Report

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City of Whitehorse

Whistle Bend
Transportation Network Impact Study

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Table of Contents

List of Appendices

List of Tables

List of Figures

Executive Summary

The City of Whitehorse is interested in seeing the development of a new residential area in the northern section of the municipality on the Lower Porter Creek bench between the existing Porter Creek community and the Yukon River. The proposed area, to be called Whistle Bend, is significant in size and is estimated to be able to house in the order of 10,000 new residents when it is fully developed, ased on the development cenario that were being planned at the time of this study. At build-out, the new sustainable community of Whistle Bend will constitute a significant percentage of the City's total population and will have a large impact on the utility and transportation infrastructure in Whitehorse – not just locally near the development, but also further away in the City's downtown area and on major commuter roads and highways through the City. This report presents and documents an assessment of the traffic and transportation impacts of Whistle Bend's growth on the City of Whitehorse's transportation network.

A transportation model of the Whitehorse road network has been developed for the City in the EMME platform using detailed land use, demographic and traffic volume data for the base year 2006 which corresponds with the 2006 Census Data developed by Statistics Canada. The model consists of several components: a traffic zone system and associated demographic and land use data, a base network (auto and transit), and a four stage transportation modelling procedure. A review of data available from the City was conducted, and where required additional data including mapping, traffic volume, turning movement counts and transit data was collected. The model built to reflect the physical characteristics of the road links and transit routes that connect the various zones that make up the City, was calibrated and validated to 2006 PM (peak afternoon) conditions, with a high degree of closeness of fit between model output and intersection traffic counts. Unlike previous road network models in Whitehorse, this EMME model can accurately simulate the operations of the City's major roads and intersections and can be used by transportation planners for road network capacity analyses and by traffic engineers for detailed intersection operational analysis. A transit system model is included to assist with alternative transportation mode assessments. Road network impacts are predicted for future growth by inputting new population and new growth area data.

The model requires demographic data to simulate City development. Growth scenarios up to and including full development of Whistle Bend have been developed using existing land use and anticipated future developments. Each horizon is identified by the total population reached at that stage; for example the 2006 (20,000) horizon represents a total City population of 20,000.

The development of the 2006 (20,000 population threshold) base model was based on existing demographic and land use data fore each traffic zone within the City created from 2006 Census data from Statistics Canada. Following iterative discussions with the City's Planning Department, future projections were developed to reflect the anticipated threshold horizons. Projections for population, employment and school enrolment were developed for the City as a whole and distributed to areas of Greenfield (new) or infill development for population, and commercial and industrial areas for employment.

The existing Whitehorse population recorded by StatsCan in 2006 is 20,470 people. The **2006 (20,000) Base Scenario** is built to reflect 2006 data and conditions – for population, road network and traffic volumes. Subsequently, five planning horizons have been modelled and their road network impacts detailed. Their defining characteristics are as follows:

Table ES-1 – Characteristics of the Planning Horizons

Horizon	Total City Population	Total City Employment	Average Annual Growth Rate	Comment
2006 (20,000) Base	20,470	11,075	n/a	2006 Census data + 2006 road network
2006 (20,000) Prime	20,470	11,075	n/a	2006 Census data + 2008 road network
Short Term (24,000)	23,753	12,851	20,000 Prime +10 yrs @ ~1.5%	1.5% of Whistle Bend (145 population)
Medium Term (25,000)	24,968	13,509	Short Term +10 yrs @ ~0.5%	10% of Whistle Bend (1,000 population)
Long Term (30,000)	29,413	15,914	Medium Term + 50% Whistle Bend	50% of Whistle Bend (5 ,000 population)
Long Term (35,000)	33,913	18,348	Medium Term + 100% Whistle Bend	100% of Whistle Bend (10,000 population)

2006 (20,000) Prime Horizon does not examine any population growth but updates the modelled road network to the current 2008 configuration where the Hamilton Boulevard Extension to Robert Service Way is in place and new traffic signals are operating at the Industrial/Quartz and the 2nd Avenue / Black Street intersections. This horizon's base network is built upon to assist in the identification of required network improvements in the next planning horizon.

With the newly installed traffic signals in place, in 2008 there are no substantial traffic operational problems identified by the model.

Short Term (24,000) Horizon Scenario

The first future growth scenario modelled and analyzed is the Short Term (24,000) Horizon, which forecasts the impact of new (and infill) growth in Whitehorse on the City's current road network with a 16% increase in total population. This is roughly equivalent to strong to moderate growth in Whitehorse to the year 2016. The new population is distributed within most of the known developments currently planned for Whitehorse such as Arkell, Takhini North, Stan McCowan and others, as well as infill and redevelopment in the City's downtown and other residential areas.

No significant development is expected in Whistle Bend in this short-term scenario and therefore no new road links are physically needed into the development area based on traffic volume projections. Initial access needs can be met by the use of Range Road, although upgrading of Range Road to met acceptable standards would be recommended. However, given the desire to build a new access to the new community to coincide with lot availability, the development of a new connector from Whistle Bend to Mountainview Drive can be advanced.

The extension of the Whistle Bend road link from Mountainview Drive to the Alaska Highway, will be required later when growth and development is significant. Therefore, protection of this road corridor should be done now in the form of ultimate roadway classification and functional alignment design and property acquisition when opportunities arise. In keeping with this ultimate classification this connector n corridor will reduce access points for any future residential developments that could occur within this area.

Within this growth period, some network improvements can occur now:

- new traffic signals at Two Mile Hill / Industrial Road
- geometric laning improvements for northbound Range Road at Two Mile Hill intersection
- Whistle Bend Connector to Mountainview Drive

Medium Term (25,000) Horizon Scenario with Whistle Bend Population of 1,000

The next future growth scenario modelled and analyzed is the Medium Term (25,000) Horizon, which forecasts the impact of new growth on the road network with a further 5% increase in the City's total population. However, much of the currently planned developments in the City would be built-out at this stage and most of the new population will be located in Whistle Bend. This begins to stress the transportation network between the City's Downtown area and the Porter Creek region. Specific to Whistle Bend access onto Mountainview, analysis indicates that traffic signals will be needed at this intersection for Whistle Bend to Downtown vehicle traffic in the morning peak period.

Existing development in Porter Creek as well as new development in Whistle Bend will benefit from the extension of Pine Street to Alaska Highway, as it creates network capacity for population traveling to and from the north part of the City. With additional traffic generated by growth with origins and destinations in this part of the City, transportation routes from Downtown experience increased travel delays at major intersections.

With this growth estimate, some network improvements are needed:

- new traffic signals at Whistle Bend Connector/ Mountainview Drive
- new Pine Street Extension road link to the Alaska Highway
- Transit Line 5 extension to provide bus service to Whistle Bend

Pine Street Extension is to be staged after first two phases of development, but prior to 50% build out.

Long Term – Whistle Bend 50% Build-out (30,000) Horizon Scenario

This scenario takes Whistle Bend to the 50% build-out stage and creates a new community of approximately 5,500 people in the lower bench area. This increases the City's total population by 18% from the medium term horizon and puts much of the new traffic on the City's northern major street network.

The new community benefits from having a new through route to the Alaska Highway via a connection between Mountainview Drive and the Pine Street extension (Alaska Highway Connector). An internal connecting road between this new through route and the Yukon College enables some local alternate travel relief in the area, and provides for improved transit, emergency and secondary access to the area.

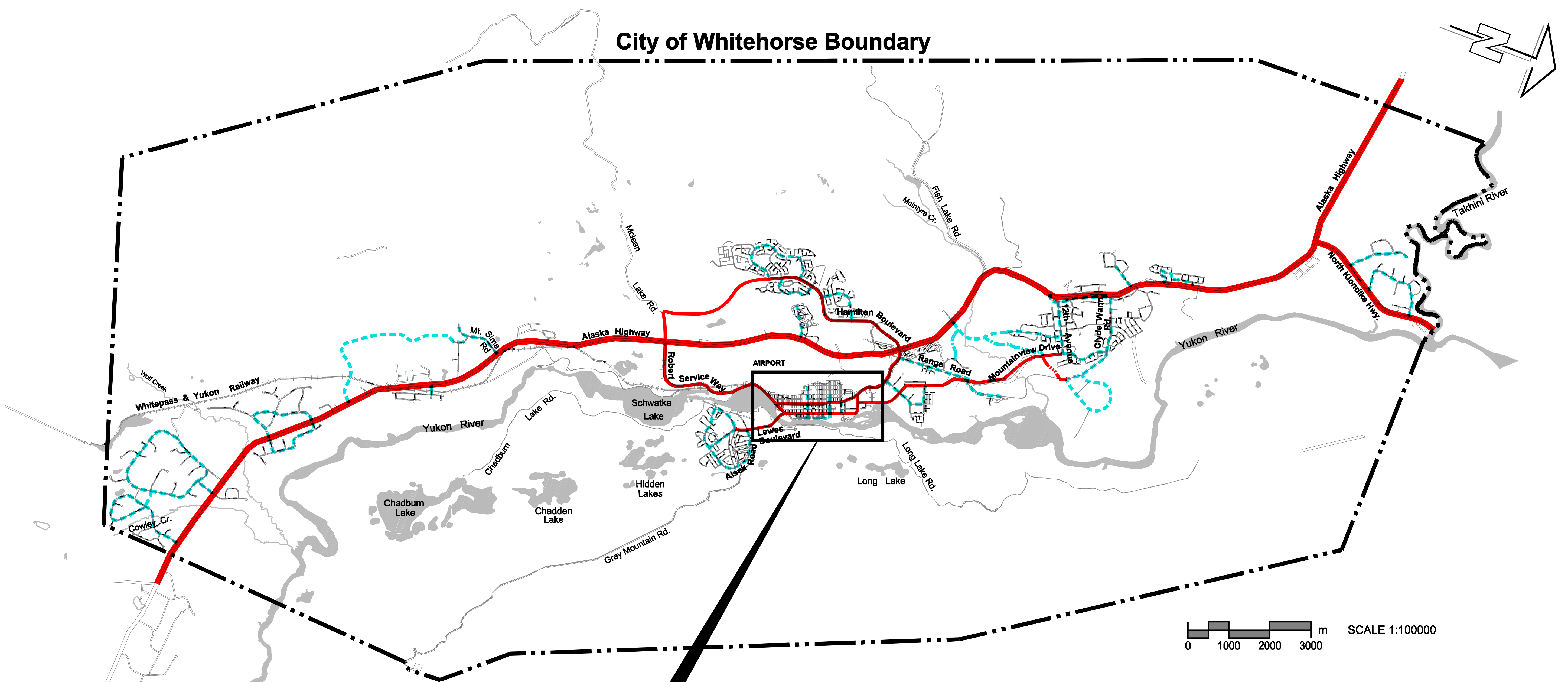
To accommodate this growth period, the following network improvements are needed:

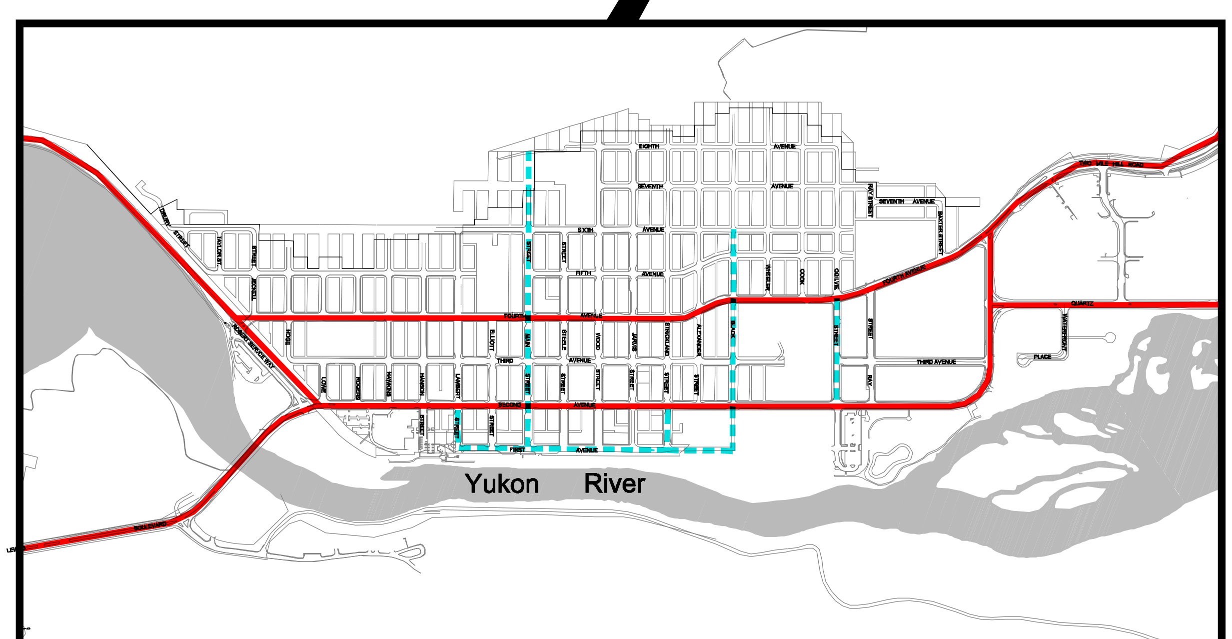
- new Alaska Highway Connector (from Mountainview Drive to Pine Street Extension)
- new College access road extension
- new traffic signals at Mountainview Drive and Whistle Bend Connector (Mountainview Drive to Casca Boulevard) intersection

- 4 laning of Whistle Bend Connector to Mountainview Drive
- internal Whistle Bend intersection improvements at connection with old Range Road
- Mountainview corridor intersection auxiliary laning improvements: the Whistle Bend Connector; Range Road; Quartz Road / Industrial Road
- 4^{th} Avenue corridor intersection laning improvements at Black and Main Street
- optimize signal timings at 4^{th} Avenue / Ogilvie Street, 2^{nd} Avenue / 4^{th} Avenue and Alaska Highway / Robert Service Way
- add new Transit Line 7 to serve Whistle Bend and Porter Creek area
- increase Transit Line 5 frequency to 17.5 minute headway

A sensitivity analysis was reviewed, should the Pine Street Extension and a connection to the Alaska Highway from Mountianview not occur. Travel times and level of service on 12^{th} Avenue, Range Road and Mountainview would deteriorate.

A recommended road network to be in place at this growth period is provided in Figure ES-1.





LEGEND

EXISTING

HIGHWAY / ARTERIAL / MAJOR COLLECTOR ROAD

MINOR / INDUSTRIAL COLLECTOR ROAD

LOCAL ROADS (PAVED AND GRAVEL)

RECOMMENDED

HIGHWAY / ARTERIAL / MAJOR COLLECTOR ROAD

MINOR / INDUSTRIAL COLLECTOR ROAD

LOCAL ROADS (PAVED AND GRAVEL)

City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Whistle Bend 50% Build-Out (30 000 population) Horizon Road Network

February 2009

Figure - ES-1

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Long Term – Whistle Bend 100% Build-out (35,000) Horizon Scenario

This scenario takes Whistle Bend to full build-out and creates a new community of approximately 10,000 people in the lower bench area.

No new road connections are needed to accommodate the new population but major capacity improvements are needed on the Mountainview Drive corridor and elsewhere as follows:

- full widening of Moutainview Drive to four lanes between the Whistle Bend Connector and 2nd Avenue

For population sensitivity analysis, a review of system changes for 100% build out was confirmed should the population estimates of Whistle Bend reach only 7.500 people (say 75% of the original 10,000 population estimates). Recommendations as noted remain.

Traffic signal optimization is needed throughout the northern downtown area and all along the Mountainview Corridor to accommodated increased demand, as well as capacity increases from widening the corridor.

Transit service on Line 5 and Line 7 requires a significant increase in frequency to serve the full build-out condition. Other transit routes can be adjusted to a lower frequency to balance this, however, it is probably more useful to do a full transit system analysis with more complete data to determine the best overall transit solution.

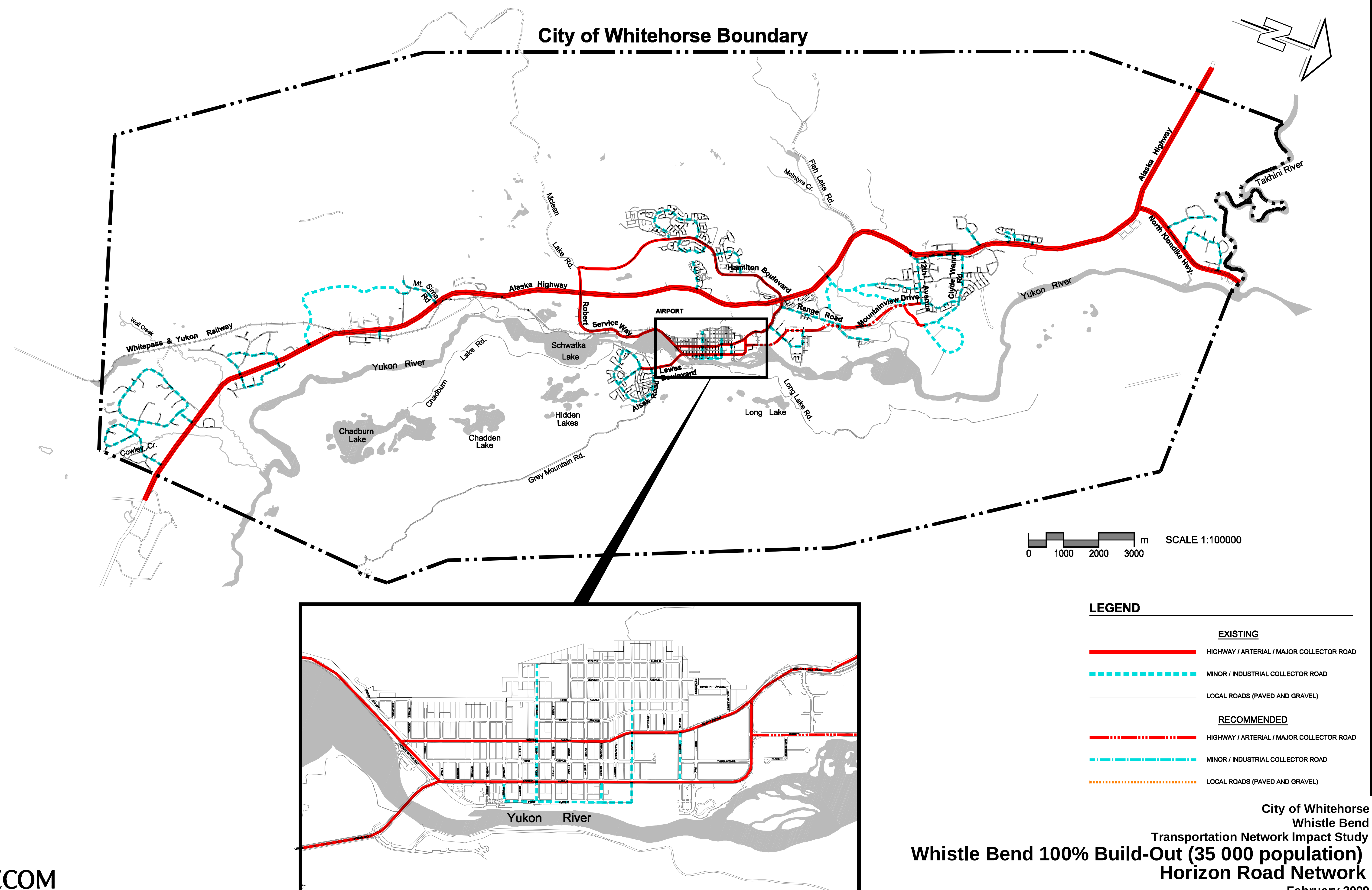
A recommended road network to be in place at this growth period is provided in Figure ES-2.

To assist the City in planning for the various recommended road and intersection improvements, preliminary cost estimates were prepared for each element based on local construction unit rates. These order of magnitude costs based on City-wide development information (surface costs only), account for capital costs (clearing, grubbing, grading, and paving), but not property acquisition, engineering and planning costs, nor contingencies.. A summary of the costs by element and horizon are provided in Table ES-2.

Table ES-2 - Cost Estimate of Recommended Road and Intersection Improvements

Horizon / Network Element Breakdown	Item	Cost
Short-term (24,000 population)		
Industrial Road / Two Mile Hill		
Signalize Intersection	Signalize Intersection	$250,000
Range Road / Two Mile Hill		
NBR Lane	Auxiliary Lane (Urban)	$50,000
Whistle Bend Connector to Mountainview		
New Roadway	New Roadway (Rural)	$1,770,000
	Sub-Total	$2,070,000
Medium-term (25,000 population)		
Pine Street Extension		
New Roadway	New Roadway (Rural)	$6,910,000
Whistle Bend Connector		
Signalize Intersection	Signalize Intersection	$350,000
	Sub-Total	$7,260,000

Horizon Network Element Breakdown	Item	Cost
Whistle Bend 50% Build-out (30,000 population)		
Alaska Highway Connector		
New Roadway	New Roadway (Rural)	$5,390,000
New Roundabout	New Roundabout	$270,000
College Access Road		
New Roadway	New Roadway (Rural)	$2,400,000
Whistle Bend Connector		
Road Widen	Auxiliary Lane (Rural)	$2,010,000
Mountainview Drive / Whistle Bend Connector		
Road Widen	Auxiliary Lane (Rural)	$1,360,000
EBL Lane	Auxiliary Lane (Rural)	$100,000
WBL Lane	Auxiliary Lane (Rural)	$100,000
SBR Lane	Auxiliary Lane (Rural)	$60,000
Range Road / Casca Boulevard		
Mountainview Drive Corridor Intersections		
Mountainview/Range NB Acceleration Lane	Auxiliary Lane (Rural)	$100,000
Quartz/Industrial NB Acceleration Lane	Auxiliary Lane (Urban)	$50,000
Quartz/Industrial SB Acceleration Lane	Auxiliary Lane (Urban)	$50,000
Downtown Intersections		
4th/Black NBR Lane	Auxiliary Lane (Urban)	$70,000
4th/Black SBR Lane	Auxiliary Lane (Urban)	$70,000
4th/Main NBR Lane	Auxiliary Lane (Urban)	$70,000
4th/Main SBR Lane	Auxiliary Lane (Urban)	$70,000
	Sub-Total	$12,170,000
Whistle Bend 100% Build-out (35,000 population)		
Mountainview Drive 4-lane		
Road Widen	Auxiliary Lane (Urban)	$1,890,000
Road Widen	Auxiliary Lane (Rural)	$6,580,000
Mountainview Drive Intersections		
Mountainview / Range SB Acceleration Lane	Auxiliary Lane (Rural)	$200,000
Alaska Highway / Prospector Road		
Signalize Intersection	Signalize Intersection	$350,000
EBL Lane	Auxiliary Lane (Rural)	$60,000
WBL Lane	Auxiliary Lane (Rural)	$60,000
SBT Lane	Auxiliary Lane (Rural)	$200,000
SBT Lane	Auxiliary Lane (Rural)	$160,000
NBR Lane	Auxiliary Lane (Rural)	$180,000
	Sub-Total	$9,680,000
	Total	**$31,180,000**



City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Whistle Bend 100% Build-Out (35 000 population)
Horizon Road Network

February 2009

Figure - ES-2

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Alternative Transportation and Potential Model Follow Up Work

Whistle Bend is proposed to be developed with a strong focus on creating a sustainable community. The City's new EMME transportation model provides a powerful tool to assist in the comparative qualitative assessment of conventional and alternative modes of transportation such as transit. Through the modelling work program, transit as a viable alternative mode was developed both as a network test element, and as well as a recommended program component at various horizon stages. Model results can be used to assist the City's transit planners in developing service improvements to attract and retain more customers.

With the anticipated growth in Whitehorse's population, particularly in the northern sections of town, an upgrading of the transit route servicing existing and emerging neighbourhoods is expected. In the medium term (population threshold of 25,000), the provision of transit service via an extension of an existing transit line (No 5 Takhini-College) was recommended as the most effective and affordable means of serving the growing population.

As the growth of Whistle Bend approaches 50% build-out, increased transit service is required to maintain market-share and provide efficient service to transit users. This includes a new transit line serving Porter Creek neighbourhoods as well as an increase in transit frequency [i.e., increased headways for Transit Line No 5 (Takhini -College)].

With the full development of Whistle Bend, the opportunity exists to improve service on various transit lines including increase in frequency for transit lines No 4 (McIntyre-Logan-Granger), No 5 (Takhini-College), and No 7 (Whistle Bend).

The additional transit service may be provided through clean diesel or hybrid bus technologies for a more sustainable approach. While hybrid bus technologies which combine electric and diesel power offer a better overall emission reduction opportunity than the clean diesel option, the capital cost is significantly higher at $650,000/unit relative to the clean diesel option at $425,000/unit.

The development of the Whitehorse Transportation Planning Model for testing the impacts of the Whistle Bend development area provides the City with a powerful tool by which to examine transportation demands and priorities within the City, resulting from this and any other large-scale development project. To continue to build on the work of this project and this tool, it is recommended that consideration be given to the following future activities:

- Development of Morning Peak Hour Model: The existing model is built on the basis of afternoon peak hour traffic volumes only. There would be value in modeling the AM Peak traffic and examining traffic issues that are not apparent or in existence in the PM. Modeling and calibrating a morning peak hour model – since the physical road network has already been input in detail – is a reasonably straightforward procedure.
- Land Use: With the anticipated update to the Citywide Official Community Plan in Spring 2009, the land use assumptions included in the model should be revisited as this could affect the timing of various projects
- Calibration: The calibration of the EMME model should be updated within five years, reflecting updated data collected by the City

1.0 Introduction

The Whistle Bend Transportation Network Impact Study is a result of the City of Whitehorse's interest in wanting to develop the Porter Creek lower bench area in a sustainable manner with an eye to understanding the impacts on the municipal transportation network. The new community area will consist of residents in the order of 10,000 people, based on the development scenarios that were planned at the time of this study. The effects of their living and working in Whitehorse will be felt throughout the City.

The City requires an understanding of the transportation network impacts of the new neighbourhood on the off-site transportation network as well as on the adjacent road network of the Porter Creek neighbourhood. Given the significant potential traffic impact of development at this location, as well other areas slated for future development, a larger scale network assessment study rather than a typical traffic impact evaluation is necessary.

