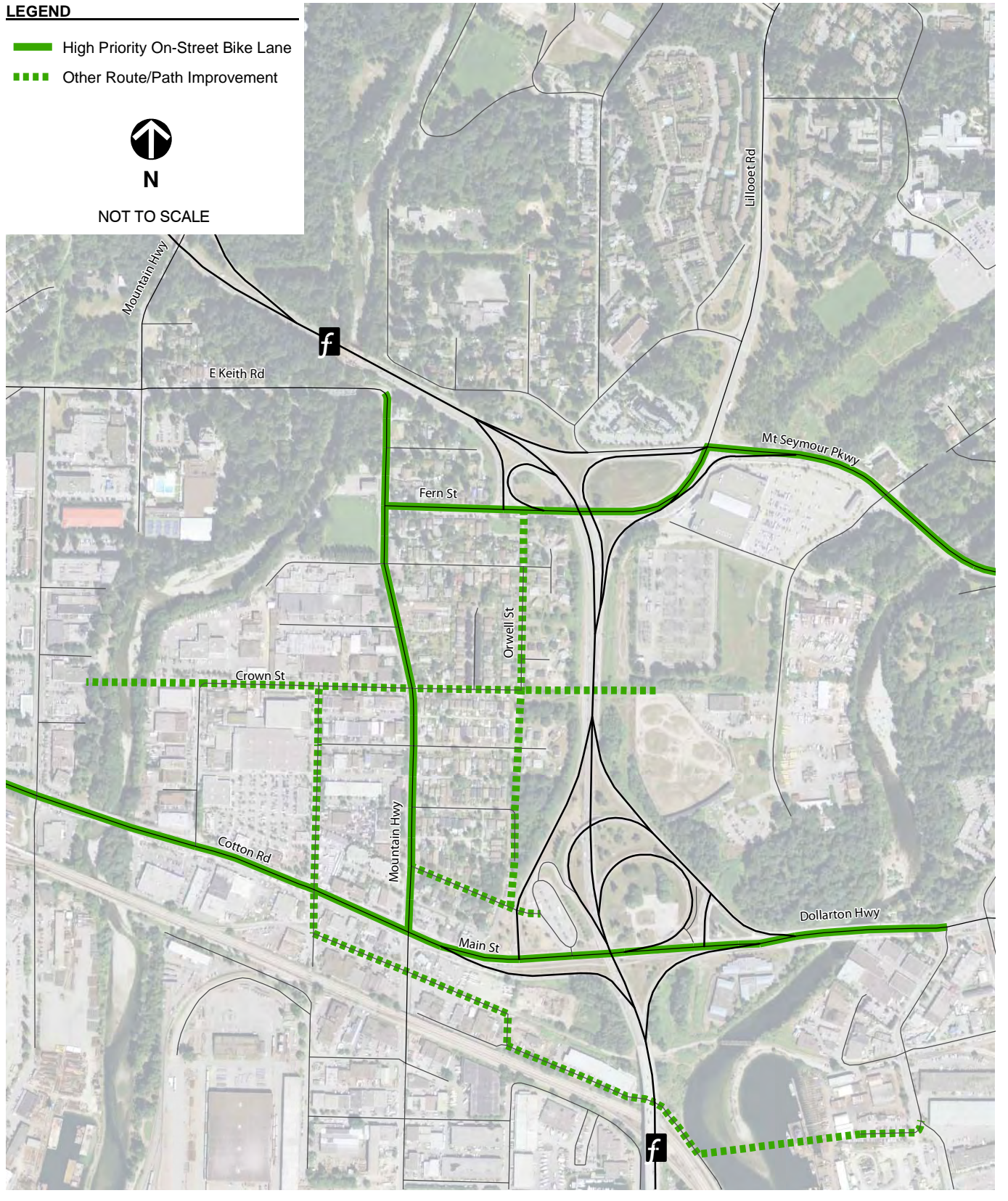
*Special pavement markings along a bicycle boulevard*

**LEGEND**

- High Priority On-Street Bike Lane
- Other Route/Path Improvement



NOT TO SCALE



to connections to the Lynn Creek Trail, Mountain Highway, and Phibbs Exchange.

### **Short-Term Improvements**

*Provide electronic bicycle lockers or some other form of user-administered long-term bicycle parking at Phibbs Exchange. Start with six spaces (lockers typically come in sets of two) and monitor use to add as needed.*

*Conduct an inventory of wayfinding signs, focused on Main Street, Mountain Highway, and Oxford Street to eliminate excess signs and evaluate for consistency. Add signs at key turning points along existing routes where needed.*

*Install sharrows along northbound Mountain Highway between Keith Road and Main Street.*

*Designate Orwell Street as a bicycle boulevard with special pavement markings and other traffic calming devices, such as a traffic circle at Hunter Street and Crown Street as the connection to Phibbs Exchange is completed.*

*Include wayfinding signs along Crown Street and either Lynn Avenue or Harbour Avenue to connect to Main Street. Provide signs along Hunter Street from the Lynn Creek Trail to Orwell Street and Phibbs Exchange.*

*Install loop detector stencils where needed along Main Street and Mount Seymour Parkway and ensure the minimum green time is appropriate for cyclists.*

### **Medium/Long-Term Improvements**

*Extend Crown Street across Lynn Creek to provide access to the Park and Tilford Shopping Centre. Provide a signalized crossing at Brooksbank Avenue and a clearly-marked route to bicycle parking. Include bicycle lanes on the reconstructed Keith Road Bridge.*

*Select an alignment for the Spirit Trail and construct segments, paying special attention*

*Require short and long-term bicycle parking as part of new development projects in Lower Lynn.*

*Install a dedicated bikeway on Mountain Highway.*

*Pave and widen the Lynn Creek Trail.*

## Transit

TransLink provides robust transit service to key destinations including Capilano University, downtown North Vancouver, the SeaBus, and Grouse Mountain. We considered several ideas to improve transit service, reliability, and the passenger experience at Phibbs Exchange. The ideas fall into three primary categories:

1. Improve transit reliability and speed, such as additional HOV lanes along Mountain Highway or Keith Road.
2. Improve access to Phibbs Exchange, such as a transit-only signal at the Main Street/Phibbs Exchange entrance.
3. Relocate Phibbs Exchange to Seymour Creek or reimagine it at its current location to incorporate transit-supportive land uses immediately adjacent to it. A relocated Phibbs Exchange to a Seymour Creek Village location will require a partnership with the Squamish Nation, and assumes that a transit hub, such as the exchange, would fit with and benefit the redevelopment plans of the Nation at this location.

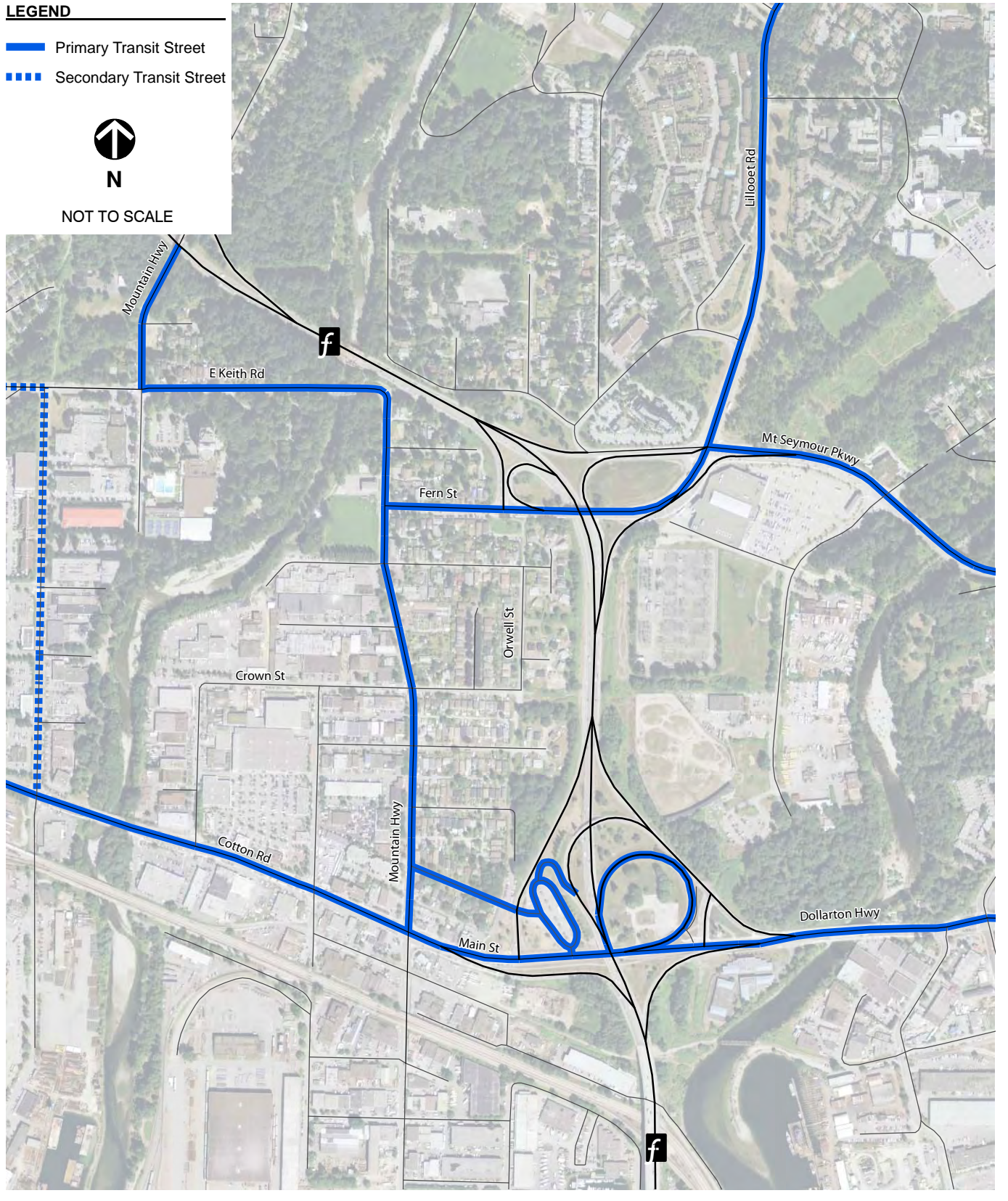
Several improvements to bicycle and pedestrian access are described in the previous chapters. Figure 16 shows the primary transit network. The following are the short, medium, and long-term improvements for transit.

**LEGEND**

- Primary Transit Street
- Secondary Transit Street



NOT TO SCALE



**FEHR & PEERS**  
TRANSPORTATION CONSULTANTS

N:\2009Projects\SE\_Projects\SE09-0152\May2010\MXD\fig17\_Transit\_PrimSec2.mxd

**PRIMARY AND SECONDARY  
TRANSIT STREETS**

**FIGURE 16**

## **Short Term**

*Implement recommendations to improve pedestrian and bicycle access (see previous section).*

*Install pedestrian-scale lighting at the parking area west of the station at the terminus of Oxford Street.*

*Preserve the southbound HOV lane on Mountain Highway.* The analysis of future traffic conditions on Mountain Highway projects a reasonable volume for a three-lane road. The analysis shows that additional lanes of travel would not be required to handle future traffic volumes. With this design, the congestion during the AM peak hour is likely to remain. Therefore, the southbound HOV lane is still necessary during the AM peak.

