McElhanney

FINAL REPORT

TO

CRYSTAL MOUNTAIN SKI RESORT AT WESTBANK

TRAFFIC IMPACT STUDY

2111-02219-0

Prepared By:

McElhanney Consulting Services Ltd.
13160 - 88 Avenue
Surrey, British Columbia
V3W 3K3

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13160 - 88th Ave
Surrey BC
Canada V3W 3K3

Tel 604 596 0391
Fax 604 596 8853

EXECUTIVE SUMMARY

The Crystal Mountain Ski Resort expansion includes additional chairs and ski lifts, golfing and summer activities, hotels, bed and breakfasts, condominiums, etc. It is proposed to be completed in three phases, which are assumed to be 2010, 2015, 2020. As the expansion will bring more customers to the resort, the Glenrosa Road corridor, which is the major route to the resort, and the Glenrosa Road / Highway 97 Interchange were analyzed for the traffic impacts caused by the expansion.

The average daily skier visits are expected to rise from 280 (2004) to 1,800 (2020 – completion of phase 3). As a result of development traffic increase along with local population growth, proposed impacts were analyzed at the following locations:

- Webber Road / Glenrosa Road
- McIver Road / Glenrosa Road
- Gates Road / Glenrosa Road
- Glenrosa Road / Highway 97 interchange

Analysis results show the following:

- The Glenrosa Road / Webber Road intersection will require signalization shortly after the completion of Phase 1.
- The McIver Road / Glenrosa Road intersection will continue to operate satisfactorily until the year 2020. Thereafter, signalization may be required.
- The Gates Road / Glenrosa Road intersection will continue to operate effectively at least until the year 2020.
- The Glenrosa Road / Webber Road interchange is expected to operate effectively at least until the year 2020.

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1.0 INTRODUCTION

Phedias Development Management Corporation, on behalf of Crystal Mountain, has commissioned McElhanney Consulting Services Ltd. (MCSL) to investigate the traffic impacts caused by the proposed expansion of the Crystal Mountain Ski Resort on the Glenrosa Road / Highway 97 interchange and the Glenrosa Road Corridor. The study results are provided in this report.

2.0 EXISTING AND PROPOSED CONDITIONS

2.1 LOCATION

Crystal Mountain Ski Resort is located at the base of Mount Last, approximately 9 km from the Westbank community. Access to the resort is via Glenrosa Road, which links the ski resort to Highway 97.

2.2 EXISTING CONDITIONS AND DEVELOPMENT DESCRIPTION

The resort expansion includes the addition of chairs and ski lifts to increase the skiable area, golfing and summer activities, hotels, bed and breakfasts, condominiums, etc., in order to accommodate and attract additional visitors.

Expansion is anticipated to occur in 3 stages: Phase 1 is planned to be completed in 2010; Phase 2 will be completed 5 to 10 years after the completion of Phase 1; and Phase 3 will be completed 5 to 10 years after the completion of Phase 2. For the purpose of this report, Phase 2 and Phase 3 were assumed to be completed in the year 2015 and 2020, respectively. With each new phase, the resort increases the ability to accommodate more skiers and visitors. For the year 2004, there were approximately 31,000 annual skiers, which translates to an average of approximately 280 daily skiers. After the completion of Phase 3, there will be an estimated 1800 daily skiers on average. The proposed development details of each phase are included in Table 2-1 below.

Table 2-1. Proposed Development Details

Dwelling / Building Type	Bed Units	Lift Installation
Existing Conditions		
Current Bed Units	0	Fixed Grip Chair Fixed Grip Triple Chair
Phase 1		
Single Family Chalets	258	Fixed Grip Triple Chair
Townhomes	556	T-Bar
Condominiums	213	Tube Lift & Magic Carpet
B+B	24	Fixed Grip Quad Chair
First Nation Joint Venture-Condotel	75	
Phase 1 Bed Units	1126	
Phase 2		
Single Family Chalets	672	Detachable Quad Chair
Condominiums	192	Fixed Grip Quad Chair
Hotels	400	Main Lift - Pulse Gondola
First Nation Joint Venture-Townhouse / condo-hotel	88	
Employee Housing	30	
Phase 2 Bed Units	1382	
Phase 3		
Single Family Chalets	1236	Fixed Grip Quad Chair
B+B	24	Fixed Grip Quad Chair
Hotels	200	Fixed Grip Quad Chair
Phase 3 Bed Units	1460	Detachable Quad Chair
Total Bed Units	**3968**	

In addition, the resort currently only operates from Thursdays to Sundays during the day time, which is 70 days of operation in an average season. By the time Phase 1 is completed, the resort will open 7 days a week with day and nighttime skiing for aa average of 120 days of operation in a season.

2.3 DEVELOPMENT ACCESS AND EMERGENCY ACCESS OPTIONS

The major access route to Crystal Mountain is from Glenrosa Road via Highway 97. Glenrosa Road is a two lane roadway and is currently mostly used by commuter and

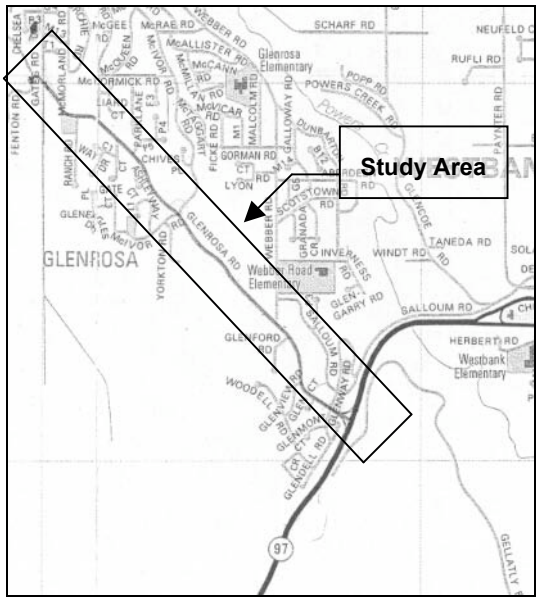
local traffic. The Glenrosa Road corridor does not contain any signals with the exception of the Glenrosa Road / Highway 97 interchange. An alternate access opportunity exists via Gellaty Road. This road connects to the southeast end of Glenrosa Road past the Glenrosa Road / Highway 97 interchange. Gellaty Road then joins with Angus Drive, which allows access to Westbank areas east of Powers Creek.

3.0 AREA CONDITIONS

3.1 STUDY AREA

The study area consists of the Glenrosa Road corridor from Highway 97 to Gates Road, and includes the Glenrosa Road interchange as well as key intersections at Webber Road, McIver Road, and Gates Road. A figure of Glenrosa Road and the above intersections is shown in Figure 3-1 below.

Figure 3-1. Study Area Location Map



3.2 TRAFFIC VOLUMES AND CONDITIONS

Traffic volume data was obtained from various sources including MoT's permanent count stations, existing reports, and supplemental traffic count data conducted by McElhanney.

3.2.1 MoT's Count Stations

MoT count station P-25-10 is located within the study area at the Glenrosa Road / Highway 97 interchange. This permanent count station records traffic data on Highway 97 and the on/off ramps to Glenrosa Road.

A figure showing the schematic drawing of the interchange, the location of the count stations, and the count data is included in Appendix A. As the traffic data was collected in 2002, a factor of 2% compound annual growth has been added when comparing to 2005 traffic data.

3.2.2 Manual Intersection / Interchange Counts

In addition to the count data gathered from MoT count station P-25-10, manual counts were also conducted at the following locations:

- Webber Road / Glenrosa Road
- McIver Road / Glenrosa Road
- Gates Road / Glenrosa Road
- Glenrosa Road / Highway 97 interchange

Parking inventory counts at the Crystal Mountain Ski Resort for December 2004 and January 2005 were also obtained from the Ski Resort as reference for calculations.

Details of the manual traffic counts and parking inventory can be found in Appendix A.

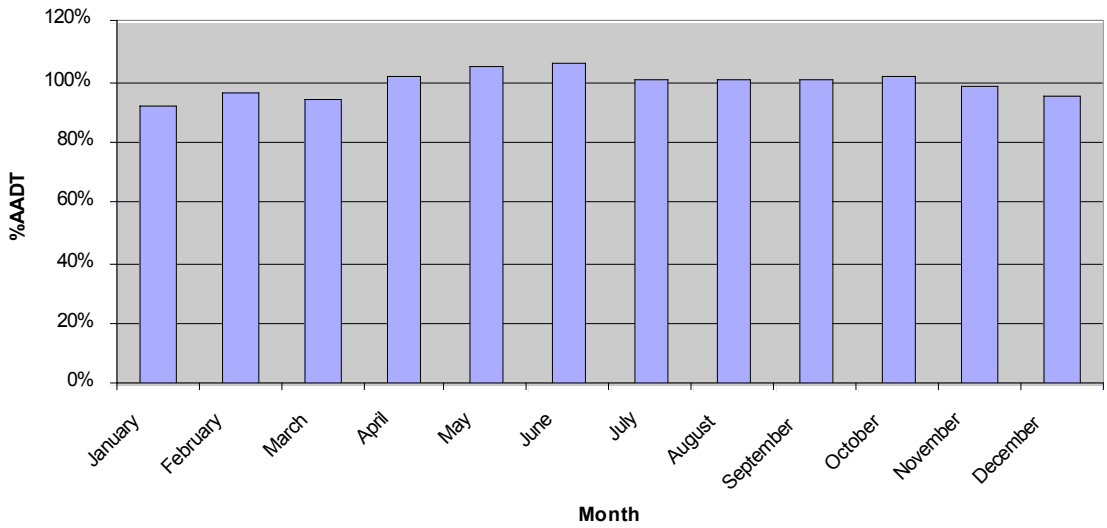
3.2.3 Existing Traffic Volume Characteristics

Average Annual Daily Traffic and Monthly Average Daily Traffic

The main source of traffic along Glenrosa Road originates from the Glenrosa Road / Highway 97 interchange, therefore, data from MoT count station P-25-10 is considered to be representative of traffic conditions along Glenrosa Road. Figure 3-1 shows the

2002 Monthly Average Daily Traffic (MADT) expressed as a percent of the Average Annual Daily Traffic (AADT).

Figure 3-2. Glenrosa: Monthly Traffic Variation as a Percent of AADT



As shown by the monthly variation in the graph above, the MADT for the summer months is slightly higher than that of the winter months. Although the ski resort has golfing facilities during the summer months, the number of winter skier visits far exceeds the number of summer golfing visits. Therefore, the winter season was selected for analysis.

The AADT and MADT for the on and off-ramps at the interchange is shown in Table 3-1 for the winter months of resort operation.