The existing City of Whitehorse T-model2 Transportation Model lacked the capabilities needed to assess the impact of large developments at the traffic operational (intersection) level. To fully answer the City's questions regarding the impact of the new Whistle Bend community, a new model using the EMME software platform has been used to develop the network simulation model – taking advantage of the most recent developments in modelling techniques.

With EMME, it has been possible to generate reliable forecasts of turning traffic volumes at major intersections for future land use and network scenarios. In combination with other analytical tools, the model has been used to evaluate present and future transportation conditions in the City and to develop short, medium and long term transportation recommendations. These recommendations identify capital reconstruction projects and improvements necessary for the orderly development of the Whistle Bend area.

One of the key objectives of the proposed new Whistle Bend community is to be a sustainable development that encourages alternative modes of transportation by residents. Land use planning scenarios are currently being developed by the City to achieve this. The Whitehorse EMME model that has been created and developed here can be used to help assess these new and creative ideas.

Other and further uses for the model are presented for the City's consideration at the end of this report.

The following report sections present the model development work, the analysis of future population and land use growth scenarios and the evaluation findings for City growth horizons in the next 10 years, 20 years and beyond.

2.0 Background Information

Background information for this Study was collected from the City and Yukon Government during the Project Familiarization phase, and is documented in Appendix A. Specifically, the process included the collection of relevant information, and review of past work and data, which in turn, informed the development of the analysis tool based on the EMME platform.

2.1 Data Collection & Review

Prior to the Study Start-up Meeting, the City was provided with a list of preliminary data and report requirements. Some of this material was readily available, while other information was to be subsequently provided. The items included:

- various relevant reports
- digital mapping, including graphics of recent planning initiatives
- as-built drawings for key locations
- aerial photography
- current zoning plans
- traffic count data and traffic signal timing plans
- current design standards
- T-Model files for the 1992 model

The reports and data collected were assessed for their usefulness for the project. The preliminary traffic data provided by the City was examined to identify any gaps in information including outdated or missing traffic data. A working spreadsheet was prepared that illustrated both the locations for which this existing data was available (for the years 2004-2006) as well as the locations where additional data was required.

Through this process new data requirements were identified, with a particular focus placed on travel and land use data needs. During the Fall of 2007, travel data was collected and included turning movement counts at specified key intersections, a survey of travel times in selected corridors and transit ridership data. Specifically this included:

Turning movement counts at:

- Alaska Highway at: Hillcrest Drive, Roundel Road, Burns Road, Range Road, and North Klondike Highway (Mayo Road), Miles Canyon Road (before Mt. Sima Road), and south of Azure Road
- Two Mile Hill at: Hamilton Boulevard, and Range Road
- 4th Avenue at: 2nd Avenue
- Alsek Road at: Nisutlin Drive.
- Hamilton Boulevard at: Thompson Road / Lazulite Drive, Falcon Drive, Thompson Road / Heron Drive, and Sumanik Drive

Travel time surveys along:

- Alaska Highway (Salmon Trail (Crowley Creek) – North Klondike Highway (Mayo Road))
- Mountainview Drive / Range Road / Hickory Street / Clyde Wann Road

- Robert Service Way
- 2nd Avenue
- Hamilton Boulevard

Additional information on the new data collected is available in Appendix A.

Land use data based on the 2006 Census demographic and employment information contained therein was obtained on behalf of the City from Statistics Canada. The information was assembled and vetted by City Planning staff for use in the modelling process. Future year land use data by zone was developed in conjunction with the project team for input into the model; details of which are documented in Appendix B.

2.2 Road Inventory

As the intention of the Study is to assess the impacts of the Whistle Bend development on the adjacent transportation network, the accurate representation of the network within the analysis process and tools is a critical element. To this end, a road inventory of the hierarchy of roadways (as defined in the 2004 Citywide Transportation Plan), was undertaken. The on-site road inventory[1] which included driving the length of the existing road network, was conducted to identify any changes that may have occurred since the 2004 plan, as well as to document the characteristics of the road network. Special attention was given to study intersections. Intersection geometry and the types of intersection controls present were documented by hand drawn sketches, and speed limits and laning information was recorded on all major roads.

2.3 EMME Tool

Traditionally, network assessments are conducted using computerized transportation demand models. The existing City of Whitehorse T-model2 Transportation Model lacks some of the capabilities needed to assess the impacts of large developments at the traffic operational (intersection) level. To fully answer the City’s questions regarding the impact of the new Whistle Bend community, the existing model was migrated to the EMME software platform.

The Whitehorse Transportation Model, developed by AECOM, is based on the EMME software package. This Canadian software, developed and maintained by INRO Consultants in Montreal, is perhaps the most successful and widely used software of its type and is used in several hundred countries spanning all the populated continents of the world. The most advanced modellers in the industry rely on EMME's credibility and reliability to model the world's most complex transport systems. EMME offers efficient, robust algorithms that have earned a reputation as the gold standard in transport modelling.

The key impetus for this migration to EMME, is to develop the capability to generate reliable forecasts of turning traffic volumes at major intersections for future land use and network scenarios. In combination with other analytical tools, the model can then be used to evaluate present and future transportation conditions in the City, which will assist the City in identifying future network needs including infrastructure required for the phased development of the Whistle Bend area.

The model was developed using the aforementioned data inputs, and was calibrated and validated to 2006 PM (peak afternoon) conditions. The afternoon condition was selected as the basis for modelling as

[1] An onsite road inventory is a form of surveying the conditions on a facility by traversing the length of it and identifying and documenting physical characteristic elements including laning, speed, traffic control, etc.

it represents the worst case relative to the morning peak hour. Based on a comparison of 10 locations, the general condition is worse for the PM than the AM peak hour by 20%. This process, outlined in Appendix C, documents how well the model compares to reality, as a measure of its reliability and details its validation to intersection turn volumes, travel time, transit ridership and trip time.

The model was validated to reconciled turn counts at 44 intersections within the City boundary, with the closeness of fit between the reconciled intersection turning counts and 2006 model volumes suggesting a strong relationship between modelled and reconciled volumes. This is further substantiated by the R^2 statistic between the two data sets of 0.999[2], suggesting an extremely satisfactory goodness of fit between the two.

Model validity was also measured through a comparison of surveyed and modelled vehicle travel times. This is an important validation measure because travel time is most often the basis of drivers' decisions on the selection of routes and travel mode. While the model is a simplified representation of the reality, it is well calibrated to provide estimates of travel time in line with actual results. A comparison of actual (based on a moving car travel time survey) and model vehicle travel times also indicates a good fit as summarized in Table 2.1.

Table 2.1 – Actual and Base Model Auto Travel Time by Route (mm:ss)

Route	Segment	Actual		Model		Diff		% Diff	
		SB	NB	SB	NB	SB	NB	SB	NB
1. Alaska Highway	N Klondike - Wann	04:09	03:53	03:54	03:54	-00:15	00:01	-6%	0%
	Wann - 2 Mile	05:06	04:59	04:48	05:18	-00:18	00:19	-6%	6%
	2 Mile - RSW	04:52	05:18	05:12	04:48	00:20	-00:30	7%	-10%
	RSW - Salmon Trail	09:52	09:32	09:18	09:18	-00:34	-00:14	-6%	-3%
	Total	***23:58***	***23:43***	***23:12***	***23:18***	***-00:46***	***-00:25***	***-3%***	***-2%***
2. Robert Service Way-2nd-Quartz-Hickory	Wann - Range	03:47	03:52	03:42	04:00	-00:05	00:08	-2%	3%
	Range – Main	06:40	05:56	06:00	05:30	-00:40	-00:26	-10%	-7%
	Main - Alaska	05:20	05:54	05:30	05:42	00:10	-00:12	3%	-3%
	Total	***15:46***	***15:42***	***15:12***	***15:12***	***-00:34***	***-00:30***	***-4%***	***-3%***
3. Main-4th-Two Mile-Hamilton	Falcon - Alaska	04:26	04:35	04:12	04:54	-00:14	00:19	-5%	7%
	Alaska - Main	06:23	06:01	05:16	05:43	-01:07	-00:19	-18%	-5%
	Total	***10:49***	***10:36***	***09:28***	***10:37***	***-01:21***	***00:01***	***-13%***	***0%***
	Abs Mean					***00:32***	***00:17***	***6.4%***	***3.4%***

As one of the key objectives of the proposed new Whistle Bend community is to be a sustainable development that encourages alternative modes of transportation by residents, the development of a tool that can compare traditional and alternative transportation impacts on the City's road network infrastructure and transportation systems is an important capability of the EMME model. As such, the ability to model transit was an important component of the model development.

The model was validated to total transit ridership to achieve the best possible fit between 2006 transit ridership and modelled transit ridership. A comparison of validated model output and actual transit ridership for the PM peak hour is summarized in Table 2.2.

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[2] The R^2 statistic is the measure of correlation between two datasets. The closer to 1 the R^2 is, the higher the goodness of fit between two data sets.

Table 2.2 – Actual and Base Model Transit Ridership (passengers)

	Actual	Model	Diff	% Diff
Total Passenger	570	577	7	1%
Total Transfer	67	69	2	3%
Total Boardings	***637***	***646***	***-9***	***-1%***
Abs Mean			***4.5***	***1.4%***

The model was not validated to individual transit line ridership due to the lack of detailed data. Therefore, it currently has limited potential to estimate ridership or address issues associated with individual transit lines. It is, however, an important strategic tool to be able to analyze total transit ridership across the City.

The model was also validated to transit trip times to achieve the best possible fit between transit trip times and modelled transit trip times, as it is an important decision making factor on which people base their decisions on the selection of transit lines and travel mode. A comparison of validated model output and actual transit trip times for the PM peak hour suggests a good fit with the mean of the absolute difference between the two of 0.9 minutes and the mean absolute percentage difference of 3.5%.

With the validation of the base model to intersection turn volumes, travel time, transit ridership and trip time achieved, and with the base model established and future horizons defined, the model was used to identify problems and conduct network assessments arising from changes in land use or network options.

3.0 Transportation Network

The transportation network within the City of Whitehorse consists of infrastructure and services. The primary infrastructure is the road network system and the dominant service is the transit system.

Roads serve two primary functions: access to land and travel mobility. Each road fulfills, to some extent, the conflicting roles of access and mobility. The design of the roads, and the network as a whole, provides different trade offs between these two roles. It is important that there be a clear understanding of what role each road is intended to serve. The City of Whitehorse classified its roadways in 1987 into a hierarchical system with three basic categories of roadway whose roles range from primarily access to primarily mobility:

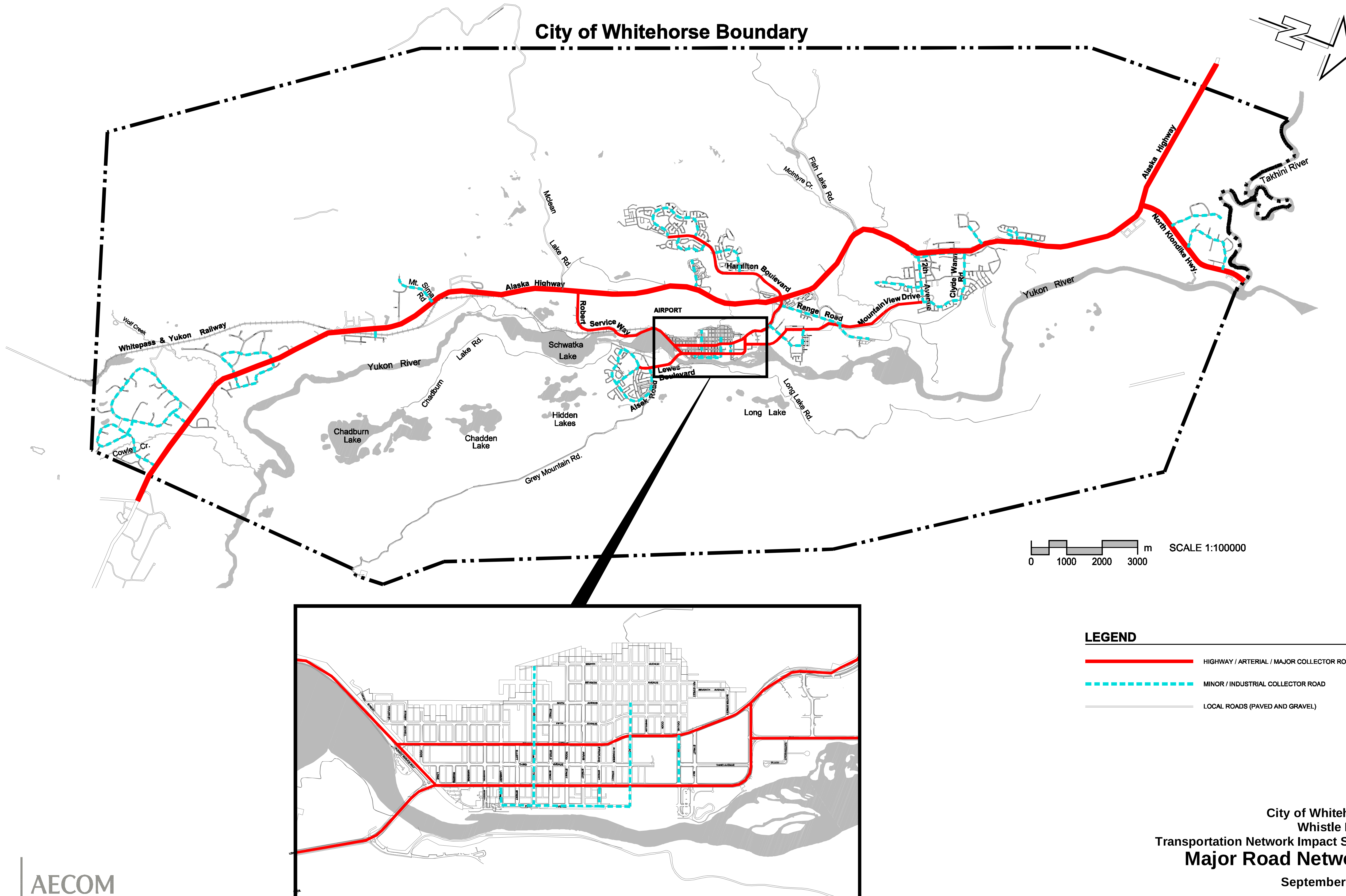
- Local
- Collector
- Arterial

Local roadways are developed to provide access to abutting properties. Collector roadways have the dual purpose of providing access to abutting properties as well as providing mobility for through traffic. Arterial roadways are developed to accommodate the movement of traffic. Direct access to/from existing arterial roadways to/from adjacent properties is discouraged and, in the case of new arterial roadways, limited to the connection with other arterials or with collector roadways.

The Alaska Highway serves as the main highway providing access to all sections of the City. Arterial roads, including 2nd Avenue, 4th Avenue, Two Mile Hill, Robert Service Way, Mountainview Drive, and Hamilton Boulevard, provide access to the Highway and connect the principal areas of traffic generation. Collectors and local residential roads make up the remaining network. The classification of the existing major roadways in the City is illustrated on Figure 3.1.

The City of Whitehorse has a total of 6 bus routes serviced by Whitehorse Transit. The bus routes cover the neighbourhoods of Riverdale, Hillcrest, Lobird, Airport, McIntyre, Logan, Granger, Takhini, College, Porter Creek, Crestview, and Ponderosa. Transit service runs from Monday to Saturday, departing from Ogilvie Street. Weekday peak service is provided every 35 minutes from 6:50am to 9:45am and from 3:00pm to 5:55pm. All other times of day service is every 70 minutes.

As this study makes use of a transportation planning model, this information was used to develop the framework for testing transportation needs and priorities.



City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Major Road Network

September 2008

Figure - 3.1

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3.1 Modelled Road Network

The modelled road network was developed by importing the City's GIS mapping base into EMME. It includes all highways, arterials and collectors, together with a few local roadways which serve important roles in the network, as illustrated on Figure 3.2. Inputs to the modelled road network are:

- vehicle operating costs
- roadway speed
- intersection control type
- turning movement directions
- laning
- signal timing
- phasing

Modeling of new facilities in future horizons involves coding the associated inputs to the road network.

3.2 Modelled Transit Network

The modelled transit network defines a set of transit routes each of which comprises a connected set of transit segments between the beginning and end of the route. It includes all 6 bus routes serviced by Whitehorse Transit as shown in Table 3.1.

Table 3.1 – Transit Routes

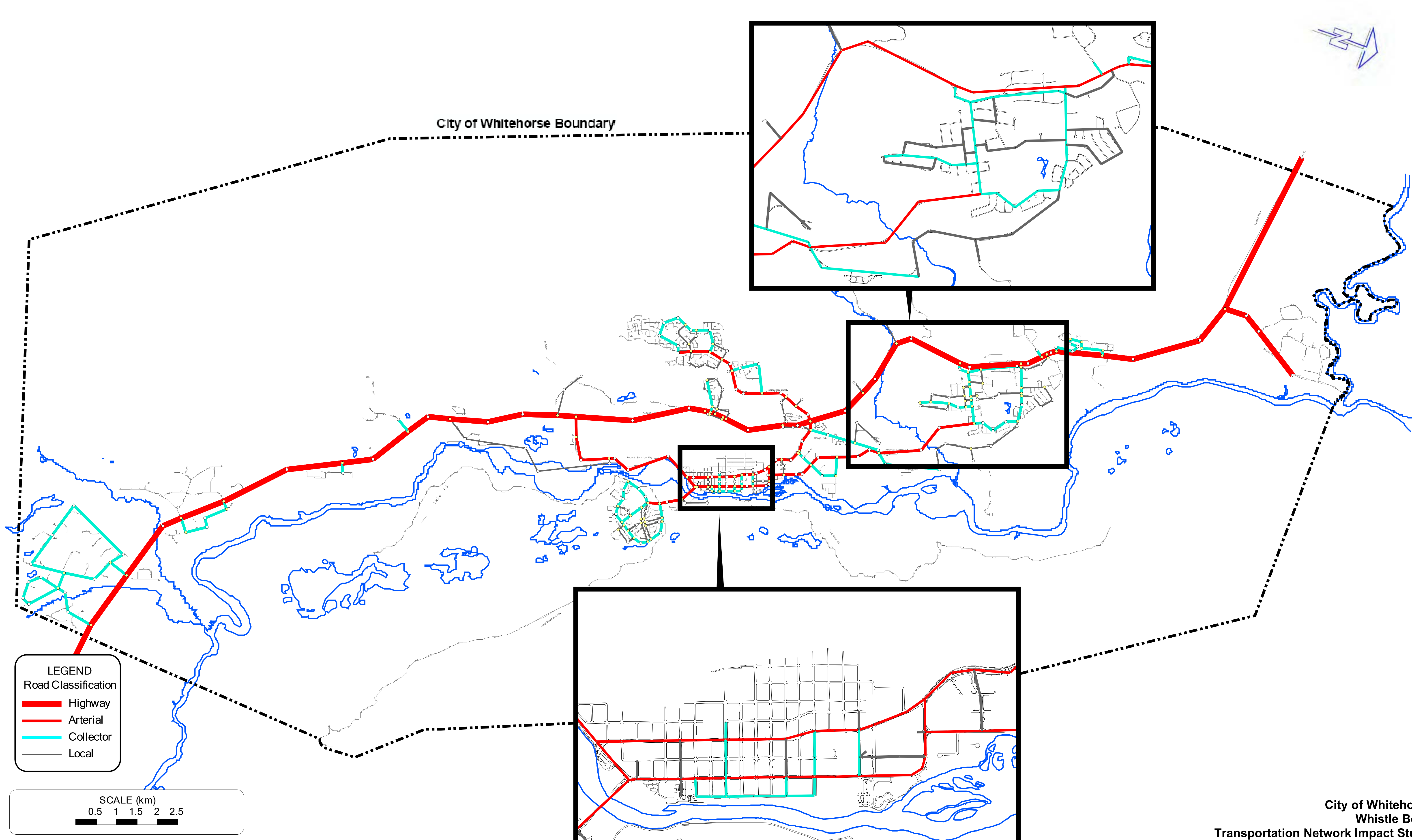
Route	Name
1	Riverdale
2	Airport – Hillcrest – Lobird
3	Porter Creek – Crestview
4	McIntyre – Logan – Granger
5	Takhini – College
6	Porter Creek – Ponderosa

Inputs to the modelled transit network are:

- transit fares
- bus capacities
- headway
- route

Modeling of transit service improvements in future horizons involves coding the associated inputs to the transit network.

Further information on the structural framework and development procedures of the Whitehorse Transportation Model is provided in a separate technical report entitled *Model Documentation*.



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City of Whitehorse
Whistle Bend
Transportation Network Impact Study
Modelled Base Road Network

September 2008
Figure 3.2

4.0 Land Use and Demographics

The transportation planning model was developed and calibrated to 2006 conditions using 2006 land use and traffic count data from the City and 2006 demographic data from Statistics Canada as collected in the latest Federal Census. Use of the 2006 StatsCan information enabled detailed distribution of population and employment data throughout the City areas in correlation with actual detailed traffic movement data in the corresponding road network zones.

A comparison of the Federal and Territorial population statistics was also made. The official StatsCan population for Whitehorse in 2006 was recorded as 20,470 people. The Yukon Government records a 2006 population of 24,473 people in the City. Discussions with the Yukon Bureau of Statistics determined that their data is derived from the Health Care registry, which includes any Yukon resident that has a mailing address (including PO boxes) in Whitehorse and in fact would include residents outside the City from nearby rural communities such as Marsh Lake, Golden Horn and elsewhere. The Yukon also adds an “undercount” factor of approximately 5% which inflates their recorded population a bit more.

Because the transportation model is calibrated to actual counted vehicle traffic movements, the base population number used is not a critical concern to assess the road network. Where the people live and where they work within the City is most important. As the Federal database contains both residence and employment location information in detail, in contrast to the Territorial database which does not, the Federal database was selected for use in this work.

The development of the 2006 (20,000 population threshold) base year model was based on existing demographic and land use data for each traffic zone within the City of Whitehorse created from 2006 Statistics Canada Census data. Following the calibration to 2006 conditions, the model was supplied with future projections for the study horizon thresholds based on growth in demographics. The development of land use projections was based on iterative discussion with the City’s Planning Department by threshold horizon.

4.1 Horizons

As the study is designed to identify short, medium and long term problems and requirements, corresponding model horizons based on population thresholds were developed and are summarized in Table 4.1. The short term is characterized by a total population of 24,000 and the medium term is represented by a base population of 25,000 people. The development of the Whistle Bend neighbourhood anticipated for the long term is represented by two thresholds corresponding with 50% and full build-out. The selection of the threshold horizons was developed as a tool to identify the need for network improvements due to development in the Whistle Bend area. The approach and assumptions for each model thresholds are summarized below, and are based on projections from 2006 forward.

The Short-term (24,000) model horizon represents approximately 16% increase in total population which is roughly equivalent to strong to moderate growth in Whitehorse to the year 2016. This represents growth as follows:

- City population has reached 24,000 with a corresponding 13,000 jobs. This horizon threshold was developed by projecting an increase in population, employment and school enrolment based on an annual growth rate of 2% per annum for 5 years, followed by a period of growth at 1% per annum for 5 years. This total growth in City demographics was distributed to Greenfield (new) and infill development areas based on the expected lot absorption rate of 90 lots per annum for known developments currently planned in Arkell, Takini North, Stan McCowan as well as other residential areas.

The Medium-term (25,000) model represents growth as follows:

- City population has reached 25,000 with a corresponding 13,500 jobs, with a Whistle Bend population of 1,000 persons. The medium-term threshold was based on growth of the short-term demographics by 0.5% per annum for 10 years. By this horizon growth is expected to only occur in new Greenfield development areas primarily located in Whistle Bend with infill and currently planned developments in the City having reached capacity.

The 50% Build-out of Whistle Bend (30,000) model represents the partial build-out of Whistle Bend as follows:

- Medium-term (25,000) Citywide population plus additional residents within Whistle Bend to 50% build-out (5,000 new residents). Additional employment growth is distributed throughout the City to support the increase in Whistle Bend population.

The 100% Build-out of Whistle Bend (35,000) model was developed to represent the ultimate or full build-out of Whistle Bend as follows:

- Medium-term (25,000) Citywide population plus additional population within Whistle Bend to full build-out (10,000 new residents). Additional employment growth distributed throughout the City to support the increase in Whistle Bend population.

Table 4.1 provides a summary of selected land use variables for all the study horizons of short-term, medium-term, and both build-out thresholds in Whistle Bend. Further information on the derivation of land use values for all years is provided in Appendix B.

Table 4.1 – Land Use Summary

Land Use	Horizon				
	2006 (20,000 pop)	Short-term (24,000 pop)	Medium-term (25,000 pop)	50% Whistle Bend (30,000 pop)	100% Whistle Bend (35,000 pop)
Population	20,470	23,753	24,968	29,413	33,913
Employment	11,075	12,851	13,509	15,914	18,348
Elementary School FTE[3]s	1,995	2,315	2,433	2,866	3,305
Secondary School FTEs	1,869	2,169	2,280	2,686	3,096
Post-Secondary School FTEs	800	928	976	1,150	1,325
Annual Growth	-	1.5%	0.5%	n/a	n/a

The development of threshold populations employed an iterative process (documented in Appendix B), which involved the projection of growth in various neighborhoods and locales within the City. This included infill growth and new developments as documented in Table 4.2 and illustrated in Figure 4.1. Distribution of increases in population was based on the likely capacities of various new developments, with a preference weighting used to prioritize the likely order of development and absorption of new

[3] FTE = full time equivalent.

areas. Targets for increases in employment were set using the same rates as population growth in each threshold horizon. The increase in employment was distributed to employment in commercial areas of new residential areas and increase in employment throughout the City. Similarly, school enrollment projections were developed using the same rates as population for each horizon threshold.