## **Medium/Long Term**

### **Operational Improvements**

*Install a signal at Main Street and the entrance of Phibbs Exchange.* The signal would be pre-empted by transit but coordinated with the signals at Main Street/Phibbs Exchange exit, the Main Street/Mountain Highway signal, and the Dollarton Highway/Highway 1 off-ramp signal. The signal would have a minimal impact on vehicle operations but would allow eastbound TransLink buses on Main Street that currently make a left onto Mountain Highway and a right onto Oxford Street to stay on Main Street and make a left directly into Phibbs Exchange. This direct route would improve transit travel times and reliability. If this improvement is infeasible, construct a new, transit-priority signal and southbound left-turn lane at Oxford Street/Mountain Highway.

*Provide an eastbound HOV lane along Keith Road during the AM peak hour.* The levels of congestion along Keith Road are high enough to justify a peak hour HOV lane for eastbound Keith Road in the AM peak hour if it is widened.

### **Phibbs Exchange Relocation Options**

In the medium and long-term, there are various opportunities to improve the experience for passengers waiting at Phibbs Exchange. One option is to surround it with transit-supportive land uses (cafes, dry cleaners, post office, and other small retail that allows passenger to run errands and link trips). Presently, residents of the new Seylynn Village would need to walk approximately 0.8 kilometres to reach the Phibbs Exchange from Fern Street/Orwell Street. Assuming a walking speed of about one meter per second, 0.8 kilometres represents a 12.5 minute walk. This distance is on the edge of desirable walking distances to transit.

Options for moving the Exchange must take into consideration the need for quick, direct access to Highway 1, proximity to riders, and the amount of land needed for bus bays. There are a limited number of locations that could meet the criteria of providing direct Highway access for buses while maximizing the number of potential new riders provided by nearby developments.

1. *In the vicinity of the Fern Street ramps, northeast of Highway 1 between Fern Street and Mount Seymour Parkway.* While closer to Seylynn Village and the concentration of future residential density, this location would require major infrastructure to connect the neighbourhood with a new Exchange location. It could provide direct Highway access, but the location would arguably be no more inviting than the current location.
2. *South of Main Street and the Highway 1 southbound on-ramp.* While close to the Highway, this location is further away from the residential density contemplated in Lower Lynn and other commercial and retail uses that could attract transit riders.
3. *Somewhere within the Seymour Creek development.* If the

Exchange were aligned with a new overcrossing at Crown Street, it would be more accessible to the new development in Lower Lynn as well as in Seymour Creek. However, it would likely require that the Crown Street extension be designed for bicycles, pedestrians, and transit. Buses using Mountain Highway could access the Exchange directly via Crown Street; buses using the Ironworker's Memorial Second Narrows Bridge could use the existing ramps at Main Street/Dollarton Highway via Orwell Street or Crown Street. We would not recommend any new ramps to/from the Exchange without eliminating one or more of the ramps at Fern Street or Main Street/Dollarton.





While challenging, moving Phibbs Exchange to Seymour Creek is the best alternative to the current location. Its success would be fully contingent on whether this matches the development plans for Seymour Creek of the Squamish Nation.

A set of interim improvements to the current location could be constructed while land use planning in Lower Lynn and Seymour Creek proceeds.

Figure 17 shows the major improvements described in this section.

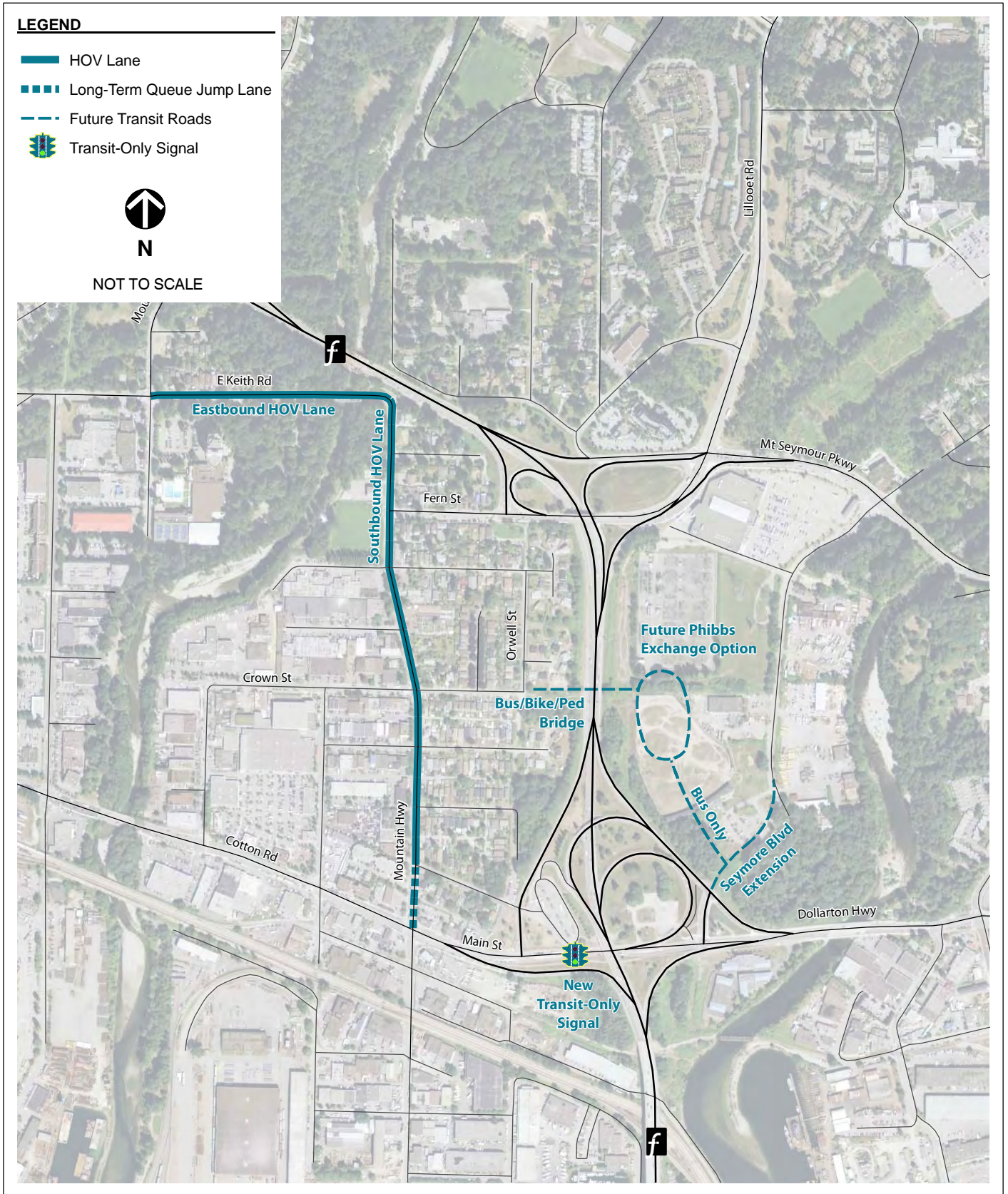


**LEGEND**

-  HOV Lane
-  Long-Term Queue Jump Lane
-  Future Transit Roads
-  Transit-Only Signal



NOT TO SCALE



## Vehicles and Freight

The analysis of vehicle and goods movement evaluated local roadway improvements, the replacement or rehabilitation of the Keith Road Bridge, and three scenarios that would alter regional access selected for further study by the Lower Lynn Transportation Strategy Partners. The three regional scenarios focus on relocating Highway 1 ramps, and each scenario moves ramps to Brooksbank Avenue, either a full interchange or a partial interchange with additional improvements at the Fern Street and Main Street/Dollarton Highway ramps.

### **Keith Road Bridge**

In 2006, the District issued a review of the condition of the Keith Road Bridge. A key finding of that report, the *Keith Road Bridge Condition Assessment Report* (ND LEA, 2006), was that the bridge needed immediate repair or replacement “within the next year.” The report also found that “The existing Keith Road bridge structure is nearing the end of its service life and will increasingly cost more to maintain on a yearly basis. In our experience, especially with respect to the recently completed Dollarton Bridge, a new widened structure has the highest long term benefit for the cost.”

The traffic analysis clearly indicates the need for a second eastbound lane on the bridge, and the *Report* concludes that if the structure needs to be widened, a new structure is more cost effective. The recommendation is to replace the Keith Road Bridge with a single new structure rather than rehabilitate it.

### **Regional Scenarios**

The traffic analysis included a review of major new infrastructure improvements to improve congestion in the neighbourhood and along Highway 1. The frequency of the current ramp spacing (Main/Dollarton, Fern, and Mountain Highway) contributes to weaving and congestion along the Highway.

In turn, drivers use neighbourhood streets to bypass Highway congestion and access the Ironworkers' Memorial Second Narrows Bridge at the last possible exit. Improving Highway congestion while restricting access through the neighbourhood could have benefits for both Lower Lynn residents and travelers throughout the District.

The three scenarios included in the analysis were:

- A. Full Brooksbank Avenue interchange and removal of Fern Street interchange and northbound off-ramp at Mountain Highway
- B. Half Brooksbank Avenue interchange (northbound on-ramp and southbound off-ramp) and half-Fern Street interchange (southbound on-ramp and northbound off-ramp)
- C. Concept 2 from North Shore Interchanges Functional Planning Study<sup>2</sup>

The primary findings are that each of the three scenarios may benefit Highway 1 operations but would not substantially improve traffic conditions in the Lower Lynn neighbourhood. Local street improvements such as realigning and widening Keith Road and adding more turn pocket storage at the Fern Street on-ramps will provide more direct benefits to Lower Lynn and surrounding neighbourhoods.

The Ministry of Transportation has been examining these infrastructure improvements as part of a separate study. The Ministry's preferred alternative, Concept C above, includes a new on- and off-ramp at Brooksbank Avenue and closure of the Fern Street off-ramp and on-ramp for traffic from the west. Other elements that could be part of a later phase include closure of the Dollarton Highway northbound on-ramp and making the Main Street off-ramp into a truck-only lane. Ultimately, the plan could also include the Keith Road flyover, an extension of Keith Road over Mountain Highway and

<sup>2</sup>Draft North Shore Interchanges Functional Planning Study prepared by CH2M Hill for the British Columbia Ministry of Transportation (December 2007).

the Highway, but this portion of the design is less certain and would very likely be the last piece of the overall project to be constructed.

The Ministry's work in refining the design is on-going. The final design has yet to be determined, and the District of North Vancouver will be working in close partnership with the Ministry to help determine which, if any, of the recommended local roadway changes will be necessary based on the Ministry's long-term vision for Highway 1, including the location and configuration of both the Keith Road Bridge and the Keith Road flyover. Some cost-sharing with the District will be required to implement the changes.

### ***Local Roadway Improvements***

The analysis contemplated two local street connections independently from the freeway interchange scenarios. These two connections were a realigned Keith Road and a Northern Service Road between Mountain Highway and Mount Seymour Parkway. Appendix A includes the full analysis and a quick comparison among all scenarios.

A key new roadway contemplated as part of the Seymour Creek development is an extension of Seymour Boulevard to connect with Highway 1. This extension offers a number of key benefits for the neighbourhood as it could provide additional transit connections, relieve congestion on Mountain Highway and Riverside, and open up the possibility of a new location for Phibbs Exchange.