Table 3-1. 2002 AADT and MADT Summary for Glenrosa Road / Highway 97 I/C

AADT	MADT			
	November	December	January	February
10127	10003	9656	9391	9829

The total monthly skier visits for 2004 is shown in Table 3-2. The low number of visitors in November can be attributed to a late start.

Table 3-2. Total Monthly Skier Visits - 2004

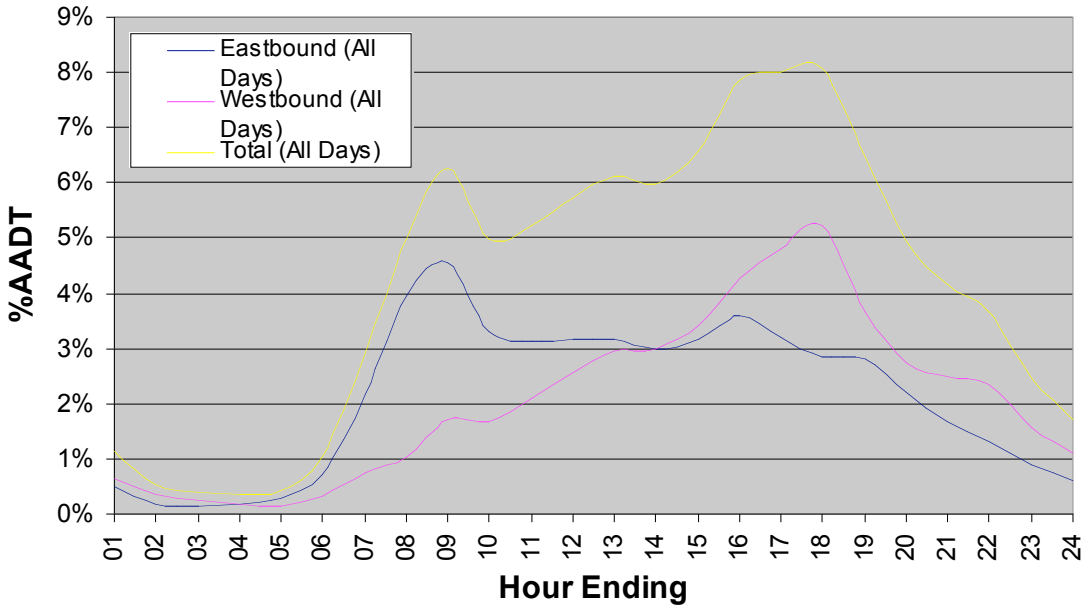
	Total Visitors
January 2004	9007
February 2004	9379
November 2004	1153
December 2004	8467

Although winter MADT along Glenrosa Road is highest in November (as per Figure 3-2), February MADT is only slightly lower and skier visits in February far outnumber skier visits in November, therefore, February is identified as the month for analysis.

Daily Variation on Glenrosa Corridor

Analysis of daily traffic at the Glenrosa Road / Highway 97 interchange on and off-ramps to Glenrosa Road, with the assumption that the Glenrosa corridor follows similar traffic characteristics, shows that the daily peak hour traffic volumes occur approximately at 8:30-9:30 A.M. and 5:00-6:00 P.M. The daily variation of traffic as compared to the percentage of AADT is shown in Figure 3-3 below.

Figure 3-3. Glenrosa Road: A Graph Daily Variation as a Percent of AADT



Observed Trip Distribution to Crystal Mountain Ski Resort

Daily resort visitors consist of local trips from the different areas throughout the Regional District of Central Okanagan (RDCO). The derivation of trip distribution percentages for daily visitor traffic considered the demographics of the different locations within the RDCO. Table 3-3 summarizes the percentages of daily visitor traffic from various RDCO areas. The resulting traffic distribution has only 3% of the daily visitor traffic to be expected from the south, which corresponds to the Municipality of Peachland.

Table 3-3. Trip Distribution for Daily Visitor Traffic (Crystal Mountain Ski Resort)

Area	Population Percentage	Approach on Highway 97
City of Kelowna	65%	North
Peachland DM	3%	South
Electoral Areas G & H (Westside)	17%	50% North 50% internal from Glenrosa Road
Reserves (IR 9, 10 and Duck Lake Reserve)	5%	North
Lake Country DM	7%	North
Electoral Area 1 (Joe Rich – Ellison)	3%	North
Total	**100%**	

Glenrosa Road Corridor Observations

From the site observations conducted at Webber Road, McIver Road, and Gates Road on the Glenrosa Road corridor, moderate to high volumes travel along the two lane roadway. Aside from commuter traffic to the interchange, a high percentage of vehicles traverse within the area. A number of these local trips include parents dropping off or picking up children from school. Traffic counts collected from these intersections can be found in Appendix A. Peak hour summaries are shown below in Figure 3-4.

Pedestrian and Cyclist Safety Implications

The Glenrosa Road corridor appears to have a minimum 1.5m shoulder in at least one direction along its extent; however, the shoulders are not continuous along one or both sides. Thus, to make use of the shoulders, a cyclist would have to switch from one side to the other.

Furthermore, during the period of observation, portions of the shoulders were mostly covered with rocks, salt, and mud, possibly left over from winter ice and snow removal. In some sections, the existence of a shoulder was almost indiscernible.

Sidewalks exist at the interchange ramps and at the intersection of Webber Road and Glenrosa Road. However, there are no marked crosswalks on Glenrosa Road at Webber Road, McIver Road and Gates Road. During morning and afternoon peak hour observations, children were observed to walk to school/home, especially on McIver Road across Glenrosa Road. Therefore, a marked pedestrian crossing may be warranted at McIver Road.

4.0 PROJECTED TRAFFIC

4.1 TRAFFIC GROWTH RATE

Traffic growth was determined from historical traffic volumes at the Highway 97 / Glenrosa Road interchange for the past 10 years, and from information found in the Official Community Plan for Central Okanagan indicating that a potential capacity of 1500 – 1700 new residential units in upper Glenrosa are planned for the next 20 years. Further to this analysis, a 2% yearly growth was applied to project future background traffic volumes along Glenrosa Road. This traffic growth is unrelated to the proposed project.

4.2 TRIP GENERATION

4.2.1 Ski Resort

A ski resort has unique traffic characteristics, and there is a lack of information in the technical literature in terms of trip generation rates for these developments. Therefore, the estimation of traffic volumes was generated from skier arrival rates, vehicle occupancy, daily turnover in residency, and employee trips.

The first step was to estimate the number of skier visits during the winter season for each stage of development. Estimates were based on Master Plan phasing data and on the number of bed units available at each stage of development. The engineering design assumptions and visitor calculations were further refined to account for typical daily / monthly peaking characteristics associated with traffic patterns to / from ski developments. The resultant trip generation tables for each stage of development are attached as Appendix B, and key traffic characteristics are summarized below.

The estimated number of peak daily skiers per stage is listed in Table 4-1 below.

Table 4-1.
Estimated Peak Skiers Per Day

Phase	Bed Units Available	Peak Skiers / Day
1	1126	1107
2	2478	2435
3	3938	3870

The second step was to select the peak traffic week during the ski season. From Table 3-2, it is noted that February is the month with most skiers. Assuming an average number of skiers per week in February, and with 4 weeks in a month, the peak week of the season would contain approximately 8.3 percent of the total number of skiers in a year. To account for variation from the mean, the peak week in February was assumed to be 10% higher than the average.

The third step was to distribute the estimated skier visits during the design week to each day. Data from other ski resort impact studies performed by McElhanney were used to approximate the daily variation. Note that during the peak periods, minimum 3 and 5 day stays are common for destination visitors at a ski resort. The daily traffic variation of skiers is shown in Table 4-2.

Table 4-2.
Daily Traffic Variation - Skiers

Day	% of the Week
Monday	12%
Tuesday	11%
Wednesday	12%
Thursday	12%
Friday	17%
Saturday	17%
Sunday	19%

The fourth step was to determine the proportion of “destination” skiers versus “day” skiers, since they have different traffic characteristics. Day skiers generally arrive during the morning and leave in the afternoon of the same day; typically on a weekend.

However, destination skiers' arrivals and departures tend to be more evenly distributed throughout the week. The number of destination skiers (skiers staying overnight at the resort) was estimated based on the capacity and the occupancy of the overnight accommodation facilities. Table 6 summarizes some of the parameters utilized in the trip generation model, noting that the peak hours associated with ski resorts typically occur during Friday AM/PM and Sunday PM.

Table 4-3.
Trip Generation Model Parameters

Parameter	Value
Destination skiers arriving on Friday a.m.	7%
Destination skiers arriving on Friday p.m.	13%
Destination skiers departing Sunday p.m.	18%
Destination skiers departing on Friday a.m.	4%
Destination skiers departing on Friday p.m.	11%
Destination skiers arriving on Sunday p.m.	7%
On-Site accommodation occupancy	70%
% of On-Site accommodation occupancy are skiers	90%
Vehicle occupancy (passengers/vehicle)	2.0
Auto Share	80%
Friday peak hour factor during the morning (inbound/outbound)	50% / 35%
Friday peak hour factor during the afternoon (inbound/outbound)	43% / 48%
Sunday peak hour factor during the afternoon (inbound/outbound)	41% / 45%

The resultant trip generation information gathered from the above-mentioned factors is shown in Table 4-4 below.

Table 4-4.
Summary of Peak Hour Volumes

Parameter		Phase 1	Phase 2	Phase 3
Peak Week Skiers		5,295	11,652	18,517
Day Skiers	Friday	259	571	907
	Sunday	397	874	1,389
Destination Skiers	Friday	709	1,561	2,481
	Sunday	709	1,561	2,481
Friday a.m. peak hour volumes	In*	92	177	271
	Out*	4	10	16
	Total*	96	187	287
Friday p.m. peak hour volumes	In*	18	39	63
	Out*	81	166	260
	Total*	99	205	323
Sunday p.m. peak hour volumes	In*	9	20	32
	Out*	113	235	363
	Total*	122	255	395

*These volumes include employee vehicles.

The impact of development trips on Glenrosa Road, between highway 97 and Weber Road, is highlighted in Table 4-5 for the peak hours of analysis.

Table 4-5.
% Impact of Development Trips on Glenrosa Road

Time Period	Phase 1				Phase 2				Phase 3			
	BG	Dev	Total	Diff	BG	Dev	Total	Diff	BG	Dev	Total	Diff
Friday AM	824	96	920	+10.4%	910	187	1097	+17.0%	1004	287	1291	+22.2%
Friday PM	952	99	1051	+9.4%	1053	205	1258	+16.2%	1161	323	1484	+21.8%
Sunday PM	529	122	651	+18.7%	583	255	838	+30.4%	645	395	1040	+38.0%

BG = Background traffic; Dev = Development (ski) trips

4.3 TRIP DISTRIBUTION AND ASSIGNMENT

4.3.1 Skier Traffic

For this study, destination trips were defined as trips originating from outside of RDCO that include overnight accommodation at the resort. Directional distribution for destination trips were based on Table I-19 – Visitor Origin to Kelowna of the Master Plan Proposal. Table 4-6 summarizes the percentages used to estimate the distribution of destination trips for this analysis.

