C.C. Tatham & Associates Ltd.
Consulting Engineers

BLUE VISTA

Town of The Blue Mountains

Traffic Impact Study

prepared by:

C.C. Tatham & Associates Ltd.
115 Sandford Fleming Drive, Suite 200
Collingwood, ON L9Y 5A6
Tel: (705) 444-2565 Fax: (705) 444-2327
info@cctatham.com

prepared for

Royalton Homes Inc.

February 27, 2019

CCTA File 117159

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

1 Introduction

This traffic impact study has been prepared in support of the Blue Vista residential development located on the west side of Grey Road 21, north of Grey Road 19/Mountain Road, in the Town of The Blue Mountains, as illustrated in Figure 1.

The purpose of this study is to address the requirements of the Town of The Blue Mountains and Grey County with respect to the potential transportation impacts of the development on the area road network. In particular, the following will be discussed:

- the operations of the road system through the study area prior to the proposed development;
- an estimation of the growth in the traffic volumes not otherwise attributed to the development (i.e. from overall growth in the area and/or other developments);
- an estimation of the number of new trips the proposed development is likely to generate;
- the operations of the study area road system upon completion of the development; and
- the resulting impacts and need for mitigating measures (if required) to ensure acceptable overall road operations.

Chapter 2 of this report addresses the existing conditions, detailing the road system and corresponding traffic operations. Chapter 3 addresses future conditions, prior to the completion of the proposed development, and will address the expected growth in the traffic levels and the resulting operating conditions. Chapters 4 and 5 address the proposed development, the ensuing vehicle trips that it will generate, and the associated impacts on the road system. Lastly, Chapter 6 summarizes the report and the key findings.

2 Existing Conditions

This chapter will describe the road network, traffic volumes and operations for the existing conditions.

2.1 Road Network

2.1.1 Road Sections

The immediate road network includes Grey Road 19, Grey Road 21 (Osler Bluff Road), and Monterra Road. Photographs of the road system are provided in Figure 2.

Grey Road 19

Grey Road 19 is an arterial road under the jurisdiction of Grey County. The road provides a single lane in each direction with a 2.0 to 2.5 metre paved shoulder/bike lane on each side from Gord Canning Drive to Jozo Weider Boulevard and beyond. Immediately west of Grey Road 21, the horizontal alignment of Grey Road 19 is relatively straight; near Gord Canning Drive, Grey Road 19 turns 90 degrees through a smooth horizontal curve and roundabout. With respect to the vertical alignment, the road section is relatively flat. The posted speed limit on Grey Road 19 is 60 km/h and hence a design speed of 70 km/h has been assumed (posted speed + 10 km/h for lower speed roads).

Grey Road 21 (Osler Bluff Road)

Grey Road 21 (Osler Bluff Road) is also an arterial road under the jurisdiction of Grey County and the County of Simcoe in that it is a boundary road. It has a relatively straight alignment with slight vertical curves along the across the front of the Blue Vista site. The road section immediately north of Grey Road 19 was recently resurfaced and provides a single lane in each direction with a 1.5 metre paved shoulder/bike lane. The posted speed limit on the road is 60 km/h and hence a design speed of 70 km/h has been assumed.

Monterra Road

Monterra Road is a major collector road under the jurisdiction of the Town of The Blue Mountains. It has an east-west orientation providing connection between Grey Road 19 and Grey Road 21. The road maintains a relatively straight and flat alignment within the study area and provides a single lane of travel in each direction. Monterra Road has a posted speed limit of 60 km/h and hence a design speed of 70 km/h has been assumed.

2.1.2 Intersections

The intersections of Grey Road 21 with Grey Road 19 and Monterra Road have been considered in the study given their proximity to the site. The existing intersection configurations are illustrated in Figure 2 and noted below:

Grey Road 21 & Grey Road 19		**control: traffic signals**
west leg:	Grey Road 19	1 left-through shared lane and 1 right turn lane
east leg:	Mountain Road	1 left-through-right shared lane
north leg:	Grey Road 21	1 left turn lane and 1 through-right shared lane
south leg:	Grey Road 19	1 left turn lane and 1 through-right shared lane

Grey Road 21 & Monterra Road		**control: stop control on Monterra Road**
west leg:	Monterra Road	1 left-right shared lane
north leg:	Grey Road 21	1 through-right shared lane
south leg:	Grey Road 21	1 left-through shared lane

2.2 Traffic Volumes

Traffic Counts

Traffic counts were completed at the intersection of Grey Road 21 with Grey Road 19 on Friday March 17, 2017 and Saturday March 18, 2017, both of which were considered typical winter days (which are considered the peak seasonal traffic conditions given the seasonal nature of Blue Mountain). To capture the turnover relating to the end of day skiing and beginning of night skiing (which occurs at 15:30), and to capture typical winter peak operations, counts were completed from 15:00 to 18:00.

Traffic counts were also completed at the intersection on Friday February 28, 2014 and Saturday March 1, 2014 (again, representative of winter conditions). In comparison to the 2014 winter counts, the 2017 winter counts were 21% greater during the Friday PM peak hour and 13% less during the Saturday peak hour. Upon further review of the 2014 and 2017 Saturday peak hour volumes, most are comparable with the exception of the north-south through volumes. To ensure representation of peak hour conditions, the north-south volumes were subsequently adjusted to better reflect 2014 conditions (i.e. more conservative).

Supplementary traffic counts were completed at the intersection of Grey Road 21 with Monterra Road on Friday October 19, 2018 and Saturday October 20, 2018. In comparison to the adjusted 2017 winter counts, the 2018 north-south volumes along Grey Road 21 were approximately 15% less during the

Friday PM Peak hour and 56% less during the Saturday peak hour. Given the seasonal nature of the study area, such fluctuations are not unexpected. In particular, the substantial traffic decrease observed during the Saturday peak hour is considered reasonable given that no winter operations were occurring at Blue Mountain Resort at the time of the counts (October). Therefore, to reflect peak winter conditions, the Friday PM peak hour volumes observed at the intersection of Grey Road 21 with Monterra Road during the October 2018 count were increased by 20%, whereas the Saturday peak hour volumes were increased by 125%.

2019 Traffic Volumes

To consider 2019 conditions at the intersection of Grey Road 21 with Grey Road 19, the 2017 volumes have been increased to account for background growth and development growth in the area, further details of which are provided in Section 3.2.

The resulting 2019 winter peak hour volumes are illustrated in Figure 3, whereas additional traffic count details are provided in Appendix A.

2.3 Traffic Operations

The assessment of existing conditions provides the baseline from which the future traffic volumes and operations (both with and without the subject development) can be assessed. The capacity, and hence operations, of a road system is effectively dictated by its intersections. As such, the analysis focused on the operations of the intersections of Grey Road 19 with Grey Road 21 and Monterra Road. The analysis is based on the 2019 winter traffic volumes, the existing intersection configurations and control, and procedures outlined in the *2000 Highway Capacity Manual*[1] (employing Synchro 10 traffic modelling software).

2019 Operations

A summary of the analysis is provided in Table 1 in the form of average delay (measured in seconds) and level of service (LOS). The results reflect the approach and overall intersection delays and levels of service - LOS A corresponds to the best operating condition with minimal delays whereas LOS F corresponds to poor operations resulting from high intersection delays. Volume to capacity ratios (v/c), which indicate the degree to which the intersection and/or approach capacity is utilized, are also noted. Detailed worksheets are included in Appendix B.

Based on the 2019 winter peak hour traffic volumes, all intersections provide acceptable operations with minimal delays.

[1] *Highway Capacity Manual*. Transportation Research Board, Washington DC, 2000.

Table 1: Intersection Operations - 2019 Traffic Volumes

Intersection and Movement		Control	Friday Peak Hour			Saturday Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Grey Road 19 & Grey Road 21	EB	signal	15	B	0.78	15	B	0.72
	WB		13	B	0.60	19	B	0.77
	NB		17	B	0.54	14	B	0.49
	SB		13	B	0.19	13	B	0.31
	overall		15	B	0.67	15	B	0.63
Monterra Road & Grey Road 21	EB	stop	10	B	0.07	14	B	0.24

2.4 Collingwood/Blue Mountains Transit Link

The Towns of Collingwood and The Blue Mountains jointly operate a public transit service between Collingwood and the Craigleith area, including Blue Mountain Resort. As illustrated in Figure 4, the route travels westbound on Grey Road 19 towards Blue Mountain, and continues through the area on its return trip to Collingwood, including southbound travel on Grey Road 21 in front of the Blue Vista site.

At present, there are no designated transit stops along either Grey Road 19 or Grey Road 21. It is expected that the need and opportunity for such will be explored by the Towns of Collingwood and The Blue Mountains as the area develops.

3 Future Background Conditions

This section will address the future background conditions (i.e. without consideration for the Blue Vista development) expected for the 2025, 2030 and 2035 horizons, and the need for mitigating measures. The 2025 horizon has been adopted to reflect completion of the Blue Vista development, whereas 2030 and 2035 correspond to 5 and 10-year planning horizons beyond build-out to consider the longer term impacts.

3.1 Road Network

Grey Road 19 Widening

With respect to the study area, *The Town of The Blue Mountain Comprehensive Transportation Strategic Plan* identified the following road improvements:

- 2013 Horizon
  - widening of Grey Road 19 to 2 lanes per direction from Grey Road 19/21 west to Jozo Weider Boulevard (east intersection)
  - provision of additional EB/WB through lanes at Grey Road 19/Grey Road 21 intersection
- 2018 Horizon
  - provision of EB and WB left turn lanes at Grey Road 19/Grey Road 21 intersection

The *Blue Mountain Resort South Base & Orchard Expansion, Town of The Blue Mountains, Traffic Impact Study*[2] also identified the need for additional lanes on Grey Road 19 through the study area, to serve the 2011 horizon year.

The noted widenings have not been implemented to date, and as there are no commitments from Grey County to implement such in the near future, they have only been considered as deemed necessary to accommodate future travel volumes.

[2] *Blue Mountain Resort South Base & Orchard Expansion, Town of The Blue Mountains, Traffic Impact Assessment.* Cansult Tatham Transportation Consultants, January 2006.

Grey Road 19/21 Roundabout

A Municipal Class Environmental Study is nearing completion for the intersection of Grey Road 19 and Grey Road 21[3], undertaken jointly by Grey County and the County of Simcoe. As per the draft report, the preferred solution for the intersection is as follows:

- a 2-lane roundabout with a 60 metre outside diameter and 2 approach lanes and 2 departure lanes on each leg; and
- the roundabout is to be located to the north and west of Mountainside Sports to avoid impacting the existing building.

Provided the Class EA is approved, it is understood that the roundabout will proceed to construction in 2020-2021.

3.2 Background Traffic Volumes

Background traffic volumes expected for the future horizon years have been estimated based on the existing traffic volumes and anticipated growth in the overall area.

3.2.1 Growth Rate

Growth rates for the horizon years have been determined considering the following:

- historic growth through the area as determined from traffic counts;
- traffic data and growth estimates presented in the *Georgian Triangle Area Transportation Study*[4]; and
- traffic data and growth estimates presented in the *Town of The Blue Mountain Comprehensive Transportation Strategic Plan*[5].

Historic counts (2005 to 2008) on Grey Road 19 both north and south of Gord Canning Drive indicate that winter volumes have increased in the order of 5 to 10% per annum. The *Georgian Triangle Area Transportation Study* indicates that winter traffic volumes in the area are expected to increase by 4 to 5% per year from the period 2000 to 2010 and 2% from 2010 to 2020. The *Town of The Blue Mountain Comprehensive Transportation Strategic Plan,* which prepared traffic forecasts for the years 2013, 2018 and 2028 (with consideration for overall growth, plus development specific growth), realized 4.4% annual

[3] *Grey Road 19 & Grey Road 21/Simcoe Road 34 Intersection Improvements, Class Environmental Assessment Phases 1 & 2 Report* - Draft, September 4, 2018.
[4] *Georgian Triangle Area Transportation Study.* Dillon Consulting, June 2001
[5] *The Town of The Blue Mountain Comprehensive Transportation Strategic Plan. AECOM in association with C.C. Tatham & Associates, March 2010.*

growth from 2008 to 2013, 3.4% from 2013 to 2018 and 2.9% from 2018 to 2028 (which translates to an overall annual growth of 3.4% over the 20 year period).

For purposes of this study, and in considering that traffic volumes from specific area developments will be addressed separately, a 2% annual growth rate has been assumed through to the year 2035. This growth rate translates to overall increases of 13%, 24% and 37% for the 2025, 2030 and 2035 horizon years (relative to the 2019 traffic volumes).

3.2.2 Other Development

Further to the overall growth through the area, a number of other specific planned developments that will contribute traffic volumes to the study area road system have been identified. These include the following developments:

- continued growth at Blue Mountain Village (both commercial and residential);
- Manorwood Block 152 and Block 153;
- Monterra Phase 2;
- Mountain House;
- Plateau East;
- Second Nature; and
- Windfall (Phases 2 through 6).

An overall map illustrating the location of the above noted developments in context of the Windfall development is provided in Figure 5, whereas additional details are provided below. As evident in the figure, Crosswinds Boulevard is to be extended through the Windfall and Second Nature developments. Similarly, a road connection will be extended through Second Nature and Blue Vista, ultimately connecting Grey Road 19 with Grey Road 21.

Blue Mountain Village

The Blue Mountain Village development consists of 1091 residential units and 9300 m^2 commercial space. Traffic volumes generated by the Village have been documented in the report *Blue Mountain Resort Village Transportation Considerations*[6] with adjustments to reflect the actual full build-out and level of remaining development. Trip distribution at the intersection of Grey Road 19 and Grey Road 21,

[6] *Blue Mountain Resort Village Transportation Considerations.* BA Group Transportation Consultants, Revised January 14, 2000.

which was not otherwise considered in the noted report, has been developed based on the existing traffic patterns at the intersection.

Manorwood Blocks 152 & 153

Manorwood, formerly a part of the Second Nature Development, is located on the south-east corner of Grey Road 19 with Jozo Weider Boulevard. Whilst still under planning, the development is expected to consist of 74 townhouses across the 2 blocks.

Monterra Phase 2

Monterra Phase 2 is a 37 unit, single family home development located at the south-west corner of Grey Road 21 with Monterra Road.

Mountain House

Mountain House is a medium density development located on the northwest corner of Grey Road 19 and Grey Road 21. Upon full build-out, it will consist of 230 condominium units constructed over 12 buildings, varying in height from 2 to 4 stories. Phase 1 is currently under construction, with Phases 2 and 3 anticipated over the next several years.

Plateau East

Plateau East is located north of the Blue Vista site, and consists of 39 single detached lots. At the time of the March 2017 traffic counts, 13 of the 39 lots were assumed developed and occupied.

Second Nature

The Second Nature development is to consist of 178 single family detached units. Phase 1 is currently under construction as is Phase 2 (which is solely the construction of Crosswinds Boulevard within the Second Nature development limits). Phase 3 is in the approval process.

Windfall

The Windfall development is to consist of 279 single family detached units and 402 semi-detached units for a total of 681 residential units. At the time of the March 2017 traffic counts, Phase 1 was fully built-out and occupied (37 single family units), whereas Phase 2 was partially constructed with 13 of the 67 single family units and 10 of the 100 semi-detached units constructed and occupied. Thus 621 units remain to be constructed. For the purpose of this report, full build out of Phase 2 has been considered under existing conditions (2019). Phase 3 is currently under construction with build-out anticipated by 2019, whereas completion of Phases 4 through 6 is expected between 2021 and 2025.

3.2.3 Other Development Traffic Volumes

Trip Generation

Trip generation estimates for the continued development at the Blue Mountain Village were obtained from the report *Blue Mountain Resort Village Transportation Considerations.* For the remaining residential developments (with the exception of the Windfall development, as detailed below), trip estimates were prepared in consideration of the number and type of units anticipated (eg. single family, townhouses, semi-detached or condo units) and corresponding trip rates as per the ITE *Trip Generation Manual* 9th *Edition.*

For the Windfall development, trip estimates have been based on trip data specific to the Windfall site, as noted in the *Windfall Traffic Impact Study*[7]. Site specific trip rates were established from the 2017 traffic counts at Crosswinds Boulevard and Grey Road 19, recognizing that Crosswinds Boulevard only served Windfall development at the time of the count (at which time there were 50 singles and 10 semi-detached units occupied). Upon comparison, it was found that the site specific trip rates were relatively similar to the ITE rates; however, to reflect the unique product of Windfall, the "existing Windfall" trip rates were employed (which are considered conservative in that a greater proportion of the remaining Windfall units will be semi-detached units as opposed to singles, which are likely to generate fewer trips).

A summary of the corresponding trips for the various background developments considered is provided in Table 2, whereas additional details are provided in Appendix C.

Table 2: Background Development Trip Generation Estimates

Development	Size		Fri PM Peak Hour			Sat Peak Hour		
			in	out	total	in	out	total
Manorwood	74	units	26	13	39	19	16	35
Monterra Phase 2	32	units	20	12	32	16	14	30
Mountain House	230	units	80	39	119	58	50	108
Plateau East	26	units	17	10	27	13	11	24
Second Nature	178	units	113	67	180	88	78	166
Windfall	621	units	300	290	590	321	290	611
Total	1,161	units	556	431	987	515	459	974

[7] *Windfall Traffic Impact Study.* C.C. Tatham & Associates Ltd., Revised September, 2018.

Traffic Volumes

Traffic volumes associated with each of the previously noted developments have been assigned to the area road system in context of the following:

- proposed development location and access to the surrounding road system;
- trip distribution and assignments as employed in the development specific traffic studies; and/or
- travel patterns realized through the traffic counts.

The resulting traffic volumes associated with each development are provided in Appendix C. As previously noted, Crosswinds Boulevard is expected to be extended and completed through to the intersection of Grey Road 19/Jozo Weider Boulevard in the year 2020 in conjunction with construction of Phase 4 of the Windfall development. As such, the illustrated assignments reflect the associated implications to traffic flows through the area considering the extension of Crosswinds Boulevard.

Phasing

The planned development timelines/phasing for each of the noted background developments has also been considered in context of when the associated traffic volumes will be realized on the area road system (and hence considered in each of the future horizon design years). Phasing details were established in context of current development plans (for those under construction) and/or anticipated timelines based on development status (i.e. concept, draft plan approved, etc.). A summary of the phasing, including full build-out, is provided in Table 3.

As noted, Plateau East and Windfall Phase 2 have been assumed as built out in 2019, and thus were included in the assessment of 2019 existing conditions. It is further noted that all of the identified background developments are assumed to be 100% complete by the year 2025 (which coincides with the expected completion of the Blue Vista development).

Table 3: Background Development Phasing

Development	Build-Out	Percent Complete by Year								
		2019	2020	2021	2022	2023	2024	2025	2030	2035
Blue Mountain Commercial	2021		66	100	100	100	100	100	100	100
Blue Mountain Residential	2021		66	100	100	100	100	100	100	100
Manorwood Block 152	2019		100	100	100	100	100	100	100	100
Manorwood Block 153	2021			100	100	100	100	100	100	100
Monterra Phase 2	2022		50	75	100	100	100	100	100	100
Mountain House Phase 1	2019		100	100	100	100	100	100	100	100
Mountain House Phase 2	2020		100	100	100	100	100	100	100	100
Mountain House Phase 3	2022				100	100	100	100	100	100
Plateau East	2018	100	100	100	100	100	100	100	100	100
Second Nature Phase 1	2019		100	100	100	100	100	100	100	100
Second Nature Phase 3	2024			25	50	75	100	100	100	100
Windfall Phase 2	2018	100	100	100	100	100	100	100	100	100
Windfall Phase 3	2019		100	100	100	100	100	100	100	100
Windfall Phase 4	2021		50	100	100	100	100	100	100	100
Windfall Phase 5	2023				50	100	100	100	100	100
Windfall Phase 6	2025						50	100	100	100

Recognizing that Second Nature Phase 2 consists solely of the construction of Crosswinds Boulevard within the Second Nature development, it has not been included in the table above (i.e. there are no dwelling units associated with Phase 2).

3.2.4 Background Traffic Volumes

The resulting future background traffic volumes (existing volume + general growth + other development traffic) are illustrated in Figure 6, Figure 7 and Figure 8 for the years 2025, 2030 and 2035.

3.3 Background Traffic Operations

3.3.1 Link Operations

As per the future background traffic projections, the peak hour traffic volumes on Grey Road 19 are projected to be in the order of 1000 to 1500a vehicles per hour per lane (vphpl), whereas the volumes on Grey Road 21 are projected to be in the order of 200 to 500 vphpl. Additional details are provided in Table 4 by horizon year, location and direction of travel. Both Grey Road 19 and 21 are assumed to have capacities of 1000 vehicles per hour per lane (which is reflective of their arterial status). As noted, the projected background volumes on Grey Road 19 (west of Grey Road 21) are expected to exceed the assumed planning capacity, confirming the long-term need for additional road capacity (i.e. additional lanes).

The projected background volumes on Grey Road 21 are expected to remain well below the available capacity and thus no improvements are required to address capacity.

Table 4: Link Operations - Background Traffic Volumes

Horizon Year	Direction	Capacity (vph)	Grey Road 19 (west of GR21)		Grey Road 21 (north of GR19)		Grey Road 21 (north of Monterra)	
			Fri	Sat	Fri	Sat	Fri	Sat
2025	WB/SB	1000	1093	1106	257	373	218	389
	EB/NB	1000	1280	1059	294	350	204	312
2030	WB/SB	1000	1161	1180	279	406	239	428
	EB/NB	1000	1371	1130	315	380	224	343
2035	WB/SB	1000	1262	1235	303	442	263	471
	EB/NB	1000	1471	1209	339	412	246	378

3.3.2 Intersection Operations

The operations of the key area intersections were again investigated given the expected increases in traffic volumes. As previously noted, a roundabout is planned for the intersection of Grey Road 19 with Grey Road 21 for 2020-2021 and hence this has been considered in the analysis (assuming a 2-lane roundabout with a 60 metre outside diameter and 2 approach lanes and 2 departure lanes on each leg). Assessment of the roundabout operations has been completed using aaSidra modelling software.

The results of the operational analyses for each horizon year are provided in Table 5 through Table 7, whereas detailed worksheets are included in Appendix D through Appendix F.

Table 5: Intersection Operations - 2025 Background Traffic Volumes

Intersection and Movement		Control	Friday Peak Hour			Saturday Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Grey Road 19 & Grey Road 21	NB	roundabout	9	A	0.40	8	A	0.34
	WB		3	A	0.46	3	A	0.47
	SB		7	A	0.24	7	A	0.37
	EB		2	A	0.49	2	A	0.47
	overall		3	A	0.49	4	A	0.47
Monterra Road & Grey Road 21	EB	stop	11	B	0.11	16	C	0.33

Table 6: Intersection Operations - 2030 Background Traffic Volumes

Intersection and Movement		Control	Friday Peak Hour			Saturday Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Grey Road 19 & Grey Road 21	NB	roundabout	9	A	0.45	8	A	0.39
	WB		3	A	0.50	4	A	0.52
	SB		7	A	0.27	8	A	0.42
	EB		2	A	0.53	2	A	0.52
	overall		4	A	0.53	4	A	0.52
Monterra Road & Grey Road 21	EB	stop	11	B	0.12	19	C	0.40

Table 7: Intersection Operations - 2035 Background Traffic Volumes

Intersection and Movement		Control	Friday Peak Hour			Saturday Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Grey Road 19 & Grey Road 21	NB	roundabout	11	B	0.52	9	A	0.44
	WB		4	A	0.55	5	A	0.58
	SB		8	A	0.31	9	A	0.49
	EB		2	A	0.59	3	A	0.57
	overall		5	A	0.59	5	A	0.57
Monterra Road & Grey Road 21	EB	stop	12	B	0.14	22	C	0.48

As indicated, the roundabout and stop controlled intersection will provide good operations (LOS C or better) through the 2035 horizon given the projected background volumes. As such, no improvements are required to address background conditions.

4 Blue Vista Development

This section will provide additional details with respect to the proposed development, including its location, the projected site generated traffic volumes and the assignment to the road network.

4.1 Site Location

As previously illustrated in Figure 1, the proposed development is located on the west side of Grey Road 21, north of Grey Road 19/Mountain Road, in the Town of The Blue Mountains.

4.2 Proposed Land Use & Phasing

The proposed Blue Vista residential development will consist of 133 single family units with full build-out anticipated by 2025.

A site plan is provided in Figure 9.

4.3 Site Access

The site will be served by two access points as follows:

- direct access to Grey Road 21 (located approximately 760 metres north of Grey Road 19 - measured from centreline to centreline); and
- access via Crosswinds Boulevard (which will run through the Windfall and Second Nature Developments) to which the internal road will be extended.

With respect to the latter, it is acknowledged that the extension of the internal road system to provide access to Crosswinds Boulevard will require a crossing of the watercourse which bisects the property and will traverse an area mapped as unevaluated wetland (as is evident in Figure 9). It is noted that this extension and crossing are necessary to provide a secondary means of access to the overall development which is required to satisfy Town standards (a single access is sufficient to service 85 units, beyond which additional access is to be provided). While it is possible that the 77 units east of the watercourse could be developed separate from the 56 units to the west (the 77 units would have direct access to Grey Road 19 whereas the 56 units would have access via Second Nature), an internal road connection is recommended from a transportation planning perspective, with benefit to not only the Blue Vista development, but also the Second Nature development. The internal connection will allow motorists to access Grey Road 19, Grey Road 21 and surrounding areas (eg. Blue Mountain) without the need to exit the development, hence reducing travel demands on the external road system. In addition, it is understood that the road corridor will accommodate municipal infrastructure and utilities that are required to service the development and to maintain service continuity.

4.4 Site Generated Trips

4.4.1 Trip Generation

Trip generation rates for the proposed Blue Vista development were determined from the *ITE Trip Generation Manual 10th Edition* reflective of a "single family detached" land use (code 210). The associated trip rates and trip estimates are provided in Table 8.