One street deserves special mention and discussion. Mountain Highway between Fern Street and Main Street presents challenging trade-offs. As the primary neighbourhood corridor that will serve new commercial and high-density residential, it will serve a critical role as a high-quality walking, bicycling, and transit connection. The Lower Lynn Concept Plan envisions Mountain Highway as a walkable, bikeable neighbourhood heart. As discussed in the previous sections, it is recommended to have a dedicated bikeway, an HOV lane,

wide sidewalks, frequent marked crosswalks, and other amenities such as curb extensions and medians.

The traffic circulation analysis projects future daily two-way traffic volumes of approximately 15,000 vehicles per day in 2030. Its present configuration - a three-lane road with a southbound HOV lane and intersections 800 metres apart, is well suited to handle this level of traffic without additional vehicle travel lanes. Additional lanes are likely to increase Mountain Highway's attractiveness as a cut-through route while providing excess capacity in the off-peak period. The introduction of additional lanes could have the unintended consequences of roadways that are over capacity, such as speeding during the off-peak hours. Additional lanes also increase the distance pedestrians must cross the street and make it more difficult to see pedestrians while they are in the crosswalk. For these reasons, widening Mountain Highway to provide additional vehicle capacity is in direct conflict with creating a high-quality bicycle, pedestrian, and transit corridor. The street could also include on-street parking and other elements. Rather than dictate the final design of the roadway, the report recommends a 27 metre right-of-way to allow design flexibility as the neighbourhood develops and the District takes advantage of opportunities to gain space in order to include its desired elements.

However, congestion at Mountain Highway/Main Street will increase. In the future, it is projected to operate at LOS E, which means it is at or near capacity. Given the fact that it already has dual southbound left-turn lanes, and it is undesirable to widen it, there are no readily apparent improvements to address the congestion. The Ministry of Transportation's preferred ramp reconfiguration includes a provision to prohibit southbound left-turns from Mountain Highway. If this occurs, the intersection will cease to be a viable cut-through route, raising the possibility that drivers will re-route to Brooksbank or Seymour Boulevard as long as Highway 1 remains congested. Based on the goals of the Lower Lynn Concept Plan and the traffic analysis, Mountain Highway should remain three

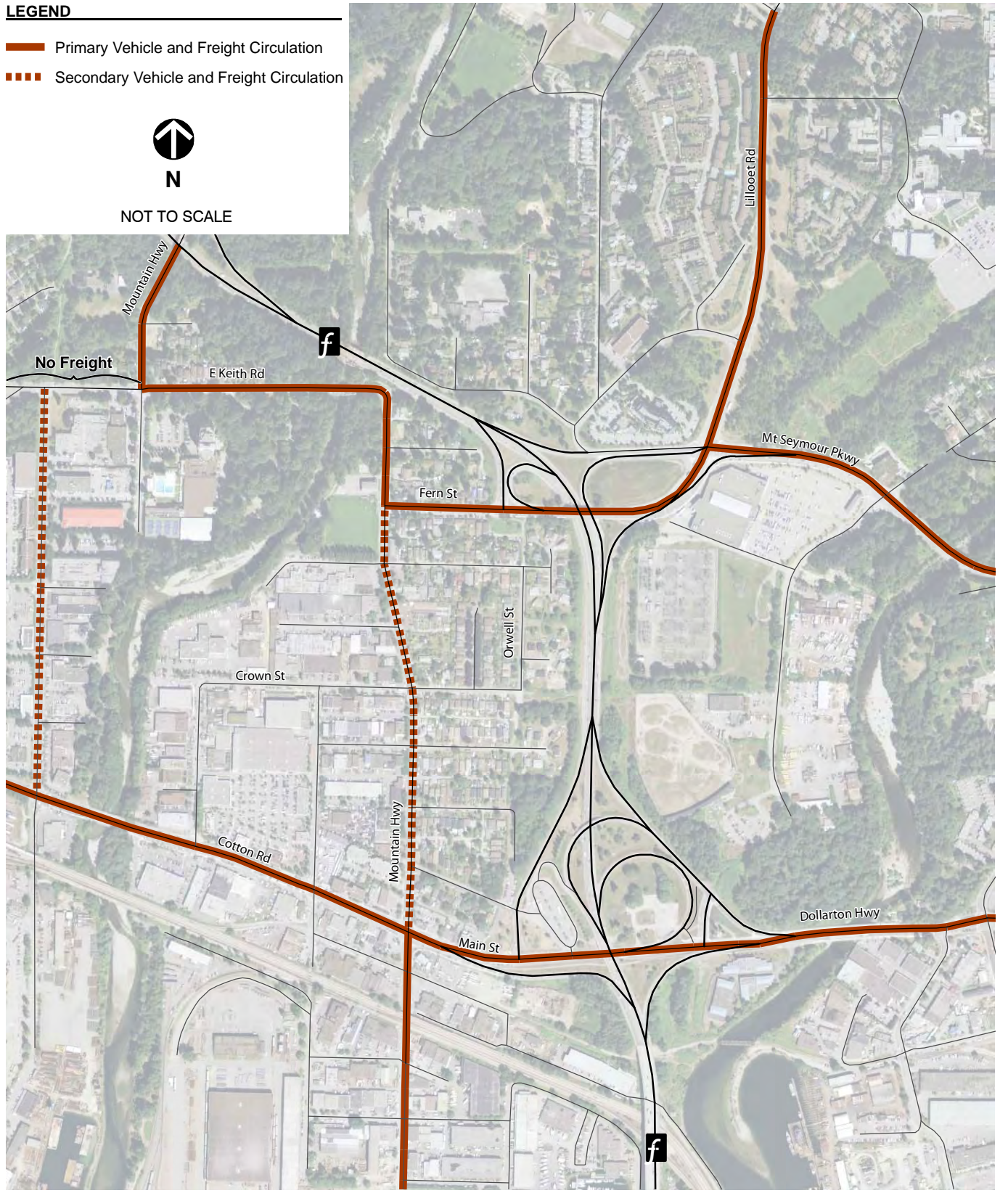
lanes with a southbound HOV lane. Use additional right-of-way for wide sidewalks, dedicated bikeways, pedestrian refuge islands, and potentially on-street parking. A 27-metre right-of-way will capture these elements.

**LEGEND**

- Primary Vehicle and Freight Circulation
- Secondary Vehicle and Freight Circulation



NOT TO SCALE



**FEHR & PEERS**  
TRANSPORTATION CONSULTANTS

N:\2009Projects\SE\_Projects\SE09-0152\May2010\MXD\fig19\_VehFreight\_PrimSec2.mxd

**PRIMARY AND SECONDARY  
VEHICLE AND FREIGHT CIRCULATION**

**FIGURE 18**

The following are the short, medium, and long-term improvements suggested by the analysis.

### **Short Term**

*Implement the improvements in the Seylynn Village Report.* Improvements include a new signal at Bruce Street/Mountain Highway; a second southbound left-turn lane at Fern Street/Mountain Highway; and a second left turn lane on Fern Street for vehicles turning south onto Mountain Highway.

### **Medium Term**

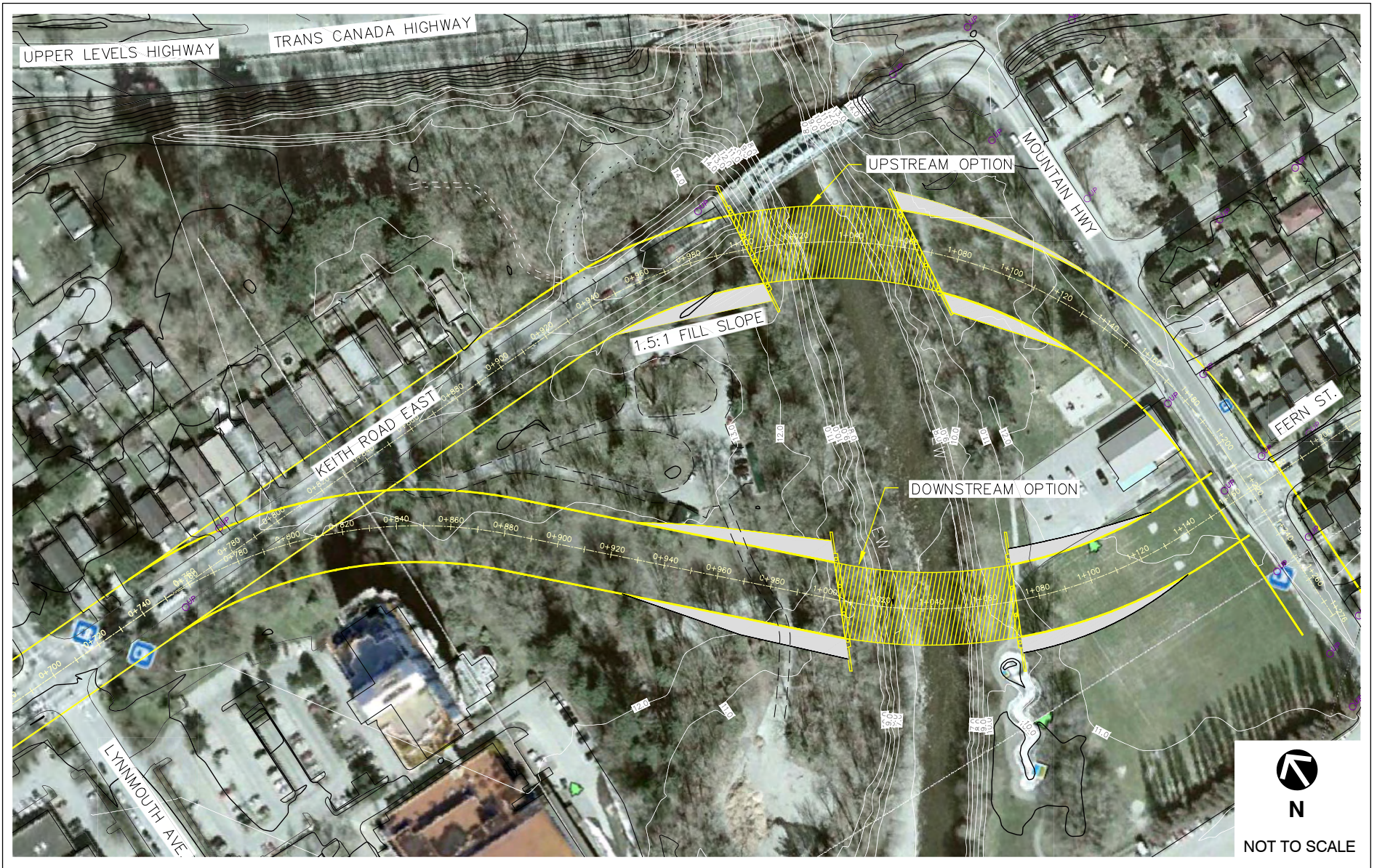
*Provide a second left-turn lane from Fern Street to the Highway 1 on-ramps.* This improvement requires that the “free right” from westbound Fern Street to the on-ramps be converted to a more traditional right-turn lane, so that vehicles in this lane must stop or yield to left-turners, or the signal could be modified to control the right turn movement.. The analysis shows some additional congestion for westbound Fern Street, but no significant impacts.