Table 4-6.
Trip Distribution for Destination Trips

Area	Percentage	Approach on Highway 97
Greater Vancouver Regional District	20%	South
Vancouver Island	4%	South
Other BC North	1%	North
Other BC South	15%	South
Alberta	18%	North
SK, MB, and ON	12%	North
Other Canada	5%	North
USA (WA/OR/CA)	5%	South
Other USA	3%	North
Overseas	17%	50% North
		50% South
Total	**100%**	

Peak hour volumes were distributed using the above percentages to analyze the volume traversing Highway 97 and Glenrosa Road to the resort.

4.3.2 Background / Local / Commuter Traffic

Background / Commuter traffic for the different stages of development was projected by applying a growth rate of 2% per annum to the original traffic count data.

4.4 TOTAL TRAFFIC VOLUMES

The combined background / commuter, skier, and total traffic volumes for the Glenrosa interchange, and Glenrosa intersections at Webber, McIver, and Gates are attached in Appendix C.

5.0 TRAFFIC ANALYSIS

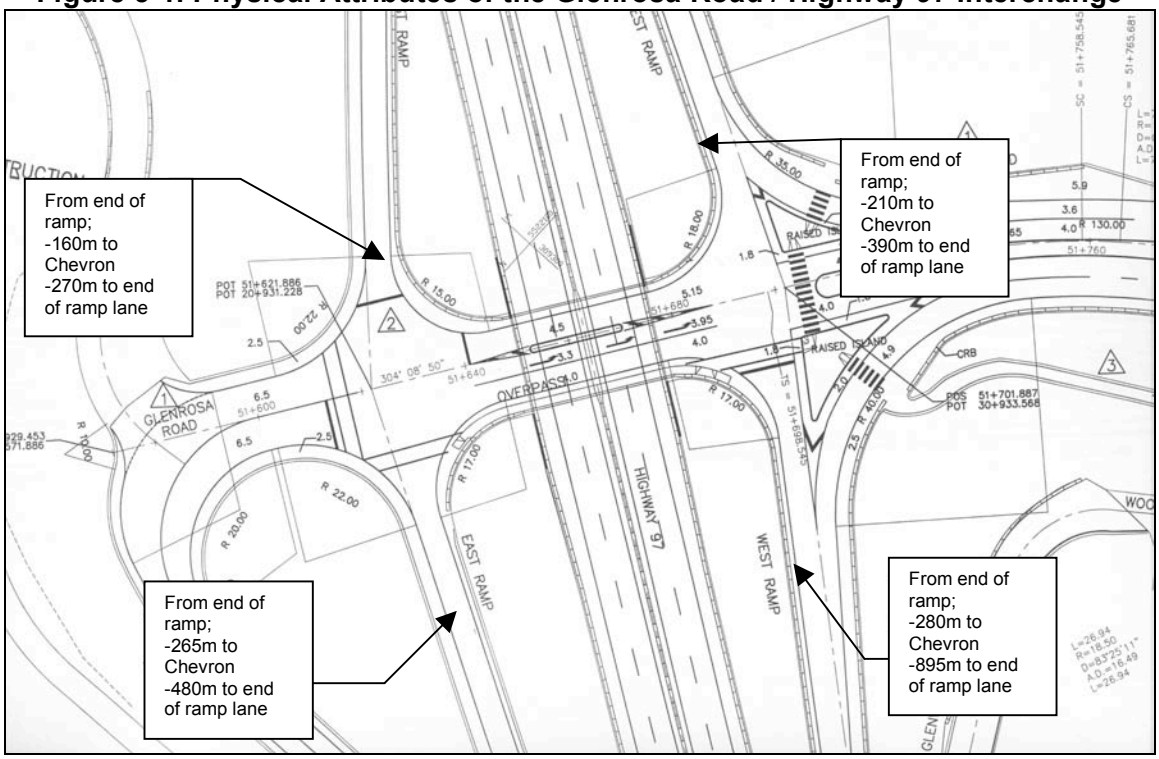
Synchro 6.0 software was used to analyze intersection performance, which is commonly expressed in terms of Level of Service (LOS). LOS can be defined as follows:

LOS	Traffic Condition
A	Excellent
B	Very good
C	Good
D	Acceptable
E	Approaching Capacity
F	Poor

5.1 GLENROSA ROAD / HIGHWAY 97 INTERCHANGE

The lane configuration and physical dimensions of the interchange, including ramp lengths, is shown in Figure 5-1 below.

Figure 5-1. Physical Attributes of the Glenrosa Road / Highway 97 Interchange



A LOS summary of the west and east ramp intersection analysis is shown in Table 5-1. During all conditions and development stages, the Glenrosa Road / Highway 97 interchange performs at an acceptable Level of Service.

Table 5-1. LOS Summary of Glenrosa Road / Highway 97 Interchange

Glenrosa Interchange LOS	West Ramp Intersection (Unsignalized)					
	Bkgrnd Vol.	Combined Vol.	Bkgrnd Vol.	Combined Vol.	Bkgrnd Vol.	Combined Vol.
	Friday AM		Friday PM		Sunday PM	
Existing Conditions	A		B		B	
Phase 1 - 2010	A	A	B	C	B	B
Phase 2 - 2015	A	B	C	C	B	B
Phase 3 - 2020	A	B	C	D	B	B
Glenrosa Interchange LOS	**East Ramp Intersection (Signalized)**					
	Bkgrnd Vol.	**Combined Vol.**	**Bkgrnd Vol.**	**Combined Vol.**	**Bkgrnd Vol.**	**Combined Vol.**
	Friday AM		Friday PM		Sunday PM	
Existing Conditions	A		B		A	
Phase 1 - 2010	A	A	A	A	A	A
Phase 2 - 2015	A	B	A	A	A	A
Phase 3 - 2020	A	B	A	A	A	A

5.1.1 Existing Conditions

For existing conditions, both the signalized east ramp intersection and the unsignalized west ramp intersection operate at either excellent or good levels of service. However, during site observations, there were several occurrences where eastbound traffic at the east ramp intersection queued across the west ramp intersection. In addition, the southbound right movement at the west ramp intersection experiences occasional congestion, likely due to a relatively high volume of traffic turning on a tight radius, followed by an uphill grade before merging into one lane on Glenrosa Road. However, the southbound ramp clears with each signal cycle without significant queuing.

5.1.2 Phase 1 - 2010 Conditions

During Phase 1 of development, increased skier volume from the south during the Friday AM peak hour will result in a 95th percentile queue of 45m on Glenrosa at the east ramp

intersection for the eastbound through and left turn movements. Because the overpass connecting the two ramp intersections is only approximately 40m in length, vehicles will back up across the west ramp intersection. The 95th percentile queue for the northbound movement at the east ramp intersection is also 30m in length. With the semi-actuated signal configuration giving the maximum recall time to the eastbound movements, these queues dissipate during each cycle.

In addition, as volumes increases from the north, the southbound right turn movement at the west ramp intersection will experience queues of approximately 45m during the Friday PM peak hour. Since there is a low volume of conflicting vehicles, queues are sporadic and dissipate quickly.

5.1.3 Phase 2 - 2015 Conditions

At Phase 2 of development, during the Friday AM peak hour, the eastbound movement at the east ramp intersection produces a 68m 95th percentile queue. Although level of service at this intersection will remain at level B, queues on the Glenrosa overpass will extend back, across the west ramp intersection. With the semi-actuated signal configuration giving the maximum recall time to the eastbound movements, these queues dissipate quickly. Similarly, the northbound off-ramp movements at the east ramp intersection will queue approximately 50m during the Friday AM peak hour, and this queue will also dissipate with each signal cycle.

An alternative to the current semi-actuated controller would be an actuated-uncoordinated control. By using an actuated-uncoordinated controller with 60 seconds of cycle length, queues for the eastbound moments on the Glenrosa overpass decrease to 55m while the east ramp northbound queue at the east ramp intersection decreases to approximately 25m.

The southbound movement at the west ramp I/C will exhibit a 95th percentile queue length of approximately 65m during the Friday PM peak hour. However, the level of service remains at an acceptable level of C and queues dissipate quickly, as the

southbound movement consists mostly of right turns and there is a small volume of conflicting eastbound traffic.

5.1.4 Phase 3 - 2020 Conditions

During Phase 3 of development, the Friday AM peak hour eastbound through and left turn movements at the east ramp intersection produce a 95th percentile queue of approximately 95m. Although vehicles back into the adjacent west ramp intersection, the intersection Level of Service remains at LOS B since queues dissipate at every cycle. The approach Level of Service remains at LOS A. The east ramp northbound movements also exhibit relatively high 95th percentile queues of approximately 70m in length. Changing the signal timing configuration would only result in a minor reduction to the queue lengths.

In addition, the west ramp southbound movement produces a 95th percentile queue of approximately 105m in length for the Friday PM peak hour.

Although relatively long queues are produced for these movements, the queue lengths are manageable and can be accommodated within the existing ramp storage (see Figure 5.1). The northbound off-ramp extending as far as 270m from the stop bar and the southbound off-ramp extends as far as 900m. Therefore, there is adequate stopping distance along the ramps, and through traffic on Highway 97 will not be impacted by ramp queues.