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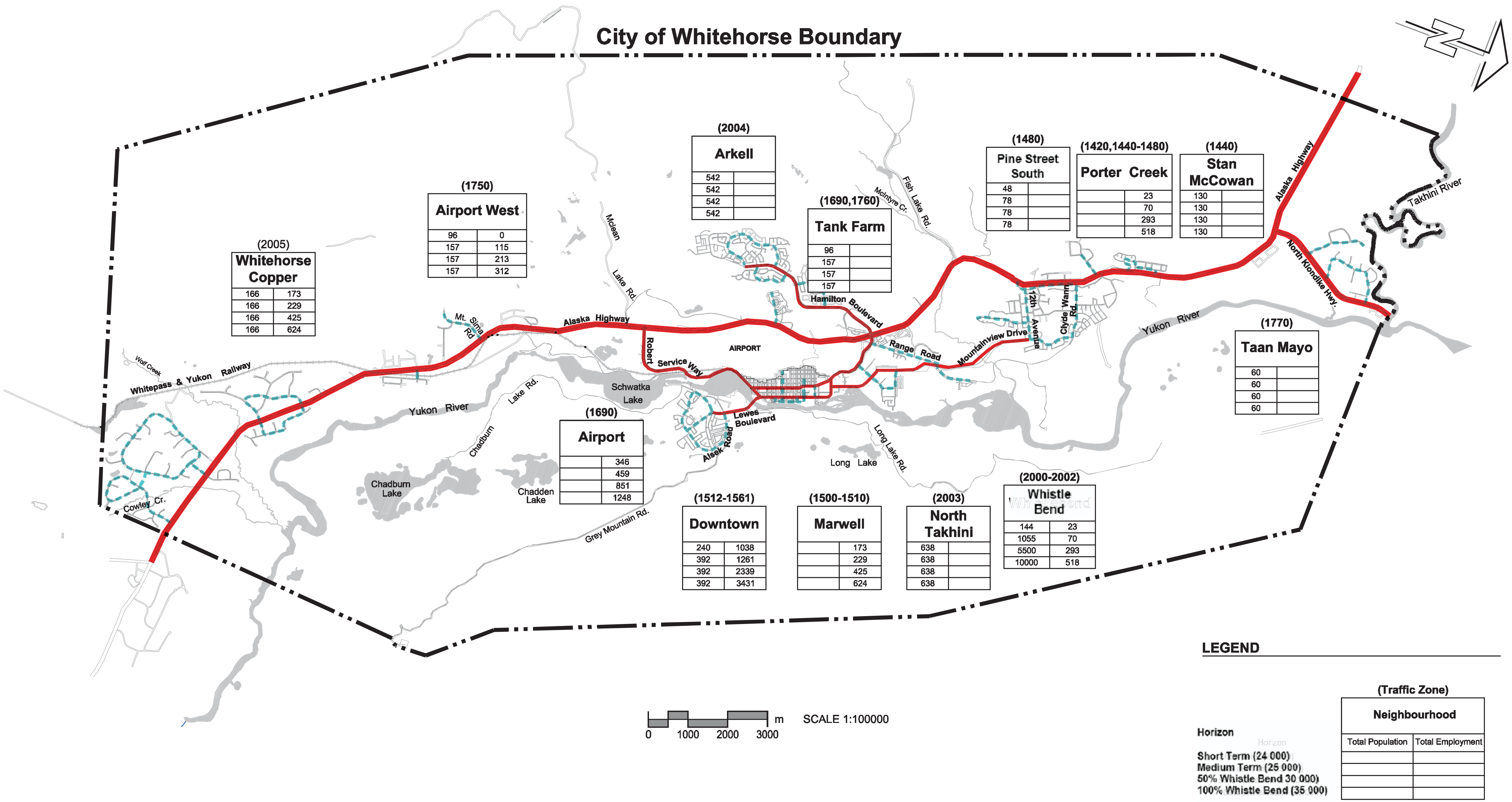
Table 4.2 – Future Demographics Projection Summary

							TZ#	1440	2003	2004	2005	2000-2002	1770	1480	1760, 1690	1512-1561	1750			2005	1750	1500-1510	1690	1512-1561	1420, 1440-1480	2000-2002
							Cap	130	638	542	166	10000	60	744	n/a	n/a	n/a			n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Population																Employment								
		Total				Infill		New Area										Total	Infill	New Area						
Horizon	Year	Start	End	New		New		YTG					Other					New	New	Business & Industrial					Residential	
								Stan McCowan	North Takhini	Arkell	Whitehorse Copper	Whistle Bend	Ta'an	Pine Street South	Tank Farm	Downtown	Airport West			Whitehorse Copper	Airport West	Marwell	Airport	Downtown	Pine Street South	Whistle Bend
	2007	20470	20879	2.0%	409	0.9%	193																			
	2008	20879	21297	2.0%	418	1.0%	202																			
	2009	21297	21723	2.0%	426	1.0%	210																			
	2010	21723	22157	2.0%	434	1.0%	218																			
	2011	22157	22601	2.0%	443	1.0%	227																			
	2012	22601	22827	1.0%	226	0.0%	10																			
	2013	22827	23055	1.0%	228	0.1%	12																			
	2014	23055	23285	1.0%	231	0.1%	15																			
	2015	23285	23518	1.0%	233	0.1%	17																			
	2016	23518	23753	1.0%	235	0.1%	19																			
Short-term								130	638	542	166	144	60	48	96	240	96			173	0	173	346	1038	23	23
(24,000 population)	2016				3283		1123	1620					540					1776	0	1730					47	
								Stan McCowan	North Takhini	Arkell	Whitehorse Copper	Whistle Bend	Ta'an	Pine Street South	Tank Farm	Downtown	Airport West			Whitehorse Copper	Airport West	Marwell	Airport	Downtown	Pine Street South	Whistle Bend
	2017	23753	23872	0.5%	119	0.0%	0																			
	2018	23872	23992	0.5%	119	0.0%	0																			
	2019	23992	24111	0.5%	120	0.0%	0																			
	2020	24111	24232	0.5%	121	0.0%	0																			
	2021	24232	24353	0.5%	121	0.0%	0																			
	2022	24353	24475	0.5%	122	0.0%	0																			
	2023	24475	24597	0.5%	122	0.0%	0																			
	2024	24597	24720	0.5%	123	0.0%	0																			
	2025	24720	24844	0.5%	124	0.0%	0																			
	2026	24844	24968	0.5%	124	0.0%	0																			
								0	0	0	0	911	0	30	61	152	61									
					1215		0	911					304													
Medium-term								130	638	542	166	1055	60	78	157	392	157			229	115	229	459	1261	70	70
(25,000 population)	2026				4498		1123	2531					844					2434	0	2293					141	
50% Build-out								130	638	542	166	5500	60	78	157	392	157			425	213	425	851	2339	293	293
(30,000 population)	2036				8943		1123	6976					844					4839	0	4253					585	
100% Build-out								130	638	542	166	10000	60	78	157	392	157			624	312	624	1248	3431	518	518
(35,000 population)	2036				13443		1123	11476					844					7273	0	6238					1035	



City of Whitehorse
Whistle Bend
Transportation Network Impact Study

New Development Demographics

February 2009

Figure - 4.1

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5.0 Problem Definition

Innovations to EMME modeling techniques enable capacities and associated delays at all signalized and stop/yield sign controlled intersections to be explicitly modelled. The procedure is developed to be capable of producing reliable traffic operations and levels of service (LOS)[4] results which closely resemble that from Highway Capacity Manual (HCM) 2000 Edition. These results serve as a tool to assess existing and future traffic operations at various intersections in Whitehorse and drive the development and evaluation of improvement projects.

The problem definition process focused on both definite as well as potential issues.

Seven criteria were defined to assist in the identification of definite problems requiring mitigation, namely network improvements. These include:

1. At any stop/yield sign controlled intersection, any approach with a LOS below “D”
2. At any signalized intersection, any turning movement with a LOS below “D”
3. No roadway access to new and emerging residential neighbourhood
4. Any roadway with a volume to capacity ratio (v/c)[5] greater than 1
5. No transit service to new and emerging residential neighbourhood of population greater than 300
6. Transit passenger load exceeds capacity
7. Transit trip time exceeds transit headway[6]

---

[4] Level of Service (LOS) – A qualitative measure directly related to average control delay per vehicle to describe operational conditions for each movement and aggregated for each approach and for the intersection as a whole. The six LOS grades are defined for signalized intersection as:
LOS A – ≤10s/veh
LOS B – >10-20s/veh
LOS C – >20-35s/veh
LOS D – >35-55s/veh
LOS E – >55-80s/veh
LOS F – >80s/veh

The six LOS grades are defined for unsignalized intersection as:
LOS A – ≤10s/veh
LOS B – >10-15s/veh
LOS C – >15-25s/veh
LOS D – >25-35s/veh
LOS E – >35-50s/veh
LOS F – >50s/veh

[5] Volume to Capacity Ratio (v/c) – The ratio of traffic volume on the subject road section divided by its capacity.
[6] Transit Headway – The time separation between transit vehicles traveling in the same direction on the same route.

Three criteria are defined to demonstrate where a potential issue may exist, and would require close monitoring and further analysis to identify any mitigation (i.e. network improvement) was required. These are:

1. At any stop/yield sign controlled intersection, any approach with a LOS “D”
2. At any signalized intersection, any turning movement with a LOS “D”
3. Any roadway with a volume to capacity ratio (v/c) greater than 0.8

5.1 2006 (20,000 population) BASE Conditions

The existing road network is constrained by the river and bluffs that cut through the City, dividing it up into distinct areas. As a result, there are often only one or two viable routes from one place to another. In the afternoon peak, traffic tends to be concentrated on Alaska Highway and the downtown-residential through routes, namely Two Mile Hill, Hamilton Boulevard, Mountainview Drive, and Lewes Boulevard. However, due to the relatively low traffic demand, the existing road network is sufficient and intersection operations are satisfactory.

In order to establish an accurate portrait of current (2006) levels of service, the analysis of existing conditions incorporated the available information without any modification. Existing levels of service at all modelled intersections were examined and shown in Figure 5.1[7].

The results at signalized intersections are summarized in Appendix D. Most of the intersections operate at acceptable LOS. Poorly operating movements or approaches (LOS below “D”) are:

- Eastbound left at 4th Avenue and Ogilvie Street (E)
- Eastbound approach at Quartz Road and Industrial Road (E)
- Westbound approach at Quartz Road and Industrial Road (E)

To address the problems at the currently four-way stop-controlled intersection of Quartz Road and Industrial Road, the City has recently approved signalization. The intersection of 4th Avenue and Ogilvie Street should be closely monitored and optimize signal timing when necessary.

5.2 2006 (20,000 population) PRIME Conditions

While the base model was developed and calibrated/validated to 2006 information, there have been several changes to the network that have occurred or are committed to occur in the near future. These include City committed network improvements for 2008 as follows:

- Traffic signalization at Quartz Road / Industrial Road
- Traffic signalization at 2nd Avenue / Black Street
- Hamilton Boulevard S. extension (2-lane) to Alaska Highway / Robert Service Way.

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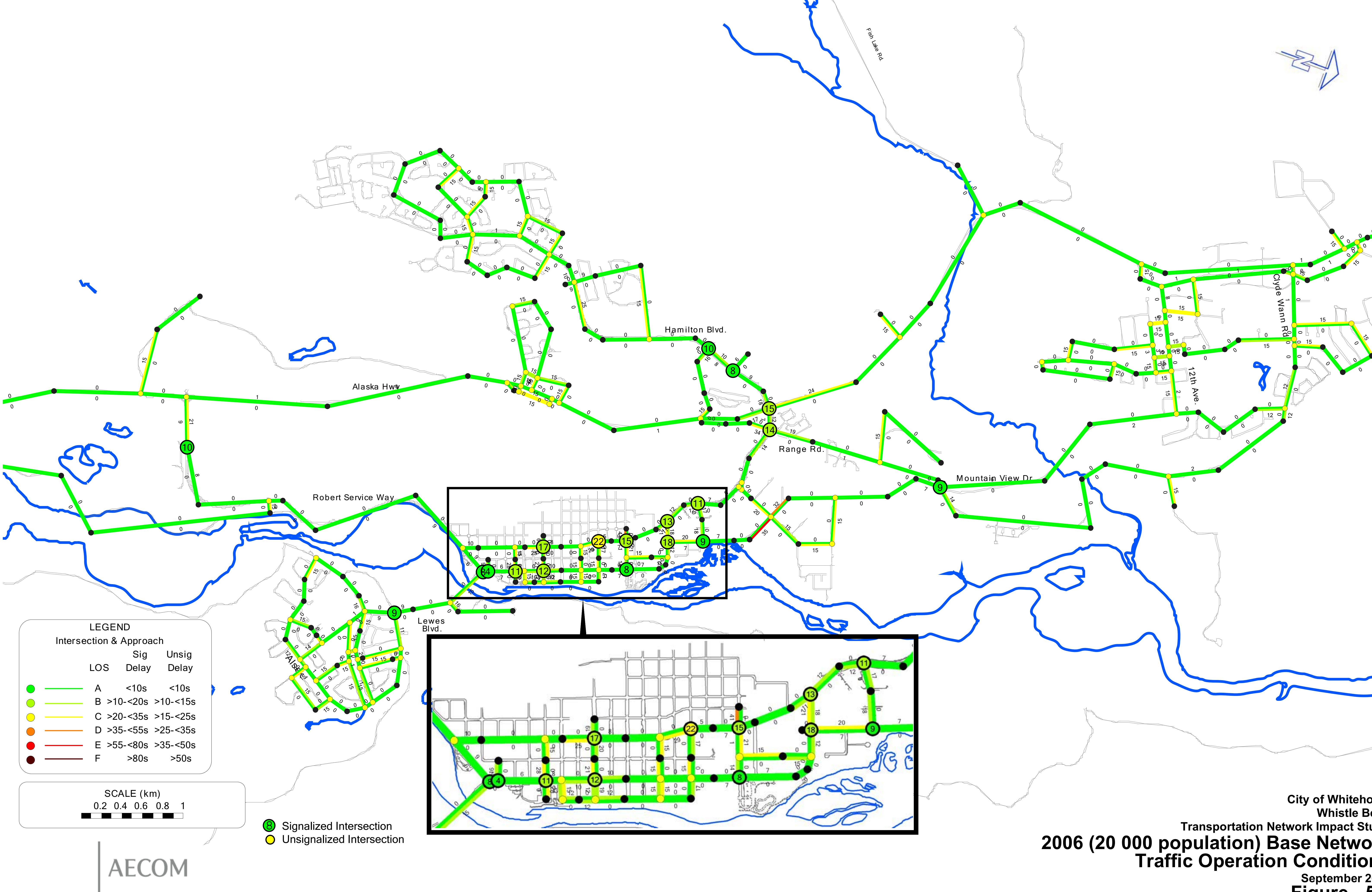
[7] Figure 5.1 and all subsequent Traffic Operation Condition figures provide information for all modelled intersections. Delay information is provided for intersections and links, with the values of the delay provided within the node at signalized intersections, and on links (by direction approaching a node). Where there is little to no delay, (ie due to free-flow conditions), the value would be low; where this is delay on the approach, the value would be a larger number.

A 2006 (20,000 population) scenario with these network improvements in place has been modelled and documented, herein referred to as 2006 (20,000 population) PRIME, with levels of service at all modelled intersections illustrated in Figure 5.2. The results are not significantly different than the 2006 base network, other than improved LOS at the Industrial and Quartz intersection from LOS D (27s/veh delay) to LOS B (12s/veh delay).

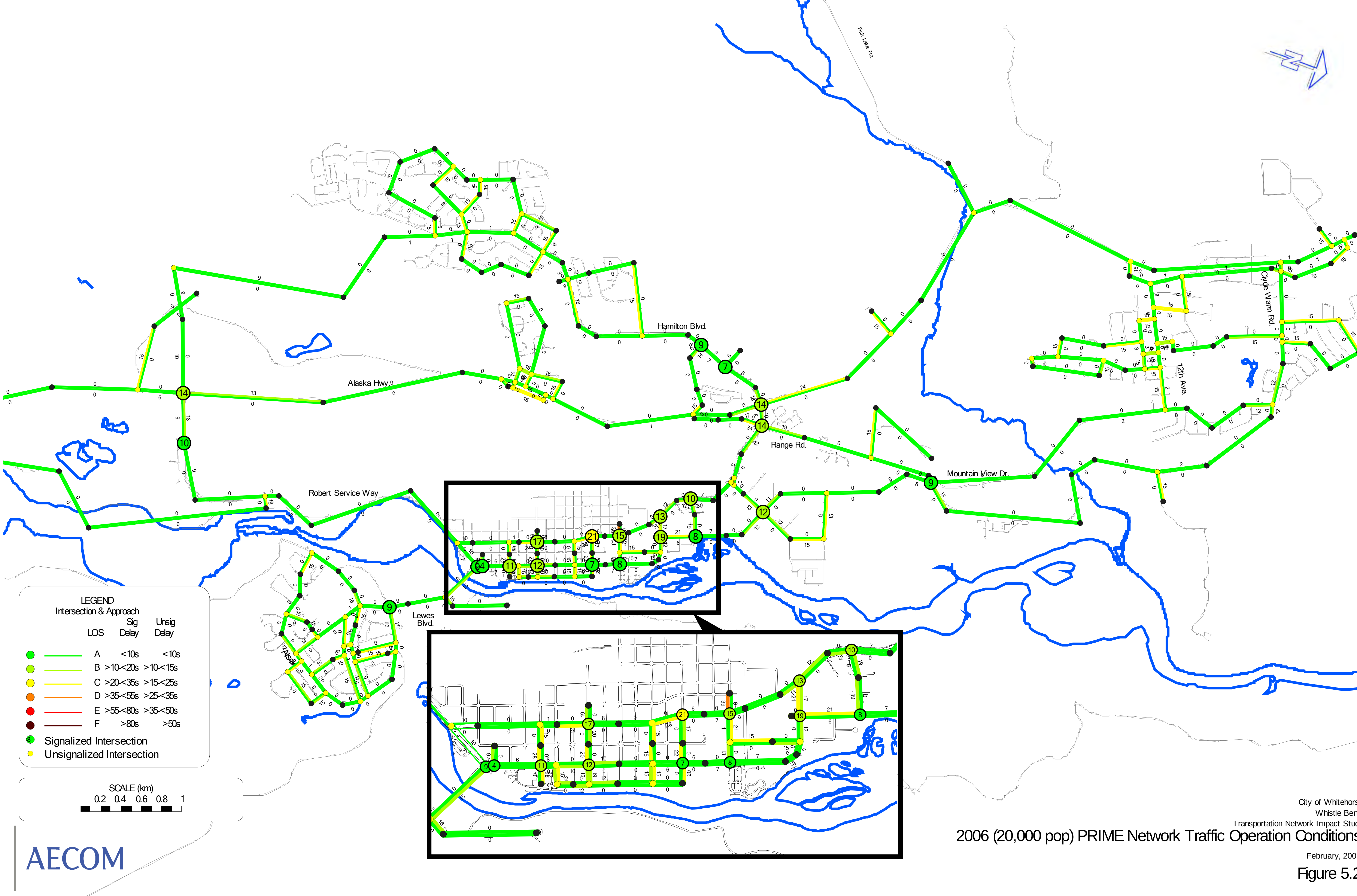


City of Whitehorse
Whistle Bend
Transportation Network Impact Study

2006 (20 000 population) Base Network Traffic Operation Conditions

September 2008

Figure - 5.1



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City of Whitehorse
Whistle Bend
Transportation Network Impact Study

2006 (20,000 pop) PRIME Network Traffic Operation Conditions

February, 2009

Figure 5.2

6.0 Network Assessment / Evaluation

This section of the report provides an evaluation of network improvement elements focusing on model output and travel pattern changes resulting from the introduction of an improvement. Network improvement recommendations and results are summarized for each population threshold horizon. The objective of the network evaluation was two-fold:

1. To recommend network improvements to support the forecast population and employment distributions, representing the short to medium term.

2. To evaluate additional network requirements beyond the Medium-term to support 50% and 100% build-out of the Whistle Bend development, representing the long term.

For both objectives, the methodology employed was to identify those network improvements that is deemed beneficial, eliminate the remainder from further analysis, and ultimately structure the recommended network for each horizon.

The first level of assessment was to examine future conditions with future demographics but no changes to the transportation network. As would be expected, future increases in demand will cause traffic conditions to intensify. The criteria developed to identify problems under current conditions were again used to measure traffic operation conditions. Table 6.1 summarizes issues that are likely to arise by each horizon which forms the basis of the network assessment and evaluation process documented in this and subsequent sections. Issues were categorized as likely/definite and potential, as a potential issue in an earlier horizon may become a definitive one in the next horizon.

Table 6.1 – Potential Network Problems Summary

Horizon	Intersection		Roadway	Transit
	Stop Controlled	Signal		
2006 BASE (20,000 pop)	Quartz/Industrial			
	Two Mile/Industrial			
		4th/Ogilvie		
		Range/Two Mile		
2006 PRIME (20,000 pop)	Two Mile/Industrial			
		4th/Ogilvie		
		Range/Two Mile		
Short-term (24,000 pop)	Two Mile/Industrial			
		4th/Ogilvie		
		Range/Two Mile		
		2nd/4th		
		4th/Black		
Med-term (25,000 pop)		2nd/4th		
		Range/Two Mile		
		Two Mile/Chilkoot		
		4th/Black		
		4th/Ogilvie		
		Alaska/Robert Service Way		

Horizon	Intersection		Roadway	Transit
	Stop Controlled	Signal		
			Whistle Bend access	
				Whistle Bend Service
50%Whistle Bend (30,000 pop)	Hamilton/Arkell Access			
	Range/Casca			
	Mountainview/Whistle Bend Connector			
		Mountainview/Range		
		Quartz/Industrial		
		2nd/4th		
		4th/Ogilvie		
		4th/Black		
		Alaska/Robert Service Way		
		Range/Two Mile		
		2nd/Main		
		4th/Main		
		2nd/Hanson		
			Whistle Bend access	
			Whistle Bend Connector	
				Line 5 Over Capacity
100%Whistle Bend (35,000 pop)	Hamilton/Arkell Access			
	Alaska/Prospector			
	Alaska/Range			
		Mountainview/Whistle Bend Connector		
		Range/Two Mile		
		4th/Black		
		2nd/4th		
		2nd/Main		
		Alaska/Robert Service Way		
		Two Mile/Chilkoot		
		Mountainview/Range		
		Quartz/Chilkoot		
		Quartz/Industrial		
		Quartz/2nd		
		4th/Ogilvie		
		4th/Main		
		2nd/Hanson		
		Alaska/Two Mile		
			Mountainview between Tlingit & Whistle Bend / Alaska Connectors	
			Quartz between 2nd & Tlingit	
			Casca	

Horizon	Intersection		Roadway	Transit
	Stop Controlled	Signal		
			Alaska between Hamilton & Prospector	
				Line 5,7 Over Capacity
				Line 4 Near Capacity

Notes:

- Highlighted elements indicate a definite problem requiring network improvements.
- Non-highlighted elements indicate a potential issue, and suggests close monitoring.

For each horizon, access and service or operational issues that were identified in the preceding horizon were defined as improvement projects. These projects consist of network improvement elements to address each issue, as illustrated in Table 6.2. Since it is important to anticipate any problems before they arise, all improvement elements in the recommended network should be in operation before the horizon it represents.

In general, where level of service was less than desirable (lower than D), adjustments were made to the signal timings. Where adjusted signal timings did not achieve an adequate level of service, additional lanes were added to the intersection.

The operational analyses provided were based on EMME travel forecasts for the afternoon peak hour. The analysis of morning peak hour conditions was outside the scope of this study. It is likely, however, the reverse movements for the morning peak hour will require improvements at several of the intersections along Mountainview Drive by 50% build-out. It is recommended the traffic management plans for the Mountainview Drive corridor include scheduled monitoring of these intersections.

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Table 6.2 – Improvement Projects for Each Identified Problem

	Intersection				
Horizon	**Stop Controlled**	**Signal**	**Roadway**	**Transit**	**Recommendations**
2006 BASE (20,000 pop)	Quartz/Industrial				Signalize (to be completed in 2008)
	Two Mile/Industrial				Monitor (require signals in the short term)
		4th/Ogilvie			Monitor (require signal optimization in the short term)
		Range/Two Mile			Monitor (require signal optimization in the short term)
2006 PRIME (20,000 pop)	Two Mile/Industrial				Monitor (require signals in the short term)
		4th/Ogilvie			Monitor (require signal optimization in the short term)
		Range/Two Mile			Monitor (require signal optimization in the short term)
Short-term (24,000 pop)	Two Mile/Industrial				Signalize
		4th/Ogilvie			Signal Optimize
		Range/Two Mile			Geometric Improvement - new NBR lane
		2nd/4th			Monitor (require signal optimization in Whistle Bend 50% build-out)
		4th/Black			Monitor (require geometric improvement in Whistle Bend 50% build-out)
Med-term (25,000 pop)		2nd/4th			Monitor (require signal optimization in Whistle Bend 50% build-out)
		Range/Two Mile			Monitor (require signal optimization in Whistle Bend 100% build-out)
		Two Mile/Chilkoot			Monitor (Improvements not required beyond Whistle Bend 100% build-out)
		4th/Black			Monitor (require geometric improvement in Whistle Bend 50% build-out)
		4th/Ogilvie			Monitor (require signal optimization in Whistle Bend 50% build-out)
		Alaska/Robert Service Way			Monitor (require signal optimization in Whistle Bend 50% build-out)
			Whistle Bend access		new Pine Ext. to Alaska, new Whistle Bend Connector
				Whistle Bend Service	Line 5 Extension to provide service for Whistle Bend
50%Whistle Bend (30,000 pop)	Hamilton/Arkell Access				Monitor (require signals in Whistle Bend 100% build-out)
	Range/Casca				Change to stop controlled on Range approach
	Mountainview/Whistle Bend Connector				Signalize, Geometric Improvement - 1 free flow NBR, 2 WBL lanes
		Mountainview/Range			Geometric Improvement - 2 NBT and 1 SBT lanes
		Quartz/Industrial			Geometric Improvement - 2 NBT and 2 SBT lanes
		2nd/4th			Signal Optimize
		4th/Ogilvie			Signal Optimize
		4th/Black			Geometric Improvement - new NBR/SBR lane
		Alaska/Robert Service Way			Signal Optimize
		Range/Two Mile			Monitor (require signal optimization in Whistle Bend 100% build-out)
		2nd/Main			Monitor (require signal optimization in Whistle Bend 100% build-out)
		4th/Main			Geometric Improvement - new NBR/SBR lane
		2nd/Hanson			Monitor (Improvements not required beyond Whistle Bend 100% build-out)
			Whistle Bend access		new Alaska Highway Connector
			Whistle Bend Connector		Road widens to 4 lanes
				Line 5 Over Capacity	Introduce new Line 7, increase service for existing Line 5 @ 17.5 min headway
100%Whistle Bend (35,000 pop)	Hamilton/Arkell Access				Signalize
	Alaska/Prospector				Signalize, Geometric Improvement - 1 free flow NBR, 1 WBL, 2 SBT lanes
	Alaska/Range				Monitor (Improvements not required beyond Whistle Bend 100% build-out)
		Mountainview/Whistle Bend Connector			Geometric Improvement - 2 NBR lanes and 2 SBT lanes, Signal Optimize
		Range/Two Mile			Signal Optimize
		4th/Black			Signal Optimize
		2nd/4th			Signal Optimize

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Horizon	Intersection		Roadway	Transit	Recommendations
	Stop Controlled	Signal			
		2nd/Main			Signal Optimize
		Alaska/Robert Service Way			Signal Optimize
		Two Mile/Chilkoot			Monitor (Improvements not required beyond Whistle Bend 100% build-out)
		Mountainview/Range			Geometric Improvement - 2 SBT lanes, 1 EBL/WBL lane, 1 EBTR/WBTR lane, Signal Optimize
		Quartz/Chilkoot			Geometric Improvement - 2 NBT and 2 SBT lanes
		Quartz/Industrial			Signal Optimize
		Quartz/2nd			Monitor (Improvements not required beyond Whistle Bend 100% build-out)
		4th/Ogilvie			Monitor (Improvements not required beyond Whistle Bend 100% build-out)
		4th/Main			Monitor (Improvements not required beyond Whistle Bend 100% build-out)
		2nd/Hanson			Monitor (Improvements not required beyond Whistle Bend 100% build-out)
		Alaska/Two Mile			Monitor (Improvements not required beyond Whistle Bend 100% build-out)
			Mountainview between Tlingit & Whistle Bend Connector		Road widens to 4 lanes
			Quartz between 2nd & Tlingit		Road widens to 4 lanes
			Casca		Road widens to 4 lanes
			Alaska between Hamilton & Prospector		Monitor (Improvements not required beyond Whistle Bend 100% build-out)
				Line 5,7 Over Capacity	Increase services for existing Line 5 and 7 @10min headway
				Line 4 Near Capacity	Increase services for existing Line 4 @20min headway

Notes:
Highlighted elements indicate a definite problem requiring network improvements.
Non-highlighted elements indicate a potential issue, and suggests close monitoring.