Table 8: Blue Vista Trip Generation Rates

Land Use	rate/ estimate	Unit/ Size	Friday PM Peak Hour			SAT Peak Hour		
			in	out	total	in	out	total
single family detached	rate	unit	0.62	0.37	0.99	0.50	0.43	0.93
	estimate	121	83	49	132	67	57	124

Overall, the proposed development is expected to generate 132 trips during the weekday Friday PM peak hour and 124 trips during the Saturday peak hour (total of inbound and outbound trips).

4.4.2 Trip Distribution & Assignment

The distribution of the trips to be generated by the site to the area road system was based on the existing traffic patterns through the study area as realized through the March 2017 traffic counts (assuming that the future residents will exhibit similar travel patterns as the existing residents). The resulting distributions are summarized in Table 9. It is noted that there is a greater emphasis for travel to/from areas to the west of Blue Vista (i.e. to the mountain) during the Saturday peak hour, which is likely attributed to winter ski activities in the immediate area.

Vehicles were assigned to the site access points based on the location of the residential units with respect to the access points and the directness of travel routes. The resulting site generated traffic volumes are illustrated in Figure 10. As previously noted, Crosswinds Boulevard is expected to be extended and completed through to the intersection of Grey Road 19/Jozo Weider Boulevard in the year 2020 in conjunction with construction of Phase 4 of the Windfall development, which is reflected in the distribution of site volumes (i.e. traffic volumes to/from the west are expected to utilize Crosswinds Boulevard and travel through Second Nature to access Grey Road 19).

Table 9: Blue Vista Trip Distribution

Direction		Friday PM Peak Hour	Saturday Peak Hour
to/from Grey Road 19	north	20%	25%
to/from Jozo Weider Boulevard	west	10%	15%
to/from Gord Canning Drive	west	10%	10%
to/from Grey Road 119 (Scenic Caves Road)	south	0%	5%
to/from Grey Road 21	north	0%	0%
to/from Mountain Road	east	40%	30%
to/from Grey Road 19	south	20%	15%
Total		100%	100%

5 Future Total Conditions

This section will address the future total conditions (i.e. with consideration for the Blue Vista development) and any resulting impacts of the development on the area road system. Namely, the following will be addressed:

- need for additional road improvements to accommodate the site generated volumes;
- operations of the study area intersections, including the site access point; and
- available sight lines on Grey Road 21 at the site access.

5.1 Total Traffic Volumes

To assess the impacts of the increased traffic volumes resulting from the proposed development, the site-generated traffic was combined with the 2025, 2030 and 2035 background traffic volumes. The resulting future total volumes are illustrated in Figure 11 through Figure 13 and consider the following:

- the completion of Crosswinds Boulevard through Windfall and Second Nature by 2020 (in conjunction with construction of Phase 4 Windfall); and
- the connection between Blue Vista and Second Nature by 2025 (in conjunction with build-out of Blue Vista).

5.2 Total Traffic Operations

5.2.1 Intersection Operations

The operations of the study area intersections have been investigated based on the future total volumes and in considering the roundabout at the intersection of Grey Road 19 and Grey Road 21 (as previously noted under background conditions for the 2020-2021 horizon year). In addition to this, the operations of the proposed site access point at Grey Road 21 have also been reviewed. While it is acknowledged that the site will also contribute traffic volumes to the intersection of Grey Road 19 with Jozo Weider Boulevard/Crosswinds Boulevard, the operations of such have not been considered in this assessment. It is noted that the intersection of Grey Road 19 with Jozo Weider Boulevard/Crosswinds Boulevard was considered in the *Windfall Traffic Impact Study,* which was comprehensive in its consideration of background traffic – including the Blue Vista development. The Windfall study concluded that the intersection would provide excellent operations through the 2035 horizon year.

The results of the operational analyses for each horizon year are provided in Table 10 through Table 12, whereas detailed worksheets are provided in Appendix G through Appendix I. As indicated, the study area intersections will continue to provide good operating conditions (LOS C or better) through 2035 with average delays given the projected background growth and additional traffic associated with the Blue

Vista development. As such, no intersection improvements are considered necessary to address the future total operations of the study area intersections.

Table 10: Intersection Operations - 2025 Total Traffic Volumes

Intersection and Movement		Control	Friday Peak Hour			Saturday Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Grey Road 19 & Grey Road 21	NB	roundabout	9	A	0.41	7	A	0.35
	WB3		3	A	0.48	3	A	0.49
	SB		7	A	0.25	7	A	0.39
	EB		2	A	0.51	2	A	0.49
	overall		4	A	0.51	4	A	0.49
Monterra Road & Grey Road 21	EB	stop	11	B	0.11	17	C	0.34
Site Access & Grey Road 21	EB	stop	10	B	0.05	11	B	0.07

Table 11: Intersection Operations - 2030 Total Traffic Volumes

Intersection and Movement		Control	Friday Peak Hour			Saturday Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Grey Road 19 & Grey Road 21	NB	roundabout	10	A	0.47	8	A	0.41
	WB		4	A	0.52	4	A	0.54
	SB		8	A	0.29	8	A	0.44
	EB		2	A	0.56	3	A	0.54
	overall		4	A	0.56	5	A	0.54
Monterra Road & Grey Road 21	EB	stop	11	B	0.13	19	C	0.40
Site Access & Grey Road 21	EB	stop	10	B	0.05	12	B	0.07

Table 12: Intersection Operations - 2035 Total Traffic Volumes

Intersection and Movement		Control	Friday Peak Hour			Saturday Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Grey Road 19 & Grey Road 21	NB	roundabout	11	B	0.54	9	A	0.47
	WB		5	A	0.57	5	A	0.60
	SB		8	A	0.33	10	A	0.52
	EB		2	A	0.61	3	A	0.59
	overall		5	A	0.61	6	A	0.
Monterra Road & Grey Road 21	EB	stop	12	B	0.14	23	C	0.48
Site Access & Grey Road 21	EB	stop	11	B	0.05	12	B	0.07

5.3 Turn Lane Requirements

Despite the otherwise acceptable operations provided at the intersection of Grey Road 21 with the proposed access point, the need for exclusive left and right turn lanes on Grey Road 21 to serve turning traffic has been reviewed based on MTO warrants. The review is based on the following:

- MTO guidelines[8] for auxiliary turn lanes at unsignalized intersections;
- a design speed of 70 km/h (reflective of the 60 km/h posted speed limit on Grey Road 21); and
- the projected 2025, 2030 and 2035 future background traffic volumes.

5.3.1 Right Turn Lane

MTO guidelines suggest that an exclusive right turn lane be considered where right turn volumes exceed 60 vehicles per hour and impede the operations of through traffic. Based on the estimated volume of southbound right turning traffic at the site access (3 to 4 vehicles per hour), an exclusive right turn lane is not warranted.

5.3.2 Left Turn Lane

For two-lane undivided highways, MTO warrants for left turn lanes at unsignalized intersections are based on design speed, advancing volume (i.e. traffic travelling in the same direction as left turning traffic), opposing volume (i.e. traffic travelling in the opposite direction that would impede left turning vehicles), and the percentage of left turns in the advancing volume. Based on the MTO warrant criteria

[8] *Geometric Design Standards for Ontario Highways*, Ontario Ministry of Transportation, undated.

(applying the MTO left turn nomograph reflecting 10% left turns in the advancing volume and a design speed of 70 km/h), a northbound left turn lane with 15 metres of storage is warranted under the 2030 total conditions. It is noted that the same is warranted under 2035 total conditions. The completed warrants are provided in Appendix J. Based on MTO geometric design standards, a left turn lane on a two-lane highway with a design speed of 70 km/h requires 40 metres of parallel lane and 115 metres of taper in addition to the storage requirement identified in the MTO warrant graphs. Thus, the left turn lane should be constructed to an overall length of 170 metres (15m storage + 40m parallel + 115m taper).

5.4 Sight Line Analysis

Based on MTO geometric design standards, the minimum stopping sight distance for a design speed of 70 km/h is 110 metres. This requirement provides sufficient distance for an approaching vehicle to observe a stationary hazard in the road (i.e. a vehicle stopped at an intersection waiting to complete a turn) and bring the vehicle to a complete stop prior to the hazard.

The available sight lines along Grey Road 21 at the proposed site access point are approximately 300 metres to/from the north and approximately 140 metres to/from the south (limited by the vertical curve).

As such, adequate sight lines are provided in both directions at the site access to ensure safe operations for vehicles turning to/from the site. As a result, no improvements to address sight line constraints are required.

5.5 Collingwood/Blue Mountains Transit Service

As previously noted, and illustrated in Figure 4, the Collingwood/Blue Mountains transit service travels southbound on Grey Road 19 across the front of the Blue Vista development site. While there are no existing transit stops on Grey Road 19, such could be considered in conjunction with overall area development, subject to approvals from the Towns of Collingwood and The Blue Mountains.

Future routing through the Blue Vista could readily be accommodated on the proposed road system (and likewise service could be extended through Windfall and Second Nature given the connectivity). Alternatively, transit stops could be implemented on the boundary roads (eg. Grey Road 19 and Grey Road 21) to serve these developments

6 Summary

This study has addressed the transportation impacts associated with the proposed Blue Vista residential development to be located on the west side of Grey Road 21, north of Grey Road 19/Mountain Road, in the Town of The Blue Mountains.

Blue Vista Development

The proposed Blue Vista residential development is currently proposed at 133 single family units. Overall, the development is expected to generate 132 trips during the Friday PM peak hour and 124 trips during the Saturday peak hour. Given the ski activities during the winter in the area, winter Friday PM and Saturday peak hours have been used as the study periods.

Site Access

Blue Vista traffic will have direct access to Grey Road 21 to the east and access to Crosswinds Boulevard to the west via connection of the internal road through the Second Nature development. As per Town standards, 2 points of access are required to serve developments in excess of 85 residential units, to ensure emergency services have appropriate means of access. The access to Grey Road 21 is sufficient to support the 77 units proposed on the east side of the water course; the connection to the Second Nature road system is required to support the remaining units (albeit the road extension and crossing may be required sooner to facilitate the delivery of municipal infrastructure and utilities).

Horizon Years

To address the potential impacts of the proposed site, peak hour operations were reviewed for the 2025 (build-out of Blue Vista), 2030 (5 years beyond build-out) and 2035 (10 years beyond build-out) horizons at the intersections of Grey Road 21 with Grey Road 19, Monterra Road and the proposed site access. In addition to Blue Vista traffic, future traffic volumes considered overall growth in the area plus traffic associated with other area developments either under construction or in the planning stages, including:

- additional commercial and residential development at the Blue Mountain Village;
- Manorwood Blocks 152 and 153;
- Monterra Phase 2;
- Mountain House;
- Plateau East;
- Second Nature; and

- Windfall.

Planned Road Improvements

The following road system improvements have been previously identified and were considered in this review:

- provision of a roundabout at the intersection of Grey Road 19 and Grey Road 21 for the time period 2020-2021; and
- extension of Crosswinds Boulevard through Windfall to Second Nature, with a connection to Grey Road 19 opposite Jozo Weider Boulevard by 2020.

The above noted roundabout is expected to be the same size as that at Grey Road 19 / Grey road 119 / Gord Canning Drive, thus providing consistency along the Grey Road 19 corridor.

Traffic Operations

In addressing the study area traffic operations, the intersections of Grey Road 19 with Grey Road 21 and Monterra Road were analysed under existing conditions (2019) and for the 2025, 2030 and 2035 horizon periods. The results of the operational analyses indicate that the study area intersections will provide good overall operations through 2035 under both future background and future total conditions. The operations at the site access point on Grey Road 21 was also reviewed and is expected to provide excellent conditions (LOS B or better) through 2035.

The capacity of the adjacent road network was reviewed under background conditions. With projected volumes expected to exceed the planning capacity on Grey Road 19, the long-term need for additional road capacity (i.e. additional lanes) was confirmed, while Grey Road 21 is expected to operate well below capacity through the 2035 horizon. It is noted that additional lane capacity on Grey Road 19 through the study area was also identified in *The Town of The Blue Mountain Comprehensive Transportation Strategic Plan* and the *Blue Mountain Resort South Base & Orchard Expansion, Town of The Blue Mountains, Traffic Impact Study.*

Turn Lane Requirements

The intersection of Grey Road 21 with the proposed site access point were reviewed with respect to the need to implement exclusive turn lanes to accommodate the projected traffic volumes. While a right turn lane is not warranted at the noted intersection, a northbound left turn lane on Grey Road 21 is warranted under 2030 total conditions. It is noted that the timing of such should be confirmed through ongoing monitoring, recognizing that the assessment considers fairly conservative background growth assumptions.

Sight Line Review

Sight lines were reviewed on Grey Road 21 at the proposed Site Access. The available sight distances exceed the minimum stopping sight distance requirements for a design speed of 70 km/h. As such, vehicles manoeuvring to/from the development can do so in a safe and efficient manner and no further improvements to address sight lines are required.

Collingwood/Blue Mountains Transit Service

The potential for the Collingwood/Blue Mountains Transit Service to service the Blue Vista development (and also the Windfall and Second Nature developments given the internal road connectivity) should be further reviewed with the Towns of Collingwood and The Blue Mountains in conjunction with overall growth and service delivery in the area. The road system as proposed internal to the Blue Vista development is deemed suitable to accommodate transit (along the main east-west spine through the site).

Authored by: Michael Cullip, P.Eng.
Vice President Head Office Operations

Reviewed by: David Perks, PTP
Transportation Planner

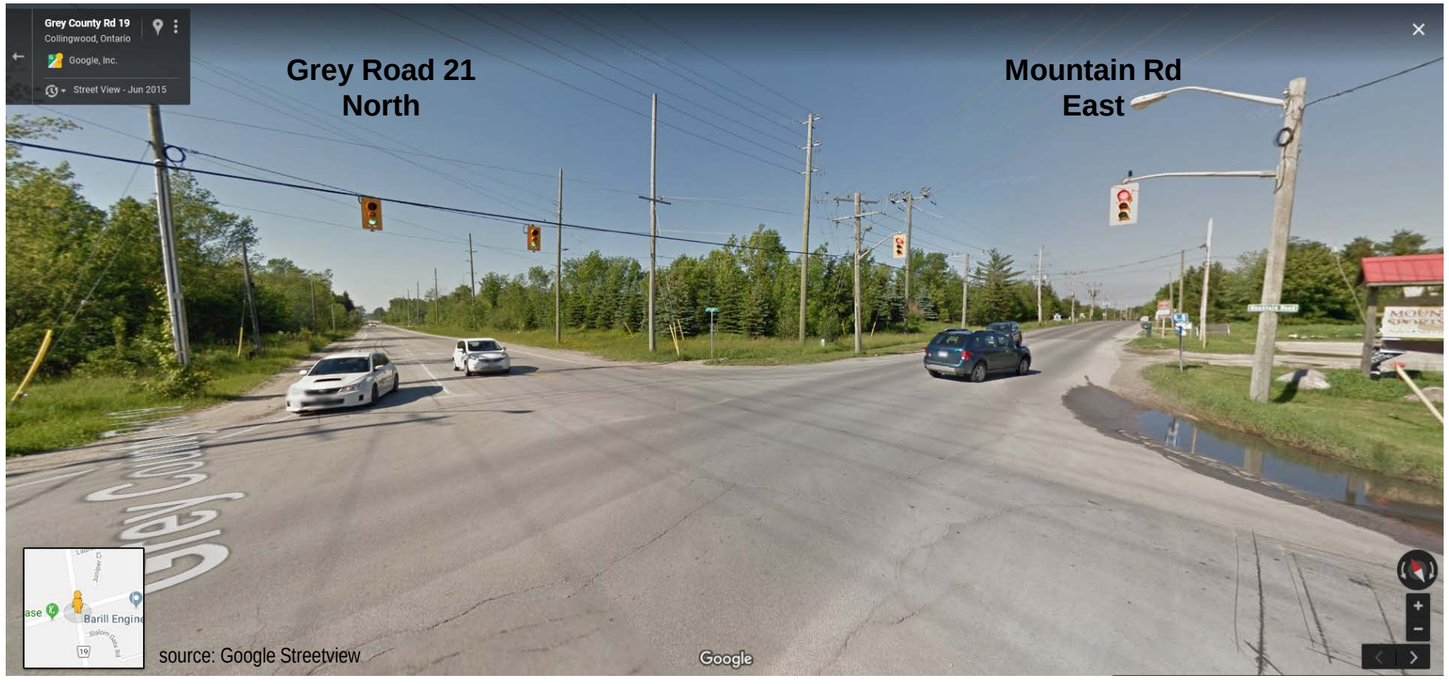
C.C.Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

Site Location

Figure

1



C.C.Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

Area Road Network - Grey Road 19 & Grey Road 21

Figure

2a

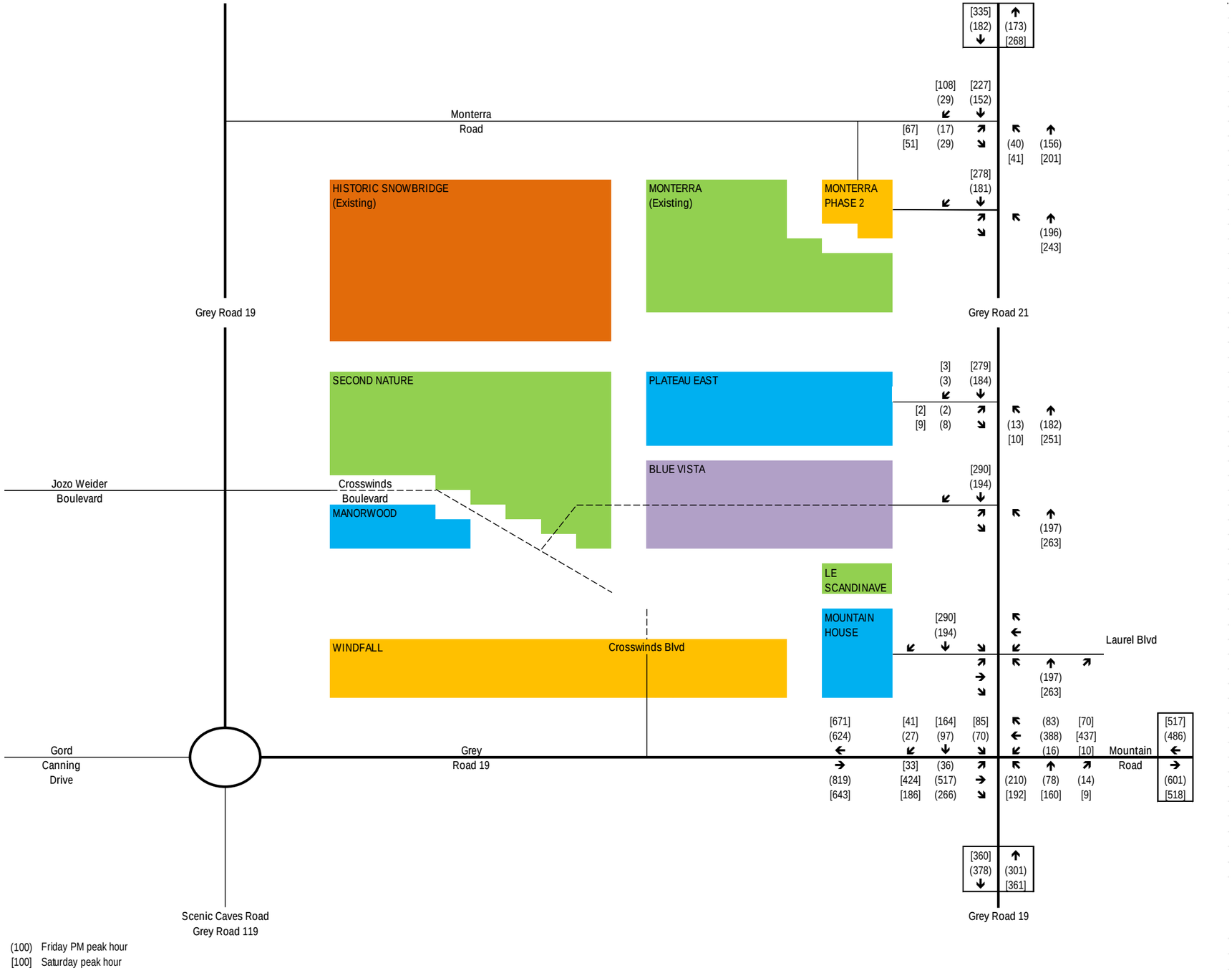
C.C. Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

Area Road Network - Grey Road 19 & Grey Road 21

Figure

2b



(100) Friday PM peak hour
[100] Saturday peak hour

C.C. Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

2019 Traffic Volumes

Figure

3

SERVICE HOURS
7 DAYS A WEEK
BETWEEN 7:00AM - 10:00AM AND 3:00PM - 7:00PM

FARE - $2:00 ONE WAY

TRANSIT SCHEDULE

ARRIVALS

COLLINGWOOD TERMINAL	*GEORGIAN MEADOWS OUTBOUND*	*BLUE MOUNTAIN VILLAGE*	*CRAIGLEITH*	*GEORGIAN MEADOWS INBOUND*
7:00	*7:06*	*7:16*	*7:27*	*7:37*
8:00	*8:06*	*8:16*	*8:27*	*8:37*
9:00	*9:06*	*9:16*	*9:27*	*9:37*
10:00				
3:00	*3:06*	*3:16*	*3:27*	*3:37*
4:00	*4:06*	*4:16*	*4:27*	*4:37*
5:00	*5:06*	*5:16*	*5:27*	*5:37*
6:00	*6:06*	*6:16*	*6:27*	*6:37*
7:00				

CRAIGLEITH COMMUNITY CENTRE

BLUE MOUNTAIN INN

BLUE MOUNTAIN VILLAGE

SOUTH BASE

MAIR MILLS

GEORGIAN MEADOWS

DOWNTOWN TERMINAL

Legend

- TRANSIT STOPS
- POINTS OF INTEREST
- COLLINGWOOD BLUE MOUNTAINS ROUTE.

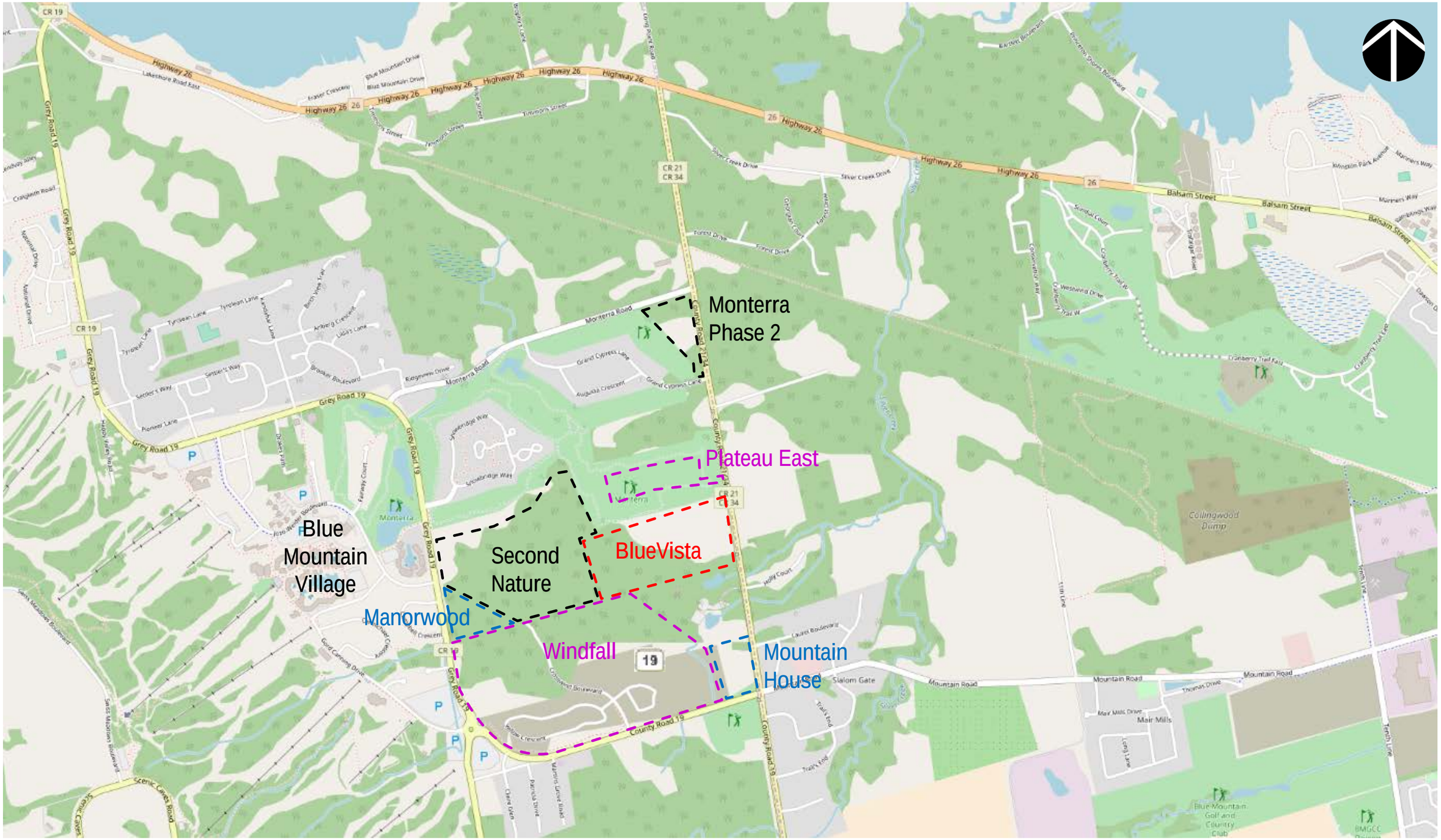
C.C.Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