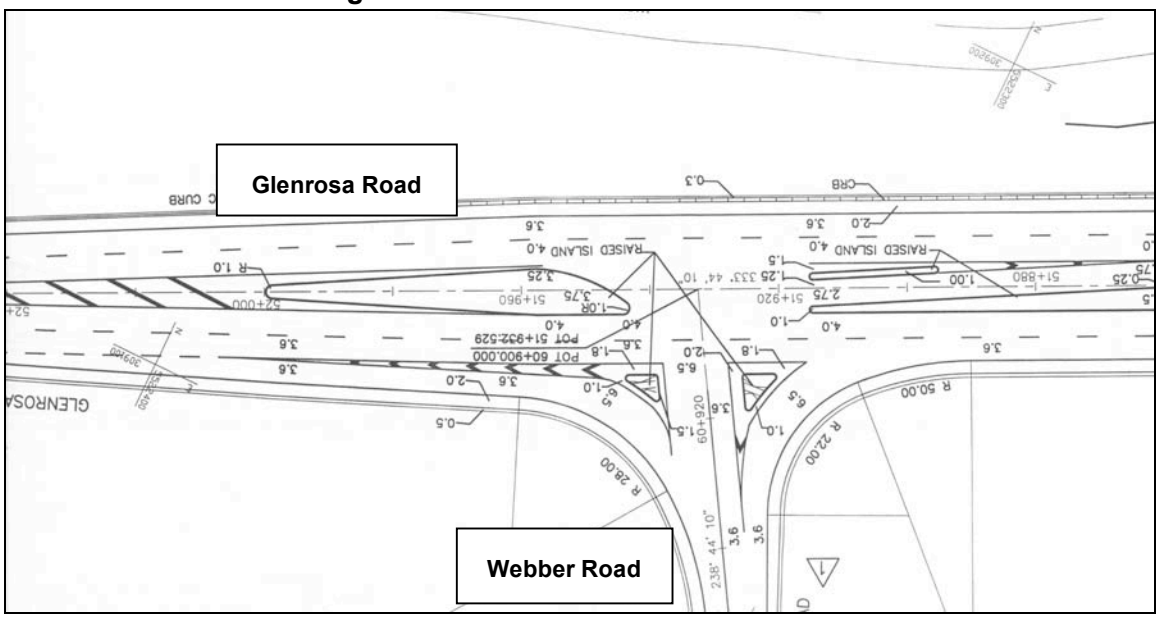
5.2 GLENROSA ROAD CORRIDOR

Since Glenrosa Road is the only major route available to access the resort, the projected increase in commuter and local traffic through population growth and the increase in skier volumes will impact this corridor. The impact on Glenrosa Road at the intersections of Webber Road, McIver Road, and Gates Road is described below.

5.2.1 Webber Road / Glenrosa Road Intersection

The Webber Road / Glenrosa Road intersection is the nearest intersection to the unsignalized west ramp intersection at Highway 97 / Glenrosa. Glenrosa Road is oriented east / west and Webber Road is the north / south route. This intersection consists of a three-leg configuration with a protected left turn median merge to facilitate the southbound to eastbound left turn from Webber Road. Further to preliminary design drawings obtained from the Ministry of Transportation, it appears that this section of Glenrosa Road is planned to be four-laned. The preliminary intersection design is shown in Figure 5-2.

Figure 5-2. Webber Road Intersection



* Note, the above lane configuration is from the preliminary design. The existing lane configuration is one lane per direction of travel on Glenrosa Road, plus a protected median merge for left turns from Webber Road.

A LOS summary of this intersection is listed in Table 5-2 below for background traffic conditions only, and with future skier trips. The LOS shown in Table 5-2 corresponds to the critical southbound left turn movement from Webber Road, assuming no intersection improvements.

Table 5-2. Webber Road Intersection LOS - Unsignalized Southbound Left Turn No Intersection improvements

Analysis Scenario	Background Traffic Only		Combined Traffic (Background + ski trips)	
Friday AM Peak Hour	LOS	Queues (m)	LOS	Queues (m)
Webber Road - Existing Condition	E	72.5		
Webber Road - 2010	F	98.2	F	130.6
Webber Road - 2015	F	151.5	F	223.3
Webber Road - 2020	F	220.0	F	327.5
Friday PM Peak Hour	LOS	Queues (m)	LOS	Queues (m)
Webber Road - Existing Condition	C	22.3		
Webber Road - 2010	D	32.0	D	33.7
Webber Road - 2015	E	48.7	F	54.6
Webber Road - 2020	F	76.3	F	90.0
Sunday PM Peak Hour	LOS	Queues (m)	LOS	Queues (m)
Webber Road - Existing Condition	B	9.9		
Webber Road - 2010	C	12.5	C	12.8
Webber Road - 2015	C	16.5	C	17.7
Webber Road - 2020	C	22.5	C	24.5

Webber Road and Glenrosa Road are situated in an area of higher residential density relative to the surrounding area; therefore, higher traffic volumes travel within this area. With or without development (ski) trips, failing levels of service will occur for the southbound left turn on Webber Road during the weekday peak hours. This is caused by the relatively high volume of opposing traffic on Glenrosa Road, making it difficult for southbound left turn volumes to dissipate. This is especially emphasized during the AM peak hour when traffic volumes on Glenrosa Road are highest.

A signal at this location would improve the LOS, and appears warranted following Phase 1 development. Signalization should coincide with the planned four-laning

improvements. A summary of the signalized intersection LOS is shown in Table 5-3 below.

Table 5-3. Summary of Signalized Webber Road Intersection LOS

	Friday AM Peak Hour	Friday PM Peak Hour	Sunday PM Peak Hour
Webber Road – Existing Condition	B	B	A
Webber Road – 2010	B	A	A
Webber Road – 2015	B	B	A
Webber Road – 2020	C	B	A

The intersection LOS for sidestreet traffic on Webber Road improves significantly as a result of installing a signal at this location. However, some delay would be introduced to through movements on Glenrosa Road, as east-west traffic is currently a free movement.

5.2.2 McIver Road / Glenrosa Road Intersection

McIver Road located between Gates Road and Webber Road. It is an offset T-intersection with its southern leg is just east of its northern leg. There is a high school on the northern leg of McIver Road. Due to the nature of this intersection, it is analyzed as two three-way unsignalized intersections. A summary of the LOS for this intersection is listed in Table 5-4 below, the level of service shown shows the worst approach level of service for the two intersections.

Table 5-4. Summary of the McIver Road Intersection LOS

Analysis Scenario	Background Traffic Only	Combined Traffic (Background + ski trips)
Friday AM Peak Hour	LOS	LOS
McIver Road - Existing Condition	B	
McIver Road - 2010	C	C
McIver Road - 2015	C	D
McIver Road - 2020	C	E(A)*
Friday PM Peak Hour	LOS	LOS
McIver Road - Existing Condition	C	
McIver Road - 2010	C	C
McIver Road - 2015	C	D
McIver Road - 2020	C	E(A)*
Sunday PM Peak Hour	LOS	LOS
McIver Road - Existing Condition	B	
McIver Road - 2010	B	B
McIver Road - 2015	B	B
McIver Road - 2020	B	C

*(X) Signalized intersection

The McIver Road intersection supports the increase in future traffic volumes up until the year 2020, at which time southbound left and right movements during the Friday AM and PM peak hours will begin to have difficulty turning due to the high volumes traversing east and westbound on Glenrosa Road. Therefore, a signal warrant will require investigation around the 2020 horizon. With the introduction of a signal, traffic performance would improve to Level of Service A.

5.2.3 Gates Road / Glenrosa Road Intersection

Gates Road is an offset T-intersection. However, its northern leg is west of its southern leg. Therefore, this intersection was also analyzed as two three-way unsignalized intersections. A summary of the LOS for this intersection is listed in Table 5-5 below, the LOS shown is for the worst movement, typically the minor road left turn.

Table 5-5. Summary of Gates Road Intersection LOS

Analysis Scenario	Background Traffic Only	Combined Traffic (Background + ski trips)
Friday AM Peak Hour	LOS	LOS
Gates Road - Existing Condition	A	
Gates Road - 2010	A	B
Gates Road - 2015	A	B
Gates Road - 2020	A	B
Friday PM Peak Hour	LOS	LOS
Gates Road - Existing Condition	A	
Gates Road - 2010	A	B
Gates Road - 2015	A	B
Gates Road - 2020	B	B
Sunday PM Peak Hour	LOS	LOS
Gates Road - Existing Condition	B	
Gates Road - 2010	A	A
Gates Road - 2015	A	B
Gates Road - 2020	A	B

Glenrosa Road, west of Gates Road, is a much less dense residential area. Although there are plans for development in the next 20 years, traffic volumes should remain manageable at this location without any improvements.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The proposed Crystal Mountain Ski Resort expansion will be developed in three phases, assumed in this report to coincide with the 2010, 2015 and 2020 horizons. Typical development characteristics include:

- A residential and hotel component, thus attracting destination skiers (multi-day visits) in addition to local day trips.
- Increased operating hours from the current four-day operation, Thursday to Sunday, to a seven-day-a-week facility, and including night skiing.
- An increase in average daily skier visits from 280 in 2004 to 1,800 at the completion of Phase 3.

Development trips will add approximately 100 vph to Friday peak hour traffic volumes on Glenrosa Road at Phase 1, representing a 10.4% and 9.4% increase over background traffic during the AM and PM peak hours, respectively. By Phase 2, development trips will add between 187vph and 205 vph to Friday peak hour traffic volumes, representing a 17.0% and 16.2% increase over background traffic during the AM and PM peak hours, respectively. By Phase 3, development trips will add between 290 vph and 325 vph to Friday peak hour traffic volumes, representing a 22.2% and 21.8% increase over background traffic during the AM and PM peak hours, respectively.

The Highway 97 / Glenrosa Road interchange will continue to operate at an acceptable Level of Service until the 2020 horizon with no improvements.

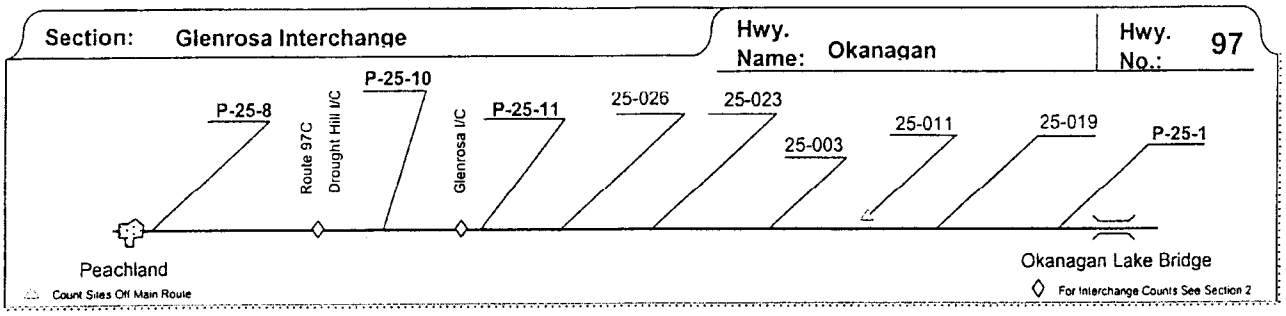
The Glenrosa Road / Webber Road intersection will require signalization after Phase 1 of the development. Signalization should coincide with planned four laning of Glenrosa Road between Highway 97 to west of Webber Road, as per the preliminary design drawings prepared by the Ministry of Transportation. Signalization would be required shortly after the Phase 1 horizon due to background traffic alone.

The McIver Road intersection will continue to operate at an acceptable Level of Service until the 2020 horizon, at which time a signal warrant analysis should be undertaken.