The following sections include the assessment of future conditions in the City. Each future horizon beginning with the Short –Term (24,000 population), is evaluated, with the corresponding model horizon scenario results presented. The evaluation begins with a base horizon network scenario (ie Sc 1601), against which new or proposed transportation improvements are tested.

6.1 Short-term (24,000 population) Horizon

6.1.1 Short-term Base Network (Sc.1601[8])

To provide a basis for comparison, a base network for the Short-term (24,000 population) horizon was developed. The base network (Sc.1601) builds upon the 2006 PRIME network which includes the following committed road improvements:

- Extension of Hamilton Boulevard to Alaska Highway at Robert Service Way
- Signalization and Geometric Improvements at the intersection of Quartz Road and Industrial Road
- Signalization at the intersection of 2nd Avenue and Black Street

In addition, Scenario 1601 includes those collector roads required to service new development in areas such as Arkell, Whitehorse Copper and Whistle Bend.

In Whistle Bend, initial access to the development can be provided from Range Road, although an upgrading of Range Road to meet acceptable standards would be recommended As significant development is not expected in Whistle Bend at this stage, no new road links are physically required into the area based on traffic volume projections.

Traffic operation conditions are demonstrated in Figure 6.1.

6.1.2 Network Improvement Elements

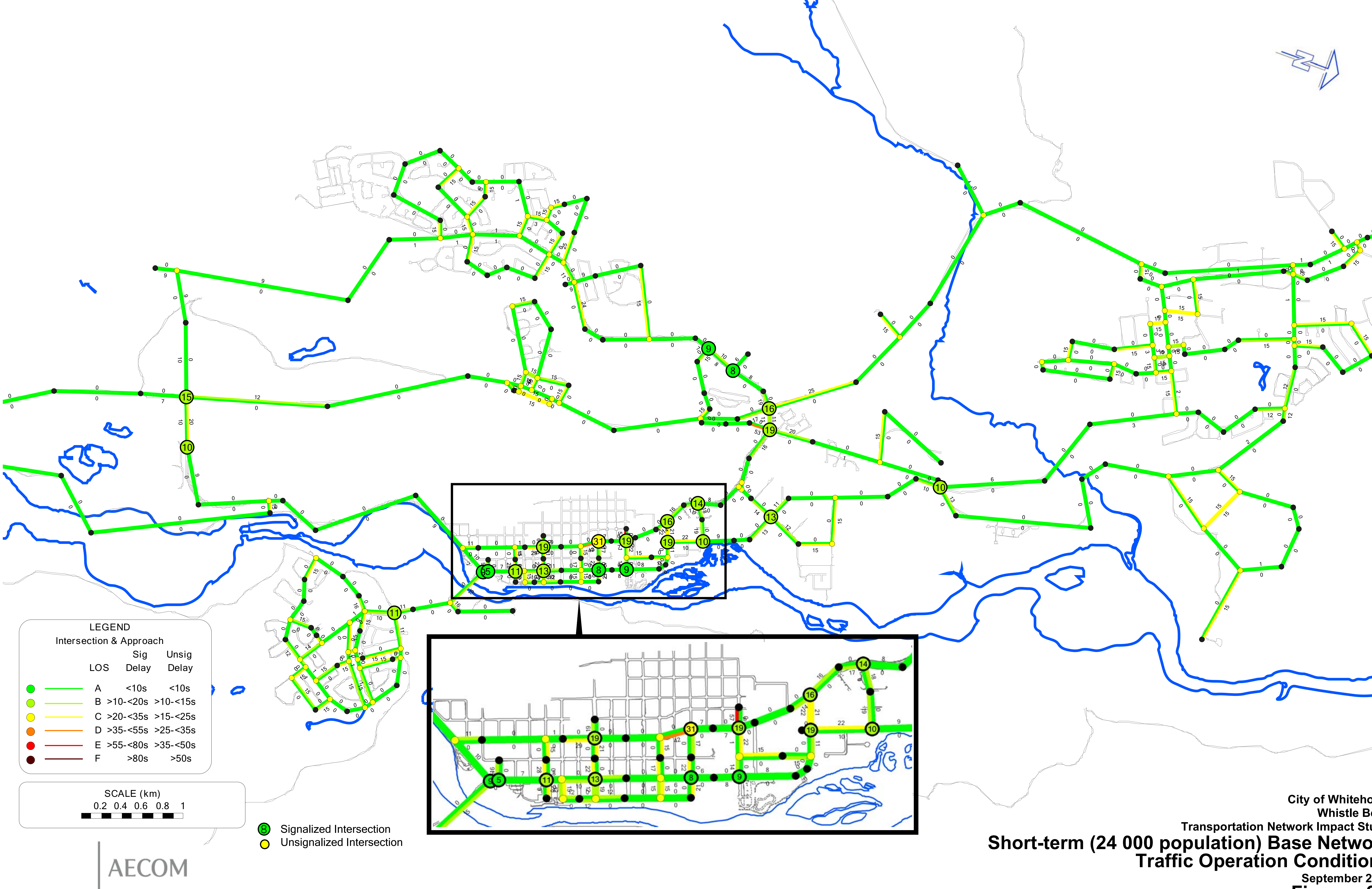
The Short-term threshold base identified "pressure points" in the network, which require mitigation. To assess the individual impact of each improvement element, a series of scenarios were developed and tested. The element was coded and incorporated into the EMME model with the results examined to determine if the improvement addressed the problem it was identified to resolve, and if there was any benefit to its retention. Given the potential for project synergies (i.e. benefit of two or more projects supersedes the sum of each project by itself),a layering approach to network analysis was utilized. Beginning with the base, each improvement scenario built upon the preceding scenarios' retained elements, ultimately resulting in a recommended network for the horizon. Figure 6.2 illustrates the approximate location of each element while Table 6.3 summarizes the results from the analysis. A summary of the automobile travel times originated from or destined to Whistle Bend is attached in Appendix E.

Pine Street Extension to Alaska Highway (Sc.1602)

Pine Street is proposed to be extended to Alaska Highway at Prospector Road. A rough alignment was developed and illustrated in the Porter Creek "D" Neighbourhood Plan. The primary objective of this extension by the Short-term (24,000 population) is to provide alternative access for the Pine Street neighbourhood in Porter Creek as well as access for the future Porter Creek "D" development, if and when it comes online. In the longer term, it will also be a major access to the proposed Whistle Bend

[8] Sc #### refers to the scenario number which corresponds to the analysis.

development. Results indicate that the extension will not be well used at this stage. The model illustrates that some traffic will shift from northbound Mountainview Drive to Alaska Highway. Automobile travel times between Porter Creek and Downtown reduces by approximately 3 minutes. It is recommended that this option be deferred and reconsidered in the Medium-term (25,000 population) horizon.

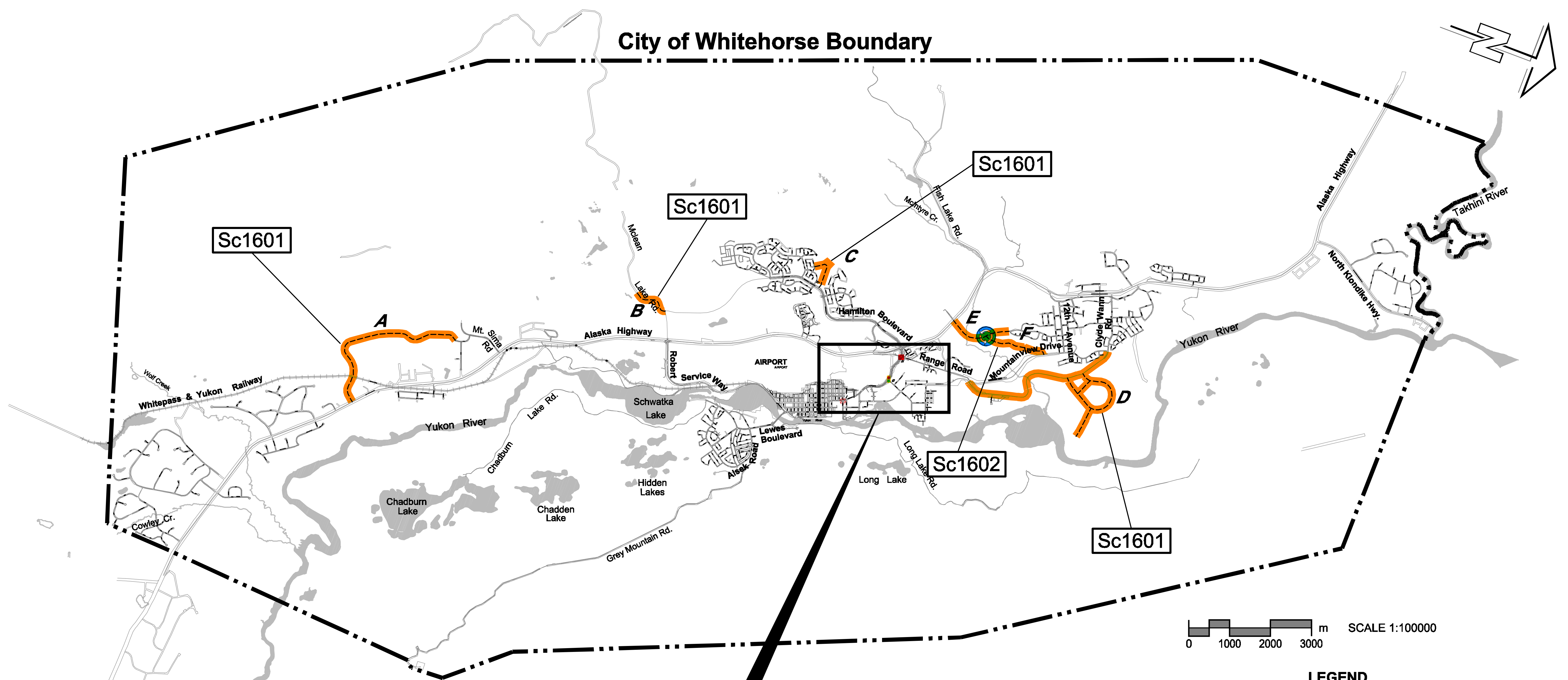


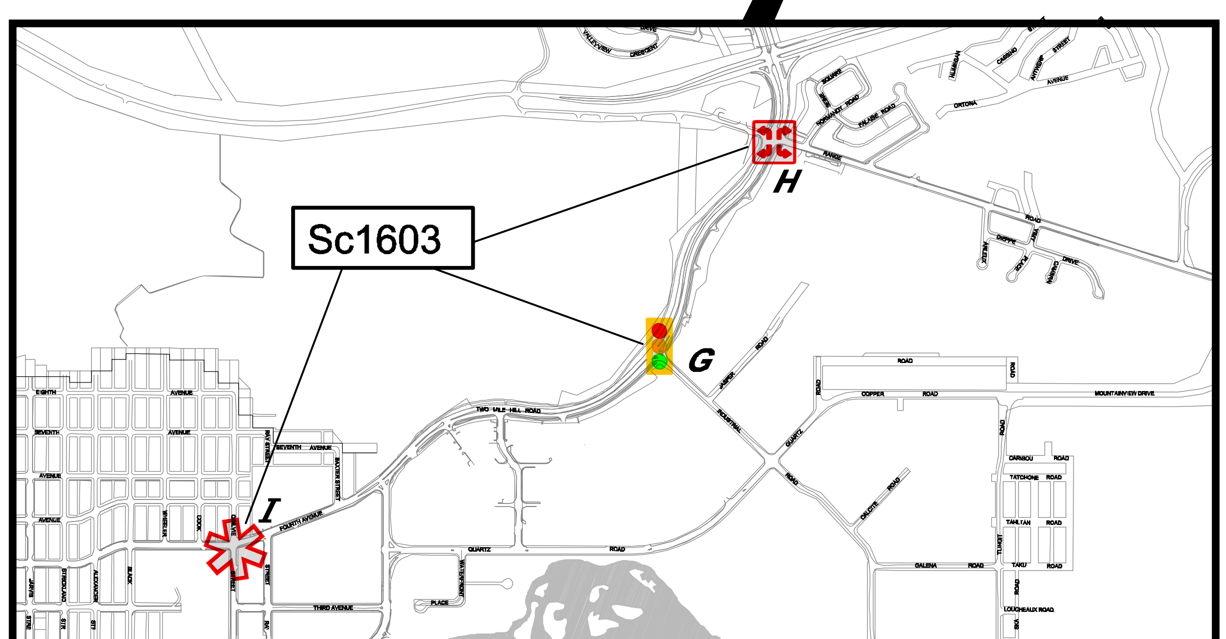
City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Short-term (24 000 population) Base Network Traffic Operation Conditions

September 2008

Figure - 6.1





Analyzed Elements		
Scenario		Element
Sc 1601	*A*	Whitehorse Copper Access Road
	B	McLean Lake Road
	C	Arkell Access Road
	D	Casca Boulevard
Sc 1602	*E*	Pine Street Extension
	F	Alaska Highway Connector
Sc 1603	*G*	Industrial Road / Two Mile Hill
	H	Range Road / Two Mile Hill
	I	4th Avenue / Ogilvie Street

LEGEND

- EXISTING ROADS
- ROAD IMPROVEMENT ANALYZED
- NEW ROADS ANALYZED
- ROUNDABOUT
- SIGNALIZATION
- SIGNAL TIMING OPTIMIZATION
- GEOMETRIC IMPROVEMENT
- Sc1601 — SCENARIO 1601

City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Short-Term (24 000 population) Horizon Network Elements Analyzed

February 2009

Figure - 6.2

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Table 6.3 – Short-term (24,000 population) Network Evaluation Summary

Horizon		Short-term (24,000 pop)			
Scenario		1600	1601	1602	1603
Network Description		2006 Existing +Hamilton Ext +Quartz / Industrial Sig +2nd/Black Sig	+New Development Accesses	+Pine Ext +Alaska Hwy Connector	+Two Mile / Industrial Sig +Sig opt
Is Traffic using the element		n/a	n/a	Pine Ext (Yes), Alaska Hwy Connector (Nominal)	n/a
Is there an increase in transit passengers		n/a	n/a	n/a	n/a
Volumes NB or EB		n/a	n/a	Pine Ext (200)	n/a
Volumes SB or WB		n/a	n/a	Pine Ext (90)	n/a
Is there a shift from other corridors		n/a	n/a	Pine Ext (from NB & SB Mountainview)	n/a
Is there a shift to other corridors		n/a	n/a	Pine Ext (to NB & SB Alaska)	n/a
Auto	Veh-Km	68210	68440	67932	68439
	Veh-Hr	1380	1383	1378	1382
	Mean Speed (kph)	49.4	49.5	49.3	49.5
Transit	Pers-Km	4323	4232	4222	4223
	Pers-Hr	104	102	101	102
	Mean Speed (kph)	41.5	41.6	41.6	41.3
Recommendation		n/a	Retain	Eliminate	Retain

Alaska Highway Connector (Sc.1602)

The proposed new two-lane collector connects Mountainview Drive and Pine Street Extension. A rough alignment was developed and illustrated in the Porter Creek “D” Neighbourhood Plan. Similar to Pine Street Extension, the primary objective of this connector is to provide access to the Alaska Highway with service for Whistle Bend development in the longer term. However, traffic usage on Alaska Highway Connector, as well as automobile travel time reductions for the neighbourhood are forecast to be nominal. It is recommended that this option be deferred and reconsidered as a testing element in the Medium-term (25,000 population) horizon.

Industrial Road / Two Mile Hill Signalization (Sc.1603)

To accommodate increasing traffic volumes and delays at the currently stop-controlled intersection, especially for the southbound left turn movement, it is recommended that this intersection be signalized.

Results indicate that traffic operation for the movement improves from LOS E (42s/veh delay) to LOS C (27s/veh delay). This option is retained in the recommended network.

Range Road / Two Mile Hill Geometric Improvement (Sc.1603)

To accommodate increasing northbound traffic volumes and delays at the currently signalized intersection, a dedicated northbound right turn lane should be provided with sufficient storage. Results indicate that traffic operation for the intersection improves from LOS B (19s/veh delay) to LOS B (17s/veh delay). Specifically, the approach improves from LOS D (53s/veh delay) to LOS C (27s/veh delay). This option is retained for inclusion in the Short-term recommended network.

4th Avenue / Ogilvie Street Signal Optimization (Sc.1603)

To accommodate increasing eastbound traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves from LOS B (19s/veh delay) to LOS B (17s/veh delay). Specifically, the approach improves from LOS E (57s/veh delay) LOS C (27s/veh delay). This option is retained in the recommended network.

6.1.3 Short-term (24,000 population) Horizon Network (Sc.1603)

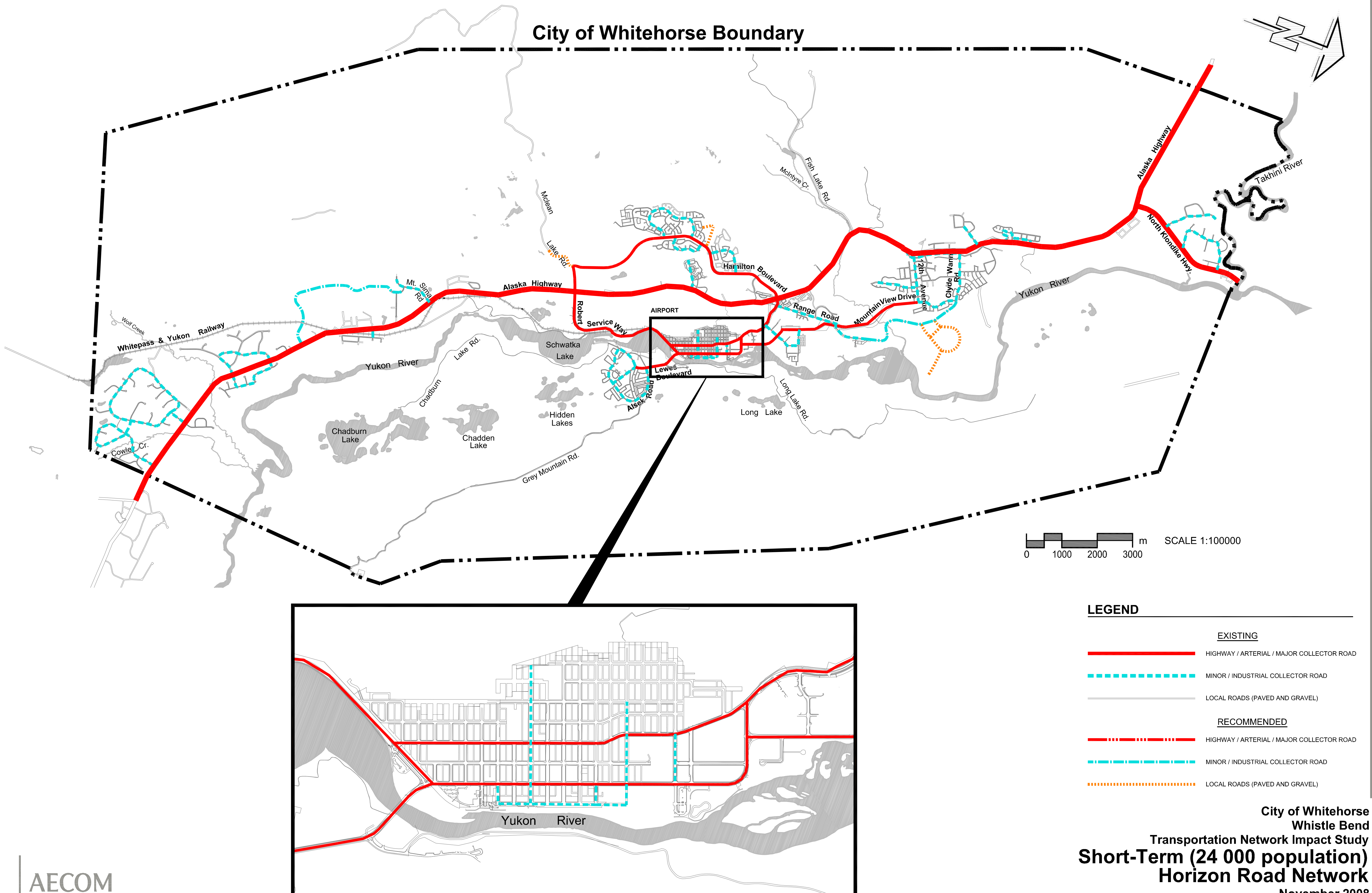
As illustrated in Figure 6.3, the Short-term Horizon Network incorporates the following improvements to the existing municipal road network, required to support this population threshold:

Intersection Improvements

- Industrial Road / Two Mile Hill Signalization
- Range Road / Two Mile Hill Geometric Improvement
- 4th Street / Ogilvie Street Signal Optimization

Traffic operations are summarized at signalized intersections by movements in Appendix D and afternoon peak hour volumes are demonstrated in Appendix F.

As no new road links are physically needed into the Whistle Bend development area based on traffic volume projections at this stage, initial access needs can be met by the use of Range Road, although upgrading of Range Road to meet acceptable standards would be recommended. However, given the desire to build a new access to the new community to coincide with lot availability, the development of a new connector from Whistle Bend to Mountainview Drive can be advanced.



City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Short-Term (24 000 population) Horizon Road Network

November 2008

Figure - 6.3

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6.2 Medium-term (25,000 population) Horizon

6.2.1 Medium-term Base Network (Sc.2601)

To provide a basis for comparison, a Medium-term base network with a population threshold of 25,000 was developed. The base network (Sc.2601) included those road improvement projects that are listed in the Short-term (24,000 population threshold) Horizon Network. Additional improvements included in the Medium-term base network include:

- Pine Street Extension to Alaska Highway
- Transit Line 5 (Takhini-College) Extension

Several alternatives were considered to provide transit service to the proposed Whistle Bend development. These included diverting or extending additional service or providing a separate service explicitly for the proposed development. It is important to provide transit service in advance of substantial completion of major new developments in order to build and retain market share. However, only approximately 10% of the ultimate development at Whistle Bend is likely to be completed by the Medium-term (25,000 population threshold). Consequently, transit passenger volumes generated by the development in the Medium-term are modest and are insufficient to support a new transit route. Extending the existing Transit Line 5 was considered to be the most effective and affordable means of serving the proposed development at 10% build-out. Results indicate that an increase of transit ridership of 30 passengers in the peak hour.

Traffic operation conditions are demonstrated in Figure 6.4.