Collingwood/Blue Mountains Transit Service

Figure

4



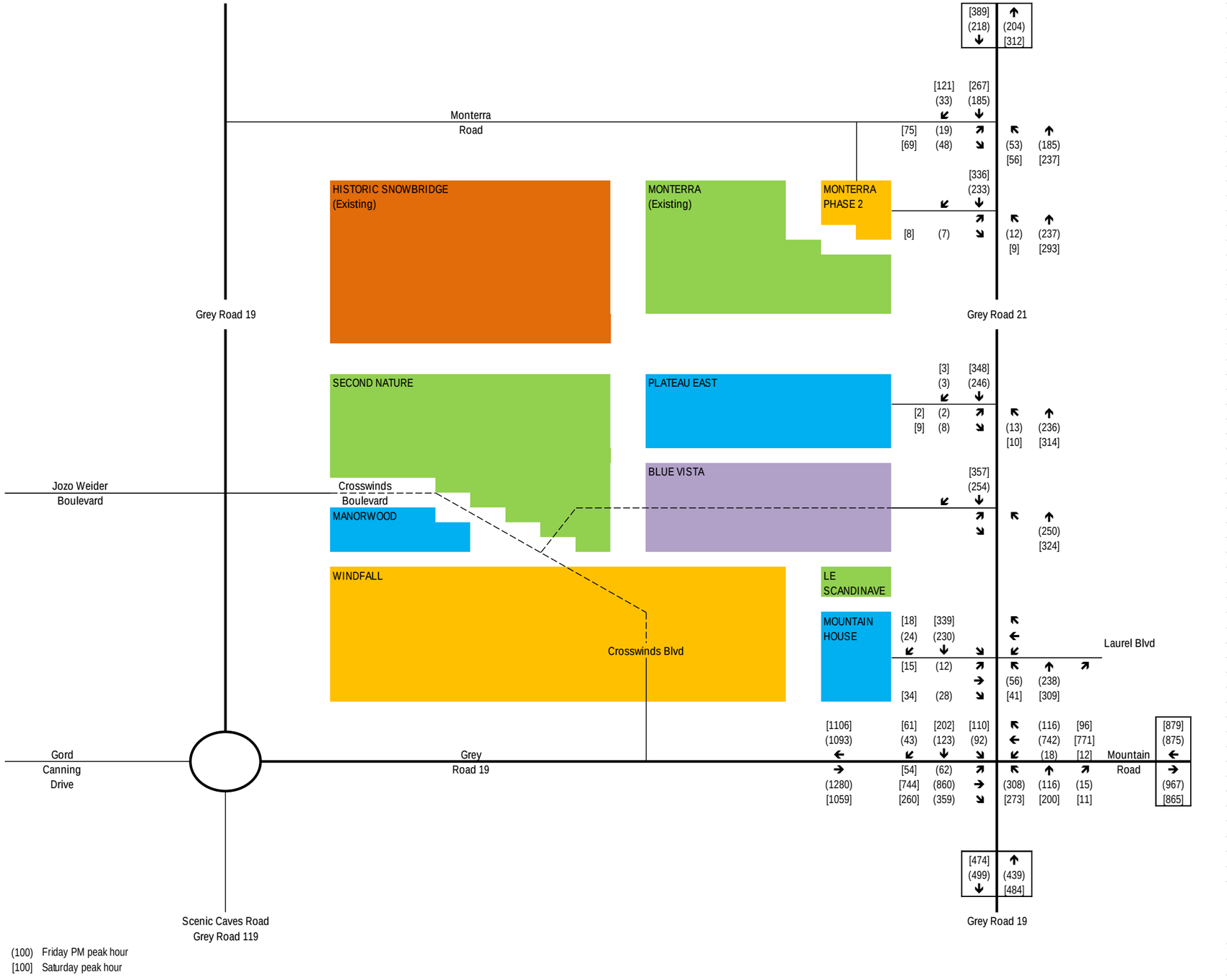
C.C.Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

Background Developments

Figure

5



(100) Friday PM peak hour
[100] Saturday peak hour

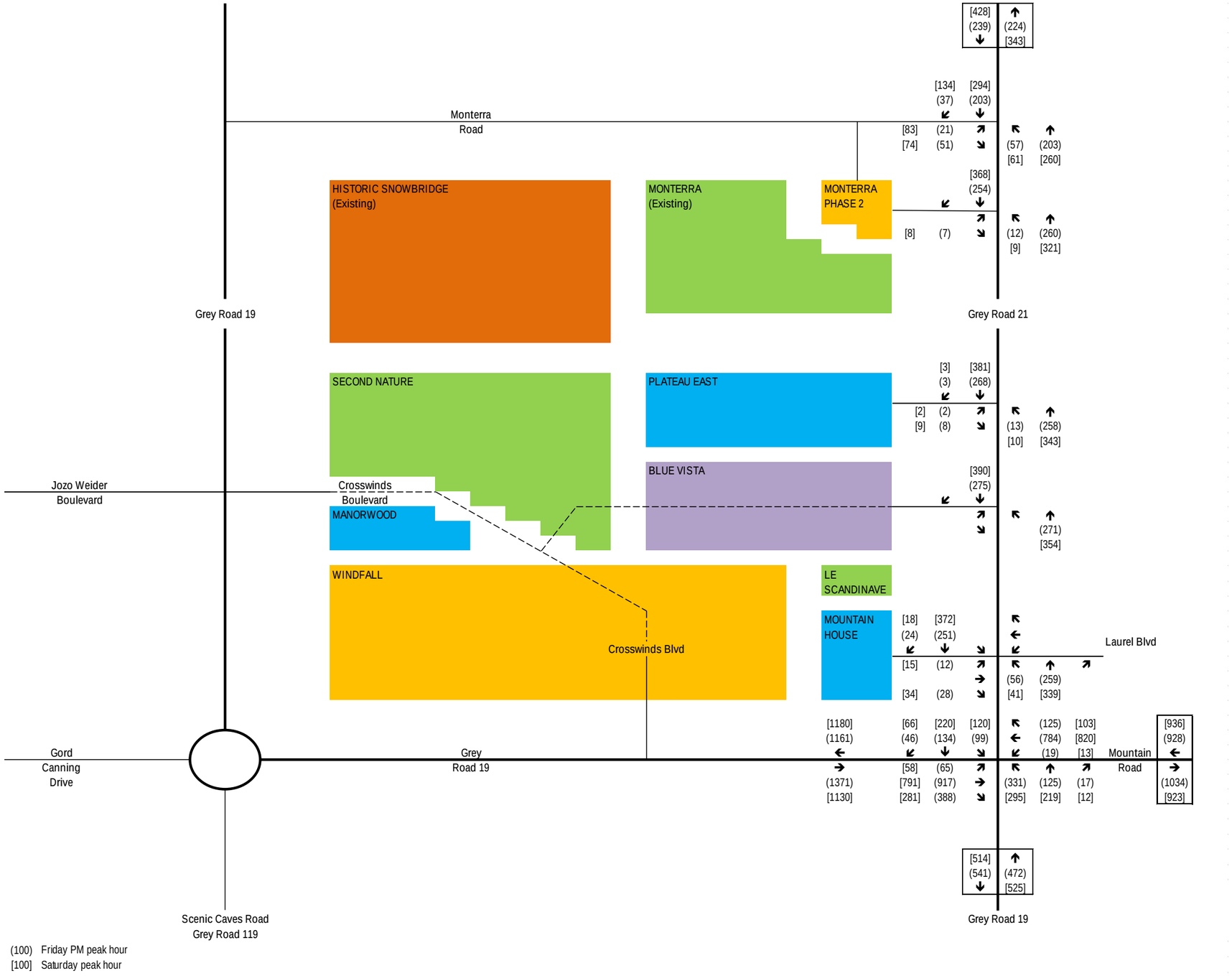
C.C.Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

2025 Background Traffic Volumes

Figure

6



(100) Friday PM peak hour
[100] Saturday peak hour

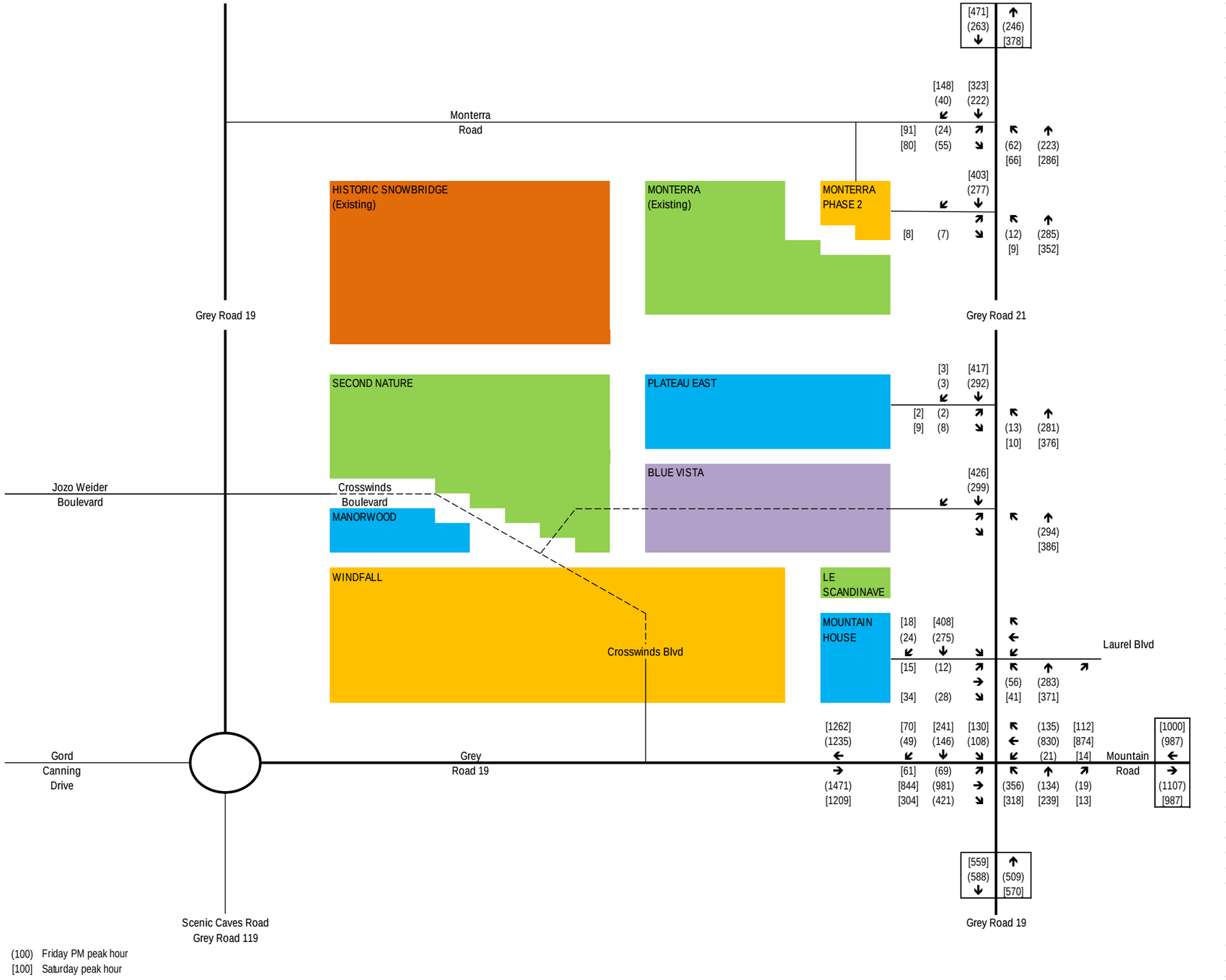
C.C. Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

2030 Background Traffic Volumes

Figure

7



(100) Friday PM peak hour
[100] Saturday peak hour

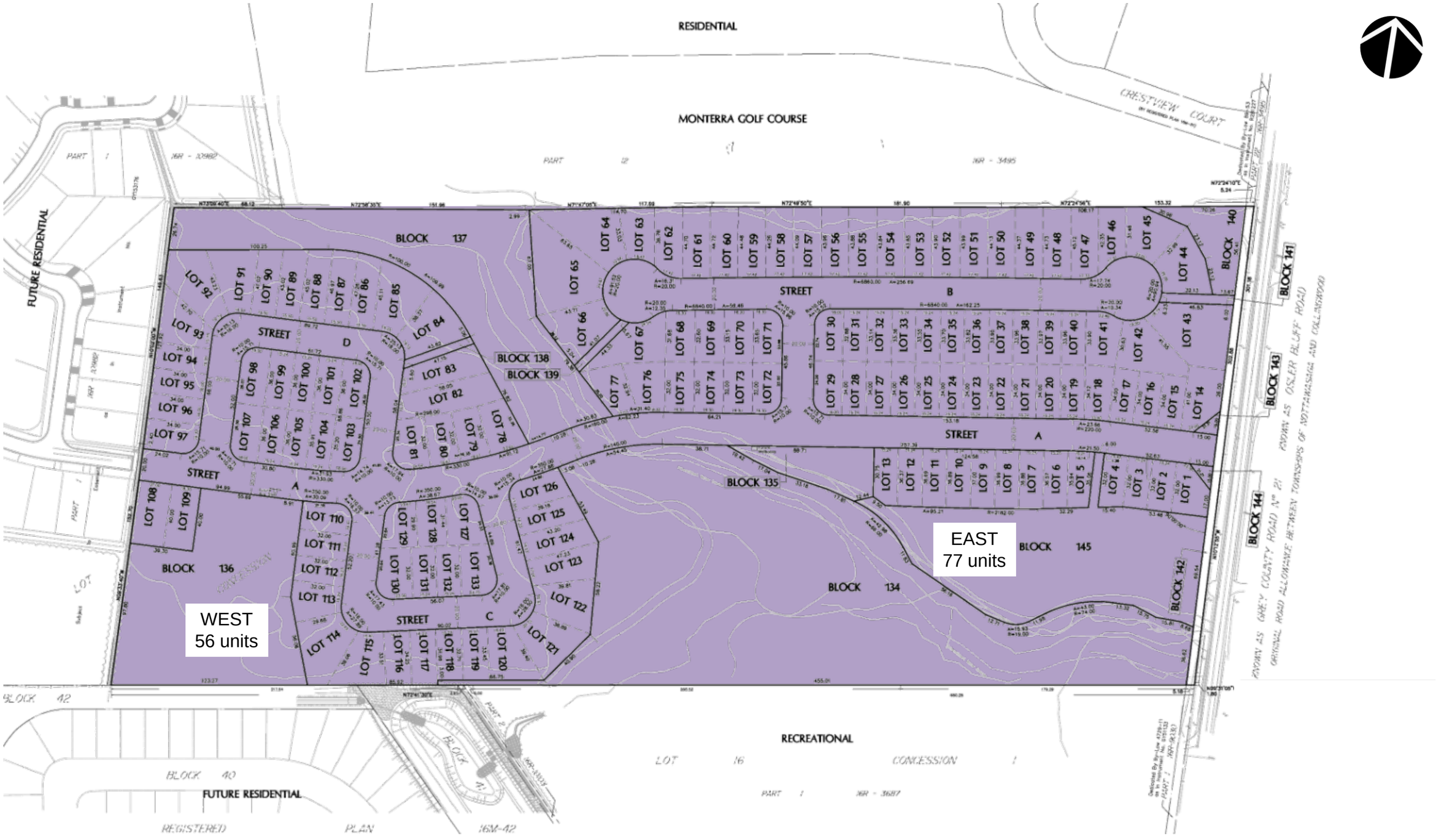
C.C. Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

2035 Background Traffic Volumes

Figure

8



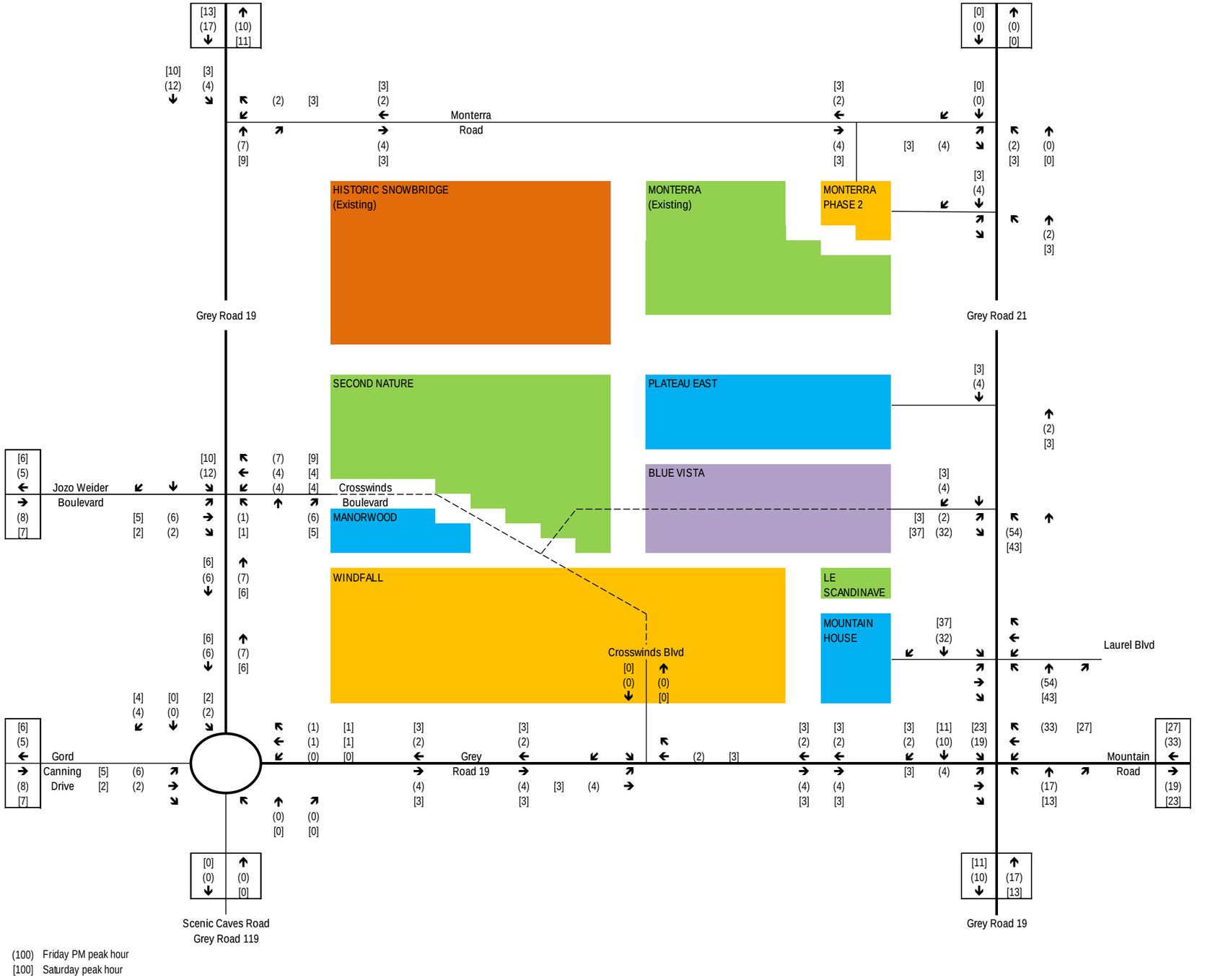
C.C.Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

Development Site Plan

Figure

9



(100) Friday PM peak hour
[100] Saturday peak hour

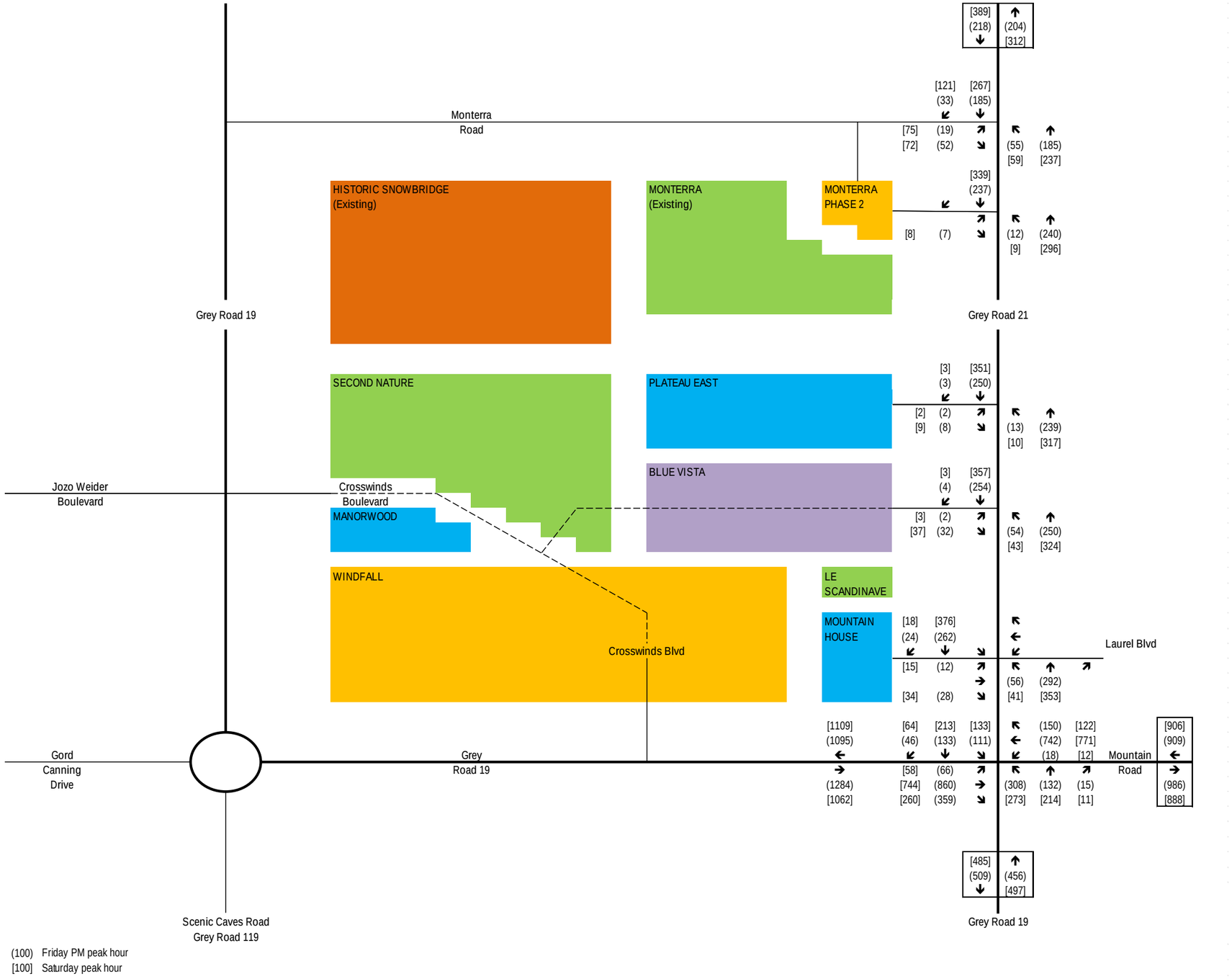
C.C.Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

BlueVista Development Traffic Volumes

Figure

10



(100) Friday PM peak hour
[100] Saturday peak hour

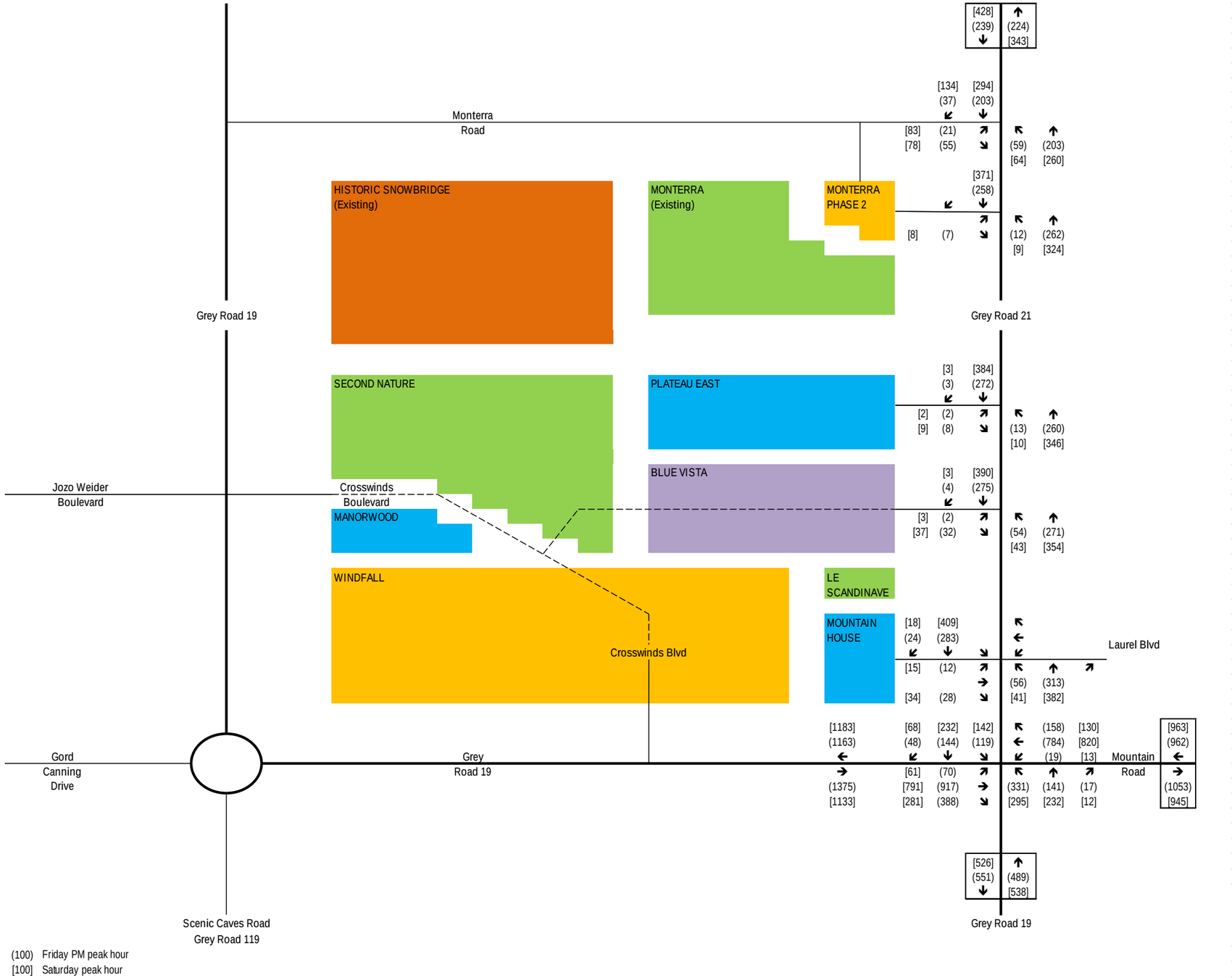
C.C. Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