Highway 1 is sometimes congested at the Fern Street on-ramp, and the lanes must merge onto the Highway. The primary benefit of the extra left-turn lane during these times would be storage approaching the ramp merge. The lane will reduce the length of the queue on Mountain Highway and Keith Road.

### **Long Term**

Review the two options for realigning and widening Keith Road (Figure 19) across the Keith Road Bridge. Either option would provide substantial benefits over the current bridge. The northern option softens the current 90-degree curve and provides width for additional travel lanes, with bicycle and pedestrian facilities. The southern option where Keith Road is substantially re-routed through the Park provides a decrease in

overall traffic delay and safety by straightening the road. The safety benefits result from more consistent speeds and fewer conflicts at the intersection. In addition, this route is 0.16 kilometres shorter than the northern option, which lowers overall vehicle kilometers traveled. Access to the properties along East Keith Road would need to be resolved in this option. For cost estimating purposes, both of these options were sized for five lanes, but could operate acceptably with four lanes.



**FEHR & PEERS**  
TRANSPORTATION CONSULTANTS

N:\Projects\SE09-0152\_N.Vancouver Lower Lynn\Graphics\Draft\AI\April2010\fig20\_Keith Road\_fp.ai

**KEITH ROAD REALIGNMENT**

**FIGURE 19**

## Conclusions

Figure 21 shows all roadways in the Lower Lynn study area and their functions. Roads such as Keith Road and Main Street remain primarily roads for vehicles, transit, and freight, while roads like Oxford Street, Orwell Street, and Crown Street serve bicyclists and pedestrians. As the map shows, main arteries for vehicles provide strong east-west connections while roads within the neighbourhoods are preserved for bikes, pedestrians, and transit. There is a broad spectrum of improvements for many of these key streets that align with the modes they serve designed to improve safety and access while achieving the long-term goals of the Lower Lynn Concept Plan. The table shows the list of short, medium, and long-term projects by mode.



Figure 20: Lower Lynn Transportation Strategy Capital Improvement Projects

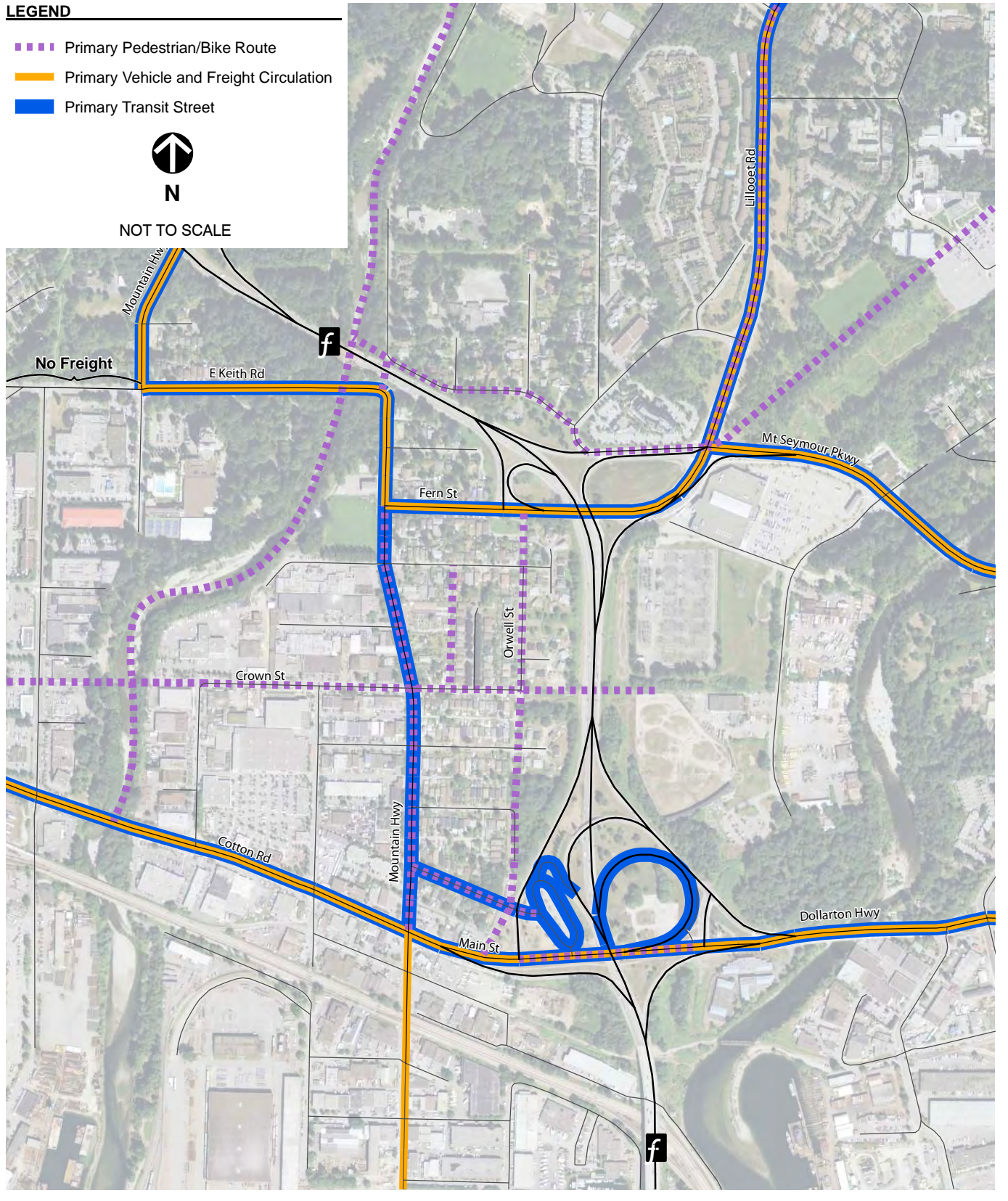
Title	Location	Description	Mode	Timing/Trigger
Mountain Highway Design Guidelines	Mountain Highway	A set of guidelines to steer future improvements as development occurs. Could include wide sidewalks, landscape strips, sidewalk-orientation for buildings.	All modes	Short-Term
Keith Road Bridge Replacement	Keith Road between Mountain Highway (north) and Mountain Highway (south)	Replace the existing structure with a new bridge and roadway connection.	All modes	Short-Term
Phibbs Exchange Bicycle Parking	Phibbs Exchange	Install long-term bicycle parking spaces (six)	Bicycle	Short-Term
Bicycle Wayfinding Improvements	Neighbourhood	Inventory existing wayfinding signs. Eliminate excess signs and install new signs where missing at turning points	Bicycle	Short-Term
Mountain Highway Bikeway	Mountain Highway between Fern Street and Oxford Street	Install sharrows along northbound Mountain Highway between Keith Road and Main Street.	Bicycle	Short-Term
Bicycle Route Improvements	Crown Street and either Lynn Street or Harbour Avenue	Include wayfinding signs along Crown Street and either Lynn Avenue or Harbour Avenue to connect to Main Street. Provide signs along Hunter Street from the Lynn Creek Trail to Orwell Street and Phibbs Exchange.	Bicycle	Short-Term
Bicycle Signal Improvements	Main Street and Mount Seymour Parkway	Install loop detector stencils where needed along Main Street and Mount Seymour Parkway and ensure the minimum green time is appropriate for cyclists.	Bicycle	Short-Term
Oxford Street Wayfinding	Oxford Street between Mountain Highway and Phibbs Exchange	Install pedestrian-scale lighting and wayfinding along Oxford Street consistent with Orwell Street.	Pedestrian	Short-Term
Phibbs Exchange Pedestrian Connections	Phibbs Exchange	<ul style="list-style-type: none"> <li>Mark crosswalks at Oxford Street/Highway 1 ramp and install a continuous pathway between the bus boarding area and the entrance at Oxford Street (Figure 12).</li> <li>Provide lighting along at the Main Street/Dollarton Highway undercrossing of Highway 1 and pave the dirt path.</li> <li>Improve the dirt paths between the boarding area and Main Street (Figure 12).</li> </ul>	Pedestrian	Short-Term
Phibbs Exchange Parking Improvements	Phibbs Exchange	Pedestrian-scale lighting	Pedestrian	Short-Term
Main Street Countdown Signals	Main Street	Countdown Signals at traffic signals along Main Street	Pedestrian	Short-Term
Seylynn Village Improvements	Seylynn Village Vicinity	As described in the Seylynn Village Traffic Report	Vehicles	Short-Term
Safe Routes to School Projects	Lynn Elementary and Keithlynn Alternative Secondary School	Improve connections to existing network from Lynn Creek and Keith Road. Work with the schools to develop a targeted set of improvements.	Pedestrian	Medium-Term
Phibbs Exchange Entrance Improvement and Oxford Street Crosswalk Improvements	Phibbs Exchange and Oxford Street/Mountain Highway	Install a signal at the Main Street/Phibbs Exchange Entrance and extend the pedestrian refuge island on Mountain Highway from Main Street to the Oxford Street Crosswalk	Transit	Medium-Term
Spirit Trail	South of Main Street	Select an alignment and construct segments	Bicycle/Pedestrian	Long-Term
West Crown Street Extension	Crown Street between Mountain Highway and Park and Tilford	A Crown Street extension across Lynn Creek to connect directly to the Park and Tilford Shopping Centre. Includes a marked crosswalk across Brooksbank Avenue between 3rd Street East and 4th Street East and a pedestrian pathway through the Park and Tilford Shopping Centre. The design of the extension should be wide enough to allow emergency vehicle access during times when Keith Road is congested	Bicycle/Pedestrian	Long-Term
Main Street Pedestrian Connections	Main Street	Pedestrian connections between the sidewalk and business entrances	Pedestrian	Long-Term
Fern Street On-Ramp Improvements	Fern Street/Highway 1 On-Ramps	Provide a second left-turn lane from Fern Street to the Highway 1 on-ramps.	Vehicles	Concurrent with the next major development in Lower Lynn
East Crown Street Extension	Crown Street between Mountain Highway and Seymour Creek	A Crown Street extension to the east across Highway 1 to be considered as the Squamish Nation creates land use plans for Seymour Creek. The bridge would require coordination among the District, the Squamish Nation, and the Ministry of Transportation.	Pedestrian/Bicycle	Concurrent with development in Seymour Creek
Oxford Street Sidewalks	Oxford Street between Mountain Highway and Phibbs Exchange	Install sidewalks on the south side of the street	Pedestrian	Concurrent with development on Oxford Street
Lower Lynn Greenway	Between Mountain Highway and Marie Place and Hunter Street and Crown Street	Construct a new greenway for bicycling and walking	Pedestrian/Bicycle	Concurrent with the development between Hunter Street and Crown Street
Mountain Highway Improvements	Mountain Highway between Fern Street and Oxford Street	Install continuous three-lane cross section with either dedicated bike lanes or a cycletrack; new high-visibility crosswalks; and curb extensions on the east side of Mountain Highway/Crown Street and pedestrian refuge islands on Mountain Highway.	Pedestrian/Bicycle/Tra	Concurrent with development in Lower Lynn

**LEGEND**

- Primary Pedestrian/Bike Route
- Primary Vehicle and Freight Circulation
- Primary Transit Street



NOT TO SCALE



**FEHR & PEERS**  
TRANSPORTATION CONSULTANTS

N:\2009Projects\SE\_Projects\SE09-0152\May2010\MXD\fig22\_Prim\_Improvs.mxd

**PRIMARY MODE FUNCTIONS**

**FIGURE 21**

**Appendix A: Regional Scenarios  
Analysis**

## MEMORANDUM

Date: March 2010  
To: Tamsin Guppy and Erica Geddes, District of North Vancouver  
From: Seleta Reynolds and Don Samdahl, Fehr & Peers

**Subject: Lower Lynn Regional Scenarios**

SE09-0152

This memo continues the analysis described in our October 27, 2009 memo and evaluates the three scenarios selected for further study by the Lower Lynn Transportation Strategy Partners. The three scenarios focus on relocating the Highway 1 ramps, and each scenario moves some combination of ramps to Brooksbank Avenue. Our primary findings are that each of the three scenarios may benefit Highway 1 operations but will not substantially improve traffic conditions in the Lower Lynn neighbourhood. Rather, focusing efforts on realigning and widening Keith Road will provide a more direct benefit to Lower Lynn and surrounding neighbourhoods. Some ramp relocation scenarios will increase the amount of regional traffic traveling through the neighbourhood.