6.2.2 Network Improvement Elements

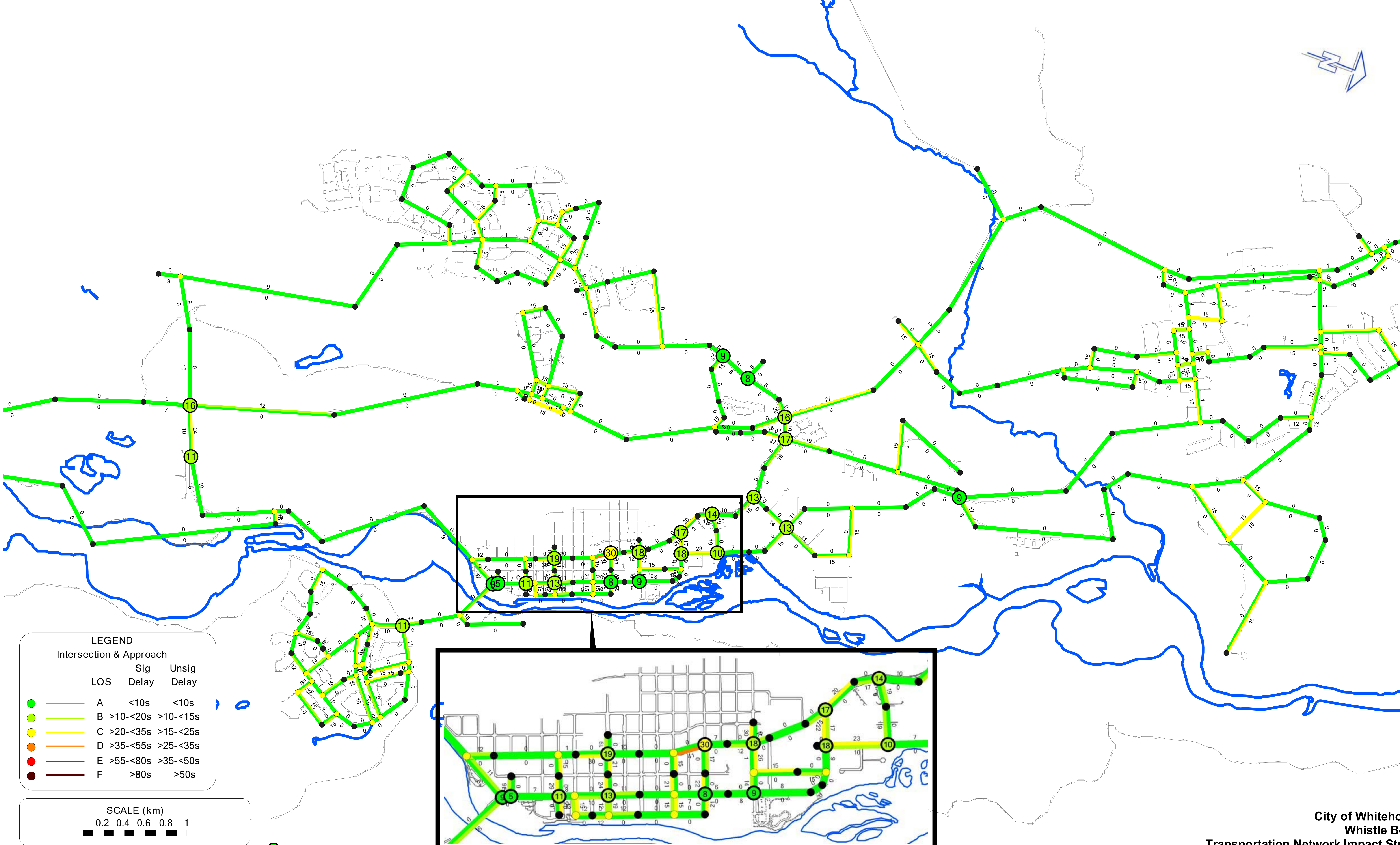
Similar to the approach utilized in assessing network improvements in the Short-term, the Medium-term base scenario was modelled and examined to identify potential problems. Figure 6.5 illustrates the approximate location of each element, while Table 6.4 summarizes the results from the analysis.

Alaska Highway Connector and Whistle Bend Connector (Sc.2602 and Sc.2603)

The proposed new two-lane collector connects Range Road and Pine Street Extension through Mountainview Drive in two (2) segments: Alaska Highway Connector which runs from Mountainview Drive to the Pine Street Extension and ultimately to Alaska Highway, and the Whistle Bend Connector which runs from Mountainview Drive to Casca Boulevard in Whistle Bend. A short stretch of Range Road to the east of the Whistle Bend Connector will be downgraded to provide transit service only. A rough alignment was developed and illustrated in the Whistle Bend and Porter Creek “D” Neighbourhood Plans. The primary objective of this connector is to provide access and service for the Whistle Bend community. Results indicate that the Whistle Bend Connector, connecting Range Road to Mountainview Drive will be well used. The model illustrates that some traffic will shift from northbound Range Road to Mountainview Drive. Automobile travel times between Whistle Bend and Downtown reduces approximately 1 minute. However, traffic usage on Alaska Highway Connector, connecting Mountainview Drive to Pine Street Extension, as well as travel time reductions due to the introduction of this connector are forecast to be nominal. Whistle Bend Connector is retained in the recommended network while Alaska Highway Connector is to be deferred and reconsidered as a testing element to support development of Whistle Bend at the 50% and 100% Build-out stages beyond the Medium-term.

College Access Road Extension (Sc.2602)

College Access Road is proposed be extended to Pine Street Extension. A rough alignment was developed and illustrated in the Porter Creek “D” Neighbourhood Plan. The primary objective of this extension is to provide improved secondary, transit and emergency access to the area. However, traffic usage on the College Access Road Extension, as well as travel time reductions for the neighbourhood are forecast to be nominal. This option is to be deferred and reconsidered as a base element in the 50% Whistle Bend Build-out horizon.



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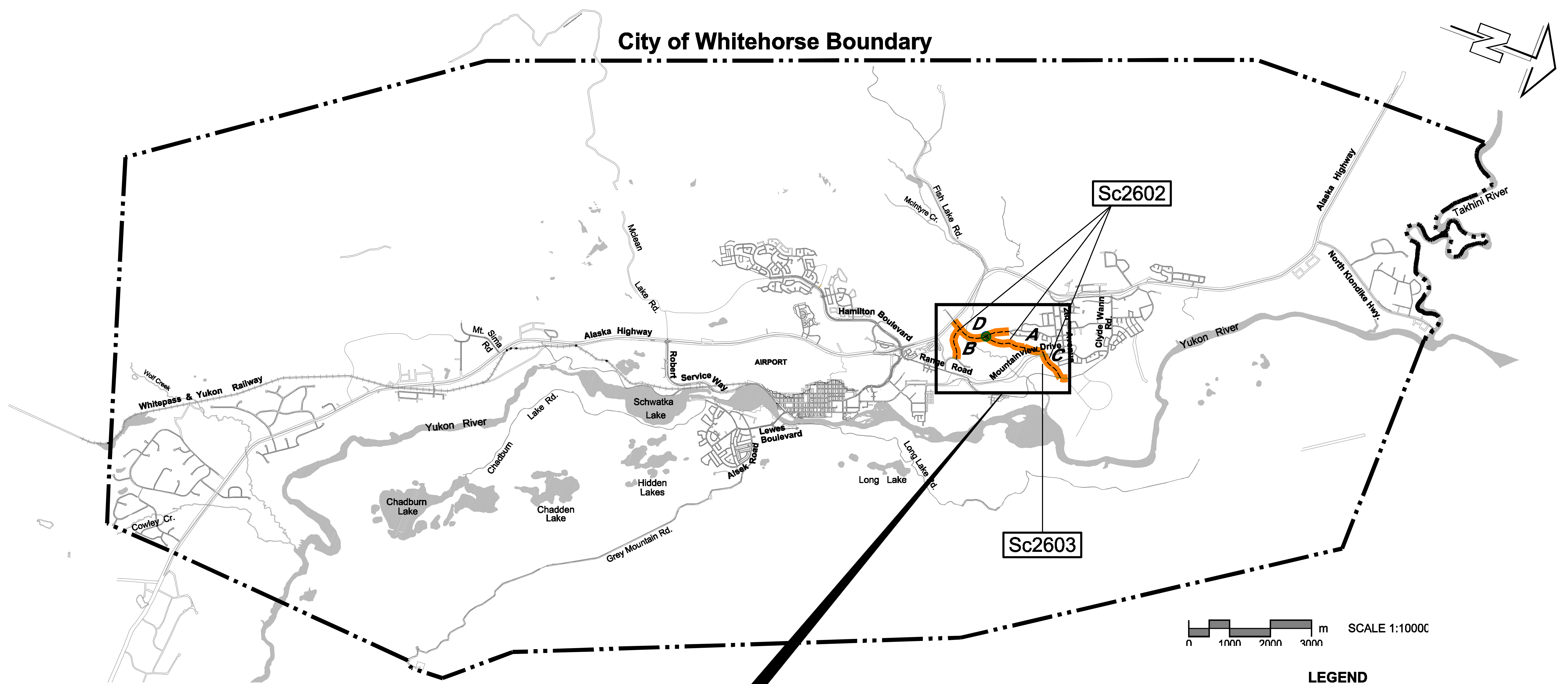
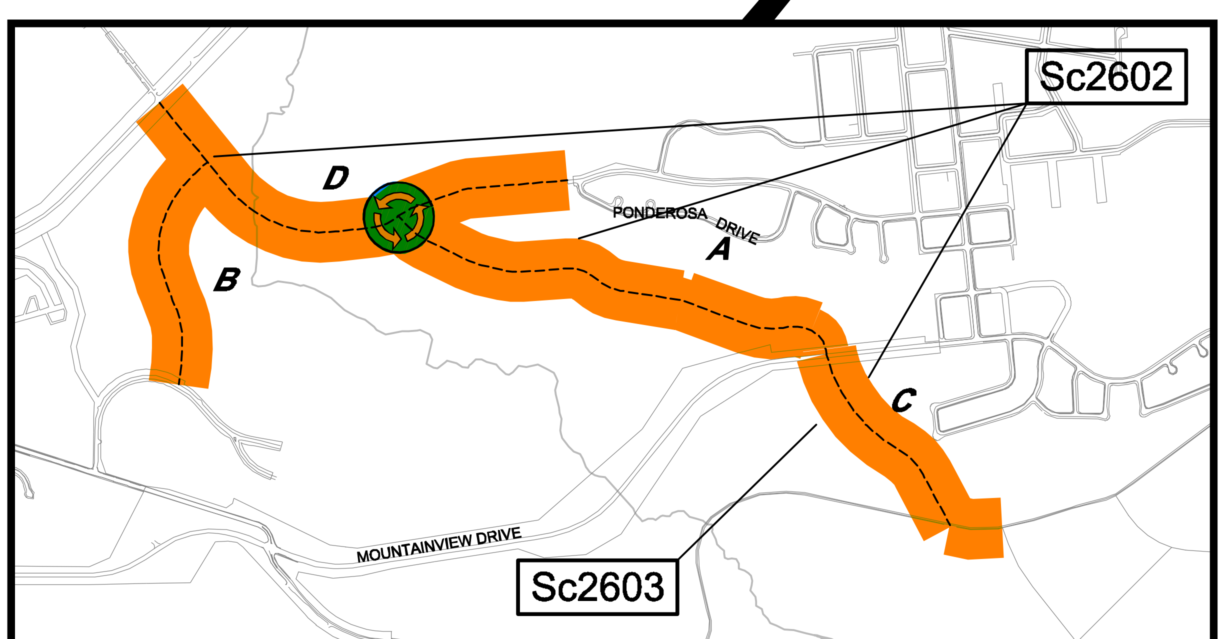
City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Medium-term (25 000 population) Base Network Traffic Operation Conditions

September 2008

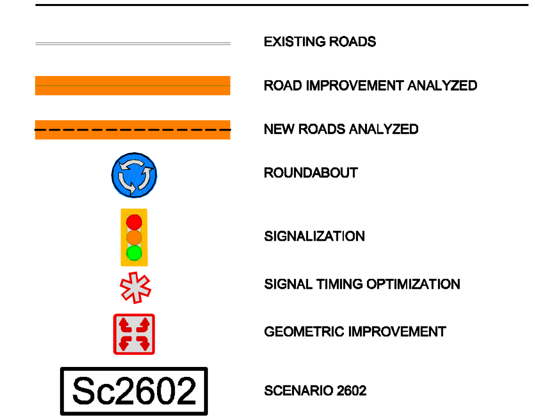
Figure - 6.4





Analyzed Elements		
Scenario	Element	
Sc 2602	*A*	Alaska Highway Connector
	B	College Access Road
	C	Whistle Bend Connector
Sc 2603	*C*	Whistle Bend Connector
Sc 2601	*D*	Pine Street Extension

LEGEND



City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Medium-Term (25 000 population) Horizon Network Elements Analyzed

February 2009

Figure - 6.5

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Table 6.4 – Medium-term (25,000 population) Network Evaluation Summary

	Horizon	Medium-term (25,000 pop)			
	Scenario	**2600**	**2601**	**2602**	**2603**
	Network Description	Short-term (24,000 population) Recommended	+Pine Ext +Transit Line 5 Ext	+Whistle Bend Connector +Alaska Highway Connector +College Access Ext	+Whistle Bend Connector
	Is Traffic using the element	n/a	Yes	Whistle Bend Connector (Yes), Alaska Highway Connector & College Access Ext (Nominal)	n/a
	Is there an increase in transit passengers	n/a	Line 5 (30)	n/a	n/a
	Volumes NB or EB	n/a	210	Whistle Bend Connector (510)	n/a
	Volumes SB or WB	n/a	100	Whistle Bend Connector (190)	n/a
	Is there a shift from other corridors	n/a	from NB & SB Mountainview	Whistle Bend Connector (from NB & SB Range)	n/a
	Is there a shift to other corridors	n/a	to NB & SB Alaska	Whistle Bend Connector (to NB & SB Mountainview)	n/a
Auto	**Veh-Km**	75114	74750	74536	74618
	Veh-Hr	1510	1510	1504	1506
	Mean Speed (kph)	49.7	49.5	49.5	49.5
Transit	**Pers-Km**	4362	4586	4625	4608
	Pers-Hr	106	111	112	112
	Mean Speed (kph)	41.2	41.5	41.4	41.3
	Recommendation	n/a	Retain	Retain Whistle Bend Connector, Eliminate Alaska Highway Connector & College Access Ext	Retain

The incremental analysis approach, the results of which are summarized in Table 6.3, indicate that not all elements examined are beneficial or required in this horizon. A summary of automobile travel times originating or destined for Whistle Bend, attached in Appendix E, suggests that Whistle Bend Connector provides improved travel time for residents of the area to various destinations in the City.

6.2.3 Medium-term (25,000 pop) Horizon Network (Sc.2603)

As illustrated in Figure 6.6, the Medium-term (25,000 population) Horizon Network incorporates the following improvements to the road network recommended to support this population threshold:

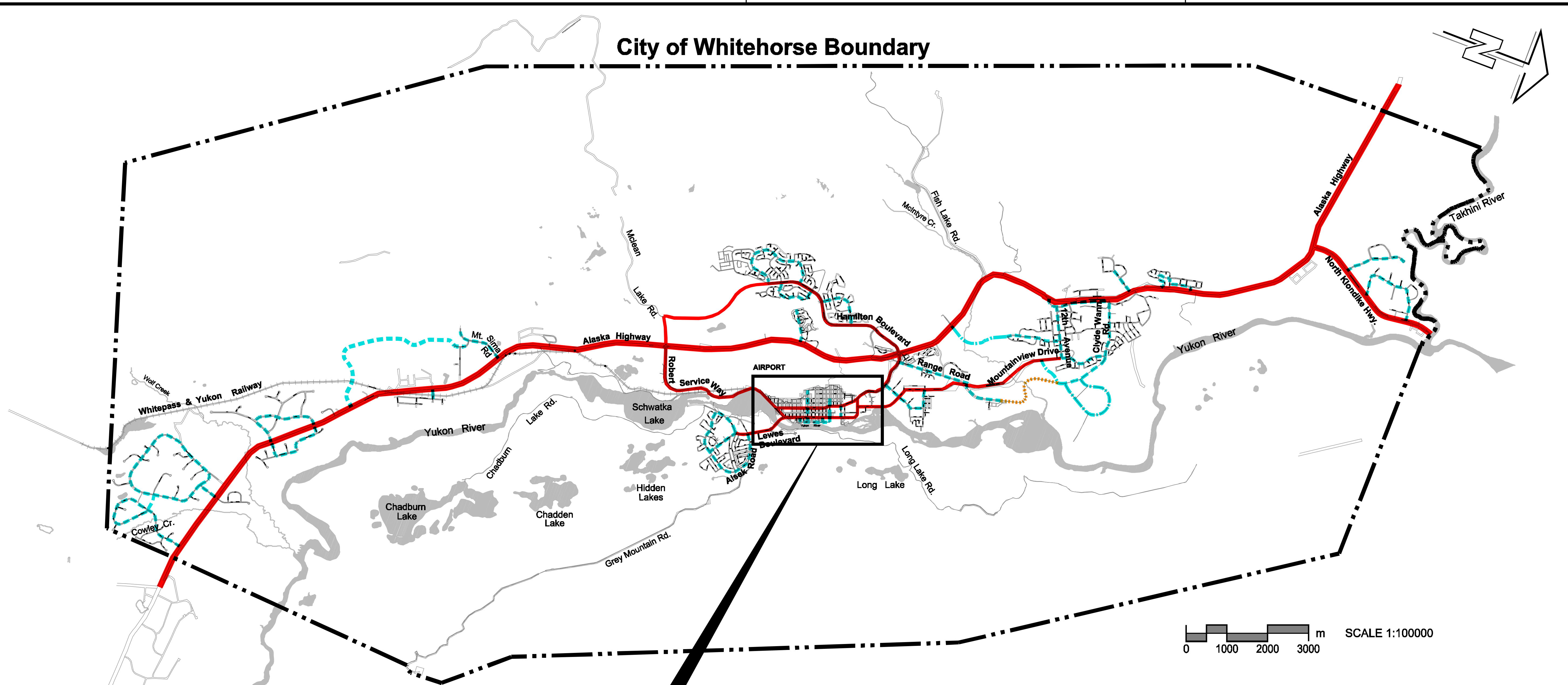
Major Road

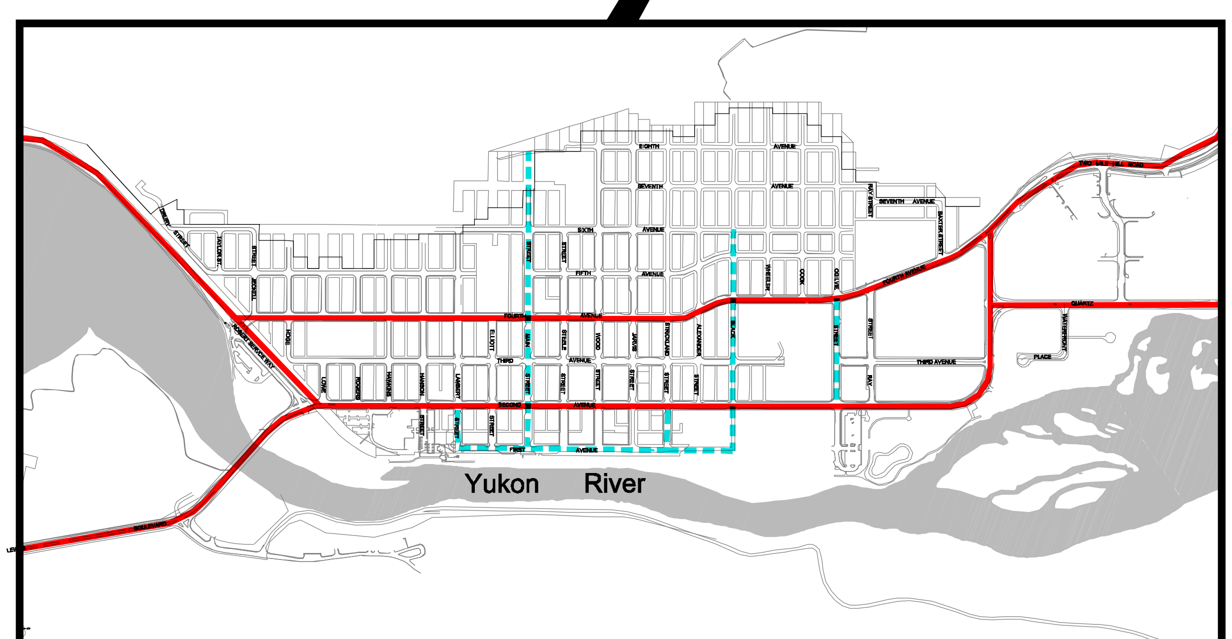
- Whistle Bend Connector between Range Road and Mountainview Drive
- Pine Street Extension to Alaska Highway

Transit Service

- Transit Line 5 (Takhini-College) Extension

Traffic operations are summarized at signalized intersections by movements in Appendix D and afternoon peak hour volumes are demonstrated in Appendix F.





LEGEND

EXISTING

- HIGHWAY / ARTERIAL / MAJOR COLLECTOR ROAD
- MINOR / INDUSTRIAL COLLECTOR ROAD
- LOCAL ROADS (PAVED AND GRAVEL)

RECOMMENDED

- HIGHWAY / ARTERIAL / MAJOR COLLECTOR ROAD
- MINOR / INDUSTRIAL COLLECTOR ROAD
- LOCAL ROADS (PAVED AND GRAVEL)

City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Medium-Term (25 000 population) Horizon
Horizon Road Network

February 2009

Figure - 6.6

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6.3 50% Whistle Bend Build-out (30,000 population) Horizon

6.3.1 50% Whistle Bend Build-out Base Network (Sc.3601)

The 50% Whistle Bend Build-out base network (Sc.3601) with a population threshold of 30,000 included those road improvement projects that are listed in the Medium-term (25,000 population) Horizon Network. Additional improvements included in this population threshold base network include:

- Alaska Highway Connector (between Mountainview Drive and Pine Street Extension)
- College Access Road Extension

To provide service for the developing neighbourhood of Whistle Bend, Alaska Highway Connector connects Whistle Bend Connector and Pine Street Extension, which provides direct access to Alaska Highway. The Pine Street Extension is required prior to the 50% build out but after the first two phases of Whistle Bend development and is therefore included in this base scenario. College Access Road was also extended to Pine Street Extension. Results indicate that Alaska Highway Connector will be well used. The model illustrates that some traffic will shift from northbound Mountainview Drive to Alaska Highway. Automobile travel time reduces approximately 2 minutes from the south side of the City to Whistle Bend.

Traffic operation conditions are demonstrated in Figure 6.7.

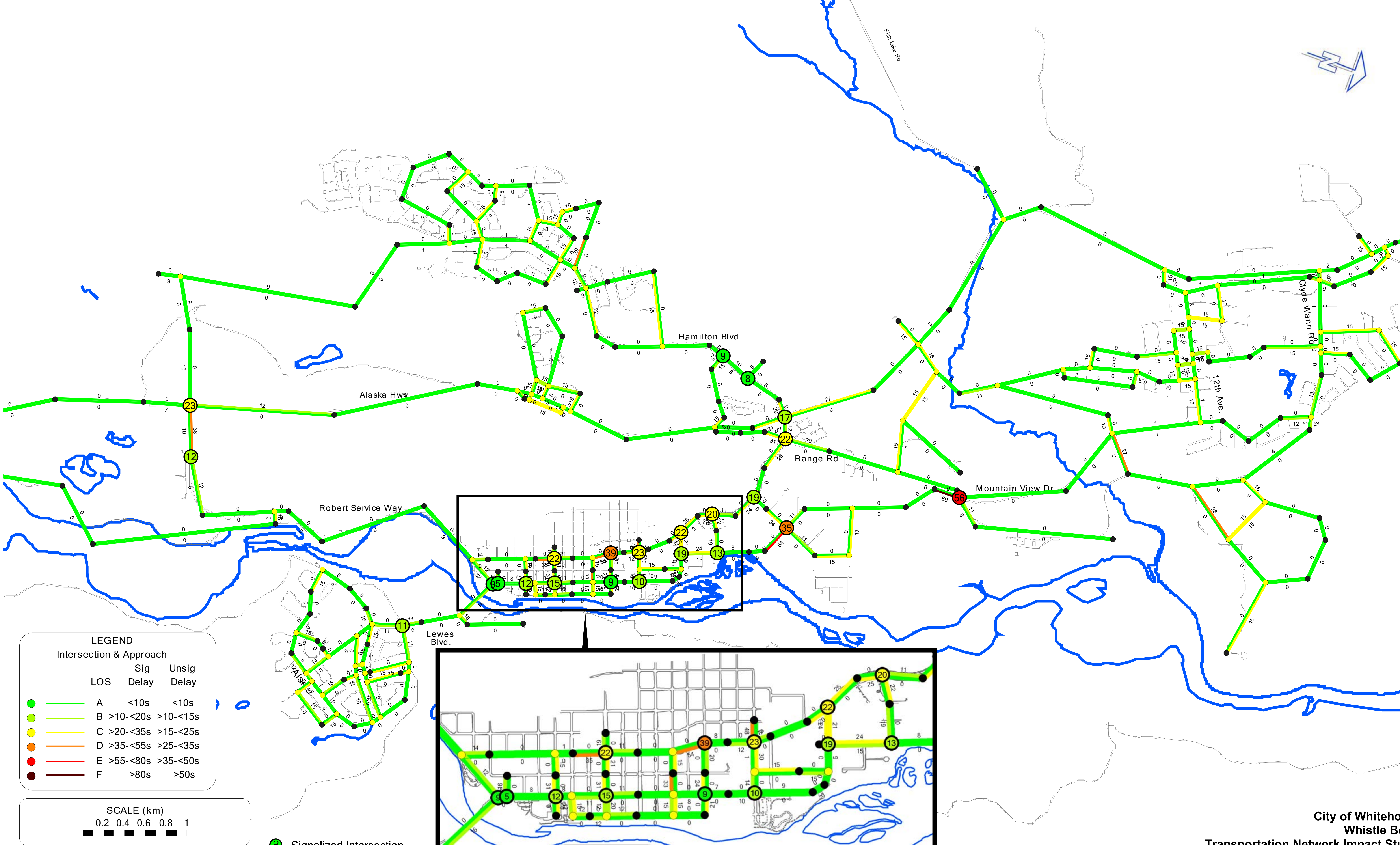
6.3.2 Network Improvement Elements

The following network improvement elements were examined for the 50% Build-out horizon:

- Transit service improvements (new transit line 7 and adjustments to transit line frequencies)
- Mountainview Drive and Whistle Bend Connector intersection (main access into Whistle Bend)
- Whistle Bend Connector
- Range Road and Whistle Bend Connector intersection
- Mountainview Drive corridor
- Downtown intersection improvements

Each element's approximate location is illustrated in Figure 6.8. Similar to preceding horizons, an incremental approach of evaluating and retaining / discarding elements was employed resulting in a recommended network.

A summary of the network evaluation results is provided in Table 6.5, with automobile travel times to and from Whistle Bend provided in Appendix E.