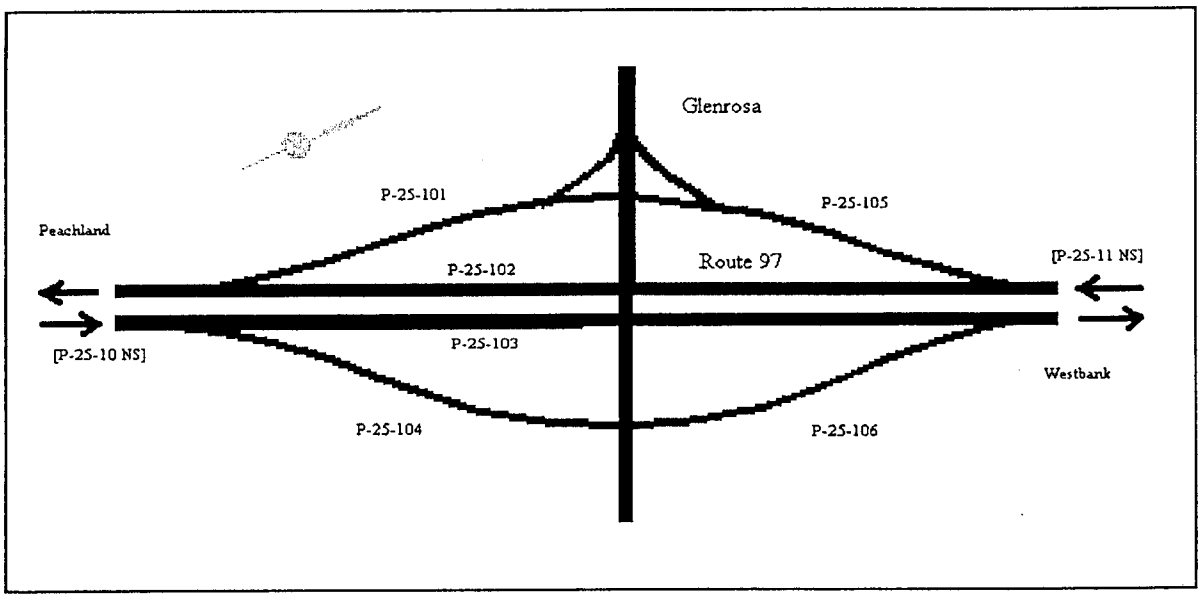
The Gates Road intersection will not require any improvements within the time horizon of this study.

APPENDIX A

TRAFFIC COUNTS AND COLLECTED DATA



LOCATION	SUMMER AVERAGE DAILY TRAFFIC 2000
P-25-10N	10888
P-25-10S	10981
P-25-11N	14292
P-25-11S	6462
P-25-101	785
P-25-102	10196
P-25-103	10166
P-25-104	1445
P-25-105	7952
P-25-106	4126



SCHEMATIC DRAWING OF
GLENROSA ROAD/HWY 97 I/C
& COUNT STATION LOCATIONS

PARKING INVENTORY

NOVEMBER 2004

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

DECEMBER 2004

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1	2	3	4
5	6	7	8	9	10	V 64 S 11
V 80 S 12	13	14	15	16	17	18
V 54 19	20	21	22	23	24	25
V 101 S 8 26	27	28	29	30	31	

JANUARY 2006

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

FEBRUARY 2006

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

Our beer out here

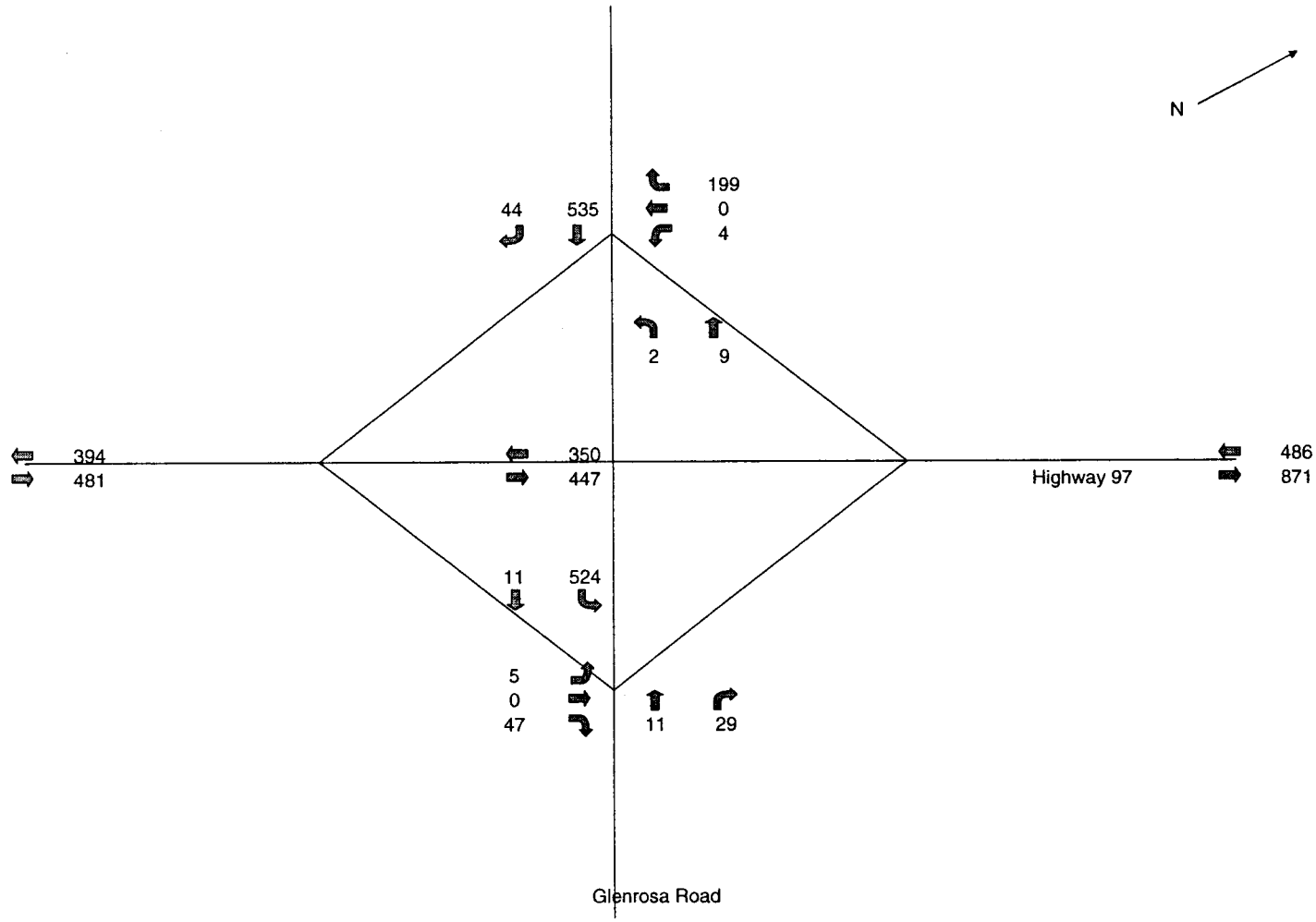
While every drop of Kokanee comes from Creston BC where glacier rivers flow from pristine mountain tops, it would be a key ingredient short without the rest of the West. Kokanee is made using #1 grade Canadian Malted Barley from the Canadian Prairies.

JANUARY 2005

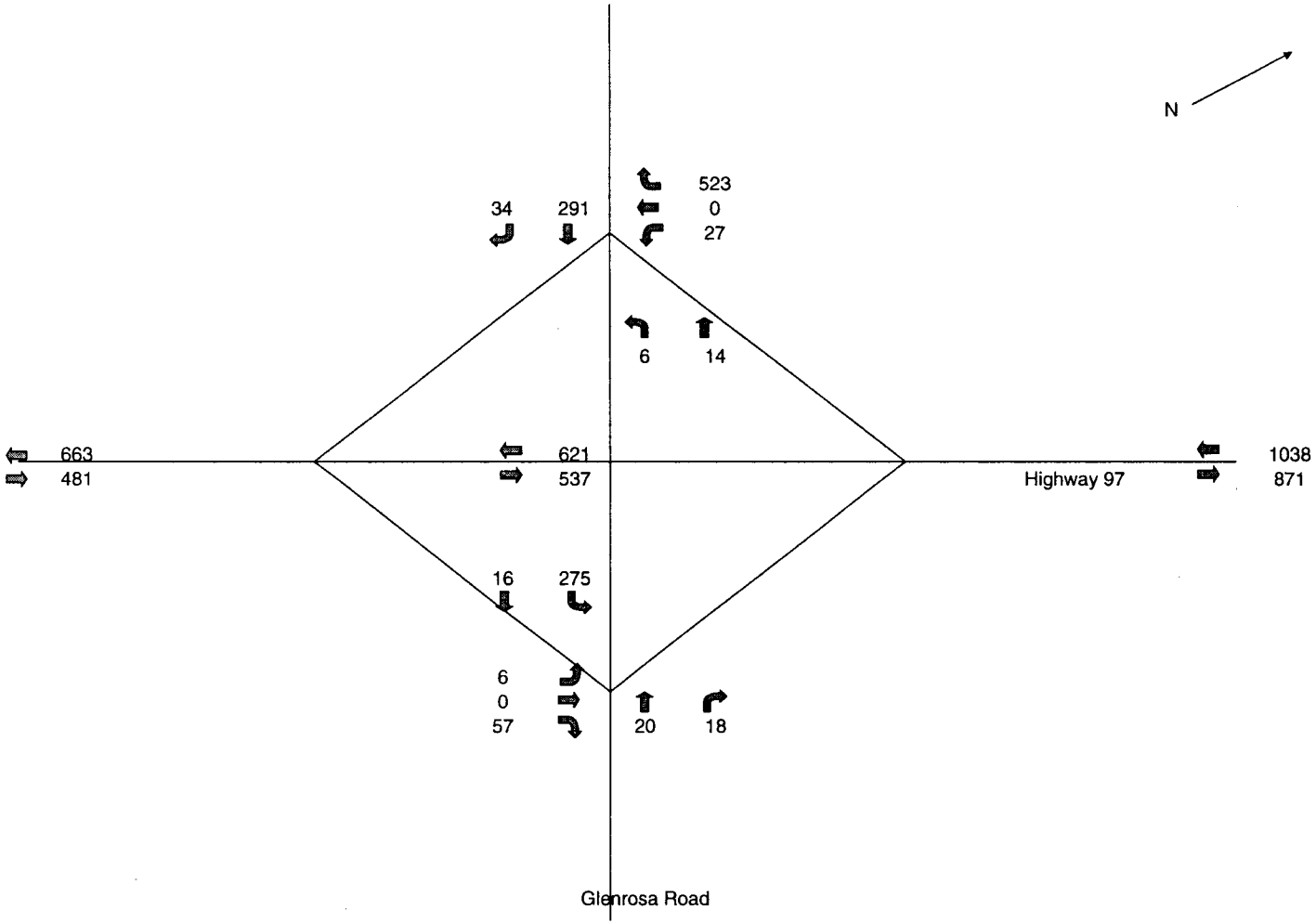
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
December S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	February S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28					New Year's Day Ranger Mountain Clean Up 1 of UPPER 40 S 1
Parking 140 2	Parking 95 3	4	5	Epiphany 32 parked 1-5 6	24 parked 7	130 Parking 26 Sunny. 8
Parking 148 70 9	10	Sir John A. MacDonald Day 11	Sir Whynothave A. Kokanee Day 12	Parking 59 2 Bison 13	Parking 24 14	Parking 32 15
Martin Luther King Jr. Day (U.S.A.) 92 cars 31 S 16	17	18	19	20	21	Parking 91 (2) 2.00 = 101 22
Parking 134 23/30	24/31	25	Brew's Birthday 26	27	Send belated birthday card to Brew 28	49 cars 29