The three scenarios included in the analysis are:

- A. Full Brooksbank Avenue interchange and removal of Fern Street interchange and northbound off-ramp at Mountain Highway
- B. Half Brooksbank Avenue interchange (northbound on-ramp and southbound off-ramp) and half-Fern Street interchange (southbound on-ramp and northbound off-ramp)
- C. Concept 2 from North Shore Interchanges Functional Planning Study<sup>1</sup>

In addition, two local street connections are analyzed independently from the freeway interchange scenarios. These two connections are a realigned Keith Road and the Northern Service Road between Mountain Highway and Mount Seymour Parkway.

### METHODOLOGY AND ASSUMPTIONS

The intent of the analysis was to gain a broad understanding of the effects of each scenario on local travel, rather than to achieve a detailed freeway operations analysis. To simplify the analysis and manage multiple scenarios, we relied mostly on current traffic volumes. This approach allowed a clearer understanding of the effect of each scenario on existing neighbourhoods on the North Shore. The analysis used 2008 traffic counts from the Seylynn Traffic Report<sup>2</sup> and the existing AM and PM peak hour counts from the draft North Shore

<sup>1</sup>Draft North Shore Interchanges Functional Planning Study prepared by CH2M Hill for the British Columbia Ministry of Transportation (December 2007).

<sup>2</sup>Seylynn Traffic Report Addendum 3 prepared by MMM Group for Hynes Developments Ltd. (November 2008).

Interchanges Functional Planning Study done in December of 2007. To calculate the shifts in traffic resulting from each scenario, we used a combination of the North Shore Sub-area Emme/2 Transportation Model and manual adjustments of the ramp volumes travel patterns in the area. However, the analysis did not include discreet model runs for each scenario and in most cases.

For the three freeway scenarios, we examined the effects of an extension of Seymour Boulevard through the Seymour Creek development with access to Highway 1 at Dollarton Highway.

## **ANALYSIS**

This section describes the analysis results for each of the freeway interchange scenarios, followed by an assessment of the local street connections.

### ***Scenario A. Full Brooksbank Interchange***

#### *Description*

Scenario A would provide a full interchange at Brooksbank Avenue, continuation of Brooksbank Road north of Highway 1, and removal of the Fern Street interchange and the northbound off-ramp at Mountain Highway. The majority of the users of Highway 1 in this area originate to the north and east of Lower Lynn and access Highway 1 via Mount Seymour Parkway and Lillooet Road. Drivers from these locations would travel via the new Seymour Boulevard extension, Dollarton Highway and Mountain Highway to access Highway 1 across the Ironworkers Memorial Bridge. The figure on the following page illustrates the conceptual alignment of Scenario A and documents the key transportation impacts.

#### *Why this Scenario?*

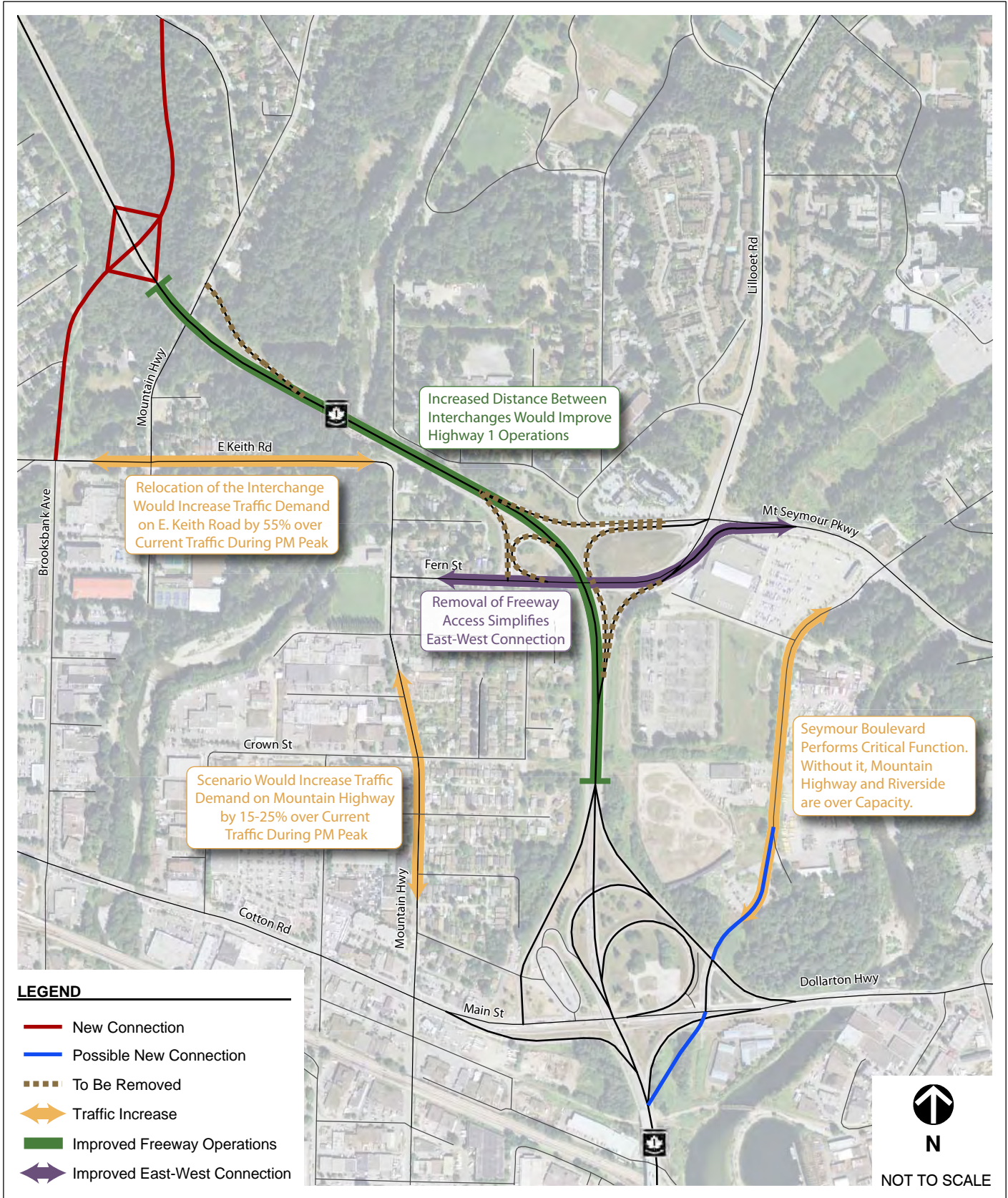
The Full Brooksbank Interchange Scenario was selected for this analysis because relocating the existing Fern Street interchange to the north should improve Highway 1 operations by increasing the distance from the Main Street/Dollarton Highway interchange. Conversely, this relocation would increase the distance drivers must travel on local streets to/from the Highway 1 ramps.

#### *Analysis Results*

Traffic volumes on Mountain Highway in the Lower Lynn neighbourhood would increase by 15-25 percent during the PM peak over current traffic levels, which could be reasonably accommodated on a four-lane road. Traffic on Keith Road between Brooksbank Avenue and Mount Seymour Parkway/Lillooet Road would also increase by and require additional east/west capacity. The benefits of removing the Highway 1 ramps from Fern Street and simplifying the east/west connection between Fern Street and Mount Seymour Parkway would be offset by the increased volumes traveling greater distances on local streets to/from Brooksbank Avenue. Riverside Drive would also experience an increase in traffic.

The Seymour Boulevard extension is a critical part of this scenario. Without the extension, traffic from the development as well as neighbourhoods to the east would access Highway 1 at either Brooksbank Avenue or Dollarton Highway, placing further strain on Riverside Drive and Keith Road.

With Scenario A, we forecast the section of Brooksbank Avenue south of Keith Road would carry 17,000-20,000 vehicles per weekday. The new section of Brooksbank Avenue north of Keith Road through the new interchange would carry 25,000-30,000 vehicles per weekday and would require two travel lanes in each direction with additional turn lanes at the intersections.



### ***Scenario B. Half Brooksbank Avenue Interchange and Half Fern Street Interchange***

#### *Description*

Scenario B would provide a half interchange at Brooksbank Avenue with a northbound on-ramp and southbound off-ramp and a half interchange at Fern Street with a southbound on-ramp and northbound off-ramp. The following Highway 1 ramps would be removed: southbound off-ramp to Fern Street, northbound on-ramp from Mount Seymour Parkway, and northbound off-ramp to Mountain Highway. The figure on the following page illustrates the conceptual alignment of the Scenario B and documents the key transportation impacts.