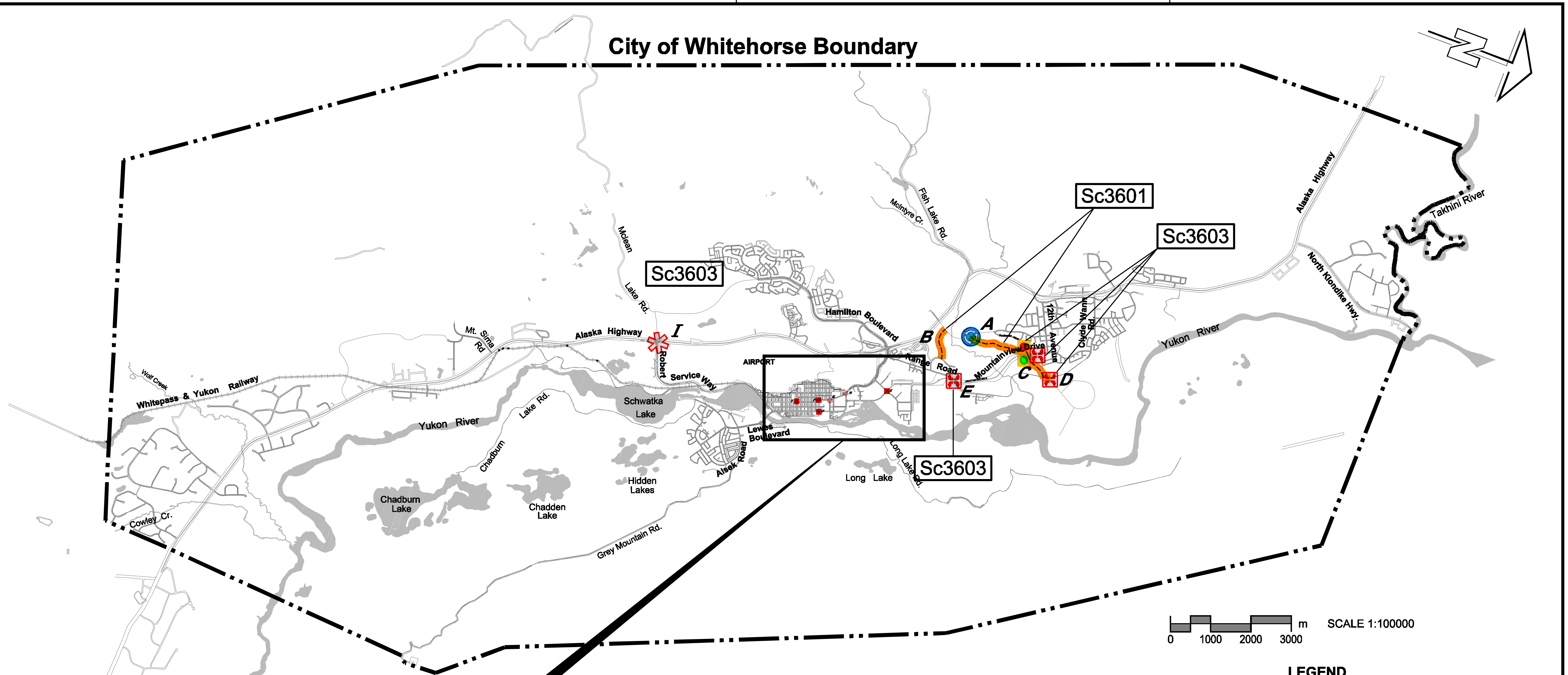


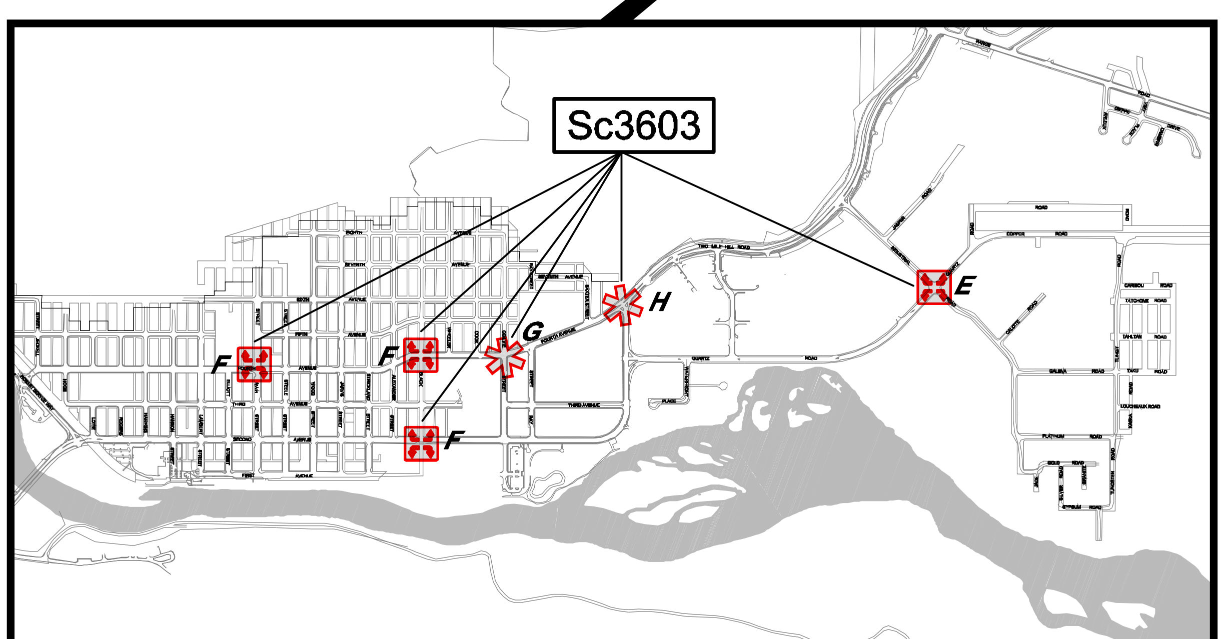
City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Whistle Bend 50% Build-out (30 000 population) Base Network Traffic Operation Conditions

September 2008

Figure - 6.7





Analyzed Elements		
Scenario		Element
Sc 3601	A	Alaska Highway Connector
	B	College Access Road
Sc 3603	C	Mountainview Drive / Whistle Bend Connector
	D	Range Road / Whistle Bend Connector
	E	Mountainview Drive Corridor Intersections
	F	Downtown Intersections
	G	4th Avenue / Ogilvie
	H	2nd Avenue / 4th Avenue
	I	Alaska Highway / Robert Service Way

LEGEND

- EXISTING ROADS
- ROAD IMPROVEMENT ANALYZED
- NEW ROADS ANALYZED
- ROUNDABOUT
- SIGNALIZATION
- SIGNAL TIMING OPTIMIZATION
- GEOMETRIC IMPROVEMENT
- Sc3601 SCENARIO 3601

City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Whistle Bend 50% Build-Out (30 000 population) Horizon Network Elements Analyzed

February 2009

Figure - 6.8

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Table 6.5 – 50% Whistle Bend Build-out (30,000 population) Network Evaluation Summary

Horizon		Whistle Bend 50% Build-out (30,000 pop)			
Scenario		3600	3601	3602	3603
Network Description		Med-term (25,000 population) Recommended	+Alaska Highway Connector +College Access Ext	+New Transit Line 7 +Transit Line 5 Increase Frequency	+Mountainview / Whistle Bend Connector Sig + Mountainview Int Improve +Sig opt
Is Traffic using the element		n/a	Alaska Highway Connector (Yes), College Access Ext (Nominal)	n/a	Mountainview Drive (Yes)
Is there an increase in transit passengers		n/a	n/a	Line 5 (294) Line 7 (365)	n/a
Volumes NB or EB		n/a	Alaska Highway Connector (332)	n/a	Mountainview Drive (221)
Volumes SB or WB		n/a	Alaska Highway Connector (38)	n/a	Mountainview Drive (-10)
Is there a shift from other corridors		n/a	Alaska Highway Connector (from NB Mountainview)	n/a	Mountainview Drive (from WB Two Mile Hill & NB Alaska)
Is there a shift to other corridors		n/a	Alaska Highway Connector (to NB Alaska)	n/a	Mountainview Drive (to NB Mountainview, Copper, Quartz, WB 2nd)
Auto	Veh-Km	89802	89810	89938	90241
	Veh-Hr	1926	1908	1911	1860
	Mean Speed (kph)	46.6	47.1	47.1	48.5
Transit	Pers-Km	5528	5513	8628	8953
	Pers-Hr	145	144	228	219
	Mean Speed (kph)	38.0	38.4	37.9	40.9
Recommendation		n/a	Retain	Retain	Retain

Details on each network option considered follow.

Transit Service (Sc.3602)

The general increase in employment to support the growth in Whistle Bend population leads to a general increase in transit demand throughout the City. This combined with the transit demand of the proposed development renders the current transit strategy of 35-minute headways on all routes and a common timed-transfer point unworkable. Our analysis suggests that a comprehensive review of transit operations will be appropriate as the City continues to grow. This may require the transit component of the transportation model to be revalidated to observed peak hour counts by route rather than to system-wide transit volumes as is currently the case.

For the current study, we have identified desirable transit improvements to support the assumed population and employment distribution consistent with the current transit strategy with a base headway of 35 minutes. However, increased demand on some services requires additional bus service at 17.5-minutes headway and some routes have running times close to or exceeding the required 35 minute turn-round time. Consequently, the transit improvements identified for the 30,000 population scenarios should be regarded as provisional pending a comprehensive review of long term transit needs.

New Transit Line 7 (Sc.3602)

To accommodate increasing passenger load of the Transit Line 5 (Takhini-College) Extension, which services the developing neighbourhood of Whistle Bend, a preliminary concept of a new Transit Line 7 (Whistle Bend) with 17.5-minute headway is introduced. The preliminary concept of the new transit line will provide service to Whistle Bend, Porter Creek and Downtown after a review of the passenger volumes and layover time. Results indicate that a ridership of 365 passengers in the peak hour. This option is retained in the recommended network.

Transit Line 5 Increase Frequency (Sc.3602)

To accommodate increasing passenger load of the Transit Line 5 (Takhini-College) Extension, which services the developing neighbourhood of Whistle Bend, the transit line requires frequency improvement to 17.5-minute headway after a review of the passenger volumes and layover time. Results indicate that an increase in ridership of 294 passengers in the peak hour. This option is retained in the recommended network.

Mountainview Drive / Whistle Bend Connector Signalization and Geometric Improvement (Sc.3603)

To accommodate increasing northbound and westbound traffic volumes and delays at the stop-controlled intersection, especially for the northbound right turn and westbound left turn movements, it is recommended that this intersection be signalized by 50% build-out. A preliminary assessment of the volumes at the intersection suggests a dedicated free-flow northbound right turn lane with sufficient storage, two westbound left turn lanes in advance phase. Results indicate that traffic operation for the westbound approach improves from LOS D (27s/veh delay) to LOS C (24s/veh delay). This option is retained in the recommended network.

Whistle Bend Connector 4-lane Widening (Sc.3603)

To accommodate increasing traffic usage on the Whistle Bend Connector, widening to 4 lanes was introduced. Traffic volumes and requirements for geometric improvements at the intersection with Moutainview Drive indicate a need for this option, which is retained in the recommended network.

Range Road / Casca Boulevard Geometric Improvement (Sc.3603)

To accommodate increasing northbound and westbound traffic volumes and delays at the stop-controlled intersection, especially for the northbound right turn and westbound left turn movements, it is recommended that this intersection be stop-controlled southbound on Range instead of westbound on the South Access by this build-out horizon. Results indicate that traffic operation is LOS D (28s/veh delay) on the westbound approach when it is stop-controlled and improves to LOS B (15s/veh delay) on the southbound approach when the southbound is stop-controlled. This option is retained in the recommended network.

Mountainview Drive Corridor Signalized Intersections Geometric Improvement (Sc.3603)

To accommodate increasing traffic usage on the Mountainview Drive, the number of lanes in the north-south directions should be increased at signalized intersections on the Mountainview Drive Corridor, namely Mountainview Drive at Range Road and Quartz Road at Industrial Road. The dedicated northbound right turn lane at Mountainview Drive / Range Road is recommended to be converted to a shared through and right turn lane. Results indicate that traffic operation for the intersection improves from LOS E (56s/veh delay) to LOS C (21s/veh delay). Specifically, the northbound approach improves from LOS F (89s/veh delay) to LOS B (18s/veh delay). Quartz Road at Industrial Road is recommended to be widened for two shared through lanes in both directions. Results indicate that traffic operation for the intersection improves from LOS C (35s/veh delay) to LOS B (14s/veh delay). This option is retained in the recommended network.

Downtown Intersections Geometric Improvement (Sc.3603)

To accommodate increasing northbound and southbound traffic volumes and delays at signalized intersections on 4th Avenue, it is recommended that current road dieting on 4th Avenue at Black Street and Main Street be relaxed to provide dedicated northbound and southbound right turn lanes with sufficient storage. Results indicate that traffic operation for both intersections improve from LOS D (39s/veh delay) to LOS D (36s/veh delay) and LOS C (22s/veh delay) to LOS B (19s/veh delay) respectively. Specifically, the northbound approaches improve from LOS D (54s/veh delay) to LOS D (48s/veh delay) and LOS C (35s/veh delay) and LOS C (25s/veh delay) respectively. This option is retained in the recommended network.

4th Avenue / Ogilvie Street Signal Optimization (Sc.3603)

To accommodate increasing eastbound traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves from LOS C (23s/veh delay) to LOS B (19s/veh delay). Specifically, the approach improves from LOS D (48s/veh delay) to LOS C (26s/veh delay). This option is retained in the recommended network.

2nd Avenue / 4th Avenue Signal Optimization (Sc.3603)

To accommodate increasing southbound traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves nominally, with a reduction in delay for the intersection and southbound approach. This option is retained in the recommended network.

Alaska Highway / Robert Service Way Signal Optimization (Sc.3603)

To accommodate increasing westbound traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves nominally, with a reduction in delay for the intersection and westbound approach. This option is retained in the recommended network.

6.3.3 50% Whistle Bend Build-out (30,000 population) Horizon Network (Sc.3603)

As illustrated in Figure 6.9, the 50% Whistle Bend Build-out Horizon Network incorporates the following improvements to the road network recommended to support this population threshold:

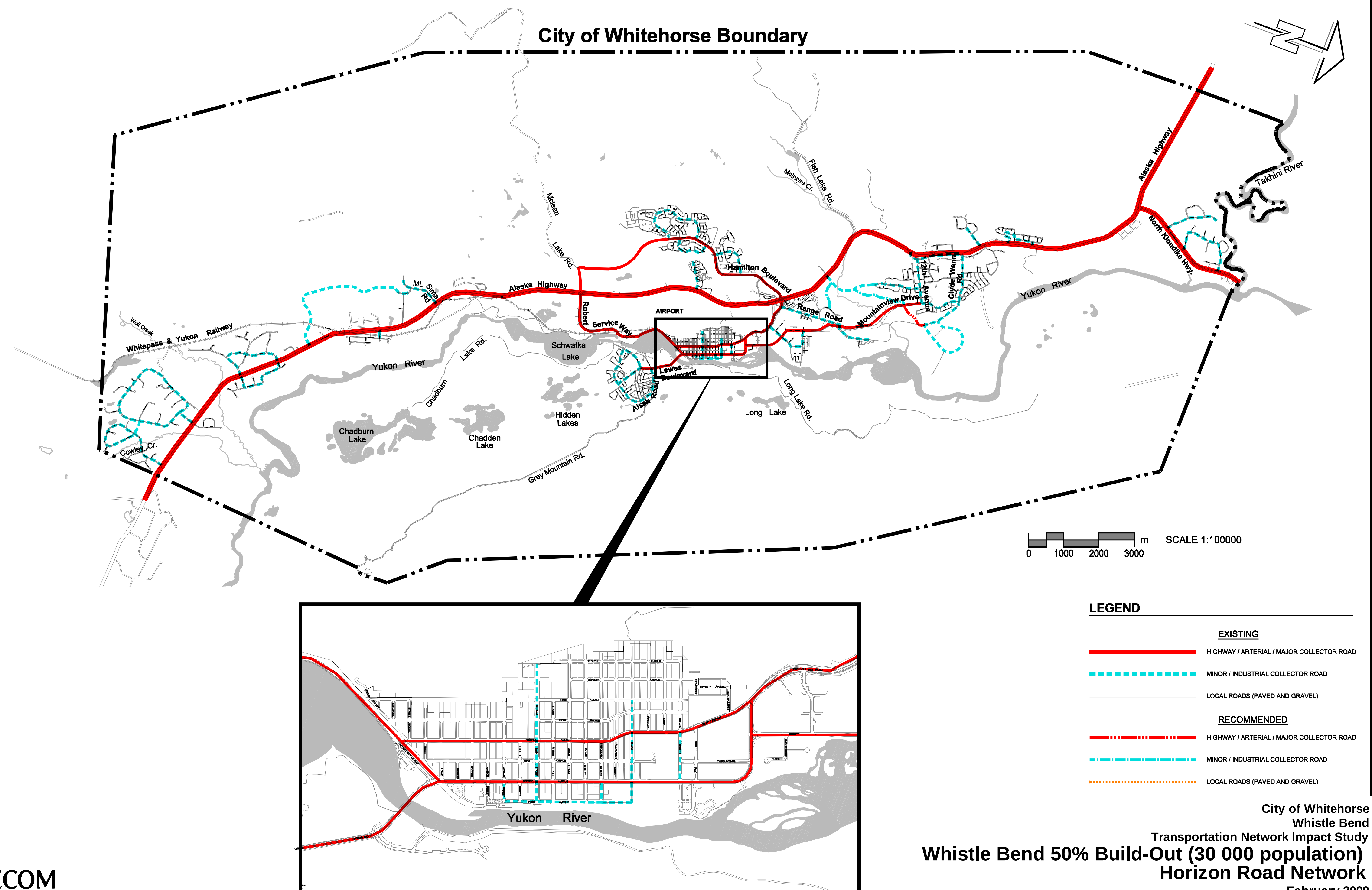
Major Road

- Alaska Highway Connector between Mountainview Drive and Pine Street Extension
- College Access Road Extension
- Whistle Bend Connector 4-lane widening

Intersection Improvements

- Mountainview Drive / Whistle Bend Connector Signalization and Geometric Improvement
- Range Road / Casca Boulevard Geometric Improvement
- Mountainview Drive Corridor Signalized Intersections Geometric Improvement
- Downtown Intersections Geometric Improvement
- 4th Avenue / Ogilvie Street Signal Optimization
- 2nd Avenue / 4th Avenue Signal Optimization *
- Alaska Highway / Robert Service Way Signal Optimization *

* Note: While the level of improvement provided by these signal optimizations is nominal, they are nonetheless included in the recommended network for consideration in improvement staging.



City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Whistle Bend 50% Build-Out (30 000 population)
Horizon Road Network

February 2009

Figure - 6.9

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Transit Service

- New Transit Line 7 (Whistle Bend) at a 17.5-minute headway
- Transit Line 5 (Takhini-College) Increase Frequency to a 17.5-minute headway

Afternoon peak hour volumes are demonstrated in Appendix F. Traffic operations are summarized at signalized intersections by movements in Appendix D.

6.4 100% Whistle Bend Build-out (35,000 population) Horizon

6.4.1 100% Whistle Bend Build-out Base Network (Sc.3651)

The 100% Whistle Bend Build-out base network (35,000 population) (Sc.3651) included those road improvement projects that are listed in the 50% Whistle Bend Build-out (30,000 population) Horizon Network. Additional improvements included in this horizon base network are identified below:

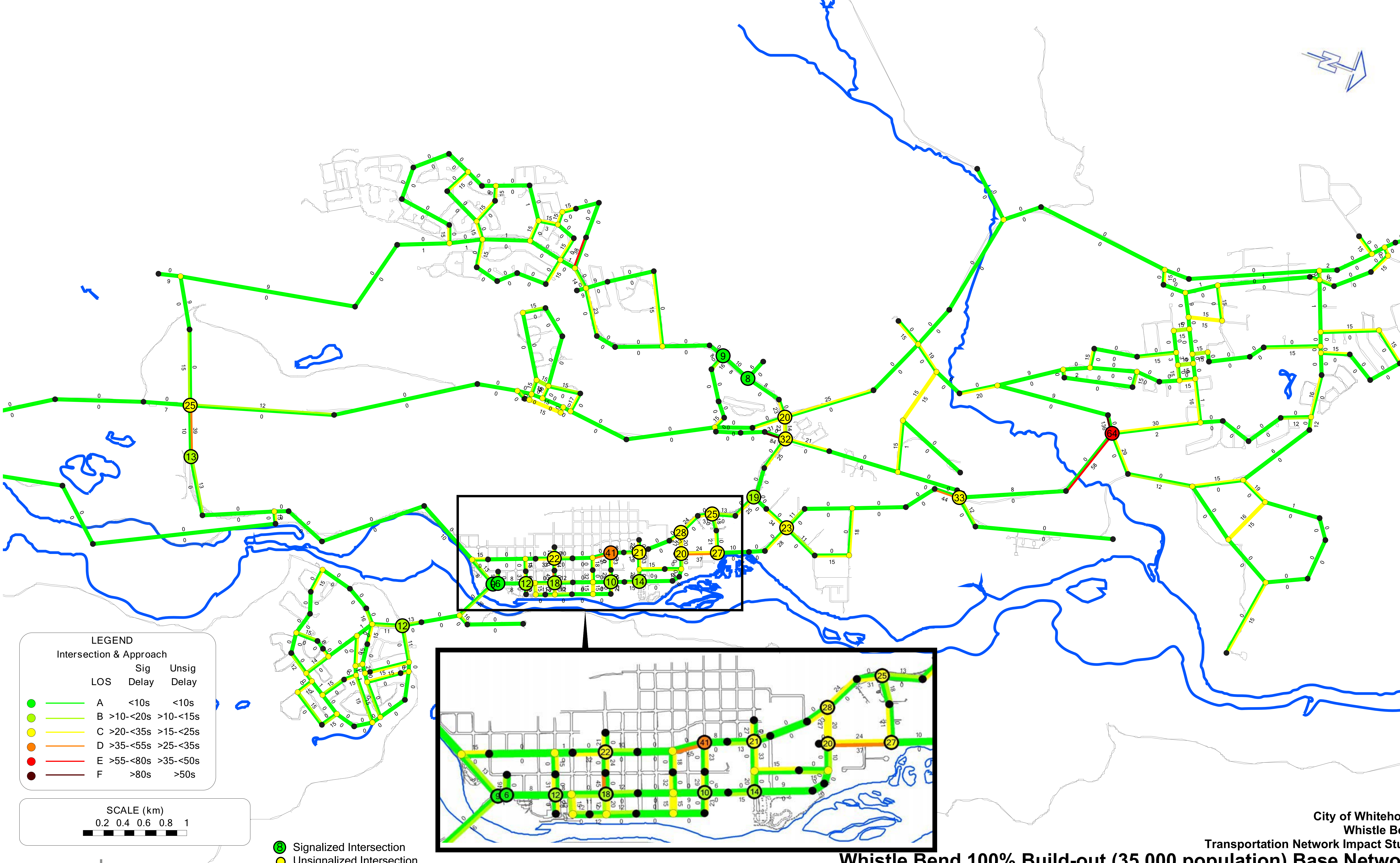
- Transit Line 4 (McIntyre – Logan – Granger) Increase Frequency to a 20-minute headway
- Transit Line 5 (Takhini-College) Increase Frequency to a 10-minute headway
- Transit Line 7 (Whistle Bend) Increase Frequency to a 10-minute headway
- Transit Lines 1-3, 6 Reduce Frequency to a 40-minute headway

To accommodate the increasing passenger load of Transit Line 4, the transit line requires frequency improvement to a 20-minute headway after a review of the passenger volumes and layover time. Results indicate that an increase in ridership of 156 passengers in the peak hour. To accommodate the increasing passenger load of the Transit Line 5 Extension and New Line 7, which services the developing neighbourhood of Whistle Bend, the transit lines require frequency improvement to a 10-minute headway after a review of the passenger volumes and layover time. Results indicate that an increase in ridership of 511 and 184 passengers in the peak hour for the two lines respectively. The remaining transit lines can reduce frequency to a 40-minute headway to maintain consistency at the common timed-transfer point on Ogilvie.

Traffic operation conditions with these improvements are demonstrated in Figure 6.10, and the impact on transit ridership is illustrated in Table 6.6.