2025 Total Traffic Volumes

Figure

11



(100) Friday PM peak hour
[100] Saturday peak hour

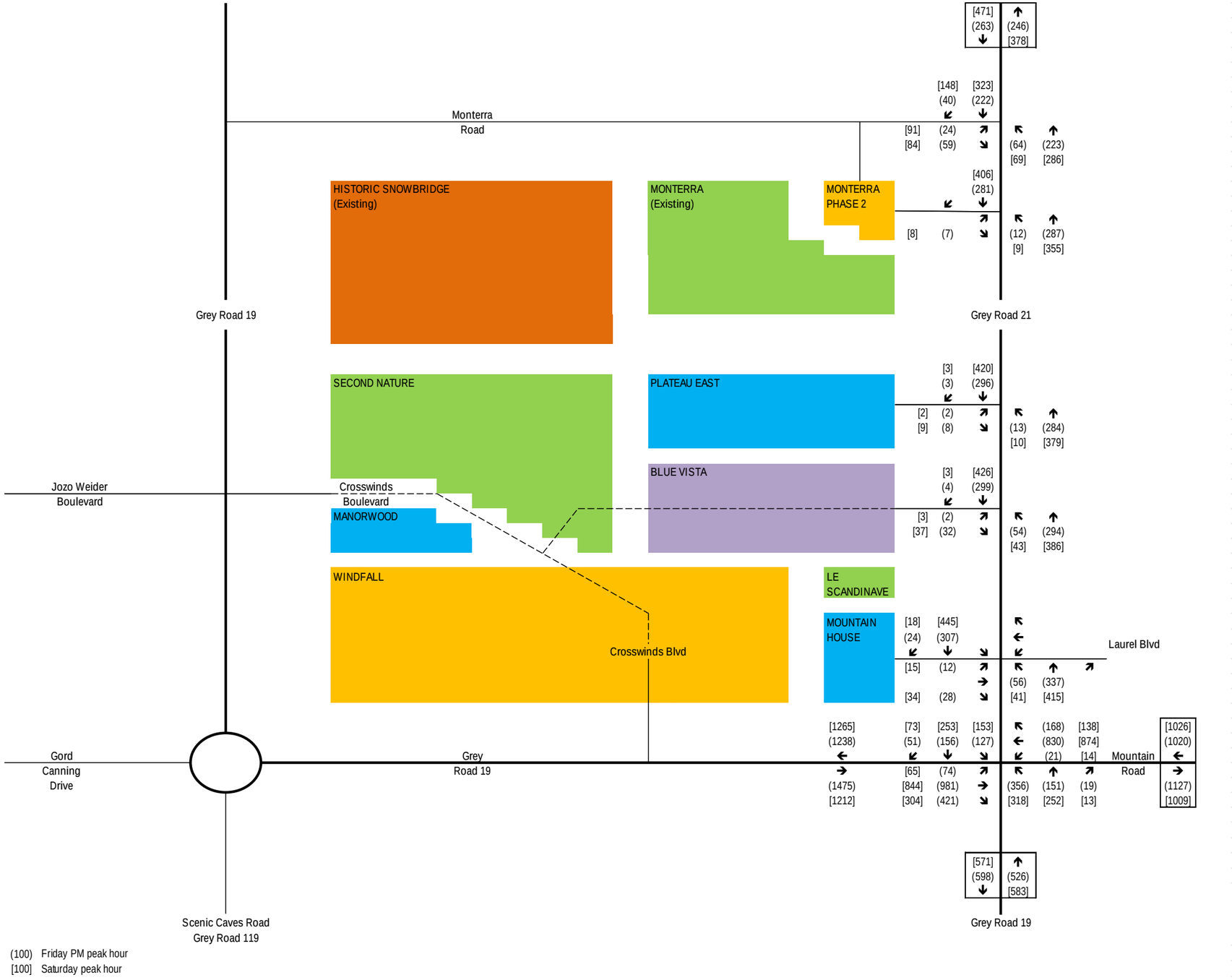
C.C.Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

2030 Total Traffic Volumes

Figure

12



(100) Friday PM peak hour
[100] Saturday peak hour

C.C. Tatham & Associates Ltd.
Consulting Engineers

Blue Vista Residential Development

2035 Total Traffic Volumes

Figure

13

APPENDIX A:
TRAFFIC COUNTS

Accu-Traffic Inc.
Traffic Monitoring & Data Analysis

Accu-Traffic Inc.

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 15:30:00
To: 16:30:00

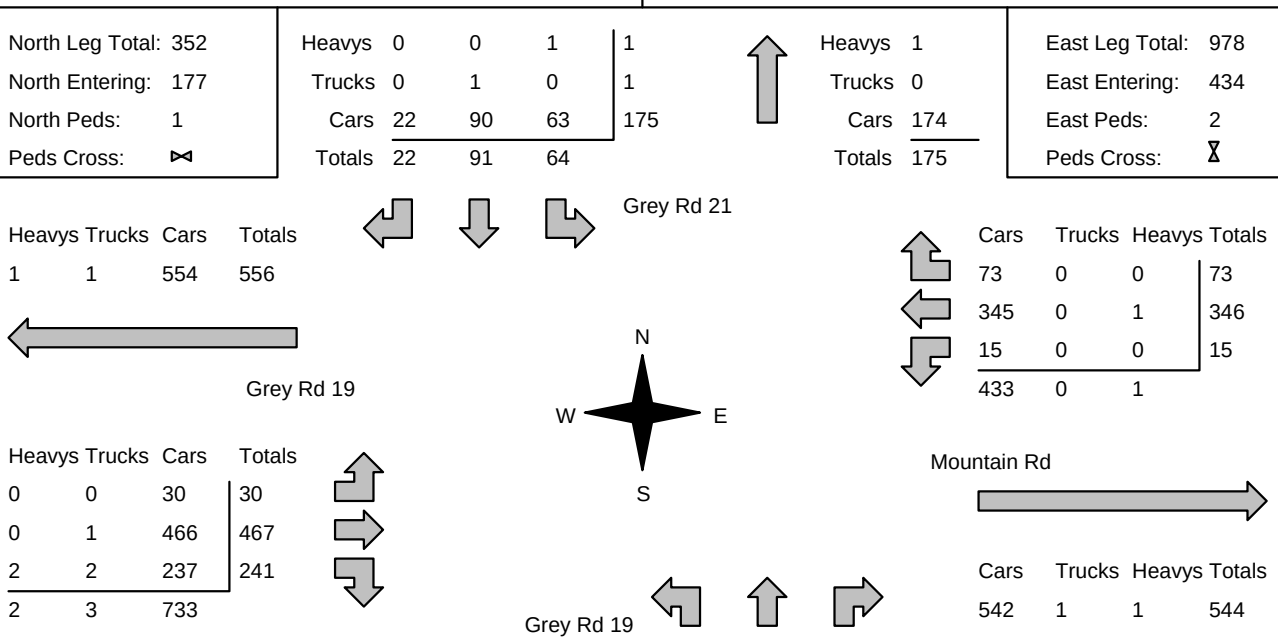
Municipality: Blue Mountain
Site #: 1705600004
Intersection: Grey Rd 19 & Grey Rd 21
TFR File #: 1
Count date: 17-Mar-17

Weather conditions:

Person counted:
Person prepared:
Person checked:

**** Signalized Intersection ****

Major Road: Grey Rd 19 runs W/E



Comments

Accu-Traffic Inc.
Traffic Monitoring & Data Analysis

Accu-Traffic Inc.

Traffic Count Summary

Intersection: Grey Rd 19 & Grey Rd 21 | **Count Date:** 17-Mar-17 | **Municipality:** Blue Mountain

North Approach Totals

Hour Ending	Includes Cars, Trucks, & Heavys				Total Peds
	Left	Thru	Right	Grand Total	
15:00:00	*0*	*0*	*0*	*0*	*0*
16:00:00	*78*	*72*	*27*	*177*	*1*
17:00:00	*61*	*92*	*15*	*168*	*0*
18:00:00	*44*	*77*	*24*	*145*	*0*
Totals:	183	241	66	490	1

North/South Total Approaches: 1208

South Approach Totals

Hour Ending	Includes Cars, Trucks, & Heavys				Total Peds
	Left	Thru	Right	Grand Total	
15:00:00	*0*	*0*	*0*	*0*	*0*
16:00:00	*165*	*75*	*9*	*249*	*2*
17:00:00	*198*	*78*	*16*	*292*	*0*
18:00:00	*107*	*57*	*13*	*177*	*0*
S Totals:	470	210	38	718	2

East Approach Totals

Hour Ending	Includes Cars, Trucks, & Heavys				Total Peds
	Left	Thru	Right	Grand Total	
15:00:00	*0*	*0*	*0*	*0*	*0*
16:00:00	*20*	*344*	*69*	*433*	*1*
17:00:00	*14*	*324*	*63*	*401*	*2*
18:00:00	*10*	*347*	*55*	*412*	*0*
Totals:	44	1015	187	1246	3

East/West Total Approaches: 3325

West Approach Totals

Hour Ending	Includes Cars, Trucks, & Heavys				Total Peds
	Left	Thru	Right	Grand Total	
15:00:00	*0*	*0*	*0*	*0*	*0*
16:00:00	*28*	*450*	*230*	*708*	*0*
17:00:00	*20*	*487*	*246*	*753*	*0*
18:00:00	*15*	*394*	*209*	*618*	*6*
W Totals:	63	1331	685	2079	6

Calculated Values for Traffic Crossing Major Street

Hours Ending:	*15:00*	*16:00*	*17:00*	*18:00*	*0:00*	*0:00*	*0:00*	*0:00*
Crossing Values:	*0*	*319*	*353*	*234*	*0*	*0*	*0*	*0*

Accu-Traffic Inc.
Traffic Monitoring & Data Analysis

Accu-Traffic Inc.

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 15:15:00
To: 16:15:00

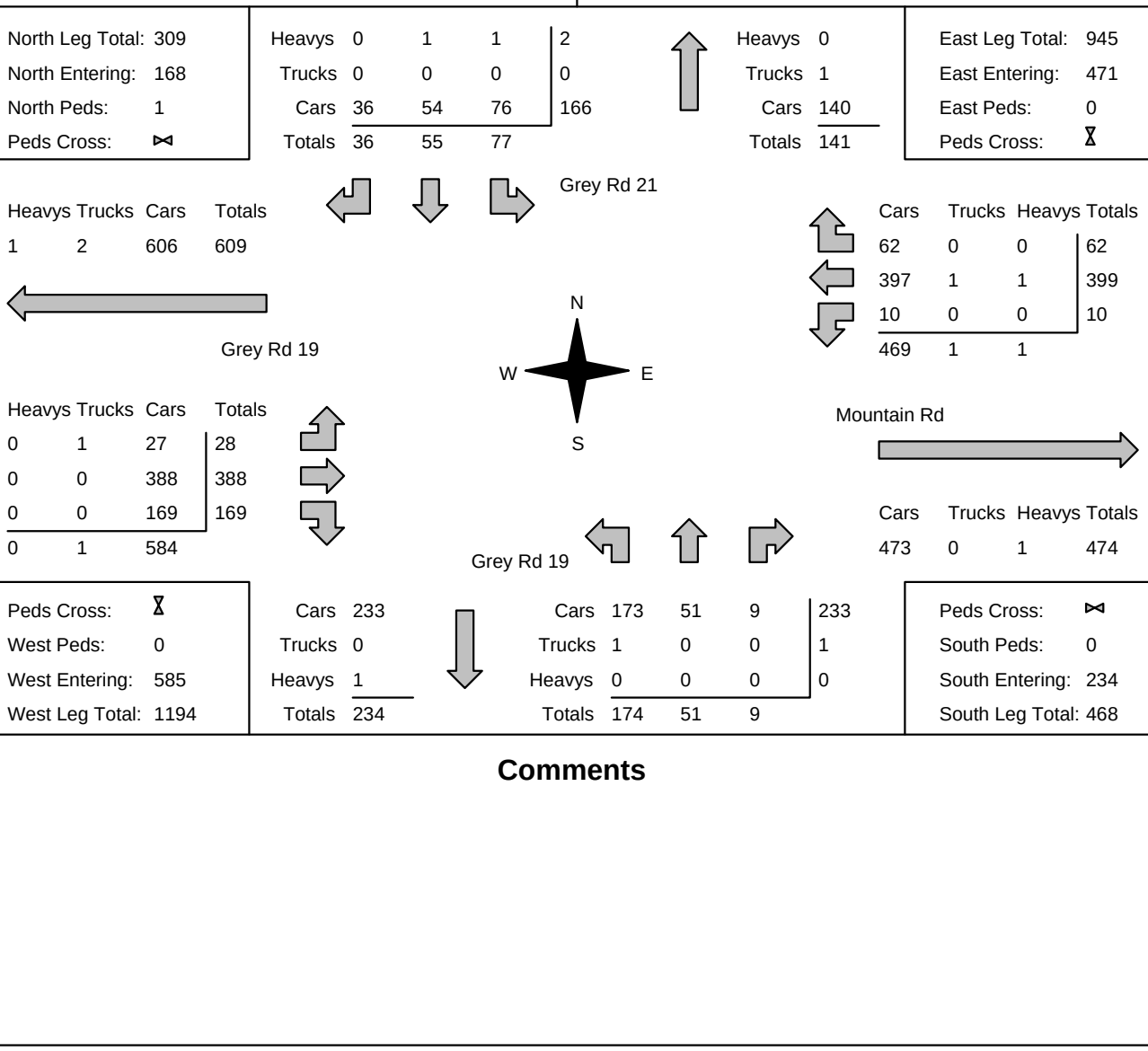
Municipality: Blue Mountain
Site #: 1705600004
Intersection: Grey Rd 19 & Grey Rd 21
TFR File #: 1
Count date: 18-Mar-17

Weather conditions:

Person counted:
Person prepared:
Person checked:

**** Signalized Intersection ****

Major Road: Grey Rd 19 runs W/E



Comments

Accu-Traffic Inc.
Traffic Monitoring & Data Analysis

Accu-Traffic Inc.

Traffic Count Summary

Intersection: Grey Rd 19 & Grey Rd 21 | **Count Date:** 18-Mar-17 | **Municipality:** Blue Mountain

North Approach Totals

Hour Ending	Includes Cars, Trucks, & Heavys				Total Peds
	Left	Thru	Right	Grand Total	
15:00:00	*0*	*0*	*0*	*0*	*0*
16:00:00	*77*	*49*	*31*	*157*	*1*
17:00:00	*62*	*55*	*34*	*151*	*1*
18:00:00	*43*	*56*	*13*	*112*	*0*
Totals:	182	160	78	420	2

North/South Total Approaches: 991

South Approach Totals

Hour Ending	Includes Cars, Trucks, & Heavys				Total Peds
	Left	Thru	Right	Grand Total	
15:00:00	*0*	*0*	*0*	*0*	*0*
16:00:00	*169*	*51*	*12*	*232*	*0*
17:00:00	*135*	*48*	*9*	*192*	*0*
18:00:00	*95*	*46*	*6*	*147*	*0*
S Totals:	399	145	27	571	0

East Approach Totals

Hour Ending	Includes Cars, Trucks, & Heavys				Total Peds
	Left	Thru	Right	Grand Total	
15:00:00	*0*	*0*	*0*	*0*	*0*
16:00:00	*15*	*388*	*62*	*465*	*0*
17:00:00	*14*	*316*	*59*	*389*	*1*
18:00:00	*10*	*274*	*42*	*326*	*0*
Totals:	39	978	163	1180	1

East/West Total Approaches: 2946

West Approach Totals

Hour Ending	Includes Cars, Trucks, & Heavys				Total Peds
	Left	Thru	Right	Grand Total	
15:00:00	*0*	*0*	*0*	*0*	*0*
16:00:00	*25*	*388*	*164*	*577*	*0*
17:00:00	*34*	*398*	*184*	*616*	*1*
18:00:00	*16*	*375*	*182*	*573*	*2*
W Totals:	75	1161	530	1766	3

Calculated Values for Traffic Crossing Major Street

Hours Ending:	*15:00*	*16:00*	*17:00*	*18:00*	*0:00*	*0:00*	*0:00*	*0:00*
Crossing Values:	*0*	*297*	*254*	*196*	*0*	*0*	*0*	*0*

C.C. Tatham & Associates Ltd.
Consulting Engineers

INTERSECTION COUNT
FRIDAY PM PEAK HOUR

GENERAL INFORMATION

Surveyor Name	Dana Arends & Michael Cullip	**Jurisdiction/Date**	TOBM i Oct 19 & Sat Oct 20, 20
Weather Conditions		**Major Street**	Grey Road 21 N-S
Project Name	Nederand	**Minor Street**	Monterra E-W
Project Number	117159	**Intersection Control**	stop control on minor street

Additional Comments

NORTH LEG	
Total Vehicles	287
% Trucks Entering	4.1%
Vehicles Entering	147
Pedestrians	0
Ped Crossing	↔

Grey Road 21

TOTAL	24	123	0
Heavy Trucks	0	0	0
Light Trucks	1	5	0
Autos	23	118	0

140	TOTAL
1	Heavy Trucks
7	Light Trucks
132	Autos

EAST LEG	
Total Vehicles	0
% Trucks Entering	-
Vehicles Entering	0
Pedestrians	1
Ped Crossing	↕

Total	Heavy Trucks	Light Trucks	Autos
55	0	2	53

Autos	Light Trucks	Heavy Trucks	TOTAL
0	0	0	0
0	0	0	0
0	0	0	0

Monterra

N
W E
S

Monterra

14	0	0	14
0	0	0	0
22	0	1	21
TOTAL	Heavy Trucks	Light Trucks	Autos

Autos	Light Trucks	Heavy Trucks	Total
0	0	0	0

Autos	139
Light Trucks	6
Heavy Trucks	0
TOTAL	145

30	118	0	Autos
1	7	0	Light Trucks
0	1	0	Heavy Trucks
31	126	0	TOTAL

Grey Road 21

WEST LEG	
Ped Crossing	↕
Pedestrians	0
Vehicles Entering	36
% Trucks Entering	2.8%
Total Vehicles	91

SOUTH LEG	
Ped Crossing	↔
Pedestrians	2
Vehicles Entering	157
% Trucks Entering	5.7%
Total Vehicles	302

15:30 to **16:30**

C.C. Tatham & Associates Ltd.
Consulting Engineers

INTERSECTION COUNT
SATURDAY MID-DAY PEAK HOUR

GENERAL INFORMATION

Surveyor Name	Dana Arends & Michael Cullip	**Jurisdiction/Date**	TOBM i Oct 19 & Sat Oct 20, 20
Weather Conditions		**Major Street**	Grey Road 21 N-S
Project Name	Nederand	**Minor Street**	Monterra E-W
Project Number	117159	**Intersection Control**	stop control on minor street

Additional Comments

NORTH LEG	
Total Vehicles	261
% Trucks Entering	1.4%
Vehicles Entering	145
Pedestrians	0
Ped Crossing	↔

Grey Road 21

TOTAL	47	98	0
Heavy Trucks	0	0	0
Light Trucks	1	1	0
Autos	46	97	0

116	TOTAL
0	Heavy Trucks
1	Light Trucks
115	Autos

EAST LEG	
Total Vehicles	0
% Trucks Entering	-
Vehicles Entering	0
Pedestrians	3
Ped Crossing	↕

Total	Heavy Trucks	Light Trucks	Autos
64	0	2	62

Autos	Light Trucks	Heavy Trucks	TOTAL
0	0	0	0
0	0	0	0
0	0	0	0

Monterra

N
W E
S

Monterra

29	0	0	29
0	0	0	0
21	0	1	20
TOTAL	Heavy Trucks	Light Trucks	Autos

Autos	Light Trucks	Heavy Trucks	Total
0	0	0	0

Autos	117
Light Trucks	2
Heavy Trucks	0
TOTAL	119

16	86	0	Autos
1	1	0	Light Trucks
0	0	0	Heavy Trucks
17	87	0	TOTAL

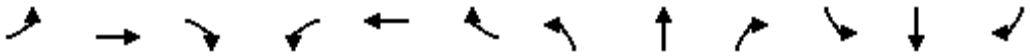
Grey Road 21

WEST LEG	
Ped Crossing	↕
Pedestrians	0
Vehicles Entering	50
% Trucks Entering	2.0%
Total Vehicles	114

SOUTH LEG	
Ped Crossing	↔
Pedestrians	0
Vehicles Entering	104
% Trucks Entering	1.9%
Total Vehicles	223

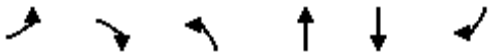
16:00 to **17:00**

APPENDIX B:
TRAFFIC OPERATIONS - 2019



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	36	517	266	16	338	83	210	78	14	70	97	27
Future Volume (vph)	36	517	266	16	338	83	210	78	14	70	97	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Frt		1.00	0.85		0.97		1.00	0.98		1.00	0.97	
Flt Protected		1.00	1.00		1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1857	1583		1812		1770	1821		1770	1802	
Flt Permitted		0.95	1.00		0.97		0.67	1.00		0.69	1.00	
Satd. Flow (perm)		1764	1583		1762		1250	1821		1290	1802	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	39	562	289	17	367	90	228	85	15	76	105	29
RTOR Reduction (vph)	0	0	163	0	16	0	0	10	0	0	16	0
Lane Group Flow (vph)	0	601	126	0	458	0	228	90	0	76	118	0
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)		23.4	23.4		23.4		18.3	18.3		18.3	18.3	
Effective Green, g (s)		23.4	23.4		23.4		18.3	18.3		18.3	18.3	
Actuated g/C Ratio		0.44	0.44		0.44		0.34	0.34		0.34	0.34	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		768	689		767		425	620		439	614	
v/s Ratio Prot								0.05			0.07	
v/s Ratio Perm		c0.34	0.08		0.26		c0.18			0.06		
v/c Ratio		0.78	0.18		0.60		0.54	0.15		0.17	0.19	
Uniform Delay, d1		13.0	9.3		11.6		14.3	12.3		12.4	12.5	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		5.2	0.1		1.3		4.8	0.5		0.9	0.7	
Delay (s)		18.2	9.4		12.8		19.1	12.8		13.3	13.2	
Level of Service		B	A		B		B	B		B	B	
Approach Delay (s)		15.3			12.8			17.1			13.2	
Approach LOS		B			B			B			B	

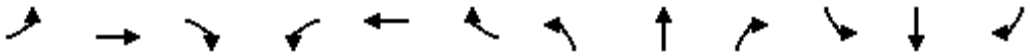
Intersection Summary			
HCM 2000 Control Delay	14.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	53.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	75.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	17	29	40	156	152	29
Future Volume (Veh/h)	17	29	40	156	152	29
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	18	32	43	170	165	32
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	437	181	197			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	437	181	197			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	96	97			
cM capacity (veh/h)	559	862	1376			

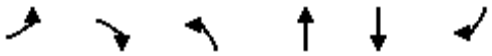
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	50	213	197
Volume Left	18	43	0
Volume Right	32	0	32
cSH	721	1376	1700
Volume to Capacity	0.07	0.03	0.12
Queue Length 95th (m)	1.7	0.7	0.0
Control Delay (s)	10.4	1.8	0.0
Lane LOS	B	A	
Approach Delay (s)	10.4	1.8	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	33.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	33	424	186	10	437	70	192	160	9	85	164	41
Future Volume (vph)	33	424	186	10	437	70	192	160	9	85	164	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Frt		1.00	0.85		0.98		1.00	0.99		1.00	0.97	
Flt Protected		1.00	1.00		1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1856	1583		1827		1770	1848		1770	1806	
Flt Permitted		0.94	1.00		0.99		0.62	1.00		0.64	1.00	
Satd. Flow (perm)		1752	1583		1805		1153	1848		1195	1806	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	36	461	202	11	475	76	209	174	10	92	178	45
RTOR Reduction (vph)	0	0	122	0	11	0	0	3	0	0	14	0
Lane Group Flow (vph)	0	497	80	0	551	0	209	181	0	92	209	0
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)		20.4	20.4		20.4		19.3	19.3		19.3	19.3	
Effective Green, g (s)		20.4	20.4		20.4		19.3	19.3		19.3	19.3	
Actuated g/C Ratio		0.39	0.39		0.39		0.37	0.37		0.37	0.37	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		691	624		712		430	689		446	674	
v/s Ratio Prot								0.10			0.12	
v/s Ratio Perm		0.28	0.05		c0.31		c0.18			0.08		
v/c Ratio		0.72	0.13		0.77		0.49	0.26		0.21	0.31	
Uniform Delay, d1		13.2	10.0		13.6		12.4	11.3		11.0	11.5	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		3.6	0.1		5.3		3.9	0.9		1.0	1.2	
Delay (s)		16.8	10.1		18.9		16.3	12.2		12.0	12.7	
Level of Service		B	B		B		B	B		B	B	
Approach Delay (s)		14.9			18.9			14.4			12.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	15.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	51.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