#### *Why this Scenario?*

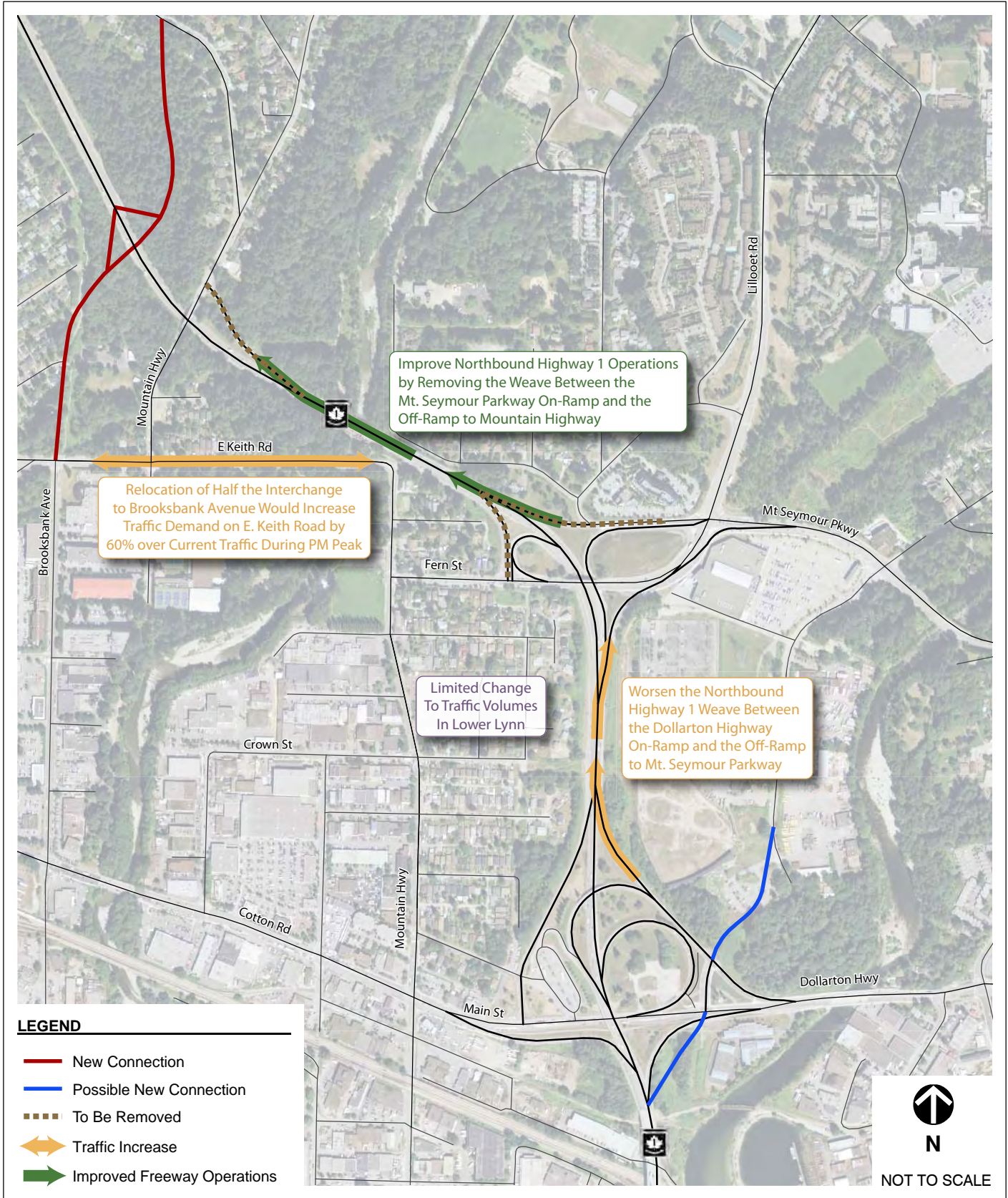
Scenario B was selected for this analysis because relocating two of the Fern Street ramps to Brooksbank Avenue would improve Highway 1 operations by increasing the distance between the two ramps and the Main Street/Dollarton Highway interchange. Retaining two of the Fern Street ramps addresses concerns about the Lower Lynn and Seymour neighbourhoods' access to Highway 1. Specifically, in the full Brooksbank interchange scenario, Lower Lynn and Seymour residents would travel farther to reach Highway 1 in both directions. In this scenario, drivers whose are going to or coming from the Iron Worker's Memorial Bridge would be able to use the same routes they currently use, while drivers headed to or from Highway 1 northbound would use the new ramps at Brooksbank. An alternative would be to retain the ramps at Fern Street for northbound Highway 1 traffic and move the access for southbound Highway 1 to Brooksbank, however, this would require Seymour and Lower Lynn residents to travel north to go south.

#### *Analysis Results*

The new Brooksbank Avenue ramps to and from the north would increase traffic on Keith Road similarly to Scenario A. Most of the other streets in Lower Lynn would be minimally affected because the Fern Street ramps to and from the south would be retained.

The effects of this scenario on Highway 1 would primarily be in the northbound direction. The scenario would improve Highway 1 operations by resolving the northbound weaving issue from the Mount Seymour Parkway on-ramp to the Mountain Highway off-ramp. However, the scenario would worsen the northbound weave between the Dollarton Highway on-ramp and the Mount Seymour Parkway off-ramp by increasing the volumes of both movements. Vehicles would shift to the northbound on-ramp from Dollarton Highway due to the removal of the northbound on-ramp from Fern Street/Mount Seymour Parkway. Similarly, volumes on the northbound off-ramp to Fern Street would increase due to the closure of the northbound off-ramp to Mountain Highway. The operational effects of these changes to Highway 1 would require a more in-depth freeway operational analysis.

Scenario B could also include retaining the existing northbound off-ramp to Mountain Highway. If the off-ramp were retained, the benefit to Highway 1 operations would diminish, which is one of the primary benefits of the ramp reconfiguration. With the Mountain Highway off-ramp, traffic volumes on E Keith Road would increase by approximately 40 percent compared to current levels. This increase could be accommodated on a four-lane road, but would leave no capacity for future growth.





### ***Scenario C. Concept 2 from North Shore Interchanges Functional Planning Study<sup>3</sup>***

#### *Description*

Scenario C relocates ramps from Fern Street to Brooksbank Avenue and removes ramps from the Main Street/Dollarton Highway interchange and constructs a new, four-lane extension of Keith Road across Highway 1. The conceptual alignment and key transportation impacts of Scenario C are illustrated on the attached figure.

#### *Why this Scenario?*

We analyzed Concept 2 from the North Shore Interchanges Functional Planning Study to evaluate the project's effect on the Lower Lynn neighbourhood. Scenario C is intended to improve Highway 1 operations by removing the number of ramp connections and separating the distances between ramps.

#### *Analysis Results*

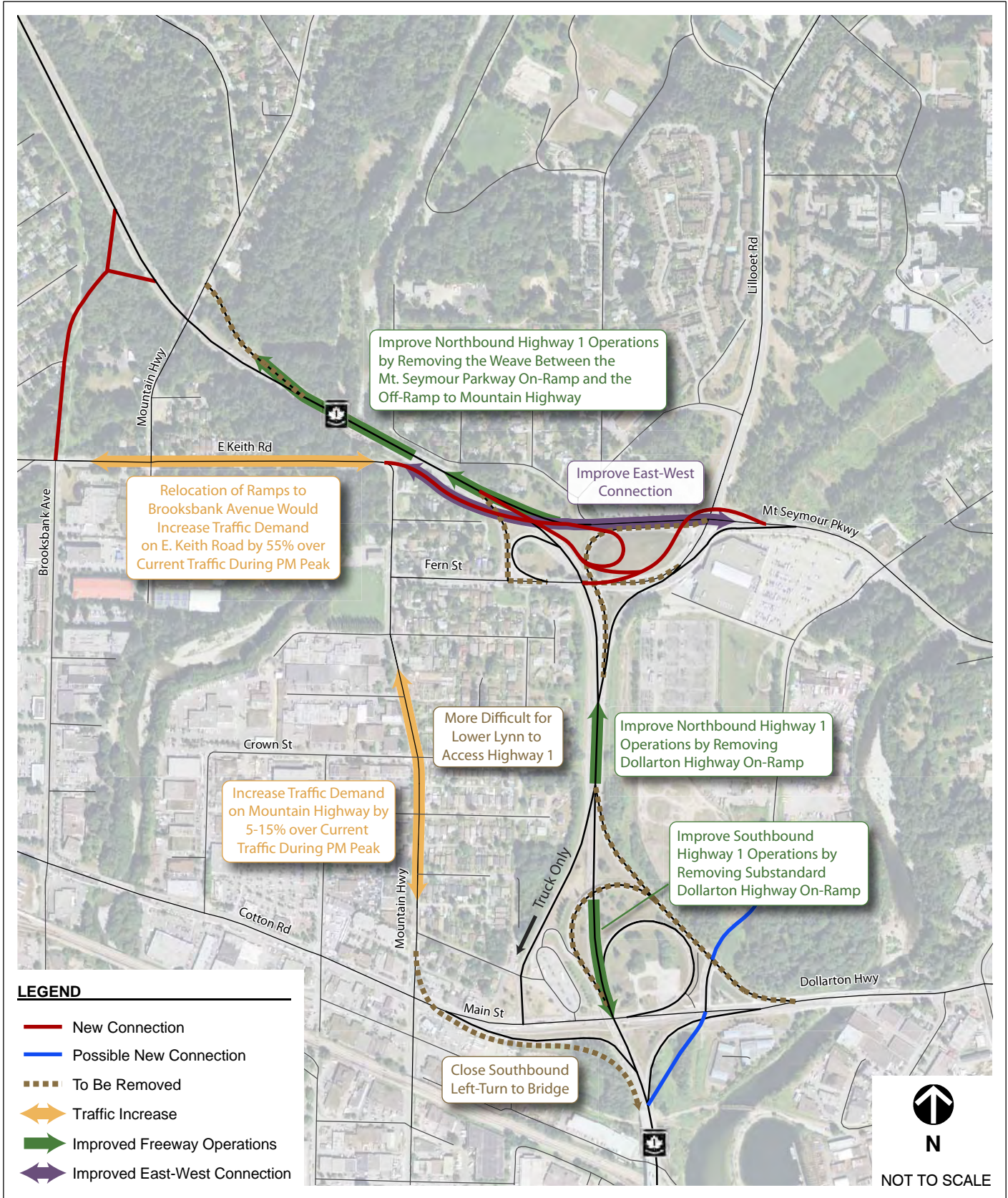
Of the three scenarios, Scenario C would likely result in the greatest improvement to Highway 1 operation. However, the removal and relocation of these ramps would increase the distance drivers must travel on local streets to/from the Highway 1 ramps. For example, the removal of the southbound off-ramp to Fern Street and the restriction of the southbound off-ramp to Main Street to trucks would cause southbound drivers to exit the freeway at Brooksbank Avenue and travel via local streets to access Lower Lynn, Main Street, Dollarton Highway, and the port area south of Lower Lynn. In Lower Lynn, Scenario C would increase traffic volumes on Mountain Highway by 5-15 percent during the PM peak hour over current levels.

To reduce cut-through traffic on Mountain Highway, Scenario C would restrict the southbound left-turn from Mountain Highway to the southbound Highway 1 on-ramp. The left-turn restriction would reduce cut-through traffic in Lower Lynn, but it would also make it more difficult for neighbourhood traffic to access southbound Highway 1.

Another aspect of Scenario C is the construction of the Keith Road flyover, a new extension of Keith Road across Highway 1. This new structure would be four lanes wide and carry a substantial amount of east-west traffic. It would entail a new elevated intersection with Mountain Highway and obviate the need for the Keith Road Bridge.

---

<sup>3</sup>Draft North Shore Interchanges Functional Planning Study prepared by CH2M Hill for the British Columbia Ministry of Transportation (December 2007).



**Summary of Freeway Interchange Scenario Findings**

Each of the three scenarios includes some combination of removing the Highway 1 ramps at Fern Street/Mount Seymour Parkway or Mountain Highway and relocating the ramps to Brooksbank Avenue. There are two potential benefits by relocating the ramps to Brooksbank Avenue

1. Improve Highway 1 operations by increasing the distance from the Main Street/Dollarton Highway interchange, and
2. Simplify the east/west connection between Fern Street and Mount Seymour Parkway.

While these changes may benefit traffic operations along Highway 1, the relocation of the Fern Street ramps to Brooksbank Avenue would not decrease traffic within the Lower Lynn neighbourhood. The majority of the users of the Fern Street/Mount Seymour Parkway ramps originate from locations to the north and east. Relocating Highway 1 ramps from Fern Street to Brooksbank Avenue would substantially increase the amount of traffic traveling on Keith Road. To accommodate this increased traffic, additional capacity would need to be provided on either Keith Road or a new connection between Brooksbank Avenue and Mount Seymour Parkway (see local street connections discussed below).