60%

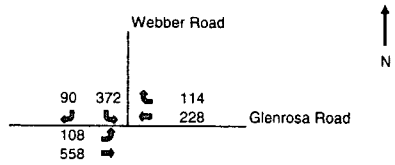
75%



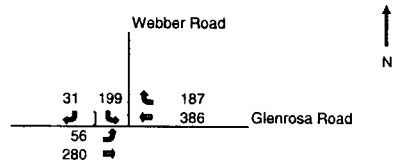
2005 Glenrosa Interchange - Commuter + Skier (Friday) AM Peak Hour Volumes - February



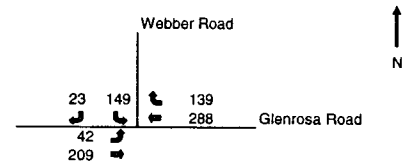
2005 Glenrosa Interchange - Weekday (Thursday) PM Peak Hour Volumes - February



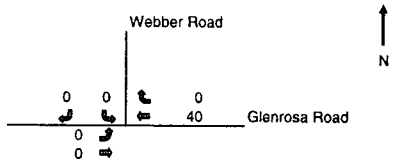
AM Peak Hour Combined Volumes



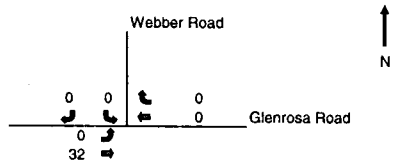
PM Peak Hour Combined Volumes



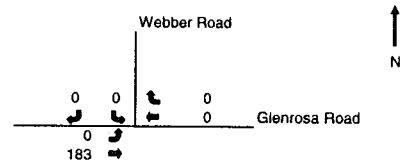
Sunday PM Peak Hour Combined Volumes



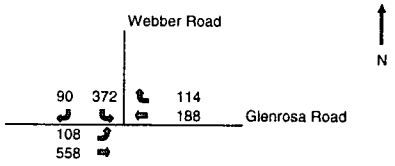
AM Peak Hour Skier Volumes



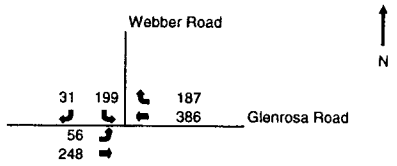
PM Peak Hour Skier Volumes



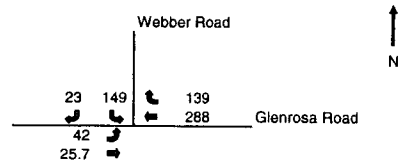
Sunday PM Peak Hour Skier Volumes



AM Peak Hour Commuter Volumes

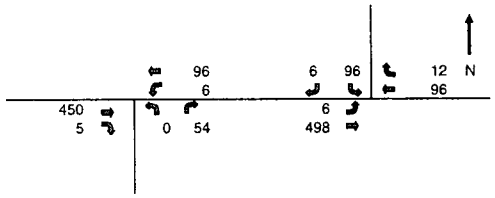


PM Peak Hour Commuter Volumes

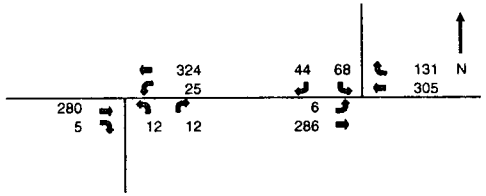


Sunday PM Peak Hour Commuter Volumes

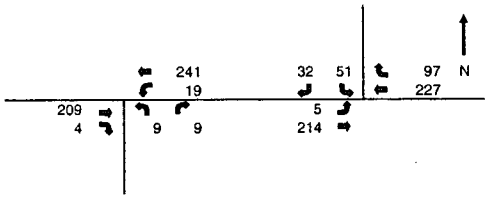
Webber / Glenrosa Road Existing Traffic Volumes



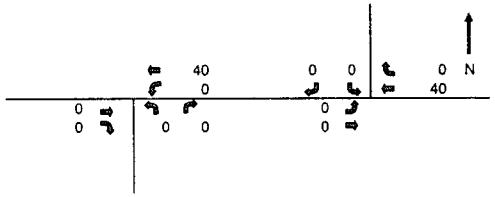
AM Peak Hour Combined Volumes



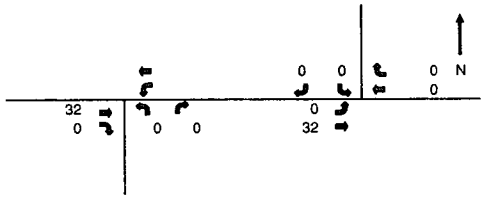
PM Peak Hour Combined Volumes



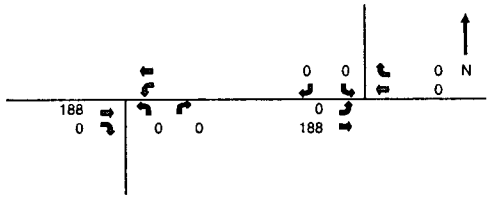
Sunday PM Peak Hour Combined Volumes



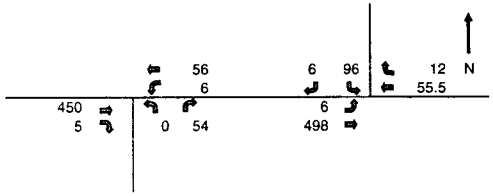
AM Peak Hour Skier Volumes



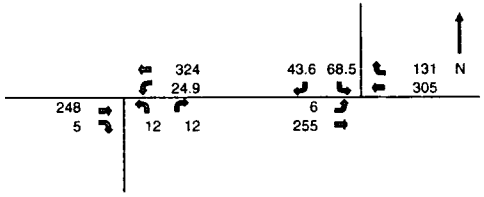
PM Peak Hour Skier Volumes



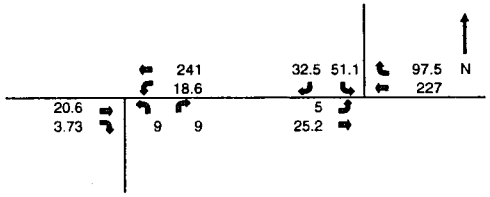
Sunday PM Peak Hour Skier Volumes



AM Peak Hour Commuter Volumes

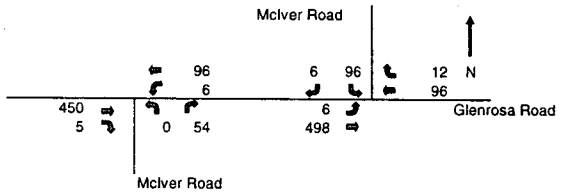


PM Peak Hour Commuter Volumes

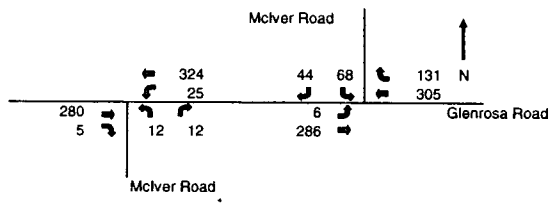


Sunday PM Peak Hour Commuter Volumes

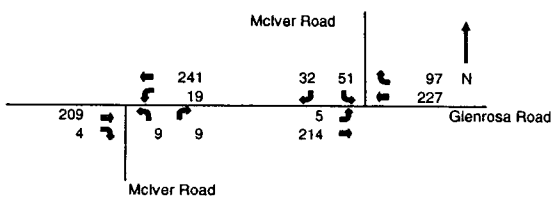
Webber / McIver Road Existing Traffic Volumes