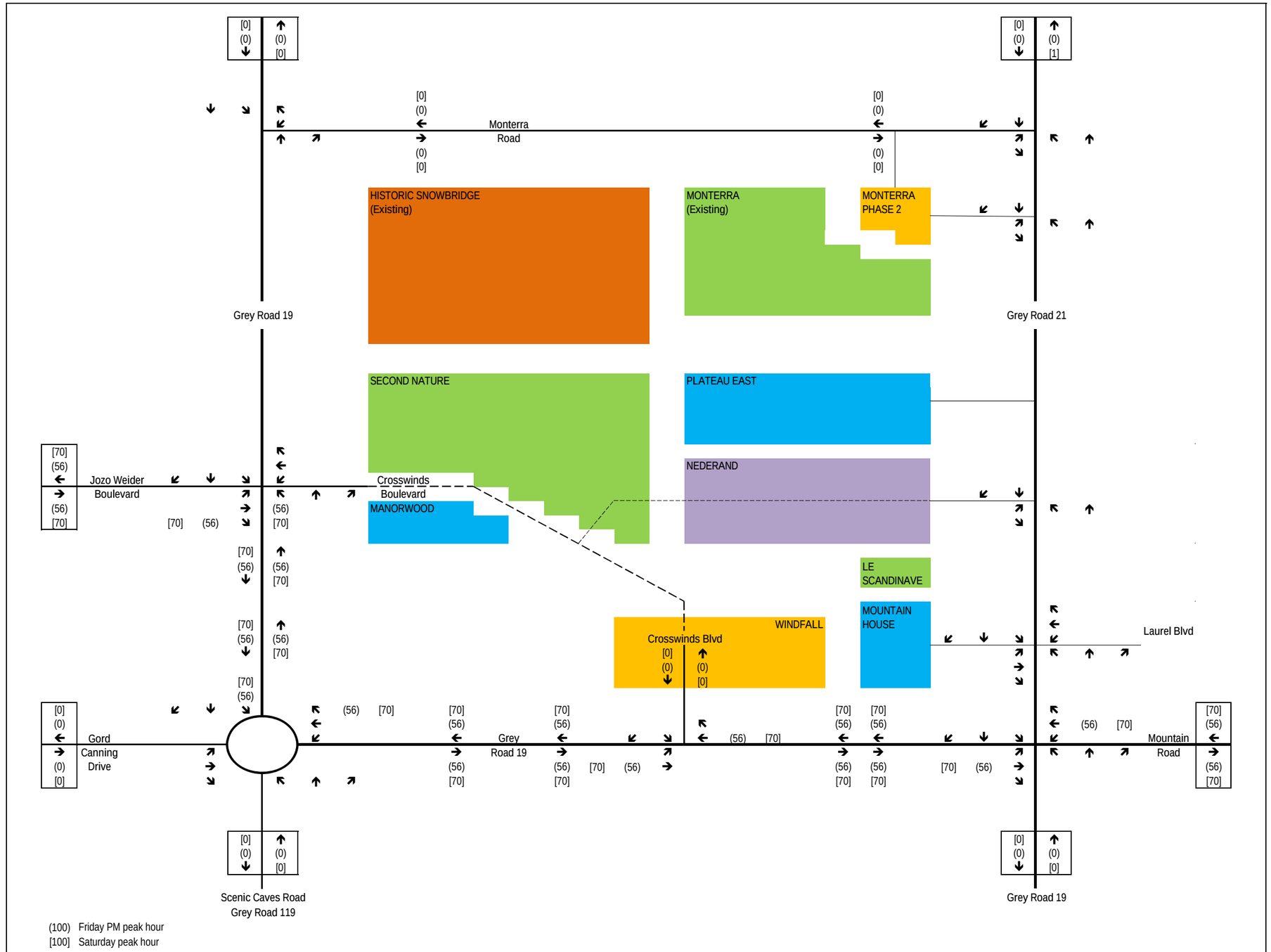


Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	67	51	41	201	227	108
Future Volume (Veh/h)	67	51	41	201	227	108
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	73	55	45	218	247	117
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	614	306	364			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	614	306	364			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	83	93	96			
cM capacity (veh/h)	438	734	1195			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	128	263	364
Volume Left	73	45	0
Volume Right	55	0	117
cSH	530	1195	1700
Volume to Capacity	0.24	0.04	0.21
Queue Length 95th (m)	7.1	0.9	0.0
Control Delay (s)	13.9	1.7	0.0
Lane LOS	B	A	
Approach Delay (s)	13.9	1.7	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	48.2%	ICU Level of Service	A
Analysis Period (min)	15		

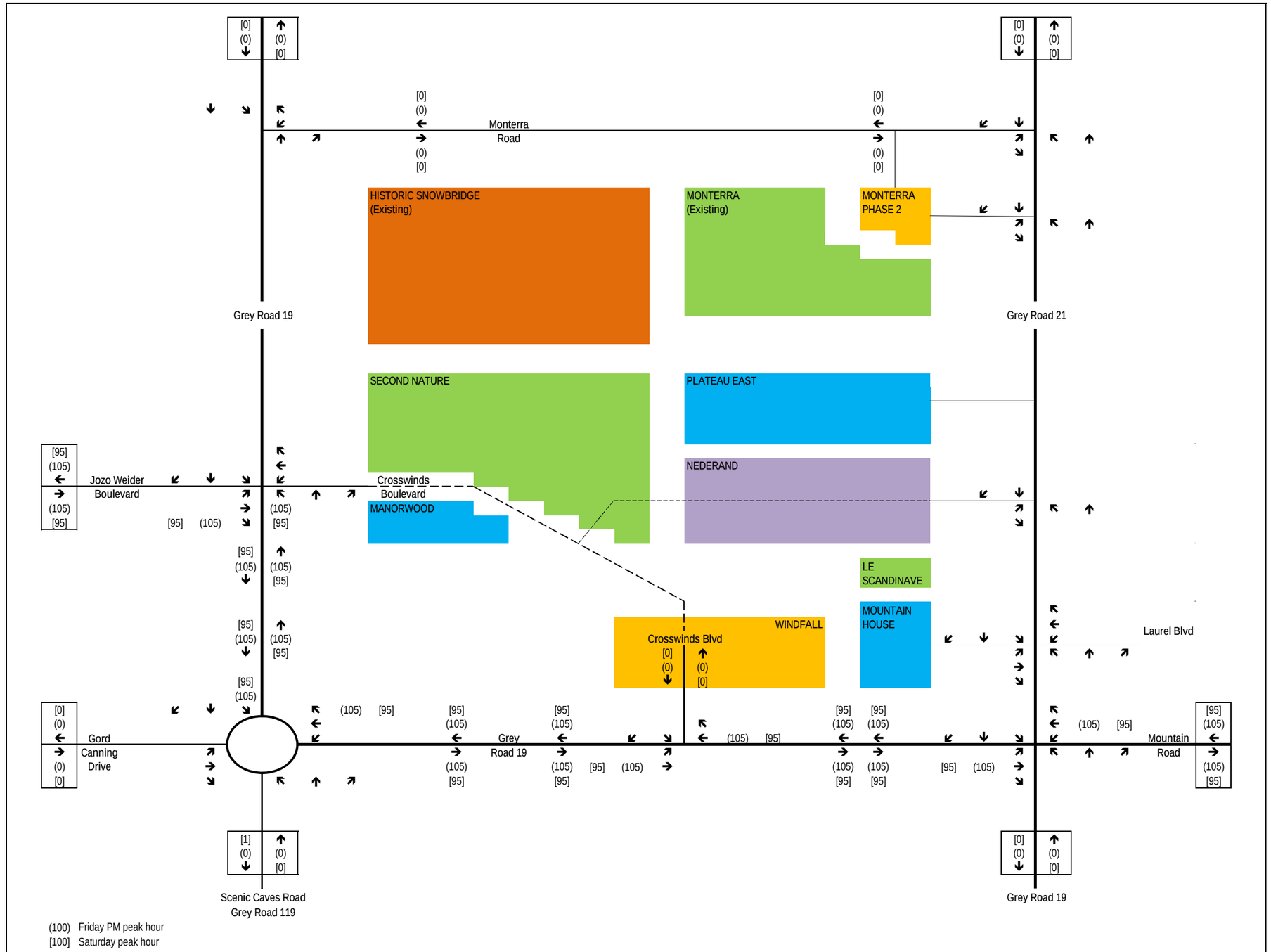
APPENDIX C:
OTHER DEVELOPMENT TRAFFIC



(100) Friday PM peak hour
[100] Saturday peak hour

source: Blue Mountain Resort Village Transportation Considerations, September 29, 1999 - revised January 14, 2000 (Figure A8) as referenced in CT105030 BMR TIS volume - sheet "Village residential"

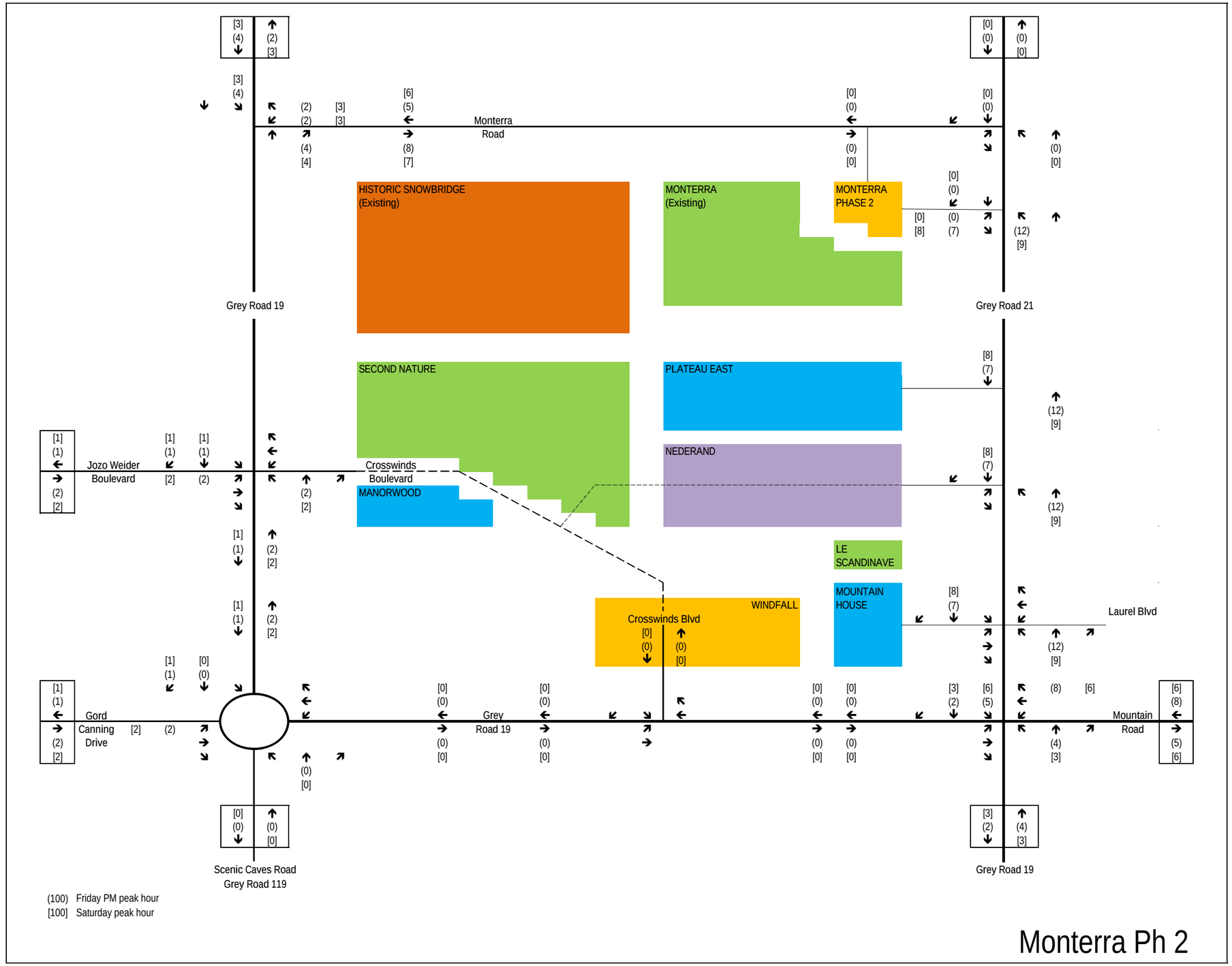
Village Commercial

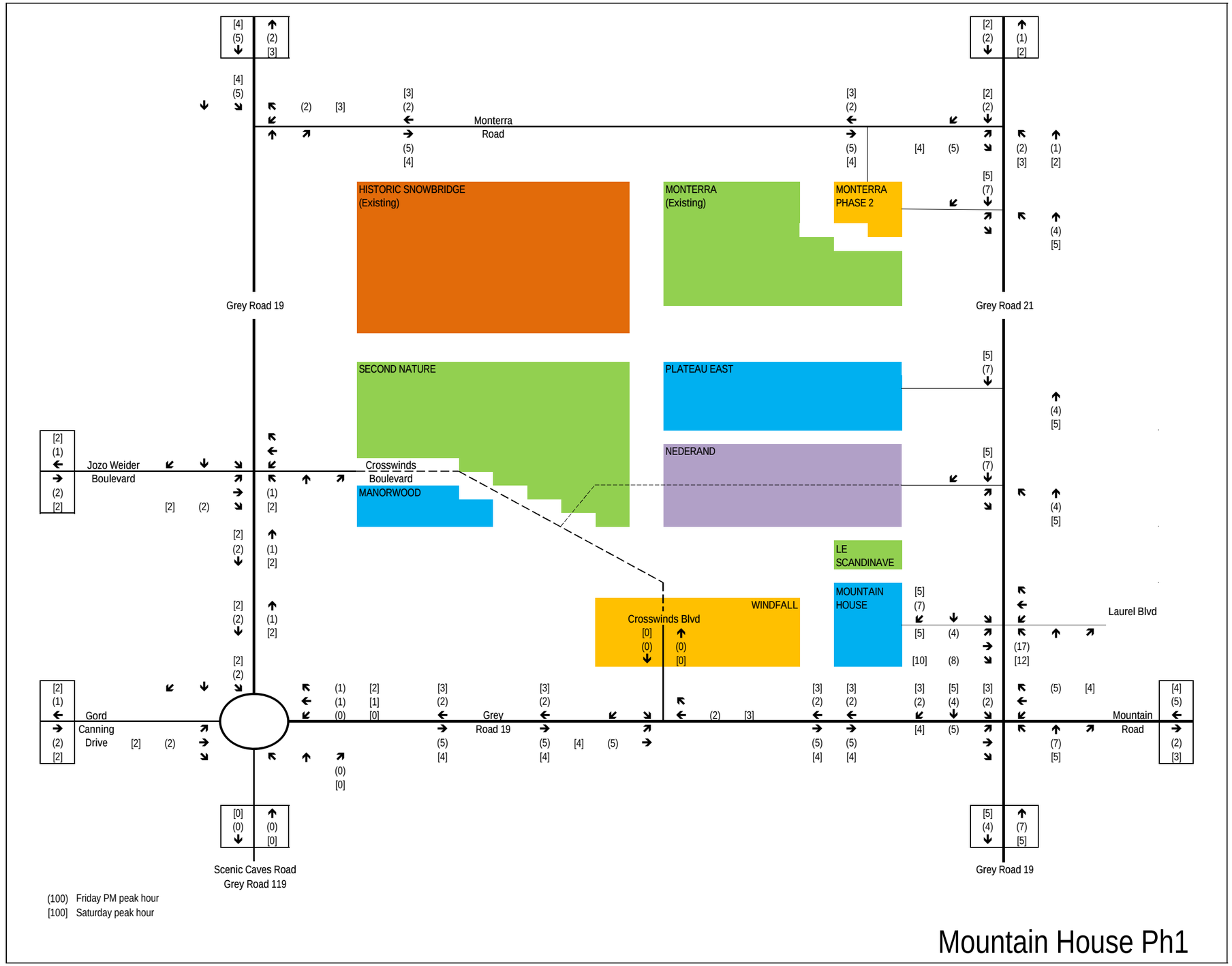


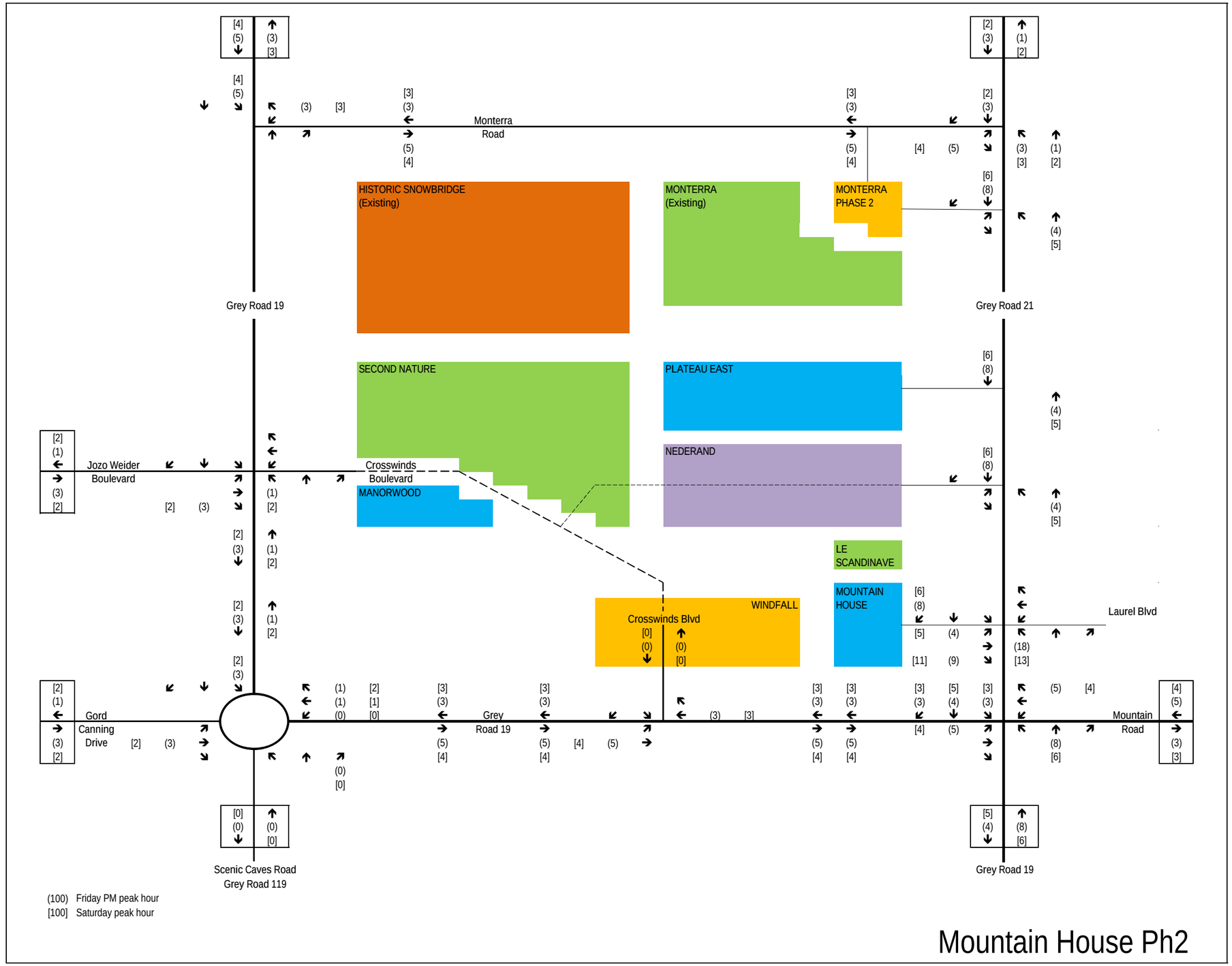
(100) Friday PM peak hour
[100] Saturday peak hour

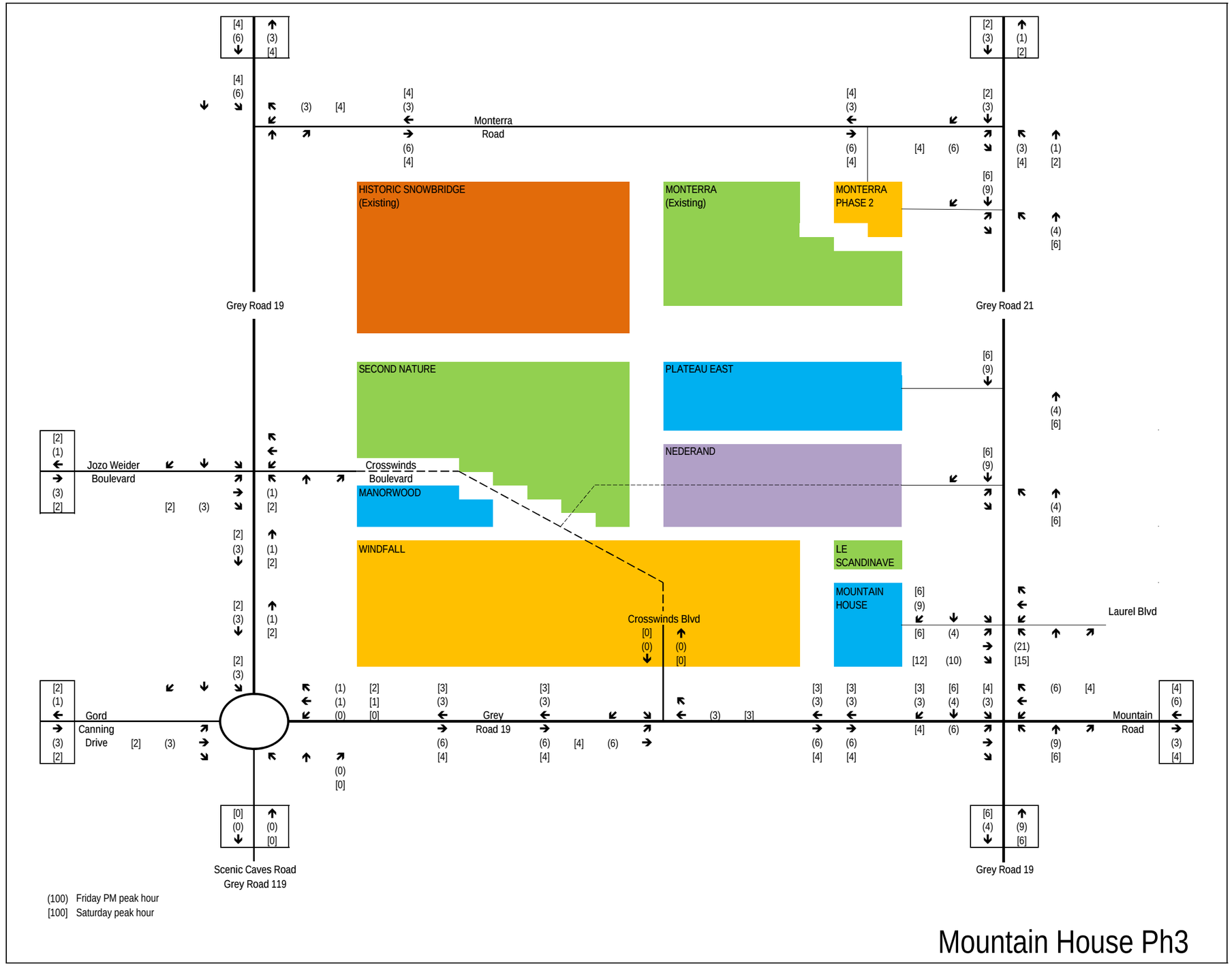
source: Blue Mountain Resort Village Transportation Considerations, September 29, 1999 - revised January 14, 2000 (Figure A8) as referenced in CT105030 BMR TIS volume - sheet "Village residential"