Table 6.6 – 100% Whistle Bend Build-out Transit Ridership Comparison

Route	Name	Before Change	After Change	Percentage Change
1	Riverdale	139	116	-17%
2	Airport – Hillcrest – Lobird	132	132	0%
3	Porter Creek – Crestview	112	80	-29%
4	McIntyre – Logan – Granger	252	408	62%
5	Takhini – College	733	1242	69%
6	Porter Creek – Ponderosa	114	74	-35%
7	Whistle Bend	538	722	34%



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Whistle Bend
Transportation Network Impact Study

Whistle Bend 100% Build-out (35 000 population) Base Network Traffic Operation Conditions

September 2008

Figure - 6.10

6.4.2 Network Improvement Elements

The following network improvement elements were examined for the 100% Build-out horizon:

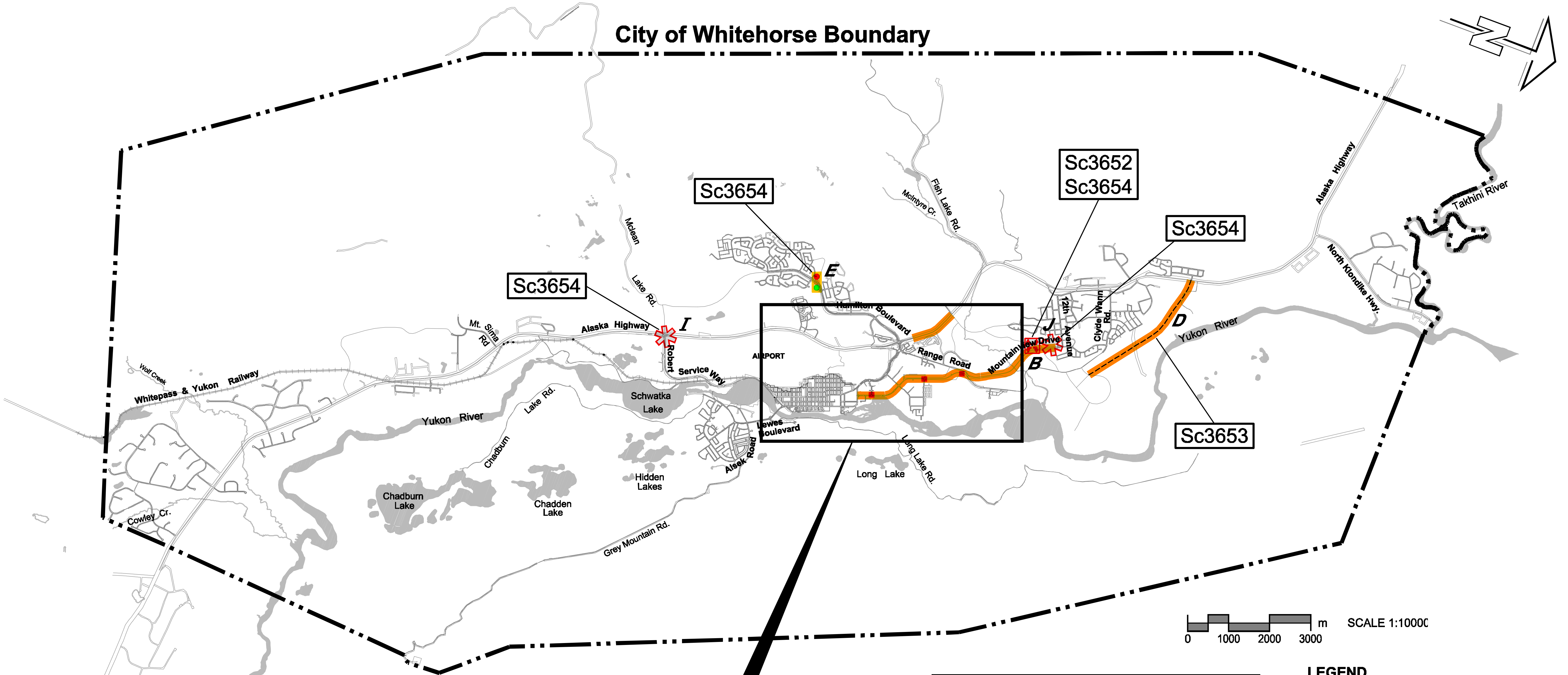
- Transit service improvements (transit lines frequency)
- Mountainview Drive corridor
- Mountainview Drive and Whistle Bend Connector intersection
- Alaska Highway and Prospector Road intersection
- Whistle Bend - Kathleen Road connection

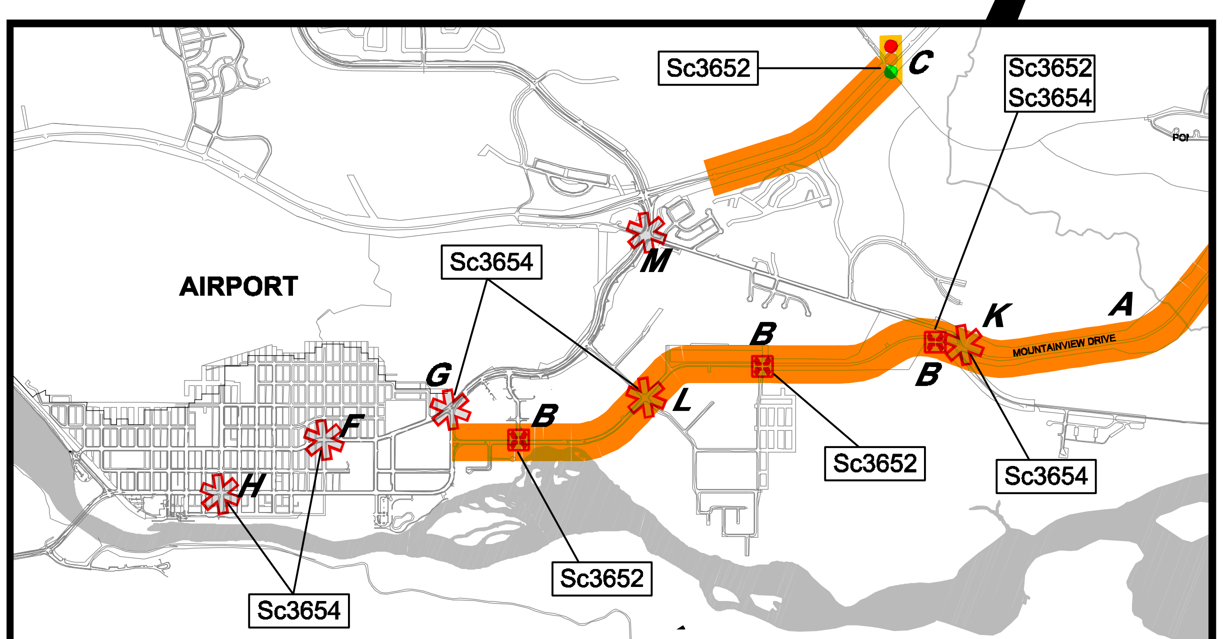
Each element's approximate location is illustrated in Figure 6.11. Similar to preceding horizons, an incremental approach of evaluating and retaining / discarding elements was employed resulting in a recommended horizon network.

A summary of the network evaluation results is provided in Table 6.7, with automobile travel times to and from Whistle Bend provided in Appendix E.

Table 6.7 – 100% Whistle Bend Build-out (35,000 population) Network Evaluation Summary

Horizon		Whistle Bend 100% Build-out (35,000 pop)				
Scenario		3650	3651	3652	3653	3654
Network Description		50% Whistle Bend Build-Out Recommended	+Transit Improve	+ Mountainview 4-lanes +Alaska / Prospector Sig	+Kathleen Ext	+ Hamilton / Arkell Sig +Sig opt
Is Traffic using the element		n/a	n/a	Mountainview Drive (Yes)	Nominal	n/a
Is there an increase in transit passengers		n/a	Line 4 (156) Line 5 (511) Line 7 (184)	n/a	n/a	n/a
Volumes NB or EB		n/a	n/a	Mountainview Drive (193)	66	n/a
Volumes SB or WB		n/a	n/a	Mountainview Drive (9)	102	n/a
Is there a shift from other corridors		n/a	n/a	Mountainview Drive (from WB Two Mile Hill & NB Alaska)	Nominal	n/a
Is there a shift to other corridors		n/a	n/a	Mountainview Drive (to NB Mountainview, Copper, Quartz, WB 2nd)	Nominal	n/a
Auto	Veh-Km	99515	99451	100013	99873	100131
	Veh-Hr	2235	2232	2164	2162	2149
	Mean Speed (kph)	44.5	44.5	46.2	46.2	46.6
Transit	Pers-Km	11574	14188	14275	14275	14310
	Pers-Hr	299	373	362	362	359
	Mean Speed (kph)	38.7	38.1	39.5	39.5	39.8
Recommendation		n/a	Retain	Retain	Eliminate	Retain





Analyzed Elements		
Scenario		Element
Sc 3652	A	Mountainview Drive
	B	Mountainview Drive Intersections
	C	Alaska Highway / Prospector Road
Sc 3653	D	Kathleen Road Extension
Sc 3654	E	Hamilton Boulevard / Arkell Access Road
	F	4th Avenue / Black Street
	G	2nd Avenue / 4th Avenue
	H	2nd Avenue / Main Street
	I	Alaska Highway / Robert Service Way
	J	Mountainview Drive / Whistle Bend Connector
	K	Mountainview Drive / Range Road
	L	Industrial Street / Quartz Road
	M	Range Road / Two Mile Hill

LEGEND

- EXISTING ROADS
- ROAD IMPROVEMENT ANALYZED
- NEW ROADS ANALYZED
- ROUNDABOUT
- SIGNALIZATION
- SIGNAL TIMING OPTIMIZATION
- GEOMETRIC IMPROVEMENT
- Sc3652 SCENARIO 3652

City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Whistle Bend 100% Build-Out (35 000 population) Horizon Network Elements Analyzed

February 2009

Figure - 6.11

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Details on each network option considered follow.

Mountainview Drive Corridor 4-lane Widening (Sc.3652)

To accommodate increasing traffic usage on the entire Mountainview Drive Corridor in the north-south directions, the entire corridor should be widened to 4 lanes between the Whistle Bend Connector and 2nd Avenue by 100% build-out. The model illustrates that some traffic will shift from westbound Two Mile Hill and northbound Alaska Highway, to westbound 2nd Avenue and northbound Quartz Road, Copper Road, and Mountainview Drive. Automobile travel time reduces approximately 2 minutes from Downtown to Whistle Bend. This option is retained in the recommended network.

Mountainview Drive Corridor Signalized Intersections Geometric Improvement (Sc.3652)

To accommodate increasing traffic usage and 4-lane widening of the Mountainview Drive Corridor, it is recommended that the number of through lanes in the north-south directions be increased at signalized intersections on the Mountainview Drive Corridor, namely Mountainview Drive at the Whistle Bend Connector, Mountainview Drive at Range Road, and Quartz Road at Chilkoot Way. A preliminary assessment of the volumes at Mountainview Drive / Whistle Bend Connector intersection suggests two dedicated free-flow northbound right turn lanes, and two westbound left turn lanes in advance phase. Results indicate that traffic operation for the intersection improves from LOS E (64s/veh delay) to LOS D (39s/veh delay). The dedicated southbound right turn lane at Mountainview Drive / Range Road is recommended to be converted to a shared through and right turn lane as required by the anticipated southbound traffic volumes in the morning peak hour. Quartz Road at Chilkoot Way will require an additional through lane in the north-south directions. Results indicate that traffic operation for the intersection improves from LOS C (27s/veh delay) to LOS A (10s/veh delay). Specifically, the northbound approach improves from LOS D (37s/veh delay) to LOS A (10s/veh delay). This option is retained in the recommended network.

Alaska Highway / Prospector Road Signalization and Geometric Improvement (Sc.3652)

To accommodate increasing northbound and westbound traffic volumes and delays at the currently stop-controlled intersection, especially for the northbound right turn and westbound left turn movements, it is recommended that this intersection be signalized by 100% build-out as warranted from a traffic volume perspective. A preliminary assessment of the volumes at the intersection suggests a dedicated northbound right turn lane with sufficient storage, a westbound left turn lane in split phase, and two southbound through lanes merging back to a single lane after the intersection. Signals will be required by the anticipated westbound left turn traffic volumes in the morning peak hour. This option is retained in the recommended network.

It should also be noted, that signalization of this location may be warranted earlier from a safety or network consistency perspective.

Kathleen Road Extension (Sc.3653)

The proposed extension of Kathleen Road connects Alaska Highway and Whistle Bend. An alignment has not been developed and it is only illustrated as a future extension in the Whistle Bend concept plan. The primary objective of this extension is to provide a secondary access for the Whistle Bend community to and from locations north of the City via Alaska Highway. However, traffic usage on Kathleen Road Extension, as well as travel time reductions for the neighbourhood are forecast to be nominal. This option is eliminated from further analysis.

Hamilton Boulevard / Arkell Access Road Signalization (Sc.3654)

While this location is at a significant distance from Whistle Bend, the increase in overall network volume which is destined for locations throughout the City result in increased volumes on such major facilities such as Hamilton Boulevard. To accommodate increasing northbound and southbound traffic volumes and eastbound stop-controlled delays, it is recommended that this intersection be signalized by 100%

build-out. Results indicate that traffic operation for the eastbound approach improves from LOS E (38s/veh delay) to LOS B (15s/veh delay). This option is retained in the recommended network.

4th Avenue / Black Street Signal Optimization (Sc.3654)

To accommodate increasing traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves from LOS D (41s/veh delay) to LOS D (36s/veh delay). Specifically, the northbound approach improves from LOS D (55s/veh delay) to LOS D (48s/veh delay). This option is retained in the recommended network.

2nd Avenue / 4th Avenue Signal Optimization (Sc.3654)

To accommodate increasing traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection nominally improves from LOS C (28s/veh delay) to LOS C (25s/veh delay). This option is retained in the recommended network.

2nd Avenue / Main Street Signal Optimization (Sc.3654)

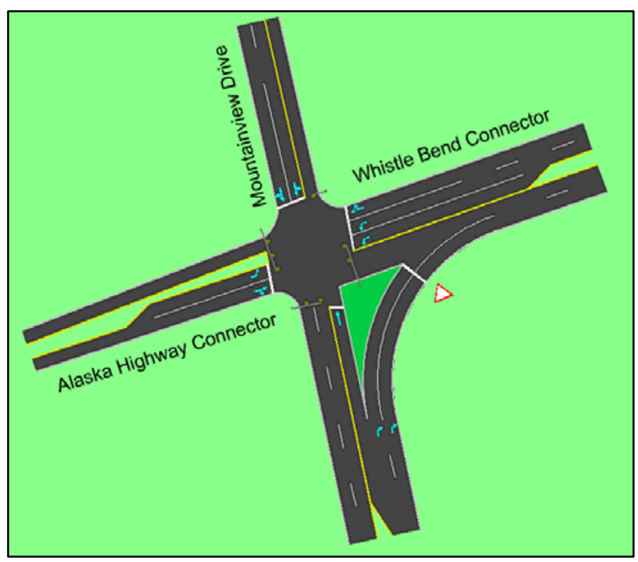
To accommodate increasing traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized.. This option is retained in the recommended network, as it is required to mitigate operational issues resulting from other project synergies such as the additional diversion of traffic on Mountainview Drive due to widening and improvements.

Alaska Highway / Robert Service Way Signal Optimization (Sc.3654)

To accommodate increasing traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves from LOS C (25s/veh delay) to LOS B (19s/veh delay). Specifically, the westbound approach improves from LOS D (39s/veh delay) to LOS C (25s/veh delay). This option is retained in the recommended network.

Mountainview Drive / Whistle Bend Connector Geometric Improvement and Signal Optimization (Sc.3654)

To accommodate increasing southbound traffic volumes and delays at the currently signalized intersection, the southbound approach should include two shared through lanes as illustrated below. It is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves from LOS E (64s/veh delay) to LOS D (37s/veh delay). This option is retained in the recommended network.



Mountainview Drive / Range Road Geometric Improvement and Signal Optimization (Sc.3654)

To accommodate increasing northbound and eastbound traffic volumes and delays at the currently signalized intersection, eastbound and westbound shared through and left turn lanes should be converted to dedicated left turn lanes while dedicated right turn lanes in the same approaches should be converted to shared through and right turn lanes. It is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection remains static with the additional diversion of traffic from the Mountainview

Drive widening and improvements following optimization. Specifically, the northbound approach improves from LOS D (44s/veh delay) to LOS D (39s/veh delay). This option is retained in the recommended network.

Industrial Street / Quartz Road Signal Optimization (Sc.3654)

To accommodate increasing traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. This option is retained in the recommended network as it is required to mitigate operation issues resulting from the additional diversion of traffic on the Mountainview Corridor resulting from the widening and intersection improvements.

Range Road / Two Mile Hill Signal Optimization (Sc.3654)

To accommodate increasing traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves from LOS C (32s/veh delay) to LOS C (23s/veh delay). Specifically, the northbound approach improves from LOS F (84s/veh delay) to LOS D (40s/veh delay). This option is retained in the recommended network.

6.4.3 100% Whistle Bend Build-out (35,000 population) Horizon Network (Sc.3654)

As illustrated in Figure 6.12, the Whistle Bend 100% Build-out (35,000 population) Horizon Network incorporates the following improvements to the road network, recommended to support the full development population threshold:

Major Road

- Mountainview Drive Corridor 4-lane Widening

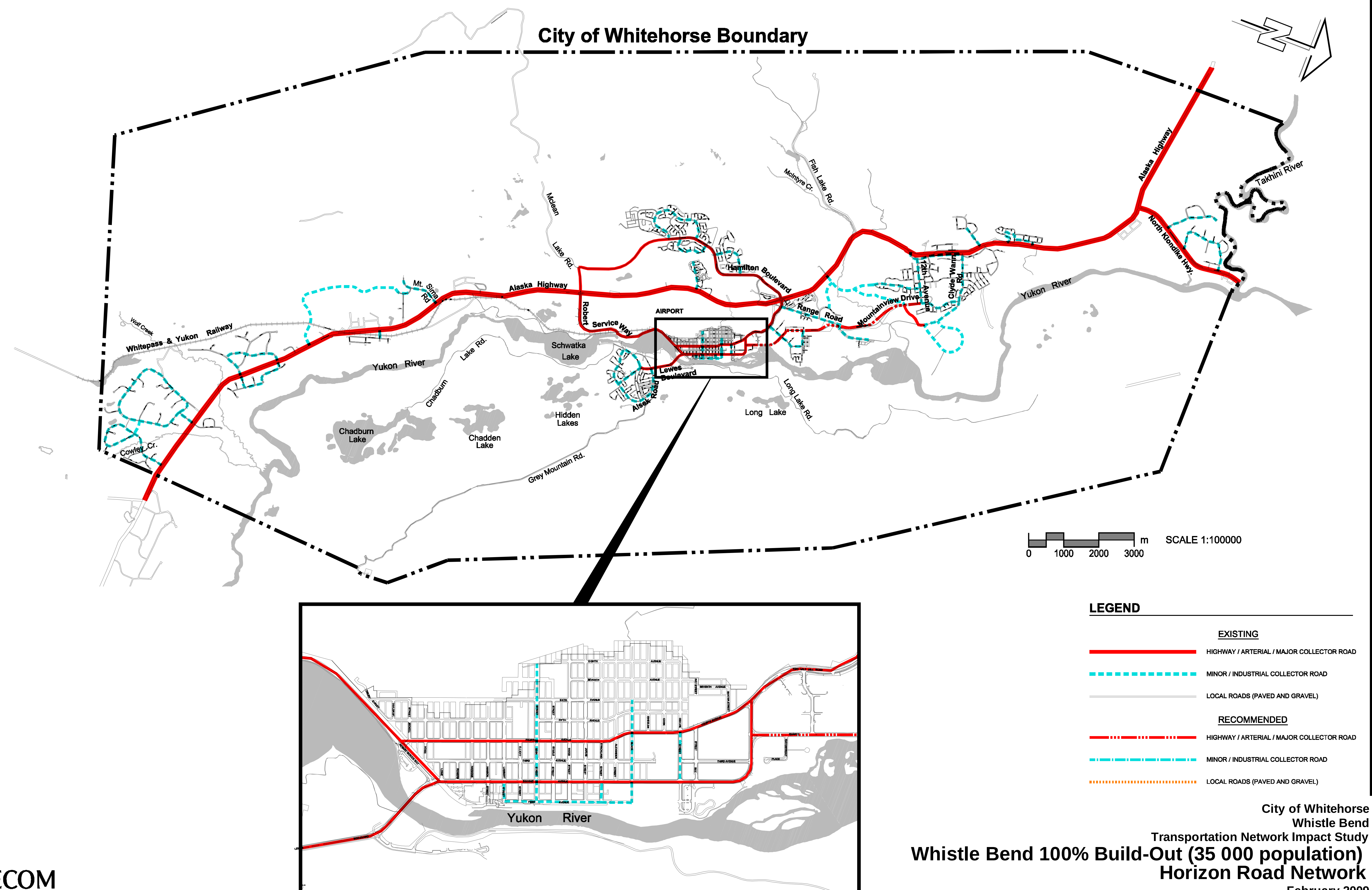
Intersection Improvements

- Mountainview Drive Corridor Signalized Intersections Geometric Improvement
- Alaska Highway / Prospector Road Signalization and Geometric Improvement
- Hamilton Boulevard / Arkell Access Road Signalization
- 4th Avenue / Black Street Signal Optimization
- 2nd Avenue / 4th Avenue Signal Optimization
- 2nd Avenue / Main Street Signal Optimization
- Alaska Highway / Robert Service Way Signal Optimization
- Mountainview Drive / Whistle Bend Connector Geometric Improvement and Signal Optimization
- Mountainview Drive / Range Road Geometric Improvement and Signal Optimization
- Industrial Street / Quartz Road Signal Optimization
- Range Road / Two Mile Hill Signal Optimization

Transit Service

- Transit Line 4 Increase Frequency to a 20-minute headway
- Transit Line 5 Increase Frequency to a 10-minute headway
- Transit Line 7 Increase Frequency to a 10-minute headway
- Transit Lines 1-3, 6 Reduce Frequency to a 40-minute headway

Traffic operations are summarized at signalized intersections by movements in Appendix D and afternoon peak hour volumes are demonstrated in Appendix F.



LEGEND

EXISTING

HIGHWAY / ARTERIAL / MAJOR COLLECTOR ROAD

MINOR / INDUSTRIAL COLLECTOR ROAD

LOCAL ROADS (PAVED AND GRAVEL)

RECOMMENDED

HIGHWAY / ARTERIAL / MAJOR COLLECTOR ROAD

MINOR / INDUSTRIAL COLLECTOR ROAD

LOCAL ROADS (PAVED AND GRAVEL)

City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Whistle Bend 100% Build-Out (35 000 population)
Horizon Road Network

February 2009

Figure - 6.12

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7.0 Alternative Transportation

As one of the major focus elements of the new community at Whistle Bend is sustainability, consideration was given to non-vehicular travel between Whistle Bend and the rest of Whitehorse. Through the modelling work program, transit as a viable alternative mode was developed both as a network test element, and as well as a recommended program component at various horizon stages.

With the anticipated growth in Whitehorse's population, particularly in the northern sections of town, an upgrading of the transit route servicing existing and emerging neighbourhoods is expected. In the medium term (population threshold of 25,000), the provision of transit service via an extension of an existing transit line (No 5 Takhini-College) was recommended as the most effective and affordable means of serving the growing population.

As the growth of Whistle Bend approaches 50% build-out, increased transit service is required to maintain market-share and provide efficient service to transit users. This includes a new transit line serving Porter Creek neighbourhoods as well as an increase in transit frequency [i.e., increased headways for Transit Line No 5 (Takhini -College)].

With the full development of Whistle Bend, the opportunity exists to improve service on various transit lines by increasing headways for those with an increase in passenger loads, and a decrease in headway for those with reduced passenger volumes. This includes an increase in frequency for transit lines No 4 (McIntyre-Logan-Granger), No 5 (Takhini-College), and No 7 (Whistle Bend).

Additional transit service may be provided through clean diesel or hybrid bus technologies for a more sustainable approach. A review of transit technologies and costs for the two options suggests that the estimated capital cost to purchase each vehicle type is as follows[9]:

- Clean Diesel $425,000
- Hybrid $650,000

Clean diesel is the most recent version of diesel engine technology, which is the standard type of technology used in transit fleets throughout North America. These engines contribute to lower emissions through technologies that combine the power and greater fuel efficiency of diesel engines with diesel emission reduction strategies, such as the use of ultra-low sulphur fuel, and post combustion technologies that capture some of the emissions prior to expulsion via the tailpipe. These engines, estimated to get an average of 35% greater fuel efficiency than an equivalent gasoline engine, comply with 2007 Transport Canada standards for diesel emissions[9].

The hybrid bus options combine electric and diesel technologies whereby power is generated via a battery pack for some of the operating needs, and supplemented by diesel power for the remainder of the time. While the hybrid option offers the best overall emission reduction opportunity, the initial capital costs are significantly higher than the diesel convention.

[9] City of Edmonton Transit Vehicle (Trolley) Technology Review, May 7, 2008.
http://edmonton.ca/transportation/transit/VehicleTechnologyReview_AdministrativeReport.pdf

The community of Whistle Bend may also be serviced by other alternative modes such as bicycling and pedestrian facilities. However, given the distance between the neighbourhood and major areas of employment such as downtown, it is not expected that these modes would be viable commuter options, save as means of connecting to transit or shared modes such as carpooling. In addition, the natural topography renders non-motorized commuter travel difficult; however, as a recreation means, both cycling and walking offer excellent forms of active transportation.

8.0 Sensitivity Analysis

To assist the City in further defining the staging sensitivities of improvements, two scenarios were developed for testing as follows:

- 50% Whistle Bend Build-out Recommended Network with no Pine Street Extension and Alaska Highway Connector
- 75% Whistle Bend Build-out (32,500 population) Horizon

The first scenario was developed to test the timing and requirement for the two network improvements (Pine Street Extension and Alaska Highway Connector). The 75% Whistle Bend build-out scenario was developed to support the development requirements for the 50% and 100% build-out scenarios, as well as a sensitivity for development requirements should Whistle Bend not develop to the anticipated 10,000 build-out.

Additionally a high level analysis and signalization strategy was conducted for the main access of Whistle Bend to ascertain if the AM (morning) peak hour condition may precipitate the need for signalization at an earlier point than the PM condition.

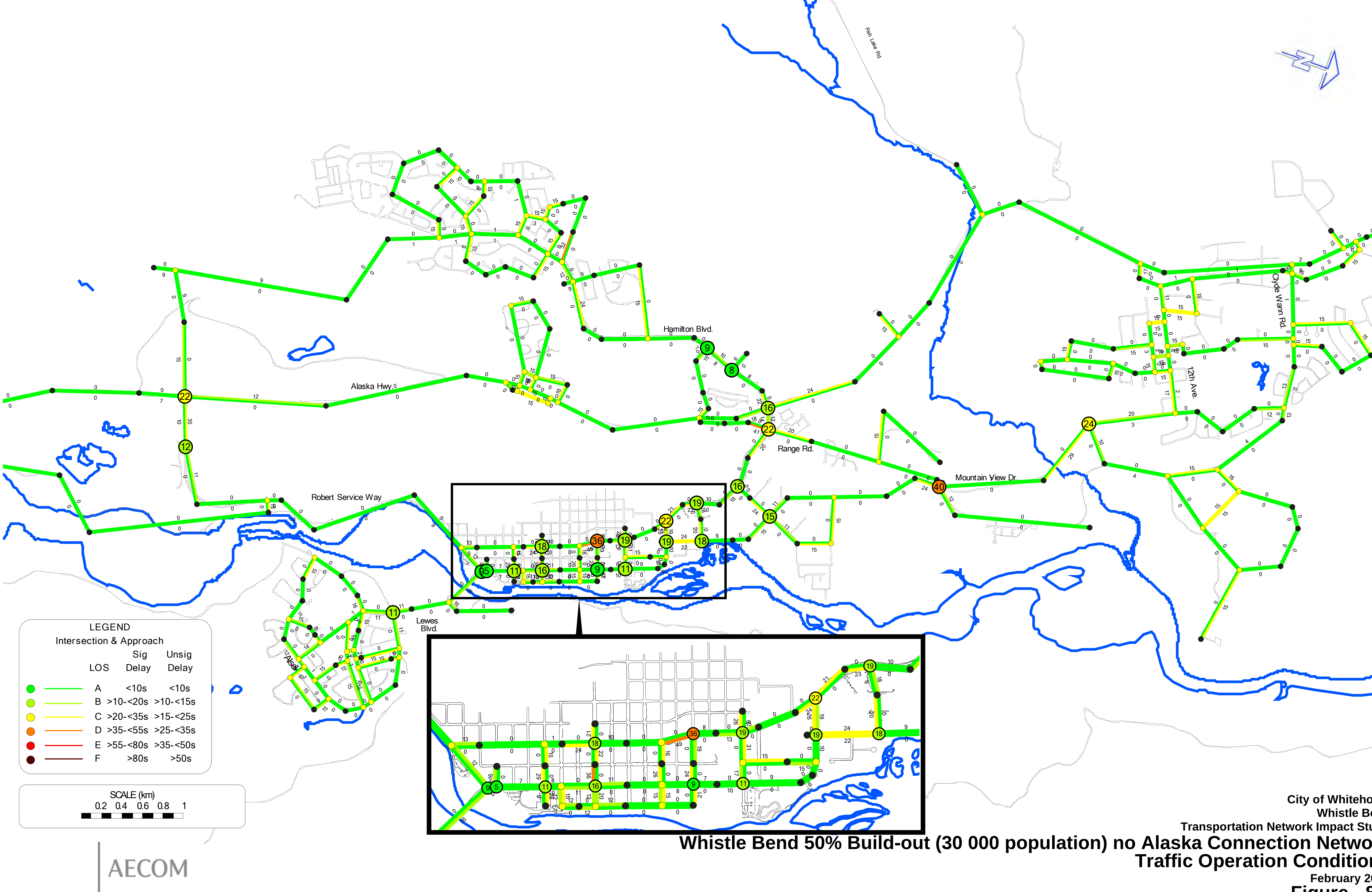
8.1 50% Whistle Bend Build-out Recommended Network – no Pine Street Extension and Alaska Highway Connector (Sc.3604)

The network scenario (Sc.3604) included those road improvement projects that are listed in the 50% Whistle Bend Build-out (30,000 population) Horizon Network, but with no construction of Pine Street Extension and Alaska Highway Connector. This network was designed to test sensitivity of this proposed connection between Alaska Highway and Mountainview Drive in order to:

- Demonstrate the effect of no construction
- Demonstrate the benefits of the connection
- Justify the need and timing of requirements
- Make recommendations for construction staging

A volume comparison of the two scenarios (Pine Street Extension and Alaska Highway Connector no-build versus build) illustrates that an increase in traffic volumes on Pine Street, 12th Avenue, Mountainview Drive, Range Road and Alaska Highway. The increased traffic puts pressure on the road network, increases travel times for both neighbourhoods, and deteriorates traffic operations at the two major intersections heading to Whistle Bend. At Mountainview Drive and Range Road, in particular, the high northbound through and eastbound left turn traffic volumes result in delays with LOS C and F respectively. Traffic operation conditions are demonstrated in Figure 8.1.