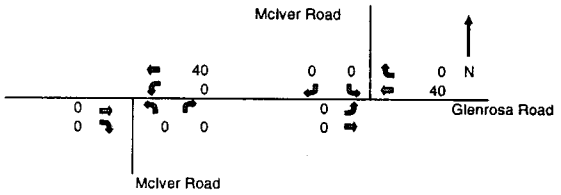
AM Peak Hour Combined Volumes



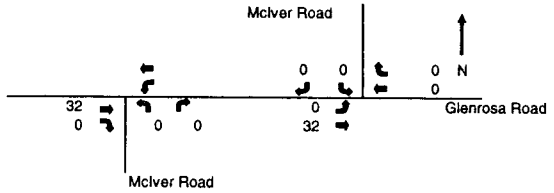
PM Peak Hour Combined Volumes



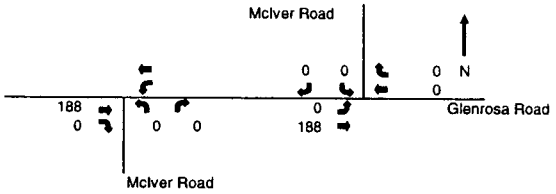
Sunday PM Peak Hour Combined Volumes



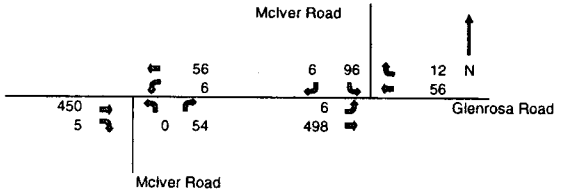
AM Peak Hour Skier Volumes



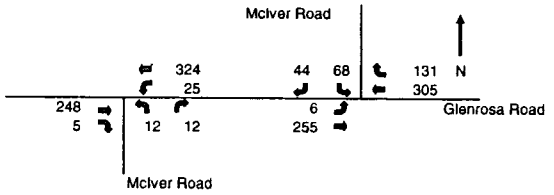
PM Peak Hour Skier Volumes



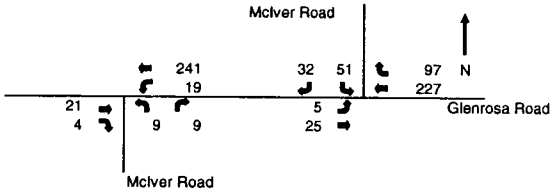
Sunday PM Peak Hour Skier Volumes



AM Peak Hour Commuter Volumes

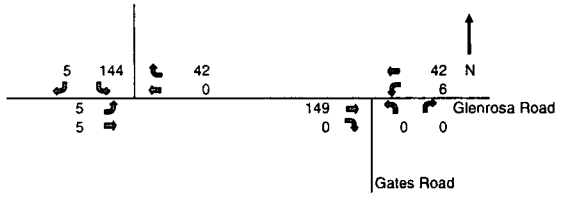


PM Peak Hour Commuter Volumes

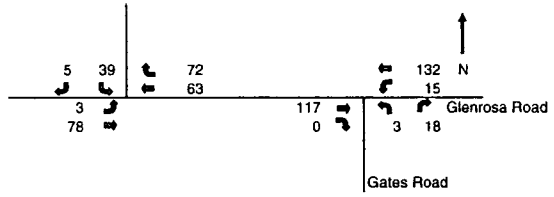


Sunday PM Peak Hour Commuter Volumes

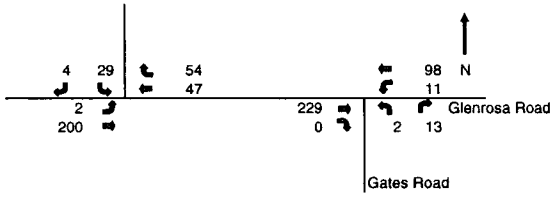
McIver / Gates Road Existing Traffic Volumes



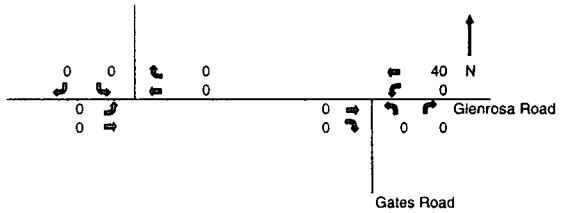
AM Peak Hour Combined Volumes



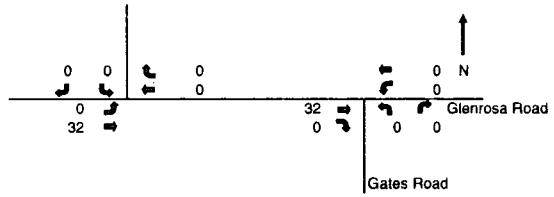
PM Peak Hour Combined Volumes



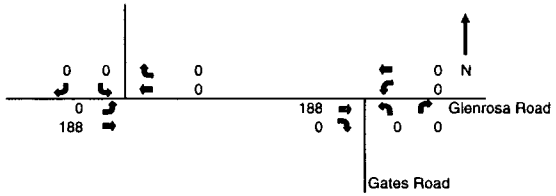
Sunday PM Peak Hour Combined Volumes



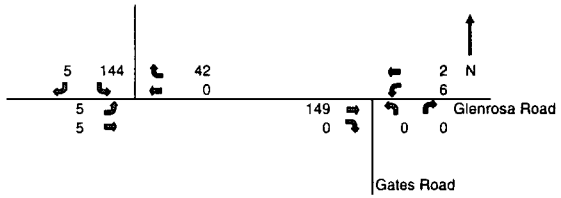
AM Peak Hour Skier Volumes



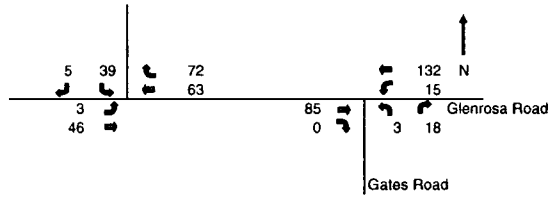
PM Peak Hour Skier Volumes



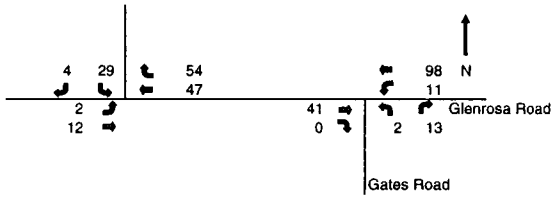
Sunday PM Peak Hour Skier Volumes



AM Peak Hour Commuter Volumes



PM Peak Hour Commuter Volumes



Sunday PM Peak Hour Commuter Volumes

Gates / Glenrosa Road Existing Traffic Volumes

APPENDIX B

TRIP GENERATION TABLES

FINAL

Crystal Mountain Resort – Engineering Design Assumptions

Design Assumptions and Visitor Calculations

Average and peak overnight and day visitor numbers are estimated by conservative design considerations and by comparison with other resorts in a similar market where data can be compared, even if every project is unique in some respects. Engineering assumptions have been reviewed in the light of the number of visitors relative to the project design, in light of market comparisons and in light of applicable precedent. Baseline data for the calculations have been provided by industry standards supplied by Lynnpeaks Consulting Ltd., by Milne Consulting Ltd., by the manager of the Crytsal Mountain Resort ski area and by CWSAA. The following shows three ways of calculating effective visitor usage:

By Number of Visitors and Design:

Comfortable Carrying Capacity and Utilization Rate calculations: the project is being designed to be capable of achieving approximately 4,480 visitors on a peak winter day. This includes both overnight visitors and day visitors. The number of visitors is based on a 50% Utilization Rate (UR) of the maximum Comfortable Carrying Capacity (CCC) of 8960 skiers at one time at build out[1]. A 50% UR is not planned by design as the actual usage nor is it recommended. A 50% utilization is so high that it is almost never achieved nor wanted because of line ups and overcrowding of critical points of ski runs – not even at Whistler (the Whistler 50% UR translates into approximately 28,000 skiers per day – this is from a bed base of 52,000 BU. Actual UR numbers at Whistler tend to range

[1] To appreciate the relationship between UR and CCC they may be compared to the maximum speed and horsepower of an automobile, which are provided as design data, on the assumption that no one will drive at full speed - the CCC may be compared to the maximum speed of which the automobile may be capable and the UR the average speed at which it is assumed it will be actually driven.

from 8,000 to 14,000 per day).

By Peak and Average Use Calculations:

Peak capacity: A peak day may achieve 85% room occupancy for overnight accommodation, equal to a theoretical 3373 people over a bed base of 3968. However, assuming that at peak season 15% of rooms with two beds have only one occupant, this would translate into 2867 overnight guests. If 10% are non skiers, this would indicate 2580 overnight skiers. Assuming during peak season a high number of 50% day skiers versus overnight skiers, there would be 1290 day skiers for a total of 3870 skiers. This would represent over 40% UR (3870 skiers over a CCC of 8960 represents a 43% UR), which would be on the high side of the industry. By comparison currently Crystal Mountain with two chairlifts and a T Bar, with a CCC of approximately 1600, achieves approximately 500 skiers in an absolutely ideal peak day (This is a UR of 31%).

Average overnight visitors: At build out there will be 3968 tourist bed units. Past and future projections for successful ski resorts indicate that yearly occupancy rates of 35% to 40% are the norm. Although this resort will offer summer activities, we have used the winter usage as the initial base for average calculations. If we use a 40% yearly occupancy rate number, this means that there could be 1587 visitors per night over the theoretical 365 nights for a total overnight maximum visitor rate of 579,255. As the resort will be closed for at least 60 days for maintenance and the low season (in the spring and fall during the change of operations from winter to summer and vice versa), the total overnight maximum annual accommodation would be 484,035. It is assumed that single individuals will occupy 25% of double occupancy rooms. Therefore rather than the 1587 maximum average number of visitors per night the actual number should be 1190 persons per night. This would translates into 362,950 overnight persons per year, a very high number that would only materialize would good occupancy in the shoulder seasons.

Average winter skier and summer visits: To determine the number of skier visits we assume that at Crystal Mountain Resort 90% of overnight visitors will be skiers and snowboarders. Therefore, overnight visitors will account for a yearly average of 1071 skier visitors per day. Day visitors, because of the proximity of Westbank and Kelowna, will be assumed to be a high number of up to 65% of the number of overnight visitors, or 774 skiers and per day. A total of 1845 skiers per day over a total of 120 ski days would project a total season of 221,400 skier days. The number of golfers per day is estimated at 200 per day over a summer season of 180 days. In combination with overnight visitors we would project some 400 visitors per day. This would total 72,000 summer visits per year at build out.

Employees: Crystal Mountain Resort is planned to be capable of employing up to 500 employees at the resort at build out, corresponding to the number of jobs the resort is expected to be generating. Almost all the employees are expected to

be commuting from Westbank and the Kelowna region, although a small number of beds will be provided at the resort for employees who are required to be at the resort

By Market Comparison:

The project should be compared, when completed, to ski areas which may receive approximately 150,000 to 200,000 skier visits per year or 1,250 to 1666 per day average over the 120 day main season. Thus the market derived assumption would produce a slightly smaller number of average overnight and day visitors, therefore confirming that the design assumptions at build out represent a conservative design for a higher number of visitors than is likely to occur. The market projections start from the current maximum number of visitors per day at approximately 500 and from approximately 25,000 visits per winter season.