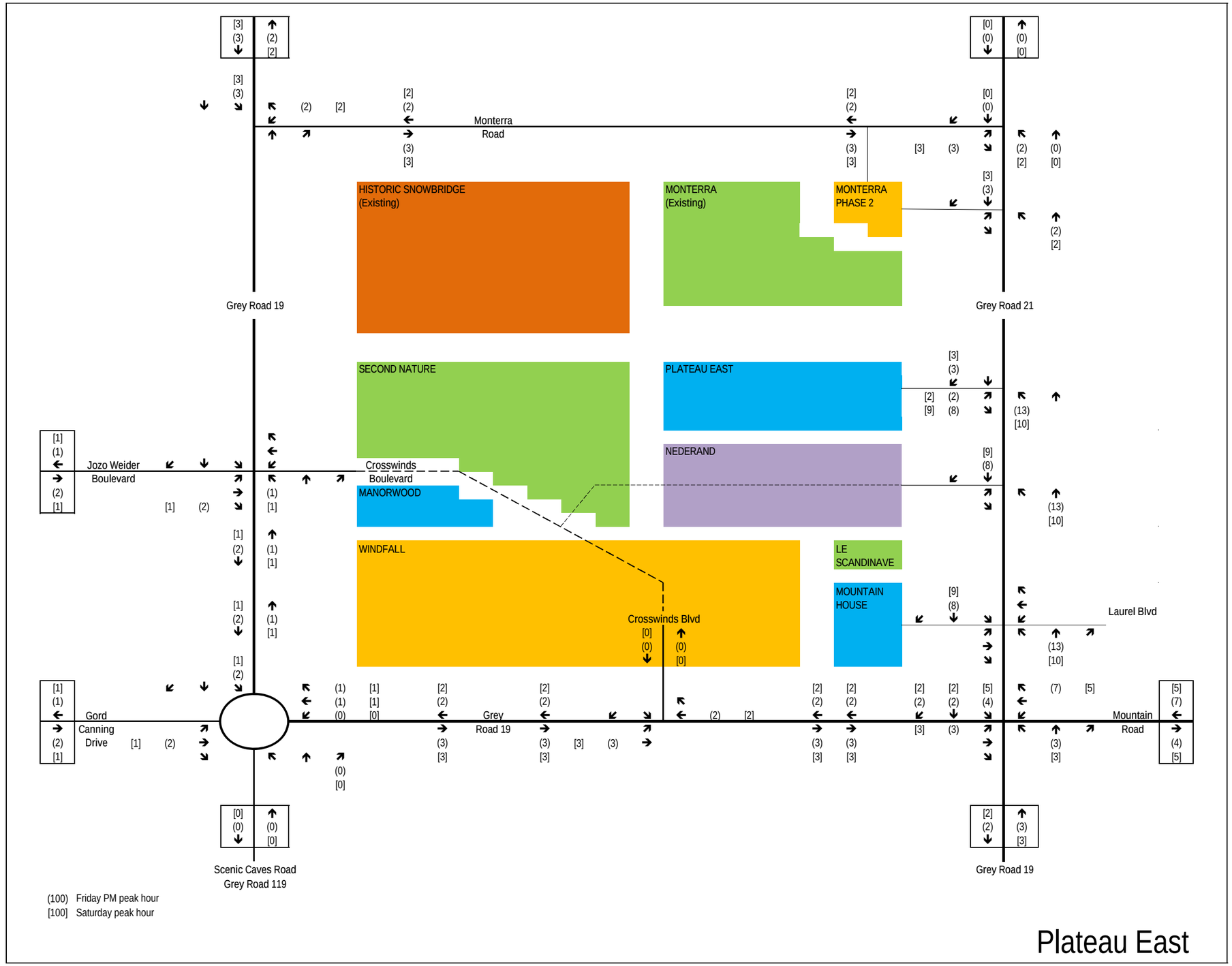
Village Residential

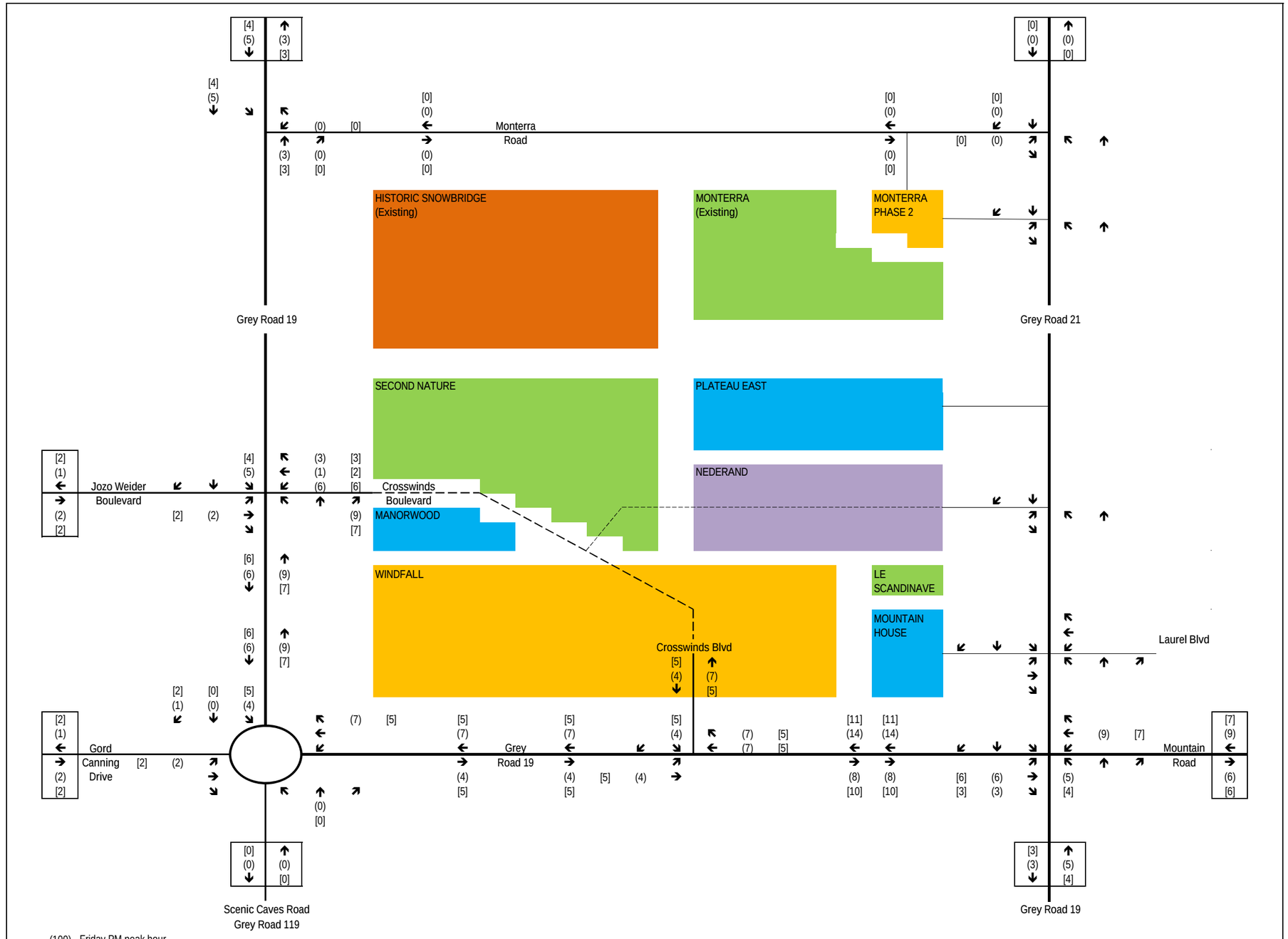

Monterra Road
Grey Road 19
Grey Road 21
HISTORIC SNOWBRIDGE (Existing)
MONTERRA (Existing)
MONTERRA PHASE 2
SECOND NATURE
PLATEAU EAST
NEDERAND
MANORWOOD
LE SCANDINAVE
MOUNTAIN HOUSE
WINDFALL
Jozo Weider Boulevard
Crosswinds Boulevard
Crosswinds Blvd
Laurel Blvd
Gord Canning Drive
Grey Road 19
Mountain Road
Scenic Caves Road
Grey Road 119
Grey Road 19
(100) Friday PM peak hour
[100] Saturday peak hour
Monterra Ph 2


Monterra
Road
HISTORIC SNOWBRIDGE
(Existing)
MONTERRA
(Existing)
MONTERRA
PHASE 2
Grey Road 19
Grey Road 21
SECOND NATURE
PLATEAU EAST
NEDERAND
Jozo Weider
Boulevard
Crosswinds
Boulevard
MANORWOOD
LE
SCANDINAVE
WINDFALL
Crosswinds Blvd
MOUNTAIN
HOUSE
Laurel Blvd
Gord
Canning
Drive
Grey
Road 19
Mountain
Road
Scenic Caves Road
Grey Road 119
Grey Road 19
(100) Friday PM peak hour
[100] Saturday peak hour
Mountain House Ph1


Monterra Road
Grey Road 19
Grey Road 21
Jozo Weider Boulevard
Crosswinds Boulevard
Crosswinds Blvd
Gord Canning Drive
Grey Road 19
Laurel Blvd
Mountain Road
Scenic Caves Road
Grey Road 119
Grey Road 19
HISTORIC SNOWBRIDGE (Existing)
MONTERRA (Existing)
MONTERRA PHASE 2
SECOND NATURE
PLATEAU EAST
NEDERAND
MANORWOOD
LE SCANDINAVE
WINDFALL
MOUNTAIN HOUSE
(100) Friday PM peak hour
[100] Saturday peak hour
Mountain House Ph2


Monterra Road
Grey Road 19
Grey Road 21
HISTORIC SNOWBRIDGE (Existing)
MONTERRA (Existing)
MONTERRA PHASE 2
SECOND NATURE
PLATEAU EAST
NEDERAND
MANORWOOD
WINDFALL
LE SCANDINAVE
MOUNTAIN HOUSE
Jozo Weider Boulevard
Crosswinds Boulevard
Crosswinds Blvd
Laurel Blvd
Gord Canning Drive
Grey Road 19
Mountain Road
Scenic Caves Road
Grey Road 119
Grey Road 19
(100) Friday PM peak hour
[100] Saturday peak hour
Mountain House Ph3

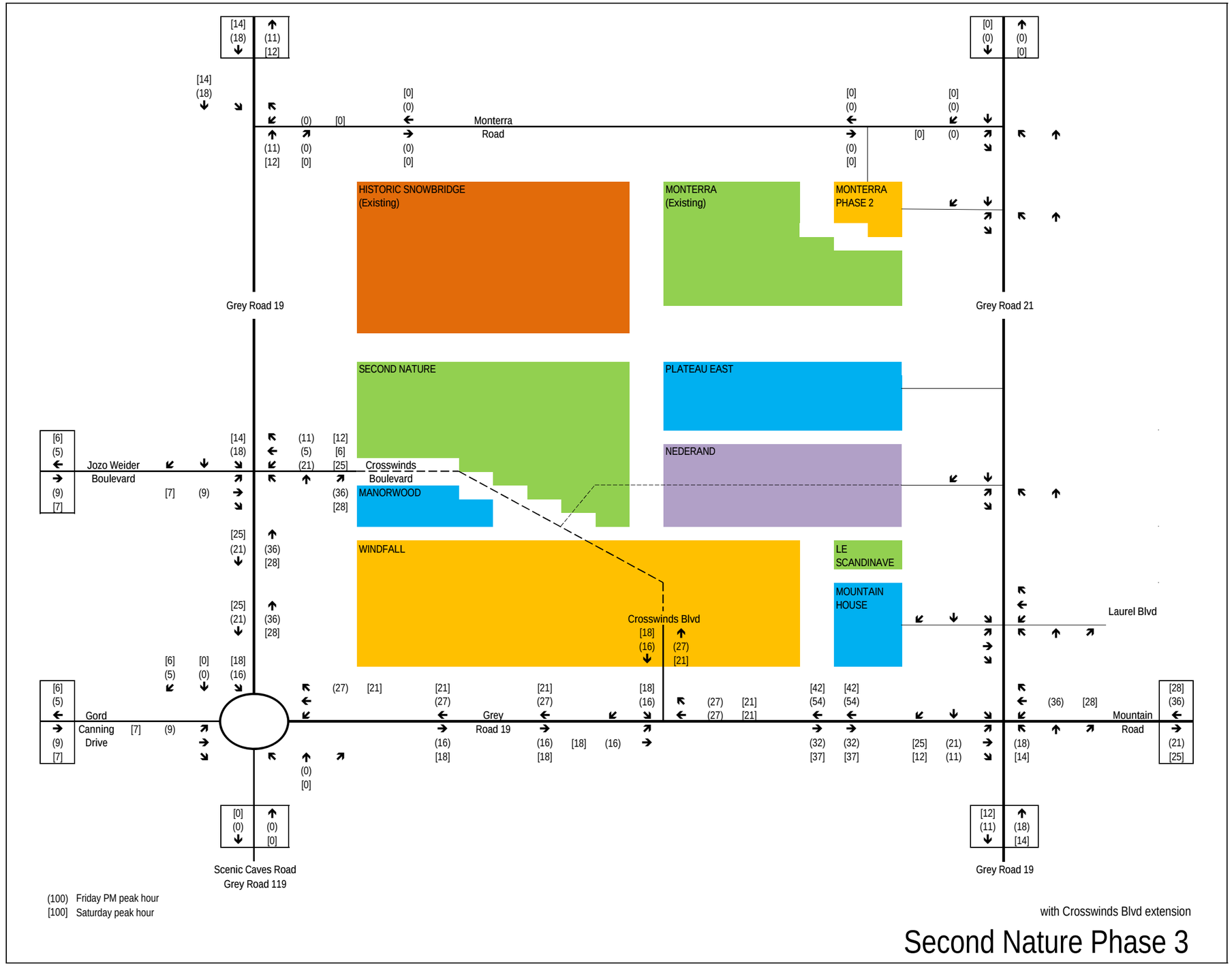

Monterra
Road
HISTORIC SNOWBRIDGE
(Existing)
MONTERRA
(Existing)
MONTERRA
PHASE 2
Grey Road 19
Grey Road 21
SECOND NATURE
PLATEAU EAST
NEDERAND
Jozo Weider
Boulevard
Crosswinds
Boulevard
MANORWOOD
WINDFALL
LE
SCANDINAVE
MOUNTAIN
HOUSE
Crosswinds Blvd
Laurel Blvd
Gord
Canning
Drive
Grey
Road 19
Mountain
Road
Scenic Caves Road
Grey Road 119
Grey Road 19
(100) Friday PM peak hour
[100] Saturday peak hour
Plateau East

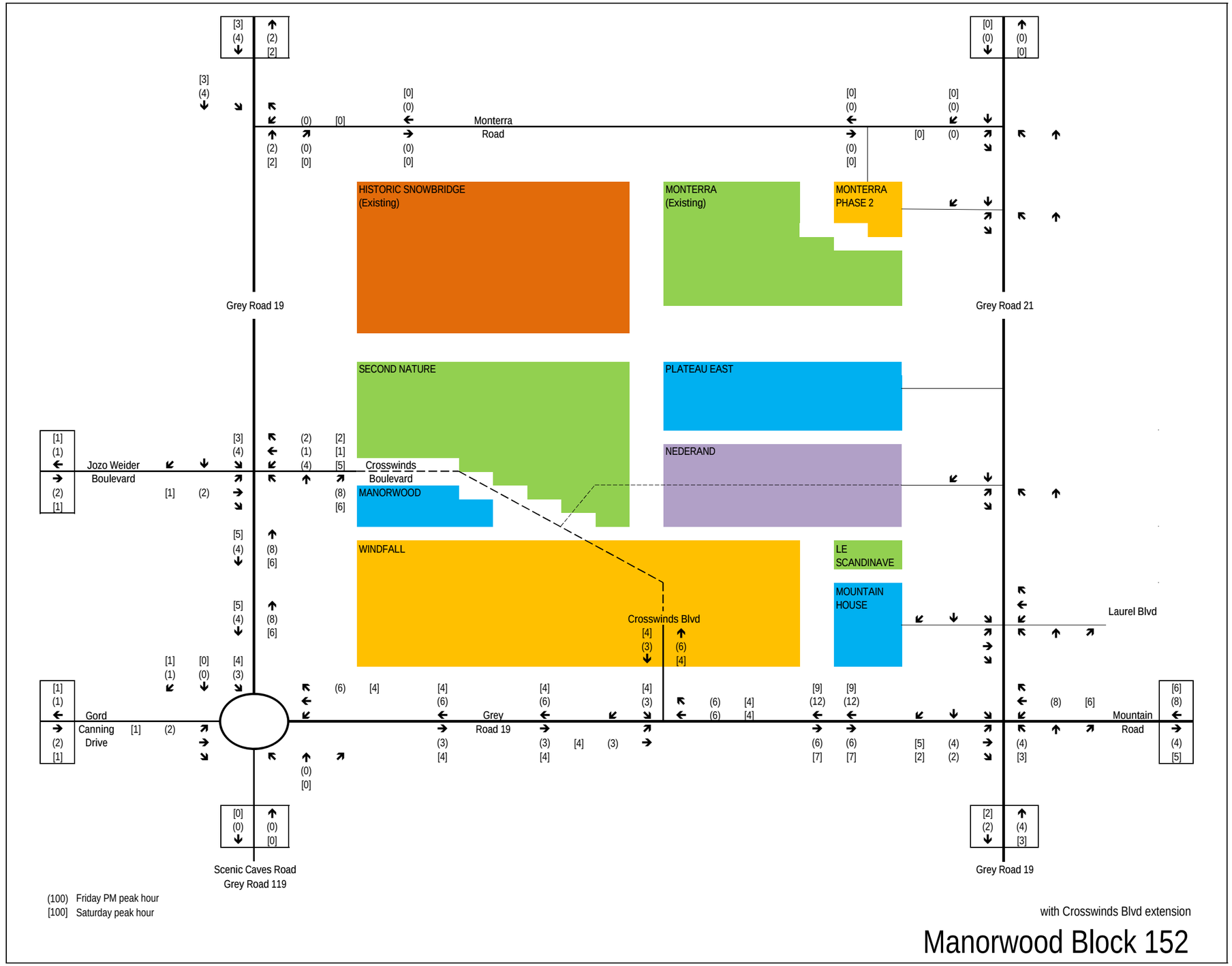


(100) Friday PM peak hour
[100] Saturday peak hour

with Crosswinds Blvd extension

Second Nature Phase 1

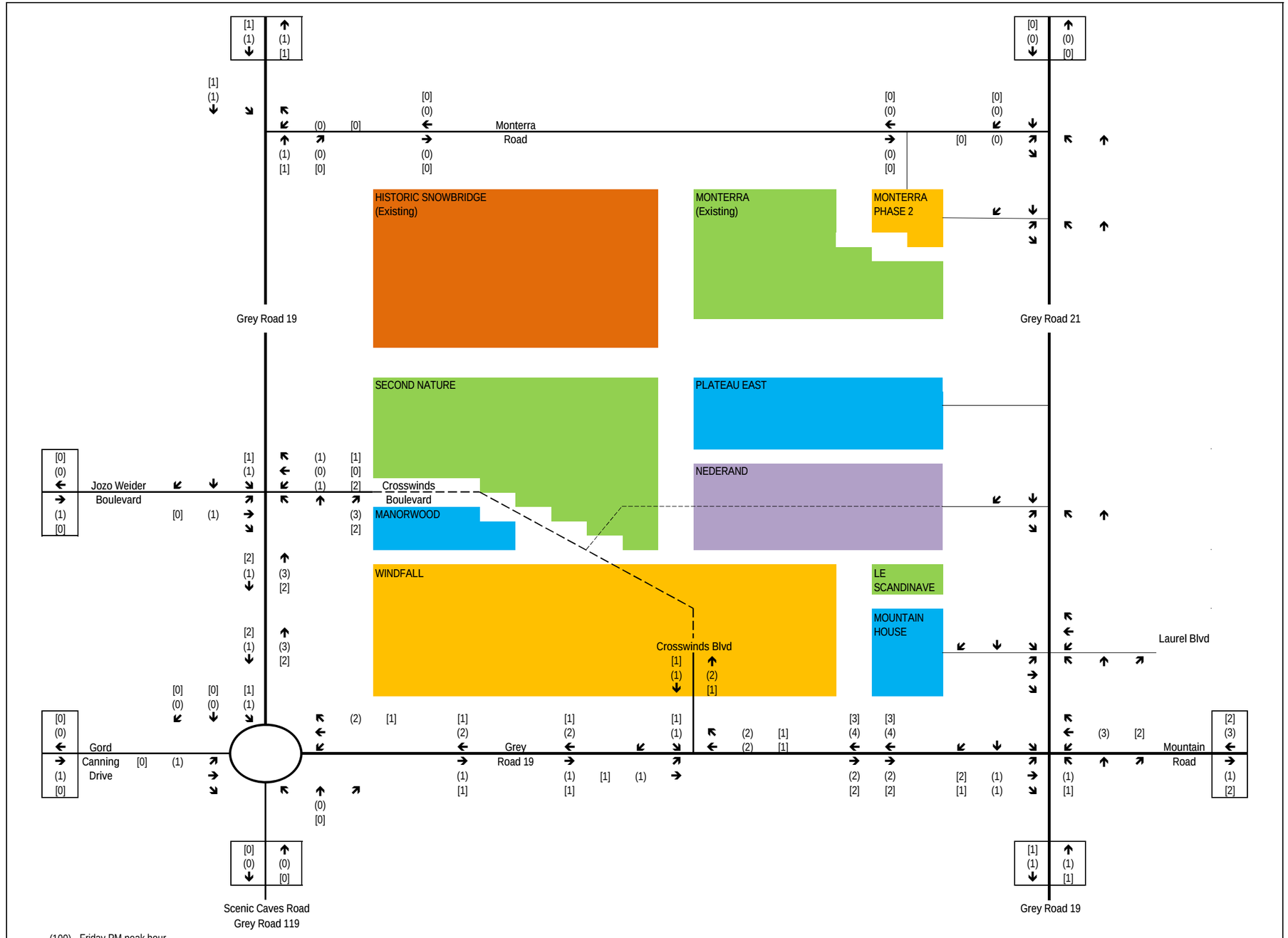

Monterra Road
Grey Road 19
Grey Road 21
HISTORIC SNOWBRIDGE (Existing)
MONTERRA (Existing)
MONTERRA PHASE 2
SECOND NATURE
PLATEAU EAST
NEDERAND
MANORWOOD
WINDFALL
LE SCANDINAVE
MOUNTAIN HOUSE
Jozo Weider Boulevard
Crosswinds Boulevard
Crosswinds Blvd
Laurel Blvd
Gord Canning Drive
Grey Road 19
Mountain Road
Scenic Caves Road
Grey Road 119
Grey Road 19
(100) Friday PM peak hour
[100] Saturday peak hour
with Crosswinds Blvd extension
Second Nature Phase 3

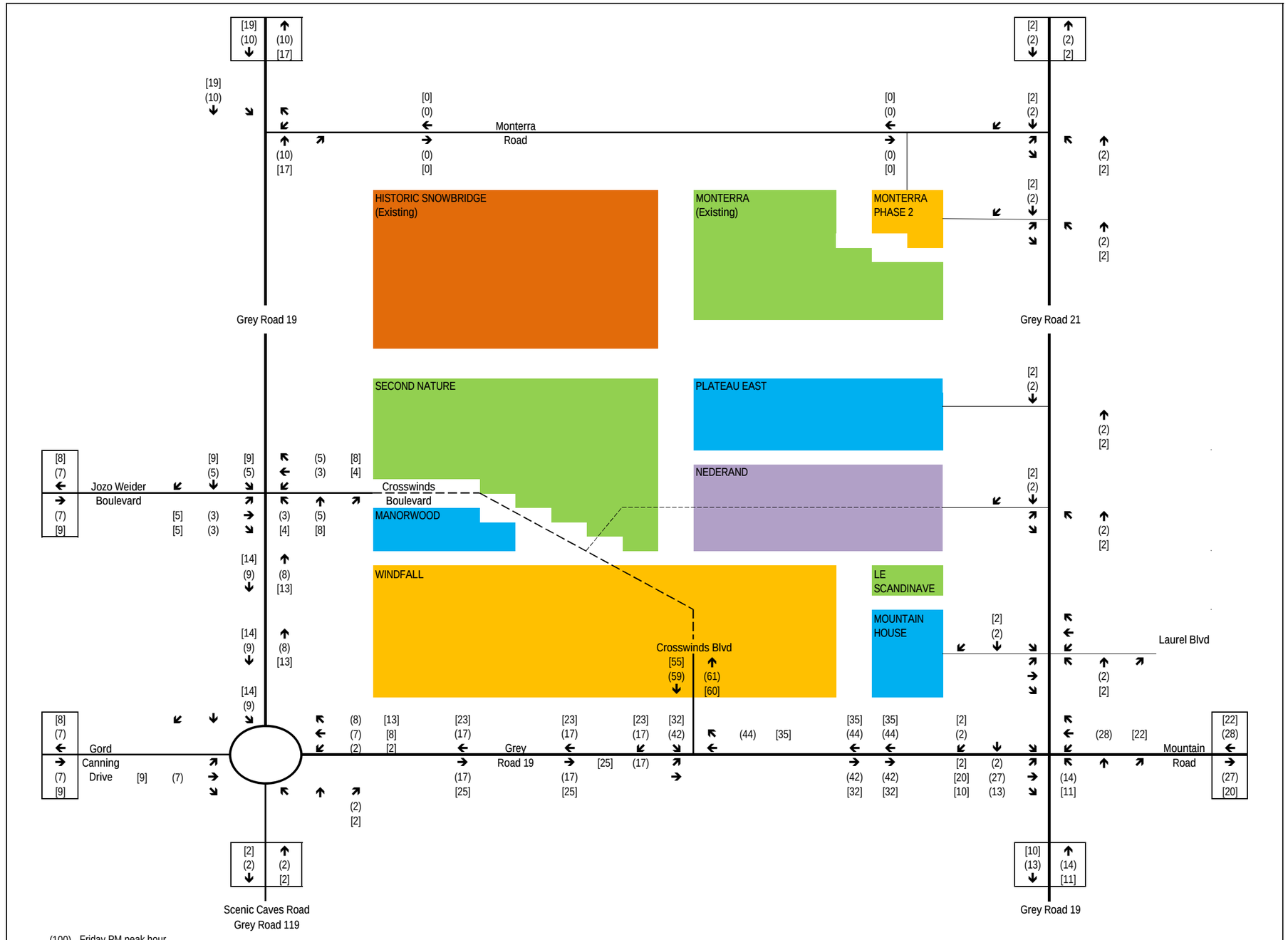


(100) Friday PM peak hour
[100] Saturday peak hour

with Crosswinds Blvd extension

Manorwood Block 152

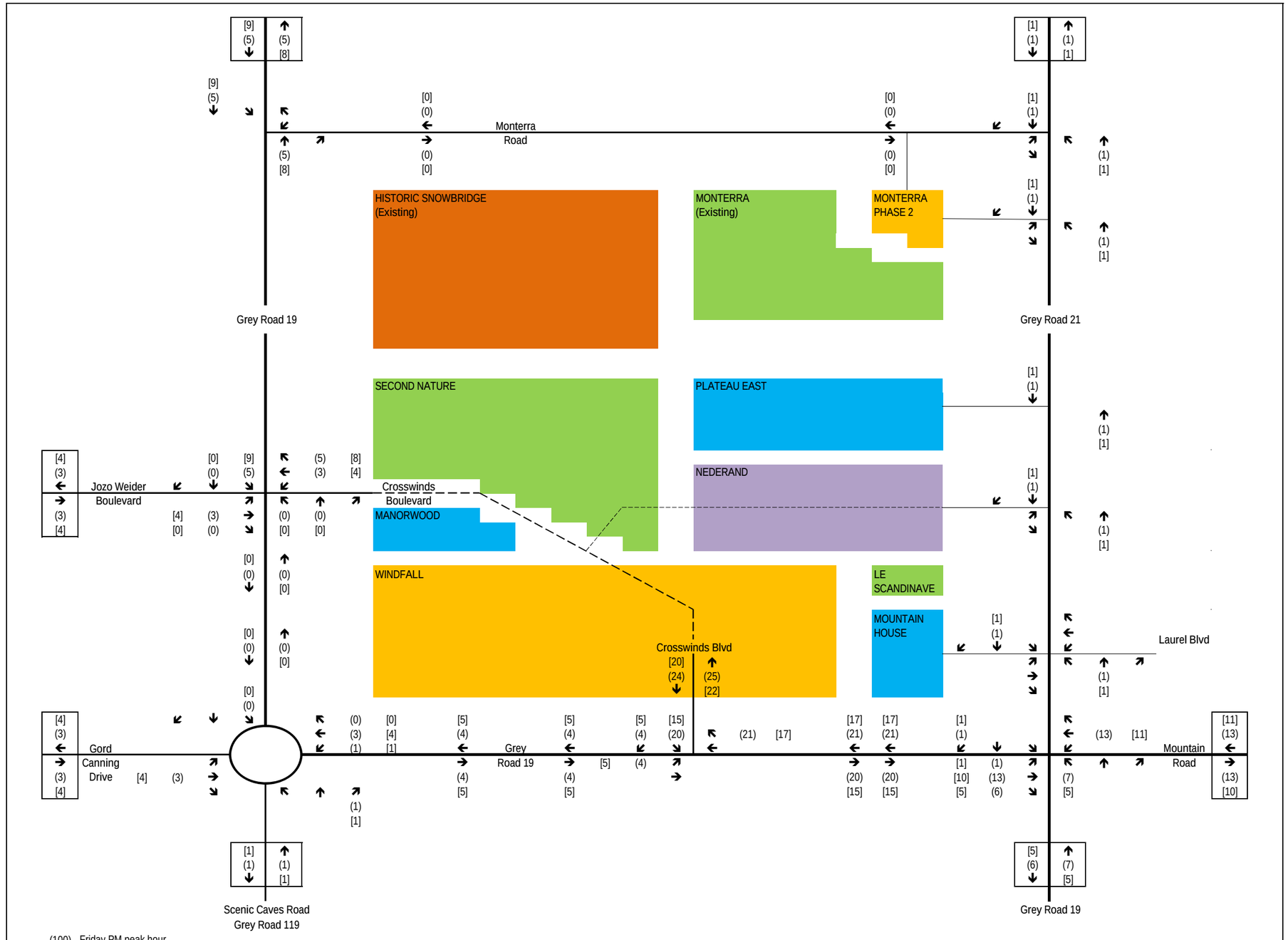

Monterra Road
Grey Road 19
Grey Road 21
Jozo Weider Boulevard
Crosswinds Boulevard
Crosswinds Blvd
Gord Canning Drive
Grey Road 19
Laurel Blvd
Mountain Road
Scenic Caves Road
Grey Road 119
Grey Road 19
HISTORIC SNOWBRIDGE (Existing)
MONTERRA (Existing)
MONTERRA PHASE 2
SECOND NATURE
PLATEAU EAST
NEDERAND
MANORWOOD
WINDFALL
LE SCANDINAVE
MOUNTAIN HOUSE
(100) Friday PM peak hour
[100] Saturday peak hour
with Crosswinds Blvd extension
Manorwood Block 153