On the other hand, with the construction of the connection, it is shown that 220 vph will use the Pine Street Extension to reach Porter Creek, and 330 vph will use the connection to reach Whistle Bend by the 50% build-out. Although it does not attract as high volume as Mountainview Drive, the connection will be an alternative route to share the load on Mountainview Drive for what could have been the only viable route to Whistle Bend from the south. Thus, there are significant user benefits associated with the connection, with a reduction in network travel time of 35 veh-hr or 1.8% and a reduction in vehicle distance travelled of 440 veh-km or 0.5%. The connector will benefit both Porter Creek and Whistle Bend at 50% build-out and will have a greater benefit to Whistle Bend beyond 50% build-out.



City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Whistle Bend 50% Build-out (30 000 population) no Alaska Connection Network
Traffic Operation Conditions

February 2009

Figure - 8.1

In light of the preceding, the entire connection should be in place by 50% build-out. However, the Pine Street Extension should be considered to be staged earlier in the medium term because the benefit to the Porter Creek community exists long before its contribution to Whistle Bend. It is later when there is enough development in Whistle Bend that the Alaska Highway Connector is required. It should be noted that after all, the entire connection will be driven by Whistle Bend development. Without Whistle Bend development the connection would not be necessary

8.2 75% Whistle Bend Build-out (32,500 population) Horizon

This scenario was developed to support the development requirements for the 50% and 100% build-out scenarios, as well as a sensitivity test for development requirements should Whistle Bend not reach the anticipated development threshold of 10,000 people at full build-out.

8.2.1 75% Whistle Bend Build-out Base Network (Sc.3621)

The 75% Whistle Bend Build-out base network (32,500 population) (Sc.3621) included those road improvement projects that are listed in the 50% Whistle Bend Build-out (30,000 population) Horizon Network. Additional improvements included in this horizon base network are identified below:

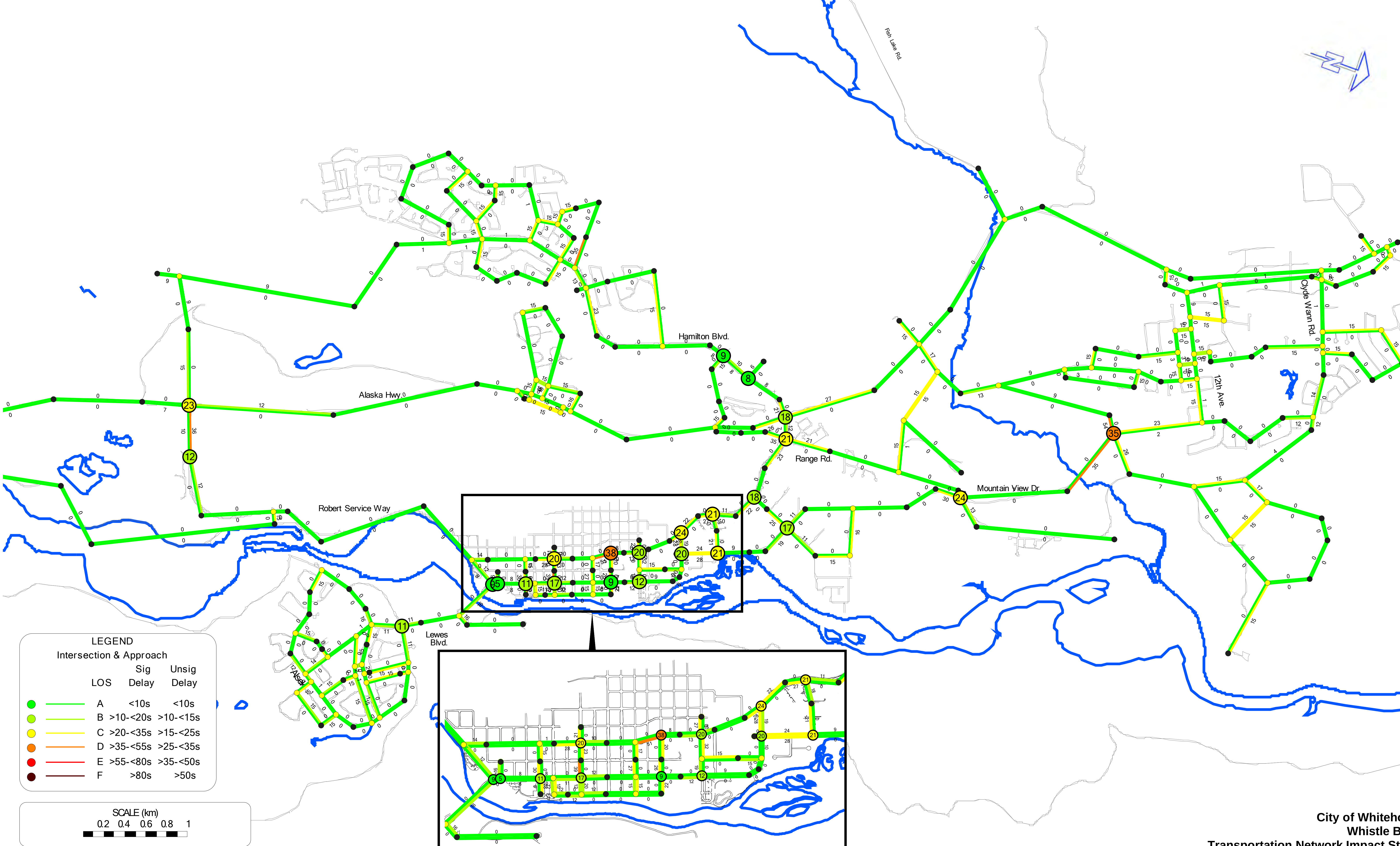
- Transit Line 4 (McIntyre – Logan – Granger) Increase Frequency to a 20-minute headway
- Transit Line 5 (Takhini-College) Increase Frequency to a 10-minute headway
- Transit Line 7 (Whistle Bend) Increase Frequency to a 10-minute headway
- Transit Lines 1-3, 6 Reduce Frequency to a 40-minute headway

To accommodate the increasing passenger load of Transit Line 4, the transit line requires frequency improvement to a 20-minute headway after a review of the passenger volumes and layover time. Results indicate that an increase in ridership of 152 passengers in the peak hour. To accommodate the increasing passenger load of the Transit Line 5 Extension and New Line 7, which services the developing neighbourhood of Whistle Bend, the transit lines require frequency improvement to a 10-minute headway after a review of the passenger volumes and layover time. Results indicate that an increase in ridership of 456 and 160 passengers in the peak hour for the two lines respectively. The remaining transit lines can reduce frequency to a 40-minute headway to maintain consistency at the common timed-transfer point on Ogilvie.

Traffic operation conditions with these improvements are demonstrated in Figure 8.2, and the impact on transit ridership is illustrated in Table 8.1.

Table 8.1 – 75% Whistle Bend Build-out Transit Ridership Comparison

Route	Name	Before Change	After Change	Percentage Change
1	Riverdale	137	113	-18%
2	Airport – Hillcrest – Lobird	124	122	-2%
3	Porter Creek – Crestview	110	78	-29%
4	McIntyre – Logan – Granger	235	387	65%
5	Takhini – College	632	1088	72%
6	Porter Creek – Ponderosa	109	72	-34%
7	Whistle Bend	455	615	35%



AECOM

City of Whitehorse
Whistle Bend
Transportation Network Impact Study

Whistle Bend 75% Build-out (32 500 population) Base Network Traffic Operation Conditions

February 2009

Figure - 8.2

8.2.2 Network Improvement Elements

The following network improvement elements were examined for the 75% Build-out horizon:

- Transit service improvements (transit lines frequency)
- Mountainview Drive corridor
- Alaska Highway and Prospector Road intersection

Similar to the methodology taken for the main study, an incremental approach of evaluating and retaining / discarding elements was employed resulting in a recommended horizon network.

A summary of the network evaluation results is provided in Table 8.2.

Table 8.2 – 75% Whistle Bend Build-out (32,500 population) Network Evaluation Summary

Horizon		Whistle Bend 75% Build-out (32,500 pop)			
Scenario		3620	3621	3622	3623
Network Description		copy of 3603	+Transit Improve	+Mountainview 4-lanes to Range	+Hamilton/Arkell Sig +Sig opt
Is Traffic using the element		n/a	n/a	Mountainview Drive (Yes)	n/a
Is there an increase in transit passengers		n/a	Line 4 (150) Line 5 (460) Line 7 (160)	No	n/a
Volumes NB or EB		n/a	n/a	Nominal	n/a
Volumes SB or WB		n/a	n/a	Nominal	n/a
Is there a shift from other corridors		n/a	n/a	Nominal	n/a
Is there a shift to other corridors		n/a	n/a	Nominal	n/a
Auto	Veh-Km	95654	94602	94654	94628
	Veh-Hr	1845	2475	2486	2485
	Mean Speed (kph)	46.6	47.1	47.3	47.3
Transit	Pers-Km	10137	12393	12455	12448
	Pers-Hr	253	315	314	314
	Mean Speed (kph)	40.0	39.4	39.6	39.6
Recommendation		n/a	Retain	Retain	Retain

Details on each network option considered follow.

Mountainview Drive 4-lane Widening Between Range Road and Whistle Bend Connector (Sc.3622)

To accommodate increasing traffic usage on Mountainview Drive in the north-south directions, the corridor should be widened to 4 lanes between Whistle Bend Connector and Range Road by 75% build-out. The model illustrates that some traffic will shift from northbound Alaska Highway, and Alaska Highway Connector, to northbound Range Road, and Mountainview Drive. Automobile travel time reduces approximately 1 minute from Downtown to Whistle Bend. This option is retained in the recommended network.

Alaska Highway / Prospector Road Signalization (Sc.3623)

To accommodate increasing northbound and westbound traffic volumes and delays at the currently stop-controlled intersection, especially for the northbound right turn and westbound left turn movements, it is recommended that this intersection be signalized by 75% build-out. A preliminary assessment of the volumes at the intersection suggests a dedicated northbound right turn lane with sufficient storage, and a westbound left turn lane. Signals will be required by the anticipated westbound left turn traffic volumes in the morning peak hour. This option is retained in the recommended network.

Hamilton Boulevard / Arkell Access Road Signalization (Sc.3623)

To accommodate increasing northbound and southbound traffic volumes and eastbound stop-controlled delays, it is recommended that this intersection be signalized by 75% build-out. Results indicate that traffic operation for the eastbound approach improves from LOS E (35s/veh delay) to LOS B (14s/veh delay). This option is retained in the recommended network.

4th Avenue / Black Street Signal Optimization (Sc.3623)

To accommodate increasing traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves from LOS D (38s/veh delay) to LOS D (35s/veh delay). Specifically, the northbound approach improves from LOS D (51s/veh delay) to LOS D (46s/veh delay). This option is retained in the recommended network.

2nd Avenue / 4th Avenue Signal Optimization (Sc.3623)

To accommodate increasing traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves from LOS C (26s/veh delay) to LOS C (24s/veh delay). This option is retained in the recommended network.

Alaska Highway / Robert Service Way Signal Optimization (Sc.3623)

To accommodate increasing traffic volumes and delays at the currently signalized intersection, it is recommended that signal phasing be revised and signal timing be optimized. Results indicate that traffic operation for the intersection improves from LOS C (23s/veh delay) to LOS B (18s/veh delay). Specifically, the westbound approach improves from LOS D (37s/veh delay) to LOS C (24s/veh delay). This option is retained in the recommended network.

8.2.3 75% Whistle Bend Build-out (32,500 population) Horizon Network (Sc.3623)

The Whistle Bend 75% Build-out (32,500 population) Horizon Network incorporates the following improvements to the road network:

Major Road

- Mountainview Drive 4-lane Widening Between Range Road and Whistle Bend Connector

Intersection Improvements

- Alaska Highway / Prospector Road Signalization
- Hamilton Boulevard / Arkell Access Road Signalization
- 4th Avenue / Black Street Signal Optimization
- 2nd Avenue / 4th Avenue Signal Optimization
- Alaska Highway / Robert Service Way Signal Optimization

Transit Service

- Transit Line 4 Increase Frequency to a 20-minute headway
- Transit Line 5 Increase Frequency to a 10-minute headway
- Transit Line 7 Increase Frequency to a 10-minute headway
- Transit Lines 1-3, 6 Reduce Frequency to a 40-minute headway

Afternoon peak hour volumes are demonstrated in Appendix F.

8.2.4 Signalization of Whistle Bend Connector

At the Mountainview Drive and Whistle Bend Connector intersection, the network evaluation and modelling work indicated that based on the PM peak hour volumes, signalization would be warranted at 50% Build-out of Whistle Bend to accommodate heavy PM peak hour volumes.

Sensitivity analysis was conducted to review the potential AM peak hour condition as this may precipitate signalization at an earlier point in time. This analysis was based on AM Peak hour volumes developed by applying a conversion factor based on the relationship of AM to PM peak hour volumes at existing locations throughout the City of Whitehorse. SYNCHRO analysis and TAC's Traffic Signal Warrant Matrix Protocol was applied to these locations with the following results.

At the 10% Build-out, the AM peak hour volumes result in an overall average intersection delay of 14.7 seconds; however the outbound movement (westbound left) experiences heavy delays and queuing resulting from the dominant westbound left movement. The approach control delay of 35 seconds and associated LOS E suggest that signalization may be warranted for the morning peak hour.

The review of the TAC Traffic Signal Warrant Matrix Protocol concurs that assuming average 6-hour volumes and nominal pedestrian activity[10] at this location, a signal will be warranted by the 10% Build-out to service movements adequately.

[10] Nominal pedestrian activity of 5 pedestrians/approach per hour was assumed at this location.

9.0 Timing of Improvements

This section provides recommendations based on the likely timing (Staging priorities) and preliminarily cost estimates for improvement related to the Whistle Bend development.

9.1 Timing of Improvements

9.1.1 Timing of Major Road Improvements

Based on the recommended network from each horizon and the sensitivity analysis, major road improvements are suggested to follow the timing listed below:

- Whistle Bend Connector (by Short-term (2,000 population threshold) to accommodate a new access to whistle Bend to coincide with lot availability)
- Pine Street Extension to Alaska Highway (after Medium-term (25,000 population threshold) but in advance of 50% build-out of Whistle Bend)
- Alaska Highway Connector (by 50% build-out of Whistle Bend)
- College Road Access Extension (by 50% build-out of Whistle Bend)
- Whistle Bend Connector 4-lane widening (by 50% build-out of Whistle Bend)
- Mountainview Drive Corridor 4-lane Widening (by 100% build-out of Whistle Bend)

9.1.2 Timing of Intersection Improvements

Based on the recommended network for each horizon and the sensitivity analysis, intersection improvements are suggested to follow the timing listed below:

- Industrial Road / Two Mile Hill Signalization [by Short-term (24,000 population threshold)]
- Range Road / Two Mile Hill Geometric Improvement [by Short-term (24,000 population threshold)]
- 4th Avenue / Ogilvie Street Signal Optimization [by Short-term (24,000 population threshold)]
- Mountainview Drive / Whistle Bend Connector Signalization and Geometric Improvement (by Medium-term (25,000 population threshold))
- Range Road / Casca Boulevard Geometric Improvement (by 50% build-out of Whistle Bend)
- Mountainview Drive Corridor Intersections Geometric Improvement (by 50% build-out of Whistle Bend)
- Downtown Intersections Geometric Improvement (by 50% build-out of Whistle Bend)
- 4th Avenue / Ogilvie Signal Optimization (by 50% build-out of Whistle Bend)
- 2nd Avenue / 4th Avenue Signal Optimization (by 50% build-out of Whistle Bend)
- Alaska Highway / Robert Service Way Signal Optimization (by 50% build-out of Whistle Bend)
- Mountainview Drive Corridor Signalized Intersections Geometric Improvement (by 100% build-out of Whistle Bend)
- Alaska Highway / Prospector Road Signalization and Geometric Improvement (by 100% build-out of Whistle Bend)
- Hamilton Boulevard / Arkell Access Road Signalization (by 100% build-out of Whistle Bend)

- 4th Avenue / Black Street Signal Optimization (by 100% build-out of Whistle Bend)
- 2nd Avenue / 4th Avenue Signal Optimization (by 100% build-out of Whistle Bend)
- 2nd Avenue / Main Street Signal Optimization (by 100% build-out of Whistle Bend)
- Alaska Highway / Robert Service Way Signal Optimization (by 100% build-out of Whistle Bend)
- Mountainview Drive / Whistle Bend Connector Signal Optimization (by 100% build-out of Whistle Bend)
- Mountainview Drive / Range Road Signal Optimization (by 100% build-out of Whistle Bend)
- Industrial Street / Quartz Road Signal Optimization (by 100% build-out of Whistle Bend)
- Range Road / Two Mile Hill Signal Optimization (by 100% build-out of Whistle Bend)

9.1.3 Timing of Transit Service Improvements

In addition to the road network improvements, it is recommended that the following options be investigated for improving the transit network:

- Transit Line 5 Extension (by Medium-term (25,000 population threshold))
- New Transit Line 7 at a 17.5-minute headway (by 50% build-out of Whistle Bend)
- Transit Line 5 Increase Frequency to a 17.5-minute headway (by 50% build-out of Whistle Bend)
- Transit Line 4 Increase Frequency to a 20-minute headway (by 100% build-out of Whistle Bend)
- Transit Line 5 Increase Frequency to a 10-minute headway (by 100% build-out of Whistle Bend)
- Transit Line 7 Increase Frequency to a 10-minute headway (by 100% build-out of Whistle Bend)
- Transit Lines 1-3, 6 Reduce Frequency to a 40-minute headway (by 100% build-out of Whistle Bend)

These recommendations are based on good transit practices of providing regular service, expanding into unserviced and developing areas, and taking advantage of new road construction.

9.1.4 Order of Magnitude Costing of Improvements

To assist the City in planning for the various recommended road and intersection improvements, preliminary cost estimates were prepared for each element based on local construction unit rates. Where signal timing optimization was recommend, no costs are provided as the improvements do not include capital costs. These order of magnitude costs based on City-wide development information (surface costs only), account for capital costs (clearing, grubbing, grading, and paving), but not property acquisition, engineering and planning costs nor contingencies. A summary of the costs by element and horizon are illustrated in Table 9.1, with details included in Appendix G.[11]

The intersection improvement at Hamilton Boulevard and Arkell Access Road were included in the recommended network, but were not put forward for cost estimation given the distance of the site to the development.

Table 9.1 – Cost Estimate of Recommended Road and Intersection Improvements

Horizon / Network Element Breakdown	Item	Cost
Short-term (24,000 pop)		
Industrial Road / Two Mile Hill		
Signalize Intersection	Signalize Intersection	$250,000
Range Road / Two Mile Hill		
NBR Lane	Auxiliary Lane (Urban)	$50,000
4th Avenue / Ogilvie Street	Signal timing improvement, no capital cost	
Whistle Bend Connector to Mountainview		
New Roadway	New Roadway (Rural)	$1,770,000
	Sub-Total	$2,070,000
Medium-term (25,000 pop)		
Pine Street Extension		
New Roadway	New Roadway (Rural)	$6,910,000
Whistle Bend Connector		
Signalize Intersection	Signalize Intersection	$350,000
	Sub-Total	$7,260,000
Whistle Bend 50% Build-out (30,000 pop)		
Alaska Highway Connector		
New Roadway	New Roadway (Rural)	$5,390,000
New Roundabout	New Roundabout	$270,000
College Access Road		
New Roadway	New Roadway (Rural)	$2,400,000
Whistle Bend Connector		
Road Widen	Auxiliary Lane (Rural)	$2,010,000
Mountainview Drive / Whistle Bend Connector		
Road Widen	Auxiliary Lane (Rural)	$1,360,000
EBL Lane	Auxiliary Lane (Rural)	$100,000
WBL Lane	Auxiliary Lane (Rural)	$100,000
SBR Lane	Auxiliary Lane (Rural)	$60,000
Range Road / Casca Boulevard		
Mountainview Drive Corridor Intersections		
Mountainview/Range NB Acceleration Lane	Auxiliary Lane (Rural)	$100,000
Quartz/Industrial NB Acceleration Lane	Auxiliary Lane (Urban)	$50,000
Quartz/Industrial SB Acceleration Lane	Auxiliary Lane (Urban)	$50,000
Downtown Intersections		
4th/Black NBR Lane	Auxiliary Lane (Urban)	$70,000
4th/Black SBR Lane	Auxiliary Lane (Urban)	$70,000
4th/Main NBR Lane	Auxiliary Lane (Urban)	$70,000
4th/Main SBR Lane	Auxiliary Lane (Urban)	$70,000
4th Avenue / Ogilvie Street	Signal timing improvement, no capital cost	
2nd Avenue / 4th Avenue	Signal timing improvement, no capital cost	
Alaska Highway / Robert Service Way	Signal timing improvement, no capital cost	
	Sub-Total	$12,170,000
Whistle Bend 100% Build-out (35,000 pop)		
Mountainview Drive 4-lane		
Road Widen	Auxiliary Lane (Urban)	$1,890,000
Road Widen	Auxiliary Lane (Rural)	$6,580,000
Mountainview Drive Intersections		
Mountainview / Range SB Acceleration Lane	Auxiliary Lane (Rural)	$200,000
Alaska Highway / Prospector Road		
Signalize Intersection	Signalize Intersection	$350,000

Horizon Network Element Breakdown	Item	Cost
EBL Lane	Auxiliary Lane (Rural)	$60,000
WBL Lane	Auxiliary Lane (Rural)	$60,000
SBT Lane	Auxiliary Lane (Rural)	$200,000
SBT Lane	Auxiliary Lane (Rural)	$160,000
NBR Lane	Auxiliary Lane (Rural)	$180,000
4th Avenue / Black Street	Signal timing improvement, no capital cost	
2nd Avenue / 4th Avenue	Signal timing improvement, no capital cost	
2nd Avenue / Main Street	Signal timing improvement, no capital cost	
Alaska Highway / Robert Service Way	Signal timing improvement, no capital cost	
Mountainview Drive / Whistle Bend Connector	Signal timing improvement, no capital cost	
Mountainview Drive / Range Road	Signal timing improvement, no capital cost	
Industrial Street / Quartz Road	Signal timing improvement, no capital cost	
Range Road / Two Mile Hill	Signal timing improvement, no capital cost	
	Sub-Total	$9,990,000
	Total	**$31,180,000**

10.0 Follow Up Analyses / Next Steps

The development of the Whitehorse Transportation Planning Model for testing the impacts of the Whistle Bend development area provides the City with a powerful tool by which to examine transportation demands and priorities within the City, resulting from this and any other large-scale development project.

It is recommended that the following activities be undertaken to build on the work documented in this Whistle Bend Transportation Network Impact Study:

- **Transit** - As the City continues to grow, a comprehensive review of transit operations would be appropriate. This may require the transit component of the transportation model to be revalidated to observed peak hour counts by route rather than to system-wide transit volumes as is currently the case.
- **Land Use** - With the anticipated update to the Citywide Official Community Plan in Spring 2009, the land use assumptions included in the model should be revisited as this could affect the timing of various projects.
- **Development of Morning Peak Hour Model -** As the model is built on the basis of the afternoon peak hour only, there is opportunity to develop an AM Peak hour model to examine issues that would be forthcoming as a result of development in the future, during the morning peak period.
- **Travel Demand Management** – The model is built and calibrated on the basis of a generalized cost, which is a function of travel time and out of pocket costs and is represented in the model as time units (minutes). A significant increase in fuel costs may encourage trip-makers to make fewer and/or shorter trips while a major highway improvement may encourage more and longer trip-making. With the cost of petroleum forecast to exceed $1.50/L in the near future, a review of what the future generalized cost may be would be appropriate. As noted in the model documentation report, the effect of this exponent on elasticity on a 5% increase in the base year auto generalized cost because of (say) a 15% increase in vehicle fuel costs would be to reduce the travel demand between affected zones by approximately 2%. Therefore this is coefficient could be reviewed and adjusted in future model upgrades as more comprehensive data becomes available.

The calibration of the EMME model should be updated within five years, reflecting updated data collected by the City.