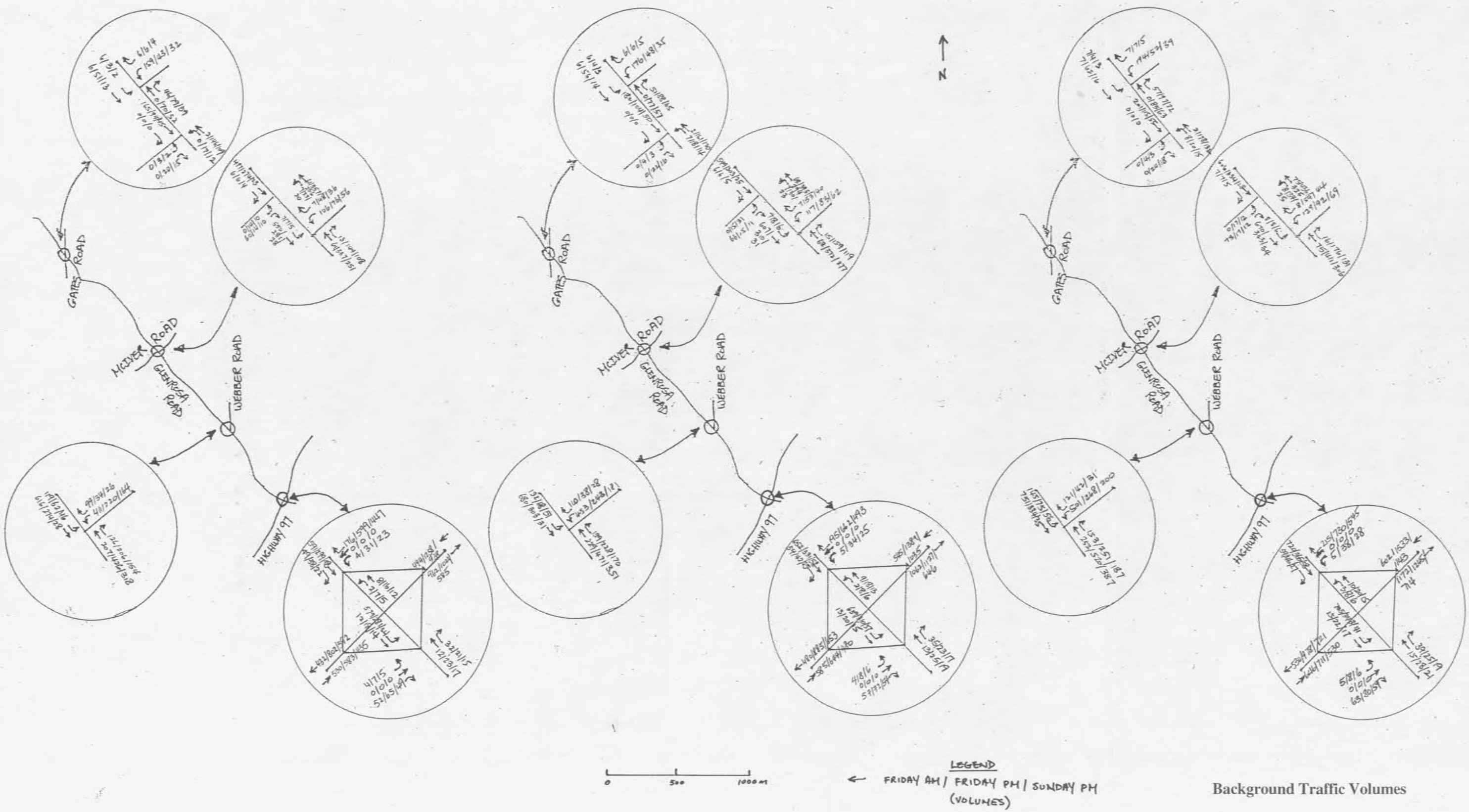
APPENDIX C

TRAFFIC PROJECT SUMMARIES

2010 - Phase 1

2015 - Phase 2

2020 - Phase 3

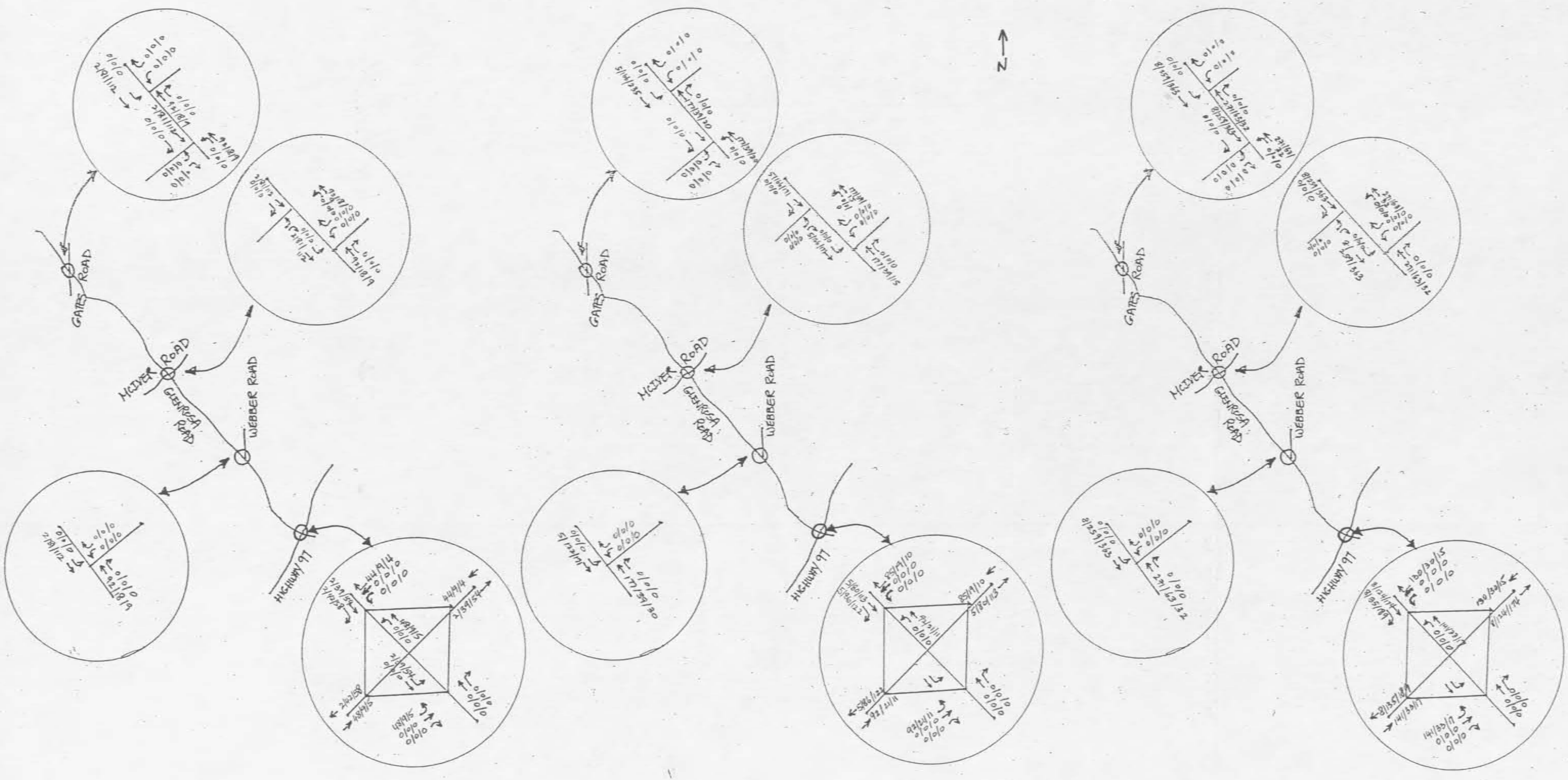


Background Traffic Volumes

2010 - Phase 1

2015 - Phase 2

2020 - Phase 3



LEGEND

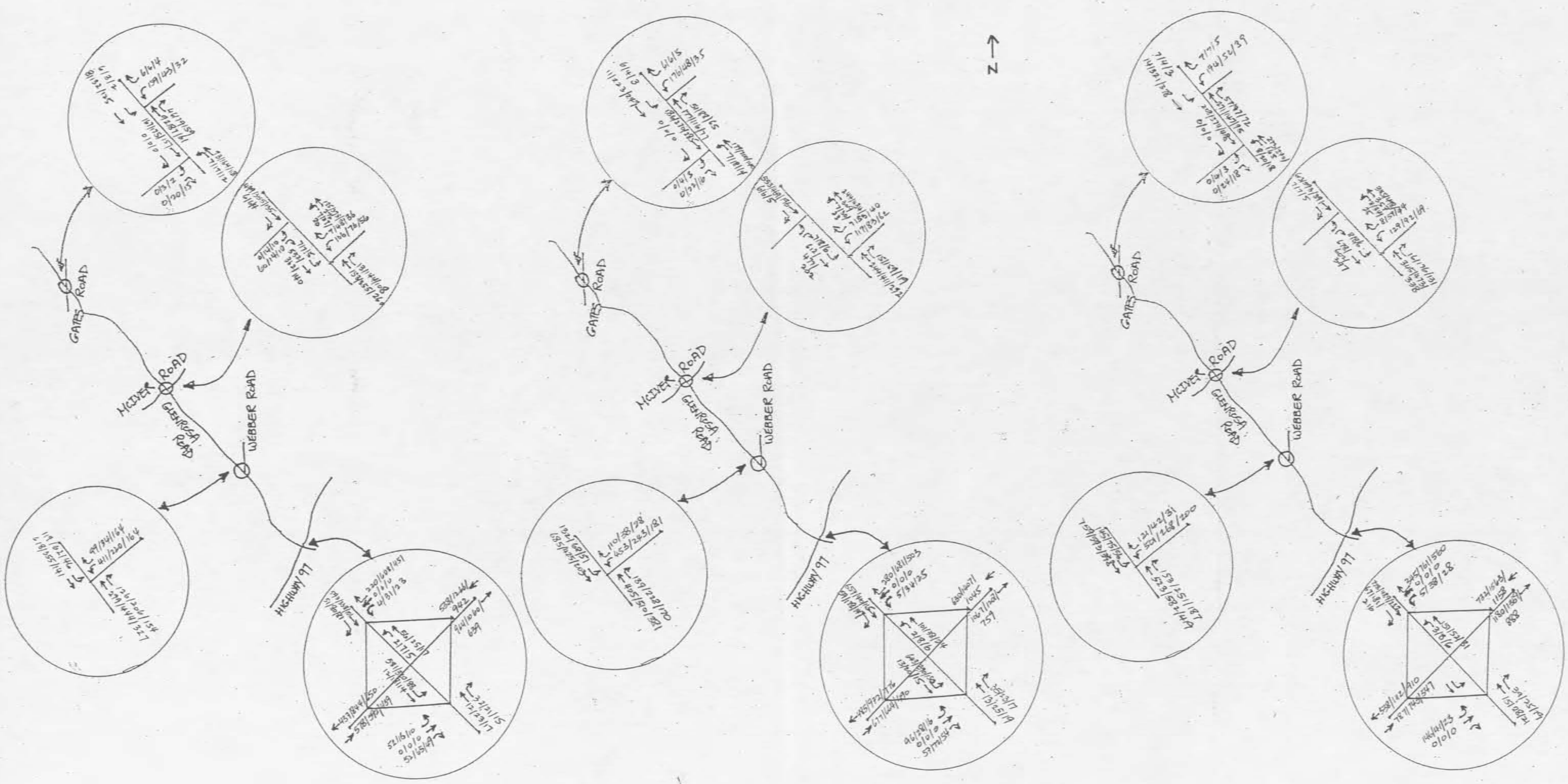
← FRIDAY AM | FRIDAY PM / SUNDAY PM (VOLUMES)

Skier / Development Traffic Volumes

2010 - Phase 1

2015 - Phase 2

2020 - Phase 3



Combined Background and Skier Traffic Volumes