(100) Friday PM peak hour
[100] Saturday peak hour

with Crosswinds Blvd extension

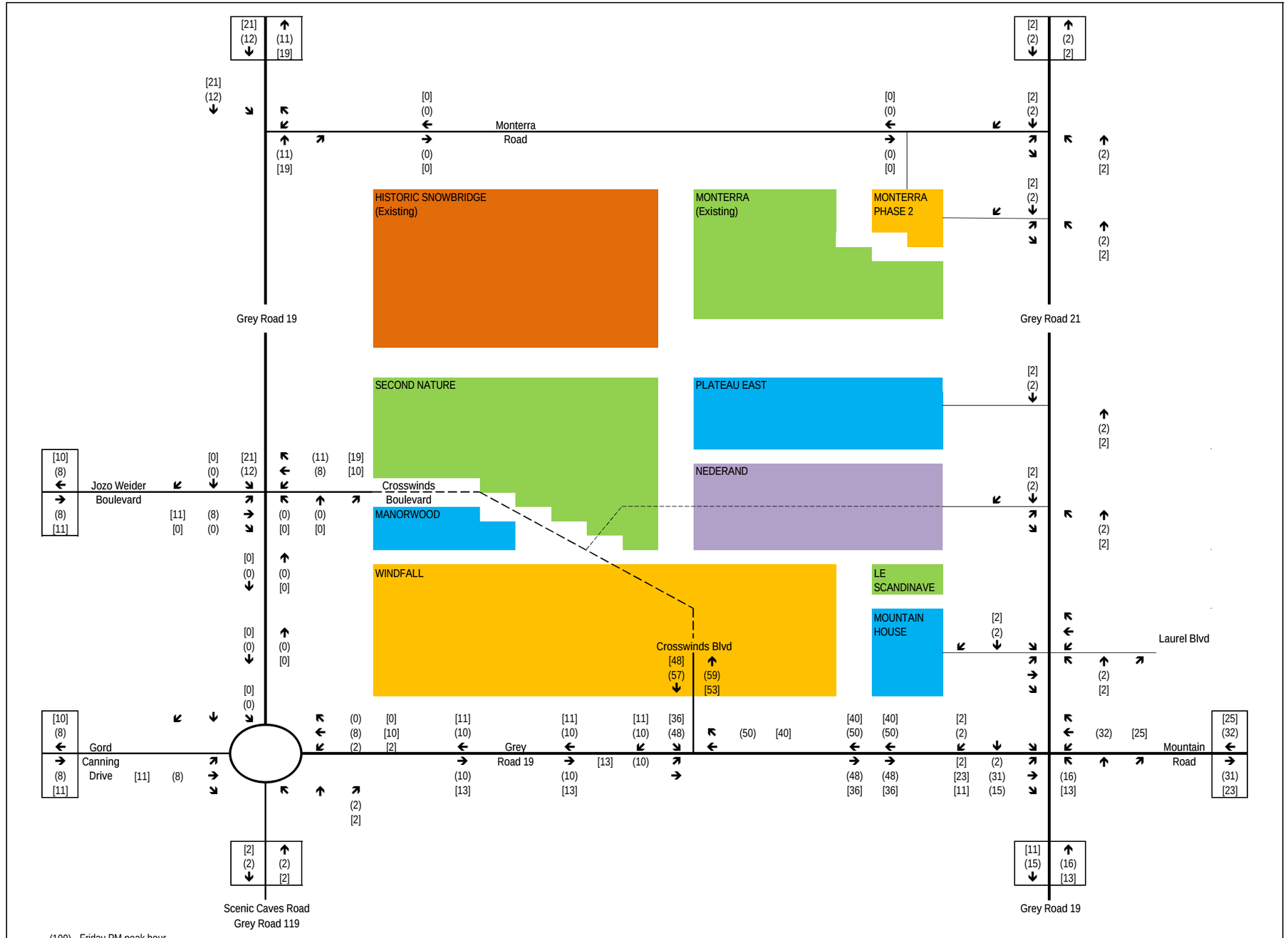
Windfall Phase 2



(100) Friday PM peak hour
[100] Saturday peak hour

with Crosswinds Blvd extension

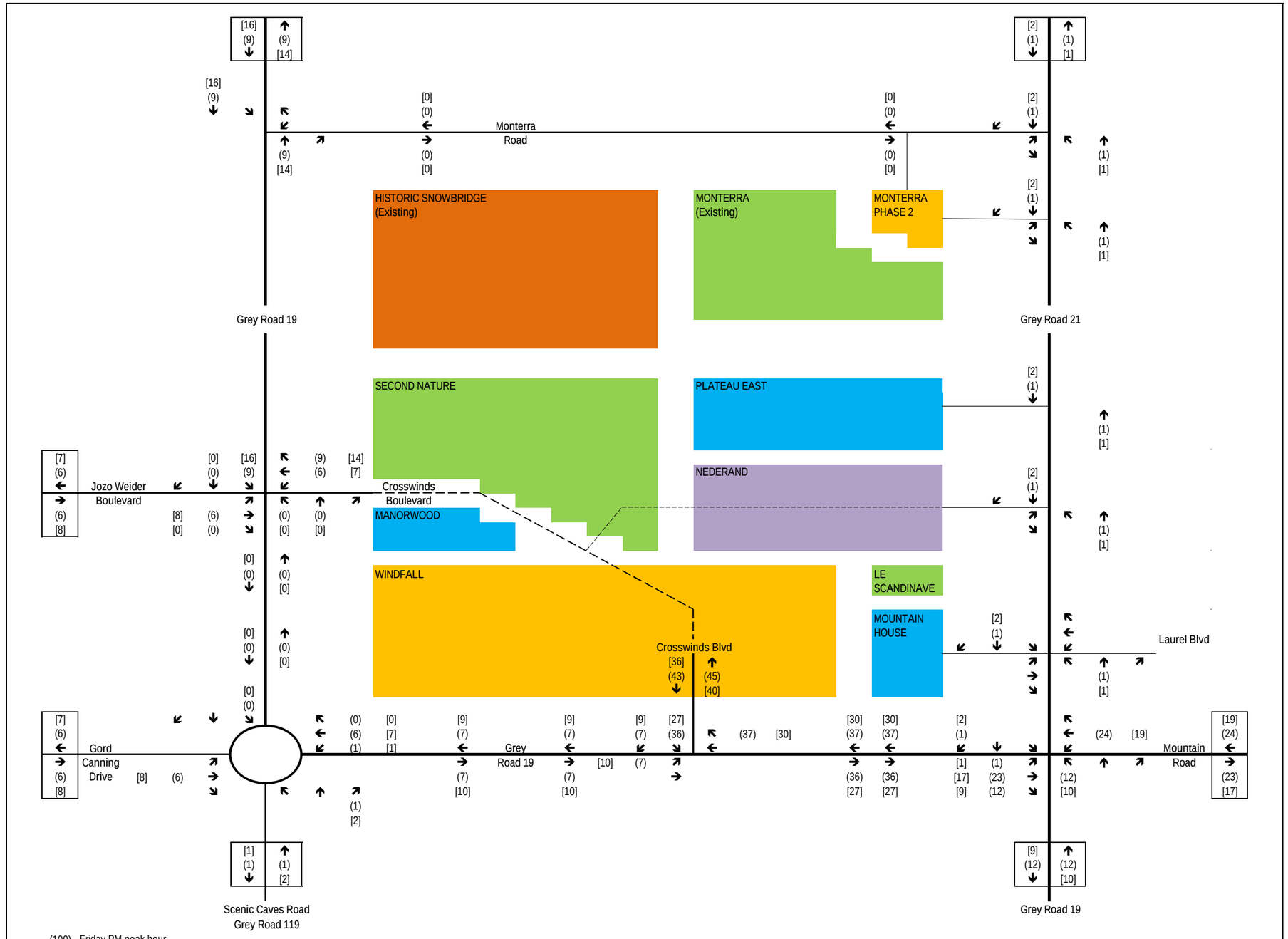
Windfall Phase 3



(100) Friday PM peak hour
[100] Saturday peak hour

with Crosswinds Blvd extension

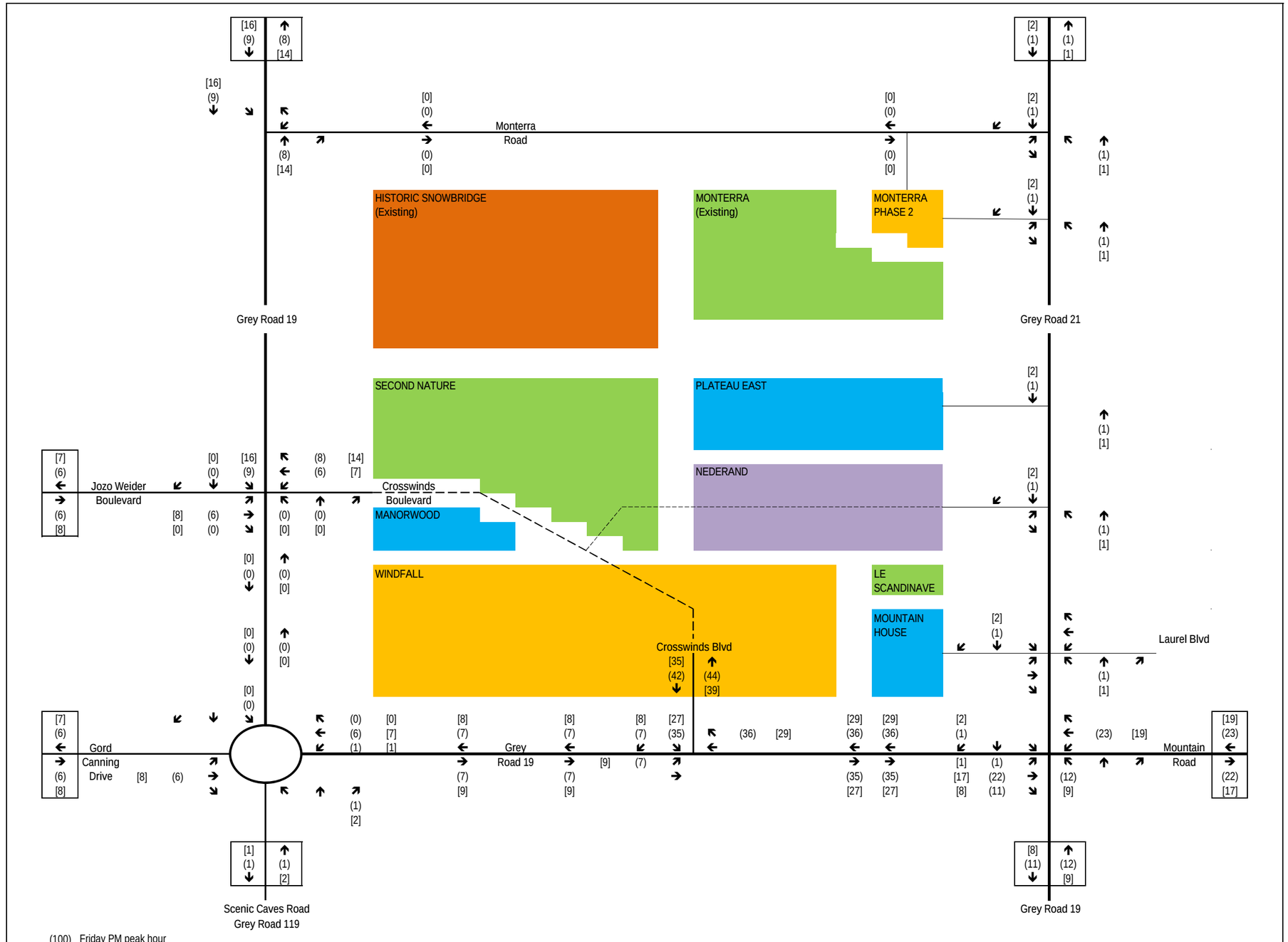
Windfall Phase 4



(100) Friday PM peak hour
[100] Saturday peak hour

with Crosswinds Blvd extension

Windfall Phase 5


Monterra Road
Grey Road 19
Grey Road 21
HISTORIC SNOWBRIDGE (Existing)
MONTERRA (Existing)
MONTERRA PHASE 2
SECOND NATURE
PLATEAU EAST
NEDERAND
MANORWOOD
WINDFALL
LE SCANDINAVE
MOUNTAIN HOUSE
Jozo Weider Boulevard
Crosswinds Boulevard
Crosswinds Blvd
Laurel Blvd
Gord Canning Drive
Grey Road 19
Mountain Road
Scenic Caves Road
Grey Road 119
Grey Road 19
(100) Friday PM peak hour
[100] Saturday peak hour
with Crosswinds Blvd extension
Windfall Phase 6

APPENDIX D:
TRAFFIC OPERATIONS - 2025 BACKGROUND

Movement Summary

GR 19/21 2025 FRI BG

Roundabout

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	324	1153	0.401	8.5	LOS A	20	1.59	30.3	68
32	T	122	1153	0.401	8.5	LOS A	20	1.59	30.3	68
32	R	16	1153	0.401	8.5	LOS A	20	1.59	30.3	68
Approach		**462**	**1389**	**0.401**	**8.5**	**LOS A**	**20**	**1.59**	**30.3**	**68**
Mountain Road										
22	L	19	2016	0.458	2.7	LOS A	24	0.80	37.1	211
22	T	781	2016	0.458	2.7	LOS A	24	0.80	37.1	211
22	R	122	2016	0.458	2.7	LOS A	24	0.80	37.1	211
Approach		**923**	**2016**	**0.458**	**2.7**	**LOS A**	**24**	**0.80**	**37.1**	**211**
Grey Road 21										
42	L	97	1159	0.235	6.8	LOS A	11	1.39	36.7	94
42	T	129	1159	0.235	6.8	LOS A	11	1.39	36.7	94
42	R	45	1159	0.235	6.8	LOS A	11	1.39	36.7	94
Approach		**272**	**1308**	**0.235**	**6.8**	**LOS A**	**11**	**1.39**	**36.7**	**94**
Grey Road 19										
12	L	65	2766	0.487	1.3	LOS A	27	0.36	32.0	83
12	T	905	2766	0.487	1.3	LOS A	27	0.36	32.0	83
12	R	378	2766	0.487	1.3	LOS A	27	0.36	32.0	83
Approach		**1348**	**2766**	**0.487**	**1.3**	**LOS A**	**27**	**0.36**	**32.0**	**83**
All Vehicles		**3005**	**7479**	**0.487**	**3.4**	**LOS A**	**27**	**0.78**	**35.0**	**456**

E:\aaSIDRA 2.0\Working Files\Nederand\2025 19&21 FRI BG
Produced by aaSIDRA 2.0.1.206 (Unregistered Version)

Generated 27/10/2018 9:29:36 AM

Movement Summary

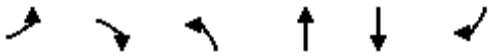
GR 19/21 2025 SAT BG

Roundabout

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	287	1489	0.343	7.1	LOS A	16	1.46	31.4	70
32	T	211	1489	0.343	7.1	LOS A	16	1.46	31.4	70
32	R	12	1489	0.343	7.1	LOS A	16	1.46	31.4	70
Approach		**510**	**1519**	**0.343**	**7.1**	**LOS A**	**16**	**1.46**	**31.4**	**70**
Mountain Road										
22	L	13	1971	0.469	2.9	LOS A	24	0.88	37.1	212
22	T	812	1971	0.469	2.9	LOS A	24	0.88	37.1	212
22	R	101	1971	0.469	2.9	LOS A	24	0.88	37.1	212
Approach		**925**	**1971**	**0.469**	**2.9**	**LOS A**	**24**	**0.88**	**37.1**	**212**
Grey Road 21										
42	L	116	1071	0.365	6.5	LOS A	16	1.44	36.8	134
42	T	213	1071	0.365	6.5	LOS A	16	1.44	36.8	134
42	R	64	1071	0.365	6.5	LOS A	16	1.44	36.8	134
Approach		**391**	**1297**	**0.365**	**6.5**	**LOS A**	**16**	**1.44**	**36.8**	**134**
Grey Road 19										
12	L	57	2364	0.471	1.9	LOS A	25	0.52	31.0	70
12	T	783	2364	0.471	1.9	LOS A	25	0.52	31.0	70
12	R	274	2364	0.471	1.9	LOS A	25	0.52	31.0	70
Approach		**1113**	**2364**	**0.471**	**1.9**	**LOS A**	**25**	**0.52**	**31.0**	**70**
All Vehicles		**2939**	**7151**	**0.471**	**3.7**	**LOS A**	**25**	**0.92**	**35.3**	**486**

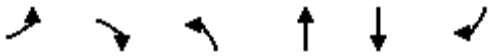
Generated 27/10/2018 9:30:15 AM



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	48	53	185	185	33
Future Volume (Veh/h)	19	48	53	185	185	33
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	21	52	58	201	201	36
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	536	219	237			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	536	219	237			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	94	96			
cM capacity (veh/h)	483	821	1330			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	73	259	237
Volume Left	21	58	0
Volume Right	52	0	36
cSH	684	1330	1700
Volume to Capacity	0.11	0.04	0.14
Queue Length 95th (m)	2.7	1.0	0.0
Control Delay (s)	10.9	2.1	0.0
Lane LOS	B	A	
Approach Delay (s)	10.9	2.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	38.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	75	69	56	237	267	121
Future Volume (Veh/h)	75	69	56	237	267	121
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	82	75	61	258	290	132
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	736	356	422			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	736	356	422			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	78	89	95			
cM capacity (veh/h)	366	688	1137			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	157	319	422
Volume Left	82	61	0
Volume Right	75	0	132
cSH	471	1137	1700
Volume to Capacity	0.33	0.05	0.25
Queue Length 95th (m)	11.0	1.3	0.0
Control Delay (s)	16.4	2.0	0.0
Lane LOS	C	A	
Approach Delay (s)	16.4	2.0	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	55.4%	ICU Level of Service	B
Analysis Period (min)	15		

APPENDIX E:
TRAFFIC OPERATIONS - 2030 BACKGROUND

Movement Summary

GR 19/21 2030 FRI BG

Roundabout

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	348	1101	0.453	9.4	LOS A	24	1.71	29.5	75
32	T	132	1101	0.453	9.4	LOS A	24	1.71	29.5	75
32	R	18	1101	0.453	9.4	LOS A	24	1.71	29.5	75
Approach		**499**	**1321**	**0.453**	**9.4**	**LOS A**	**24**	**1.71**	**29.5**	**75**
Mountain Road										
22	L	20	1959	0.500	3.3	LOS A	28	1.02	36.9	225
22	T	825	1959	0.500	3.3	LOS A	28	1.02	36.9	225
22	R	132	1959	0.500	3.3	LOS A	28	1.02	36.9	225
Approach		**979**	**1959**	**0.500**	**3.3**	**LOS A**	**28**	**1.02**	**36.9**	**225**
Grey Road 21										
42	L	104	1092	0.268	7.3	LOS A	12	1.46	36.4	102
42	T	141	1092	0.268	7.3	LOS A	12	1.46	36.4	102
42	R	48	1092	0.268	7.3	LOS A	12	1.46	36.4	102
Approach		**293**	**1232**	**0.268**	**7.3**	**LOS A**	**12**	**1.46**	**36.4**	**102**
Grey Road 19										
12	L	68	2710	0.532	1.5	LOS A	30	0.41	31.5	89
12	T	965	2710	0.532	1.5	LOS A	30	0.41	31.5	89
12	R	408	2710	0.532	1.5	LOS A	30	0.41	31.5	89
Approach		**1441**	**2710**	**0.532**	**1.5**	**LOS A**	**30**	**0.41**	**31.5**	**89**
All Vehicles		**3212**	**7223**	**0.532**	**3.8**	**LOS A**	**30**	**0.89**	**34.7**	**491**

E:\aaSIDRA 2.0\Working Files\Nederand\2030 19&21 FRI BG
Produced by aaSIDRA 2.0.1.206 (Unregistered Version)

Generated 27/10/2018 9:30:37 AM

Movement Summary

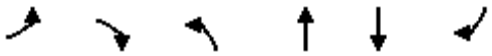
GR 19/21 2030 SAT BG

Roundabout

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	311	1434	0.386	7.7	LOS A	18	1.55	30.8	78
32	T	231	1434	0.386	7.7	LOS A	18	1.55	30.8	78
32	R	13	1434	0.386	7.7	LOS A	18	1.55	30.8	78
Approach		**554**	**1446**	**0.386**	**7.7**	**LOS A**	**18**	**1.55**	**30.8**	**78**
Mountain Road										
22	L	14	1906	0.517	3.6	LOS A	29	1.14	36.9	226
22	T	863	1906	0.517	3.6	LOS A	29	1.14	36.9	226
22	R	108	1906	0.517	3.6	LOS A	29	1.14	36.9	226
Approach		**985**	**1906**	**0.517**	**3.6**	**LOS A**	**29**	**1.14**	**36.9**	**226**
Grey Road 21										
42	L	126	1013	0.423	7.6	LOS A	21	1.59	36.3	149
42	T	232	1013	0.423	7.6	LOS A	21	1.59	36.3	149
42	R	69	1013	0.423	7.6	LOS A	21	1.59	36.3	149
Approach		**428**	**1223**	**0.422**	**7.6**	**LOS A**	**21**	**1.59**	**36.3**	**149**
Grey Road 19										
12	L	61	2298	0.518	2.2	LOS A	28	0.61	30.5	76
12	T	833	2298	0.518	2.2	LOS A	28	0.61	30.5	76
12	R	296	2298	0.518	2.2	LOS A	28	0.61	30.5	76
Approach		**1190**	**2298**	**0.518**	**2.2**	**LOS A**	**28**	**0.61**	**30.5**	**76**
All Vehicles		**3157**	**6873**	**0.518**	**4.3**	**LOS A**	**29**	**1.07**	**34.9**	**528**

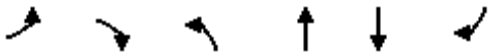
Generated 27/10/2018 9:30:59 AM



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	21	51	57	203	203	37
Future Volume (Veh/h)	21	51	57	203	203	37
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	55	62	221	221	40
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	586	241	261			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	586	241	261			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	93	95			
cM capacity (veh/h)	450	798	1303			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	78	283	261
Volume Left	23	62	0
Volume Right	55	0	40
cSH	650	1303	1700
Volume to Capacity	0.12	0.05	0.15
Queue Length 95th (m)	3.1	1.1	0.0
Control Delay (s)	11.3	2.1	0.0
Lane LOS	B	A	
Approach Delay (s)	11.3	2.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	41.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	83	74	61	260	294	134
Future Volume (Veh/h)	83	74	61	260	294	134
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	90	80	66	283	320	146
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	808	393	466			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	808	393	466			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	73	88	94			
cM capacity (veh/h)	329	656	1095			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	170	349	466
Volume Left	90	66	0
Volume Right	80	0	146
cSH	430	1095	1700
Volume to Capacity	0.40	0.06	0.27
Queue Length 95th (m)	14.1	1.5	0.0
Control Delay (s)	18.7	2.1	0.0
Lane LOS	C	A	
Approach Delay (s)	18.7	2.1	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	59.8%	ICU Level of Service	B
Analysis Period (min)	15		