The following table summarizes the order-of-magnitude increase in traffic for each scenario. Existing daily traffic volumes were derived from the peak hour counts included in the Seylynn Village Traffic study. For this purpose, we assumed that PM peak hour counts equal 10 percent of daily traffic.

	<b>Scenario A: Full Brooksbank</b>	<b>Scenario B: Partial Brooksbank</b>	<b>Scenario C: North Shore Study Concept 2</b>
<b>Keith Road</b>			
<i>Existing Daily Traffic</i>	20,000		
<i>Daily Traffic with Scenario</i>	32,000	33,000	32,000
<i>Increase in PM Peak Hour Traffic</i>	1,200	1,300	1,200
<b>Mountain Highway</b>			
<i>Existing Daily Traffic</i>	14,000		
<i>Daily Traffic with Scenario</i>	16,000 - 18,000	Minor	15,000 - 16,000
<i>Increase in PM peak hour traffic</i>	200 - 450	Minor	100 - 300

All three scenarios include elements to improve Highway 1 operations, but the limited capacity on the Iron Workers Memorial Bridge would cause southbound Highway 1 approaching the bridge to remain congested during peak travel times. This is typical of most approaches to bridges where traffic is funneled from a large network into a single crossing. Southbound Highway 1 congestion means southbound cut-through traffic will continue to be an issue for the Lower Lynn neighbourhood.

Scenario C includes two changes that have merit and could be used with any of the scenarios or as stand-alone projects. Scenario C would remove the northbound on-ramp from Main Street/Dollarton Highway and the southbound on-ramp from Dollarton Highway. The latter ramp has a substandard design. Both on-ramps carry approximately 550 vehicles during the AM peak hour and 300 vehicles during the PM peak hour. The removal of these on-ramps would have little direct impact on the Lower Lynn neighbourhood but would improve Highway 1 operations and possibly reduce cut-through traffic. We recommend continuing to evaluate the elimination of these two on-ramps to improve freeway operations and safety.

### ***Local Street Connections***

Given the limited benefits of the freeway interchange scenarios to traffic conditions within the Lower Lynn neighbourhood, we reexamined two local street connections:

1. Realigned Keith Road, and
2. Northern Service Road.

Either of these connections could address many of Lower Lynn's traffic issues separate from any interchange revisions to Highway 1.

### **Realigned Keith Road**

To increase the capacity of Keith Road, a new realigned Keith Road Bridge with 2 travel lanes in each direction could be constructed to provide a more direct connection to Fern Street. The realigned Keith Road Bridge alternative includes additional capacity along Fern Street to improve the bottleneck at the Highway 1 ramps. The intersection of Fern Street and Mountain Highway would include two westbound left-turn lanes, which is consistent with the improvements identified as part of the Seylynn Village development<sup>4</sup>. The intersection of Fern Street and the southbound Highway 1 ramps would require two eastbound left-turn lanes to accommodate the heavy volumes accessing Highway 1 at that location<sup>5</sup>. The new connection would improve the current bottlenecks at this location, which are southbound traffic on Mountain Highway turning left onto Fern Street and eastbound Fern Street traffic turning left onto southbound Highway 1. The Realigned Keith Road Scenario is also expected to improve safety by removing two 90 degree turns. The attached figure shows a conceptual realigned Keith Road.

---

<sup>4</sup> Seylynn Village is multi-use development planned to be constructed north of Fern Street and east of Mountain Highway in the Lower Lynn neighbourhood. Seylynn Village would construct roadway improvements along Mountain Highway and Fern Street, including new southbound and westbound left-turn lanes at the Fern Street/Mountain Highway intersection. The latest plans for the Seylynn Village do not improve the Fern Street/Southbound Highway 1 Ramps intersection, and the eastbound left-turn (single lane) onto the freeway will continue to operate poorly during the AM peak.

<sup>5</sup> During the AM and PM peak hours, between 300 and 550 vehicles make this movement.

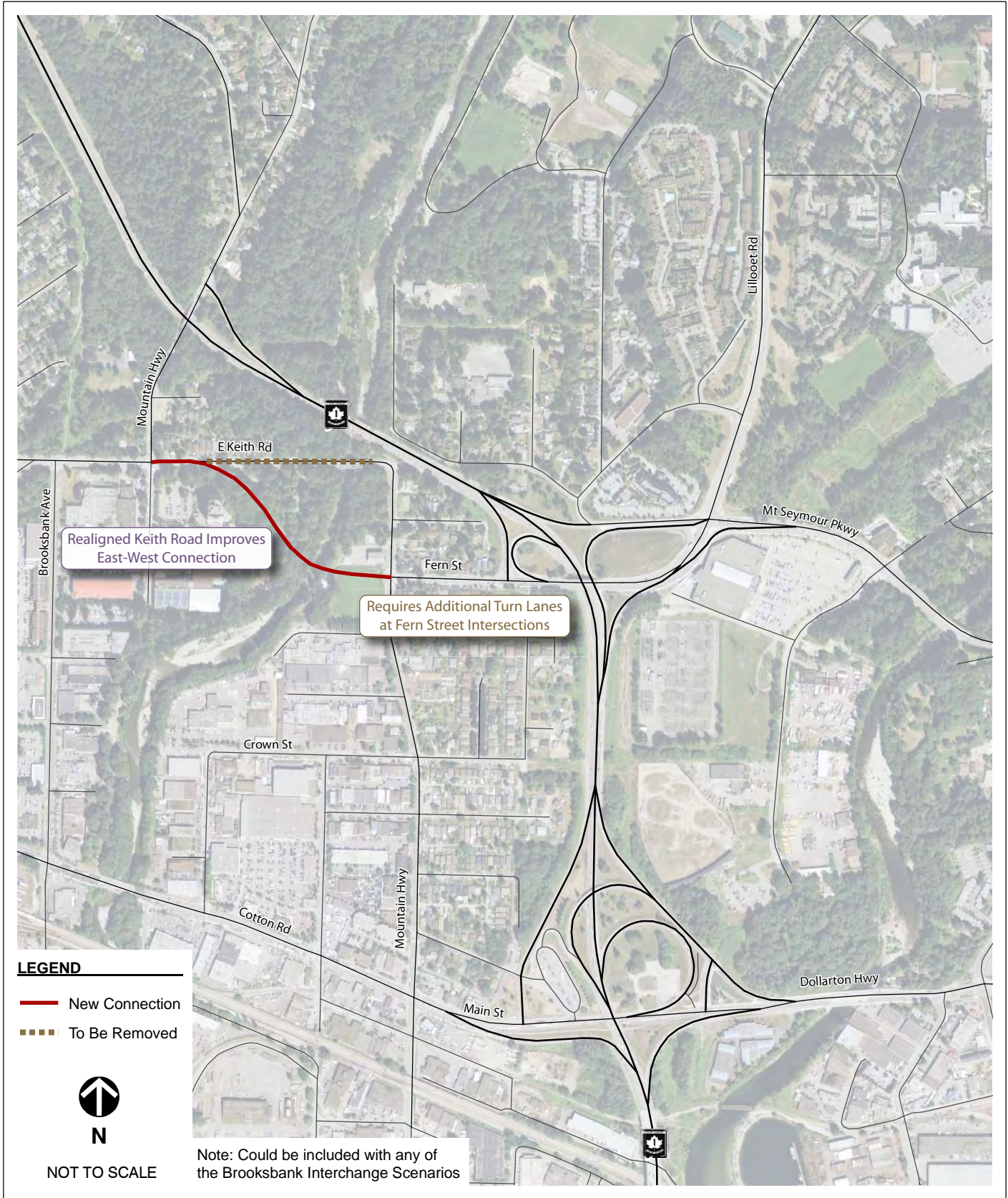
The Realigned Keith Road Scenario would reduce east/west travel time compared to the Seylynn Village improvements by widening the Keith Road Bridge to two lanes in each direction, reducing the travel distance by approximately 170 meters, and adding a second eastbound left-turn lane onto the southbound Highway 1 ramp. For eastbound traffic traveling on Keith Road to the Fern Street interchange, the Realigned Keith Road Scenario will improve travel time by an estimated average of 75 seconds during the AM peak hour.

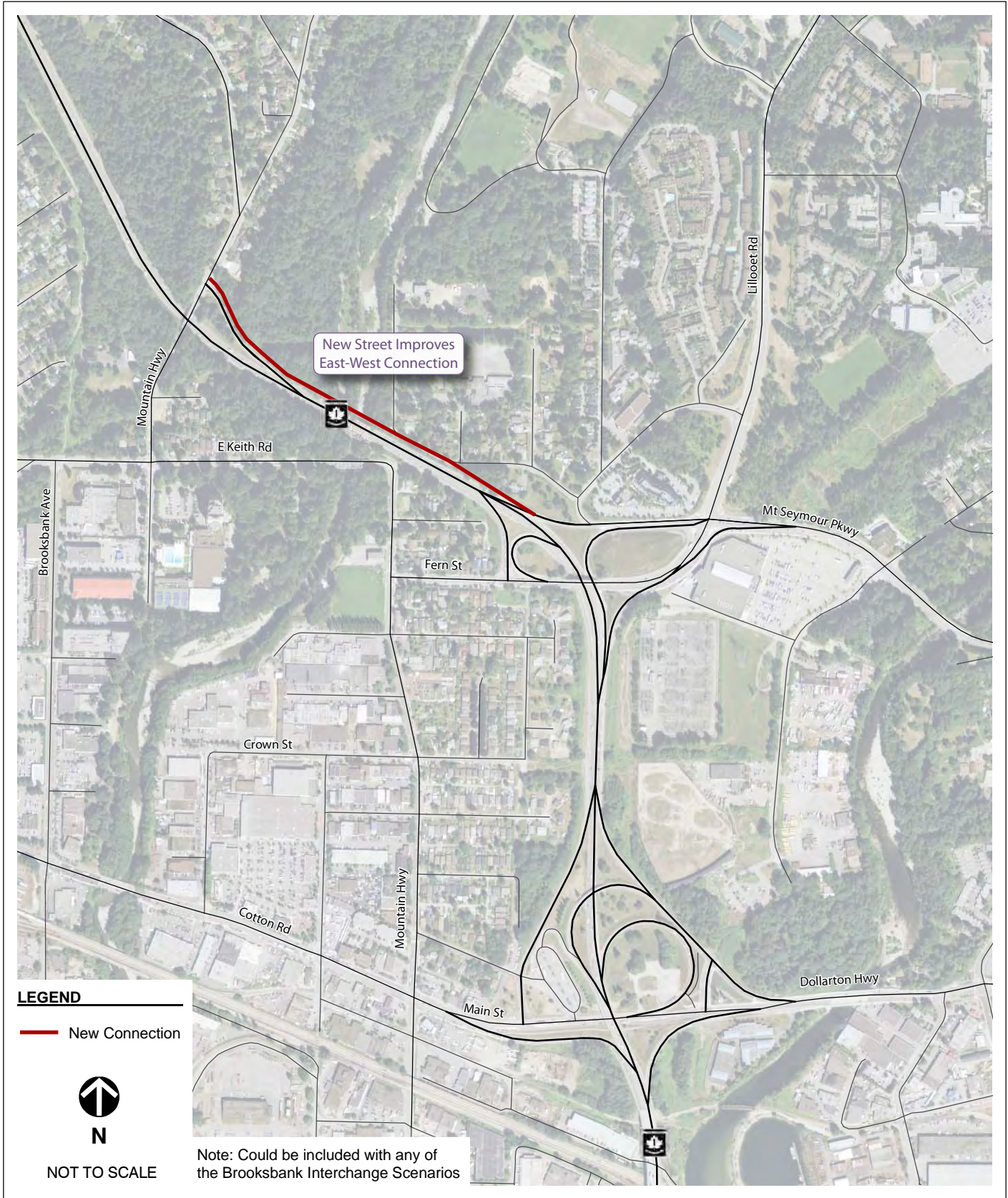
The Keith Road realignment would pass through the existing park and would require substantial mitigation of park impacts. The current Keith Road bridge and Mountain Highway to Bruce Street would be removed and could be returned to parkland. The realigned Keith Road would also provide the opportunity to build a new pedestrian and bicycle connection across Lynn Creek. This roadway could be designed as a boulevard, with landscaped medians, a buffer strip, sidewalks, and bicycle lanes, in order to mitigate the impacts of the arterial street.

For comparative purposes, we examined a scenario that would widen the Keith Road bridge but keep it at or near its current location, rather than realigning it to the south. We assumed that the Seylynn Village improvements would be constructed, along with a second eastbound left-turn lane onto the southbound Highway 1 ramp. These improvements would address both current bottlenecks (at Highway 1 and across the Keith Road bridge) and would improve operations. This set of improvements would improve travel time by an estimated average of 55 seconds during the AM peak hour. Retaining the present alignment would preserve the existing park configuration, but it would also retain the 90 degree turn at Keith Road/Mountain Highway.

#### Northern Service Road

Another local street concept would be a new connection north of Highway 1 between Mountain Highway and Mount Seymour Parkway. A primary design challenge with this concept is to avoid conflicts with the existing northbound on-ramp from Mount Seymour Parkway to Highway 1 and the northbound off-ramp to Mountain Highway. The attached figure shows the conceptual layout of the Northern Service Road. We forecast this new connection could remove between 400 and 500 vehicles from Fern Street and Keith Road during the AM peak hour and between 500 and 600 vehicles during the PM peak hour, which is approximately 5,000 vehicles per day. The new connection would reduce congestion on Fern Street and reduce the eastbound queue on Keith Road. This concept is a potentially important addition to the regional access scenarios, as it provides additional east-west access for local traffic coming to or from the Lynn Valley neighbourhood. However, on its own, the new road presents design challenges that likely outweigh the potential benefits.





## CONCLUSIONS

The ramp changes included in the three interchange scenarios may improve Highway 1 operations, but we forecast little or no improvement to traffic conditions within the Lower Lynn neighbourhood. The ramp changes would result in freeway-oriented traffic being rerouted through the neighbourhood, which would require additional roadway capacity.

Selected ramp projects have merit and could be used with any of the scenarios or as stand-alone projects. These include the removal of the northbound on-ramp from Main Street/Dollarton Highway and the southbound on-ramp from Dollarton Highway. We recommend continuing to evaluate the elimination of these two on-ramps to improve freeway operations and safety.

Traffic conditions within the Lower Lynn neighbourhood could be improved most by providing new or modified east-west connections. Two connections were examined: a realigned Keith Road and the Northern Service Road. A new realigned Keith Road Bridge would provide a more direct connection to Fern Street and would remove the current bottleneck at the intersection of Fern Street and Mountain Highway. This alignment as well as a design that would maintain the current configuration would provide immediate and long-term benefits. The realignment offers an opportunity to correct some existing safety issues with the present configuration and the chance to create a complete street with sidewalks, bicycle lanes, and potentially HOV lanes. Included in the North Shore Concept 2 is an extension of Keith Road that would pass over Highway 1 and continue east. If the District elects to reconstruct either alternative for Keith Road, it would make an investment in a Keith Road overpass less likely.

A new Northern Service Road could be constructed north of Highway 1, tying Mountain Highway and Mount Seymour Parkway. This new connection could remove substantial traffic from Fern Street and Keith Road within the neighbourhood. Design and operational issues at the east and west end of this connection would need to be more fully examined in subsequent studies.

The chart on the following page includes a side-by-side description of each of the scenarios discussed in the memo.



## Lower Lynn Regional Access Scenario Comparison

- Improves
- ◐ Neutral
- Worsens

	Full Brooksbank Interchange	Half Brooksbank /Half Fern Street	Northshore Study Concept 2	Realigned Keith Road	Northern Service Road	Comments
<b>Lower Lynn Neighbourhood Issues</b>						
<b>Neighbourhood Congestion</b> Reduces cut-through traffic in the neighbourhood?	○	◐	◐	◐	●	None of the scenarios would eliminate Highway 1 congestion, and cut-through traffic is projected to continue.
<b>Neighbourhood Livability</b> Improves the park, pedestrian connections, and bike routes?	◐	◐	○	◐	○	The Realigned Keith Road Scenario would relocate the Keith Road bridge through the park.
<b>Neighbourhood Access</b> Improves access to and from the neighbourhood for all modes?	◐	◐	○	●	◐	The Realigned Keith Road Scenario would improve east-west connection for vehicles and transit.
<b>Transit Access</b> Impacts the Phibbs Exchange or offers potential for a new transit exchange?	◐	◐	◐	◐	◐	Each of the scenarios would have minimal impact to the Phibbs Exchange.
<b>Main Street Access</b> Improves access for all modes to Park and Tilford and the Lionsgate film studio?	○	◐	◐	◐	◐	The Full Brooksbank Interchange Scenario would increase traffic volumes on the section of Mountain Highway in Lower Lynn and make it more difficult to access Main Street.

	Full Brooksbank Interchange	Half Brooksbank /Half Fern Street	Northshore Study Concept 2	Realigned Keith Road	Northern Service Road	Comments
<b>Seymour Creek / Hwy 1</b> Improves access to the future Seymour Creek Development (Squamish Nation)?	◐	◐	◐	●	●	All scenarios assume the extension of Seymour Boulevard to Dollarton Highway with access to Highway 1. The relocation of ramps from Fern Street to Brooksbank Avenue would increase the travel distance for Seymour Creek. The Northshore Study Concept 2 Scenario would remove the Highway 1 northbound and southbound on-ramps from Dollarton Highway.
<b>Cost</b> How does each Scenario compare to the other three?	○	◐	○	◐	○	Realigned Keith Road Scenario would not involve changing Highway 1, but would require a new bridge.
<b>Magnitude of Improvements</b> How does each Scenario compare to the other three?	○	◐	○	●	◐	The Full Brooksbank Interchange Scenario would remove 5 ramps and add 4 ramps. The Northshore Study Concept 2 Scenario would remove 4 ramps and add 2 ramps. The Half Brooksbank/Half Fern Street Scenario would remove 3 ramps and add 2 ramps.
<b>Non-Peak Hour Traffic</b> Improves non-peak hour traffic in the neighbourhood?	○	○	○	◐	●	The three Freeway Scenarios would result in more circuitous routes to access Highway 1 during non-peak times.

	Full Brooksbank Interchange	Half Brooksbank /Half Fern Street	Northshore Study Concept 2	Realigned Keith Road	Northern Service Road	Comments
<b>Transportation Issues for the Surrounding Neighbourhoods</b>						
<b>Port Access</b> Improves truck access to and from Neptune and Lynn terminal?	◐	◐	●	◐	◐	The Northshore Study Concept 2 Scenario would improve truck access by restricting the Highway 1 southbound off ramp to Main Street to trucks only and by improving Highway 1 operations.
<b>Capilano University / Hwy 1</b> Improves access to / from Lillooet Road and Capilano University (Student population 5,000)?	○	○	◐	●	●	The removal of the Fern Street ramps would worsen Capilano University's access to Highway 1. The Realigned Keith Road Scenario would provide additional capacity on Fern Street.
<b>Dollarton Highway / Hwy 1</b> Improves access (all modes) to the Maplewood business area including the business parks, and heavy industrial area and the transfer station?	◐	◐	○	◐	◐	The Northshore Study Concept 2 Scenario would worsen access by removing the Highway 1 northbound and southbound on-ramps from Dollarton Highway. The other three scenarios would have minimal impact.
<b>Dollarton Highway / Hwy 1</b> Improves access to the eastern neighbourhoods including Maplewood and the southern parts of Seymour and the Tsleil-Watuth Nation?	◐	◐	○	◐	◐	The Northshore Study Concept 2 Scenario would worsen access by removing the Highway 1 northbound and southbound on-ramps from Dollarton Highway.

	Full Brooksbank Interchange	Half Brooksbank /Half Fern Street	Northshore Study Concept 2	Realigned Keith Road	Northern Service Road	Comments
<b>Seymour Community / East – West Access Across the Creeks</b> Ease of access to/ from Mount Seymour Parkway and the Seymour Community to the east (25,000 residents)?	◐	◐	●	●	●	The Northshore Study Concept 2 and Realigned Keith Road Scenarios would improve the east-west connection between Keith Road and Mount Seymour Parkway.
<b>Seymour Emergency Access</b> Is there emergency access into / out of Seymour (east-west)?	◐	◐	●	●	●	The Northshore Study Concept 2 and Realigned Keith Road Scenarios would improve the connection between Keith Road and Mount Seymour Parkway.
<b>Seymour Community / Hwy 1</b> Ease of access to/ from Mount Seymour Parkway and the Seymour Community to the east (25,000 residents)?	○	○	◐	●	◐	The removal of the Fern Street ramps would worsen the Seymour Community's access to Highway 1. The Realigned Keith Road Scenario provides additional capacity on Fern Street.
<b>Lynn Valley / Hwy 1</b> Ease of access to /from Mountain Highway and Lynn Valley community to the north (30,000 residents)?	●	◐	◐	●	●	Relocation of ramps from Fern Street to Brooksbank Avenue would improve Lynn Valley's access to Highway 1. Removal of Highway 1 northbound off-ramp to Mountain Highway would worsen access to Lynn Valley.
<b>City of North Vancouver / Hwy 1</b> Ease of access to / from Keith Road and the southern portion of the City of North Vancouver to the west.	●	◐	●	●	◐	New ramps at Brooksbank Avenue would improve Highway 1 access for this community.

	Full Brooksbank Interchange	Half Brooksbank /Half Fern Street	Northshore Study Concept 2	Realigned Keith Road	Northern Service Road	Comments
<b>City of North Vancouver / East – West Access</b> Ease of access to / from Keith Road and Cotton Avenue and the southern portion of the City of North Vancouver to the west.	○	○	○	●	◐	Relocation of ramps to Brooksbank Avenue would increase traffic volumes on Keith Road. Realigned Keith Road Scenario would improve east-west traffic flow.
<b>Overall Performance</b>						
<b>Highway 1</b> Improves traffic flow on the highway?	●	◐	●	◐	◐	The Northshore Study Concept 2 Scenario would provide the greatest benefit to Highway 1 operations by removing the most ramp connections. The Full Brooksbank Interchange Scenario would also benefit Highway 1 operations by separating the interchanges.
<b>Neighbourhood Issues</b> Improves access and congestion for Lower Lynn and surrounding neighbourhoods?	○	○	○	●	●	The Northshore Study Concept 2 would mitigate additional congestion by constructing the Keith Road flyover