APPENDIX F:
TRAFFIC OPERATIONS - 2035 BACKGROUND

Movement Summary

GR 19/21 2035 FRI BG

Roundabout

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	375	1029	0.521	10.8	LOS B	30	1.84	28.4	84
32	T	141	1029	0.521	10.8	LOS B	30	1.84	28.4	84
32	R	20	1029	0.521	10.8	LOS B	30	1.84	28.4	84
Approach		**536**	**1233**	**0.521**	**10.8**	**LOS B**	**30**	**1.84**	**28.4**	**84**
Mountain Road										
22	L	22	1898	0.547	4.1	LOS A	34	1.26	36.8	240
22	T	874	1898	0.547	4.1	LOS A	34	1.26	36.8	240
22	R	142	1898	0.547	4.1	LOS A	34	1.26	36.8	240
Approach		**1038**	**1898**	**0.547**	**4.1**	**LOS A**	**34**	**1.26**	**36.8**	**240**
Grey Road 21										
42	L	114	1019	0.313	8.1	LOS A	14	1.54	36.1	112
42	T	154	1019	0.313	8.1	LOS A	14	1.54	36.1	112
42	R	52	1019	0.313	8.1	LOS A	14	1.54	36.1	112
Approach		**319**	**1146**	**0.313**	**8.1**	**LOS A**	**14**	**1.54**	**36.1**	**112**
Grey Road 19										
12	L	73	2643	0.586	1.7	LOS A	35	0.49	31.0	97
12	T	1033	2643	0.586	1.7	LOS A	35	0.49	31.0	97
12	R	443	2643	0.586	1.7	LOS A	35	0.49	31.0	97
Approach		**1548**	**2643**	**0.586**	**1.7**	**LOS A**	**35**	**0.49**	**30.9**	**97**
All Vehicles		**3441**	**6921**	**0.586**	**4.5**	**LOS A**	**35**	**1.03**	**34.2**	**532**

E:\aaSIDRA 2.0\Working Files\Nederand\2035 19&21 FRI BG
Produced by aaSIDRA 2.0.1.206 (Unregistered Version)

Generated 27/10/2018 9:31:22 AM

Movement Summary

GR 19/21 2035 SAT BG

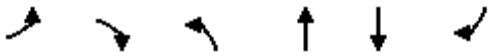
Roundabout

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	335	1362	0.441	8.9	LOS A	22	1.70	29.7	87
32	T	252	1362	0.441	8.9	LOS A	22	1.70	29.7	87
32	R	14	1362	0.441	8.9	LOS A	22	1.70	29.7	87
Approach		**601**	**1364**	**0.441**	**8.9**	**LOS A**	**22**	**1.70**	**29.7**	**87**
Mountain Road										
22	L	15	1828	0.576	4.5	LOS A	35	1.39	36.6	244
22	T	920	1828	0.576	4.5	LOS A	35	1.39	36.6	244
22	R	118	1828	0.576	4.5	LOS A	35	1.39	36.6	244
Approach		**1053**	**1828**	**0.576**	**4.5**	**LOS A**	**35**	**1.39**	**36.6**	**244**
Grey Road 21										
42	L	137	942	0.493	9.2	LOS A	27	1.75	35.6	164
42	T	254	942	0.493	9.2	LOS A	27	1.75	35.6	164
42	R	74	942	0.493	9.2	LOS A	27	1.75	35.6	164
Approach		**464**	**1137**	**0.492**	**9.2**	**LOS A**	**27**	**1.75**	**35.6**	**164**
Grey Road 19										
12	L	64	2227	0.572	2.8	LOS A	35	0.84	30.0	82
12	T	888	2227	0.572	2.8	LOS A	35	0.84	30.0	82
12	R	320	2227	0.572	2.8	LOS A	35	0.84	30.0	82
Approach		**1273**	**2227**	**0.571**	**2.8**	**LOS A**	**35**	**0.84**	**30.0**	**82**
All Vehicles		**3391**	**6556**	**0.576**	**5.3**	**LOS A**	**35**	**1.29**	**34.3**	**578**

E:\aaSIDRA 2.0\Working Files\Nederand\2035 19&21 SAT BG
Produced by aaSIDRA 2.0.1.206 (Unregistered Version)

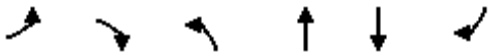
Generated 27/10/2018 9:33:03 AM



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	24	55	62	223	222	40
Future Volume (Veh/h)	24	55	62	223	222	40
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	26	60	67	242	241	43
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	638	262	284			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	638	262	284			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	92	95			
cM capacity (veh/h)	417	776	1278			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	86	309	284
Volume Left	26	67	0
Volume Right	60	0	43
cSH	616	1278	1700
Volume to Capacity	0.14	0.05	0.17
Queue Length 95th (m)	3.7	1.3	0.0
Control Delay (s)	11.8	2.1	0.0
Lane LOS	B	A	
Approach Delay (s)	11.8	2.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	44.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	91	80	66	286	323	148
Future Volume (Veh/h)	91	80	66	286	323	148
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	99	87	72	311	351	161
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	886	432	512			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	886	432	512			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	66	86	93			
cM capacity (veh/h)	293	624	1053			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	186	383	512
Volume Left	99	72	0
Volume Right	87	0	161
cSH	390	1053	1700
Volume to Capacity	0.48	0.07	0.30
Queue Length 95th (m)	18.9	1.7	0.0
Control Delay (s)	22.4	2.2	0.0
Lane LOS	C	A	
Approach Delay (s)	22.4	2.2	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		

APPENDIX G:
TRAFFIC OPERATIONS - 2025 TOTAL

Movement Summary

GR 19/21 2025 FRI TOTAL

Roundabout

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	324	1161	0.412	8.7	LOS A	21	1.62	30.1	70
32	T	138	1161	0.412	8.7	LOS A	21	1.62	30.1	70
32	R	16	1161	0.412	8.7	LOS A	21	1.62	30.1	70
Approach		**478**	**1365**	**0.412**	**8.7**	**LOS A**	**21**	**1.62**	**30.1**	**70**
Mountain Road										
22	L	19	1989	0.481	3.0	LOS A	26	0.90	37.0	219
22	T	781	1989	0.481	3.0	LOS A	26	0.90	37.0	219
22	R	155	1989	0.481	3.0	LOS A	26	0.90	37.0	219
Approach		**956**	**1989**	**0.481**	**3.0**	**LOS A**	**26**	**0.90**	**37.0**	**219**
Grey Road 21										
42	L	116	1194	0.252	7.1	LOS A	11	1.43	36.5	105
42	T	139	1194	0.252	7.1	LOS A	11	1.43	36.5	105
42	R	47	1194	0.252	7.1	LOS A	11	1.43	36.5	105
Approach		**301**	**1304**	**0.252**	**7.1**	**LOS A**	**11**	**1.43**	**36.5**	**105**
Grey Road 19										
12	L	69	2650	0.510	1.5	LOS A	28	0.42	31.5	84
12	T	905	2650	0.510	1.5	LOS A	28	0.42	31.5	84
12	R	378	2650	0.510	1.5	LOS A	28	0.42	31.5	84
Approach		**1352**	**2650**	**0.510**	**1.5**	**LOS A**	**28**	**0.42**	**31.5**	**84**
All Vehicles		**3087**	**7308**	**0.510**	**3.6**	**LOS A**	**28**	**0.85**	**34.9**	**478**

E:\aaSIDRA 2.0\Working Files\Windfall\2018 Update\2025 19&21 FRI TOTAL
Produced by aaSIDRA 2.0.1.206 (Unregistered Version)

Akcelik & Associates Pty Ltd

Generated 23/09/2018 2:33:33 PM

Movement Summary

GR 19/21 2025 SAT TOTAL

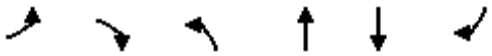
Roundabout

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	287	1484	0.352	7.2	LOS A	16	1.48	31.2	72
32	T	223	1484	0.352	7.2	LOS A	16	1.48	31.2	72
32	R	12	1484	0.352	7.2	LOS A	16	1.48	31.2	72
Approach		**523**	**1489**	**0.353**	**7.2**	**LOS A**	**16**	**1.48**	**31.2**	**72**
Mountain Road										
22	L	13	1951	0.487	3.1	LOS A	26	0.97	37.0	218
22	T	812	1951	0.487	3.1	LOS A	26	0.97	37.0	218
22	R	126	1951	0.487	3.1	LOS A	26	0.97	37.0	218
Approach		**951**	**1951**	**0.488**	**3.1**	**LOS A**	**26**	**0.97**	**37.0**	**218**
Grey Road 21										
42	L	138	1107	0.387	6.9	LOS A	18	1.50	36.6	148
42	T	223	1107	0.387	6.9	LOS A	18	1.50	36.6	148
42	R	67	1107	0.387	6.9	LOS A	18	1.50	36.6	148
Approach		**428**	**1302**	**0.386**	**6.9**	**LOS A**	**18**	**1.50**	**36.6**	**148**
Grey Road 19										
12	L	60	2285	0.488	2.1	LOS A	26	0.57	30.7	71
12	T	783	2285	0.488	2.1	LOS A	26	0.57	30.7	71
12	R	274	2285	0.488	2.1	LOS A	26	0.57	30.7	71
Approach		**1116**	**2285**	**0.488**	**2.1**	**LOS A**	**26**	**0.57**	**30.7**	**71**
All Vehicles		**3018**	**7027**	**0.488**	**4.0**	**LOS A**	**26**	**0.99**	**35.2**	**509**

E:\aaSIDRA 2.0\Working Files\Windfall\2018 Update\2025 19&21 SAT TOTAL
Produced by aaSIDRA 2.0.1.206 (Unregistered Version)

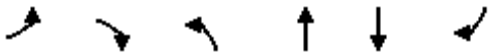
Generated 23/09/2018 2:35:17 PM



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	52	55	185	185	33
Future Volume (Veh/h)	19	52	55	185	185	33
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	21	57	60	201	201	36
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	540	219	237			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	540	219	237			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	93	95			
cM capacity (veh/h)	480	821	1330			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	78	261	237
Volume Left	21	60	0
Volume Right	57	0	36
cSH	689	1330	1700
Volume to Capacity	0.11	0.05	0.14
Queue Length 95th (m)	2.9	1.1	0.0
Control Delay (s)	10.9	2.1	0.0
Lane LOS	B	A	
Approach Delay (s)	10.9	2.1	0.0
Approach LOS	B		

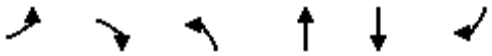
Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	38.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	29	50	250	254	4
Future Volume (Veh/h)	2	29	50	250	254	4
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	32	54	272	276	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	658	278	280			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	658	278	280			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	96	96			
cM capacity (veh/h)	411	761	1283			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	34	326	280
Volume Left	2	54	0
Volume Right	32	0	4
cSH	725	1283	1700
Volume to Capacity	0.05	0.04	0.16
Queue Length 95th (m)	1.1	1.0	0.0
Control Delay (s)	10.2	1.6	0.0
Lane LOS	B	A	
Approach Delay (s)	10.2	1.6	0.0
Approach LOS	B		

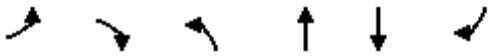
Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	75	71	59	237	267	121
Future Volume (Veh/h)	75	71	59	237	267	121
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	82	77	64	258	290	132
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	742	356	422			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	742	356	422			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	77	89	94			
cM capacity (veh/h)	362	688	1137			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	159	322	422
Volume Left	82	64	0
Volume Right	77	0	132
cSH	469	1137	1700
Volume to Capacity	0.34	0.06	0.25
Queue Length 95th (m)	11.2	1.4	0.0
Control Delay (s)	16.5	2.1	0.0
Lane LOS	C	A	
Approach Delay (s)	16.5	2.1	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	55.7%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	3	34	39	324	357	3
Future Volume (Veh/h)	3	34	39	324	357	3
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	37	42	352	388	3
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	826	390	391			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	826	390	391			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	94	96			
cM capacity (veh/h)	330	659	1168			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	40	394	391
Volume Left	3	42	0
Volume Right	37	0	3
cSH	613	1168	1700
Volume to Capacity	0.07	0.04	0.23
Queue Length 95th (m)	1.6	0.9	0.0
Control Delay (s)	11.3	1.2	0.0
Lane LOS	B	A	
Approach Delay (s)	11.3	1.2	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	51.5%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX H:
TRAFFIC OPERATIONS - 2030 TOTAL

Movement Summary

GR 19/21 2030 FRI TOTAL

Roundabout

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	348	1102	0.466	9.7	LOS A	25	1.73	29.3	78
32	T	147	1102	0.466	9.7	LOS A	25	1.73	29.3	78
32	R	18	1102	0.466	9.7	LOS A	25	1.73	29.3	78
Approach		**514**	**1292**	**0.467**	**9.7**	**LOS A**	**25**	**1.73**	**29.3**	**78**
Mountain Road										
22	L	20	1933	0.523	3.6	LOS A	31	1.14	36.9	232
22	T	825	1933	0.523	3.6	LOS A	31	1.14	36.9	232
22	R	164	1933	0.523	3.6	LOS A	31	1.14	36.9	232
Approach		**1011**	**1933**	**0.523**	**3.6**	**LOS A**	**31**	**1.14**	**36.9**	**232**
Grey Road 21										
42	L	123	1120	0.290	7.6	LOS A	13	1.49	36.3	113
42	T	151	1120	0.290	7.6	LOS A	13	1.49	36.3	113
42	R	51	1120	0.290	7.6	LOS A	13	1.49	36.3	113
Approach		**325**	**1226**	**0.290**	**7.6**	**LOS A**	**13**	**1.49**	**36.3**	**113**
Grey Road 19										
12	L	73	2597	0.556	1.7	LOS A	32	0.47	31.1	91
12	T	965	2597	0.556	1.7	LOS A	32	0.47	31.1	91
12	R	408	2597	0.556	1.7	LOS A	32	0.47	31.1	91
Approach		**1445**	**2597**	**0.556**	**1.7**	**LOS A**	**32**	**0.47**	**31.1**	**91**
All Vehicles		**3295**	**7049**	**0.556**	**4.1**	**LOS A**	**32**	**0.97**	**34.5**	**514**

E:\aaSIDRA 2.0\Working Files\Windfall\2018 Update\2030 19&21 FRI TOTAL
Produced by aaSIDRA 2.0.1.206 (Unregistered Version)

Akcelik & Associates Pty Ltd

Generated 23/09/2018 2:44:45 PM

Movement Summary

GR 19/21 2030 SAT TOTAL

Roundabout

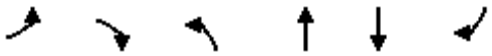
Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	311	1396	0.405	8.1	LOS A	19	1.59	30.4	80
32	T	242	1396	0.405	8.1	LOS A	19	1.59	30.4	80
32	R	13	1396	0.405	8.1	LOS A	19	1.59	30.4	80
Approach		**565**	**1413**	**0.405**	**8.1**	**LOS A**	**19**	**1.59**	**30.4**	**80**
Mountain Road										
22	L	14	1883	0.537	3.9	LOS A	31	1.22	36.9	232
22	T	863	1883	0.537	3.9	LOS A	31	1.22	36.9	232
22	R	134	1883	0.537	3.9	LOS A	31	1.22	36.9	232
Approach		**1011**	**1883**	**0.537**	**3.9**	**LOS A**	**31**	**1.22**	**36.9**	**232**
Grey Road 21										
42	L	148	1040	0.444	8.0	LOS A	23	1.64	36.1	162
42	T	243	1040	0.444	8.0	LOS A	23	1.64	36.1	162
42	R	72	1040	0.444	8.0	LOS A	23	1.64	36.1	162
Approach		**462**	**1223**	**0.444**	**8.0**	**LOS A**	**23**	**1.64**	**36.1**	**162**
Grey Road 19										
12	L	64	2223	0.537	2.5	LOS A	30	0.73	30.2	77
12	T	833	2223	0.537	2.5	LOS A	30	0.73	30.2	77
12	R	296	2223	0.537	2.5	LOS A	30	0.73	30.2	77
Approach		**1193**	**2223**	**0.537**	**2.5**	**LOS A**	**30**	**0.73**	**30.2**	**77**
All Vehicles		**3231**	**6742**	**0.537**	**4.7**	**LOS A**	**31**	**1.17**	**34.8**	**551**

E:\aaSIDRA 2.0\Working Files\Windfall\2018 Update\2030 19&21 SAT TOTAL
Produced by aaSIDRA 2.0.1.206 (Unregistered Version)

Akcelik & Associates Pty Ltd

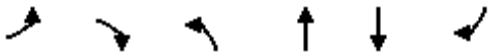
Generated 23/09/2018 2:46:25 PM



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	21	55	59	203	203	37
Future Volume (Veh/h)	21	55	59	203	203	37
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	60	64	221	221	40
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	590	241	261			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	590	241	261			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	92	95			
cM capacity (veh/h)	447	798	1303			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	83	285	261
Volume Left	23	64	0
Volume Right	60	0	40
cSH	655	1303	1700
Volume to Capacity	0.13	0.05	0.15
Queue Length 95th (m)	3.3	1.2	0.0
Control Delay (s)	11.3	2.1	0.0
Lane LOS	B	A	
Approach Delay (s)	11.3	2.1	0.0
Approach LOS	B		

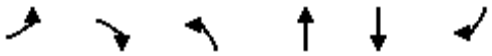
Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	41.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	29	50	271	275	4
Future Volume (Veh/h)	2	29	50	271	275	4
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	32	54	295	299	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	704	301	303			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	704	301	303			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	96	96			
cM capacity (veh/h)	386	739	1258			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	34	349	303
Volume Left	2	54	0
Volume Right	32	0	4
cSH	701	1258	1700
Volume to Capacity	0.05	0.04	0.18
Queue Length 95th (m)	1.2	1.0	0.0
Control Delay (s)	10.4	1.6	0.0
Lane LOS	B	A	
Approach Delay (s)	10.4	1.6	0.0
Approach LOS	B		

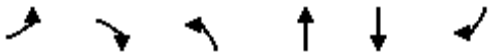
Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	83	77	63	260	294	134
Future Volume (Veh/h)	83	77	63	260	294	134
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	90	84	68	283	320	146
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	812	393	466			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	812	393	466			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	72	87	94			
cM capacity (veh/h)	327	656	1095			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	174	351	466
Volume Left	90	68	0
Volume Right	84	0	146
cSH	431	1095	1700
Volume to Capacity	0.40	0.06	0.27
Queue Length 95th (m)	14.6	1.5	0.0
Control Delay (s)	18.9	2.2	0.0
Lane LOS	C	A	
Approach Delay (s)	18.9	2.2	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	60.1%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	3	34	39	354	390	3
Future Volume (Veh/h)	3	34	39	354	390	3
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	37	42	385	424	3
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	894	426	427			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	894	426	427			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	94	96			
cM capacity (veh/h)	300	629	1132			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	40	427	427
Volume Left	3	42	0
Volume Right	37	0	3
cSH	581	1132	1700
Volume to Capacity	0.07	0.04	0.25
Queue Length 95th (m)	1.7	0.9	0.0
Control Delay (s)	11.7	1.2	0.0
Lane LOS	B	A	
Approach Delay (s)	11.7	1.2	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	54.8%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX I:
TRAFFIC OPERATIONS - 2035 TOTAL

Movement Summary

GR 19/21 2035 FRI TOTAL

Roundabout

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	375	1026	0.539	11.4	LOS B	32	1.89	27.9	88
32	T	158	1026	0.539	11.4	LOS B	32	1.89	27.9	88
32	R	20	1026	0.539	11.4	LOS B	32	1.89	27.9	88
Approach		**553**	**1200**	**0.539**	**11.4**	**LOS B**	**32**	**1.89**	**27.9**	**88**
Mountain Road										
22	L	22	1868	0.573	4.5	LOS A	37	1.36	36.6	248
22	T	874	1868	0.573	4.5	LOS A	37	1.36	36.6	248
22	R	175	1868	0.573	4.5	LOS A	37	1.36	36.6	248
Approach		**1070**	**1868**	**0.573**	**4.5**	**LOS A**	**37**	**1.36**	**36.6**	**248**
Grey Road 21										
42	L	133	1048	0.334	8.4	LOS A	15	1.57	35.9	123
42	T	163	1048	0.334	8.4	LOS A	15	1.57	35.9	123
42	R	54	1048	0.334	8.4	LOS A	15	1.57	35.9	123
Approach		**350**	**1139**	**0.334**	**8.4**	**LOS A**	**15**	**1.57**	**35.9**	**123**
Grey Road 19										
12	L	77	2534	0.613	2.1	LOS A	40	0.62	30.5	99
12	T	1033	2534	0.613	2.1	LOS A	40	0.62	30.5	99
12	R	443	2534	0.613	2.1	LOS A	40	0.62	30.5	99
Approach		**1553**	**2534**	**0.613**	**2.1**	**LOS A**	**40**	**0.62**	**30.5**	**99**
All Vehicles		**3526**	**6741**	**0.613**	**4.9**	**LOS A**	**40**	**1.14**	**34.0**	**558**

E:\aaSIDRA 2.0\Working Files\Windfall\2018 Update\2035 19&21 FRI TOTAL
Produced by aaSIDRA 2.0.1.206 (Unregistered Version)

Generated 23/09/2018 2:48:46 PM

Movement Summary

GR 19/21 2035 SAT TOTAL

Roundabout

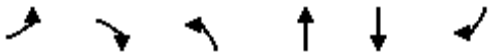
Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
Grey Road 19/Osler Bluff										
32	L	335	1301	0.471	9.4	LOS A	23	1.75	29.3	90
32	T	264	1301	0.471	9.4	LOS A	23	1.75	29.3	90
32	R	14	1301	0.471	9.4	LOS A	23	1.75	29.3	90
Approach		**613**	**1330**	**0.471**	**9.4**	**LOS A**	**23**	**1.75**	**29.3**	**90**
Mountain Road										
22	L	15	1804	0.598	4.8	LOS A	38	1.46	36.5	251
22	T	920	1804	0.598	4.8	LOS A	38	1.46	36.5	251
22	R	143	1804	0.598	4.8	LOS A	38	1.46	36.5	251
Approach		**1078**	**1804**	**0.598**	**4.8**	**LOS A**	**38**	**1.46**	**36.5**	**251**
Grey Road 21										
42	L	159	964	0.520	9.8	LOS A	29	1.81	35.3	179
42	T	265	964	0.520	9.8	LOS A	29	1.81	35.3	179
42	R	77	964	0.520	9.8	LOS A	29	1.81	35.3	179
Approach		**501**	**1135**	**0.520**	**9.8**	**LOS A**	**29**	**1.81**	**35.3**	**179**
Grey Road 19										
12	L	67	2157	0.592	3.2	LOS A	37	1.00	29.7	83
12	T	888	2157	0.592	3.2	LOS A	37	1.00	29.7	83
12	R	320	2157	0.592	3.2	LOS A	37	1.00	29.7	83
Approach		**1276**	**2157**	**0.592**	**3.2**	**LOS A**	**37**	**1.00**	**29.7**	**83**
All Vehicles		**3468**	**6426**	**0.598**	**5.8**	**LOS A**	**38**	**1.39**	**34.1**	**603**

E:\aaSIDRA 2.0\Working Files\Windfall\2018 Update\2035 19&21 SAT TOTAL
Produced by aaSIDRA 2.0.1.206 (Unregistered Version)

Akcelik & Associates Pty Ltd

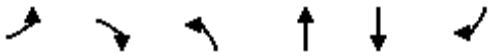
Generated 23/09/2018 2:50:28 PM



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	24	58	64	223	222	40
Future Volume (Veh/h)	24	58	64	223	222	40
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	26	63	70	242	241	43
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	644	262	284			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	644	262	284			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	92	95			
cM capacity (veh/h)	413	776	1278			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	89	312	284
Volume Left	26	70	0
Volume Right	63	0	43
cSH	618	1278	1700
Volume to Capacity	0.14	0.05	0.17
Queue Length 95th (m)	3.8	1.3	0.0
Control Delay (s)	11.8	2.2	0.0
Lane LOS	B	A	
Approach Delay (s)	11.8	2.2	0.0
Approach LOS	B		

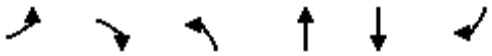
Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	44.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	29	50	294	299	4
Future Volume (Veh/h)	2	29	50	294	299	4
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	32	54	320	325	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	755	327	329			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	755	327	329			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	96	96			
cM capacity (veh/h)	360	714	1231			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	34	374	329
Volume Left	2	54	0
Volume Right	32	0	4
cSH	675	1231	1700
Volume to Capacity	0.05	0.04	0.19
Queue Length 95th (m)	1.2	1.0	0.0
Control Delay (s)	10.6	1.5	0.0
Lane LOS	B	A	
Approach Delay (s)	10.6	1.5	0.0
Approach LOS	B		

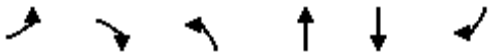
Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	47.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	91	83	68	286	323	148
Future Volume (Veh/h)	91	83	68	286	323	148
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	99	90	74	311	351	161
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	890	432	512			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	890	432	512			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	66	86	93			
cM capacity (veh/h)	291	624	1053			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	189	385	512
Volume Left	99	74	0
Volume Right	90	0	161
cSH	390	1053	1700
Volume to Capacity	0.48	0.07	0.30
Queue Length 95th (m)	19.4	1.7	0.0
Control Delay (s)	22.6	2.3	0.0
Lane LOS	C	A	
Approach Delay (s)	22.6	2.3	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	65.0%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	3	34	39	386	426	3
Future Volume (Veh/h)	3	34	39	386	426	3
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	37	42	420	463	3
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	968	464	466			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	968	464	466			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	94	96			
cM capacity (veh/h)	271	598	1095			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	40	462	466
Volume Left	3	42	0
Volume Right	37	0	3
cSH	548	1095	1700
Volume to Capacity	0.07	0.04	0.27
Queue Length 95th (m)	1.8	0.9	0.0
Control Delay (s)	12.1	1.2	0.0
Lane LOS	B	A	
Approach Delay (s)	12.1	1.2	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	58.4%	ICU Level of Service	B
Analysis Period (min)	15		

APPENDIX J:
LEFT TURN LANE WARRANTS

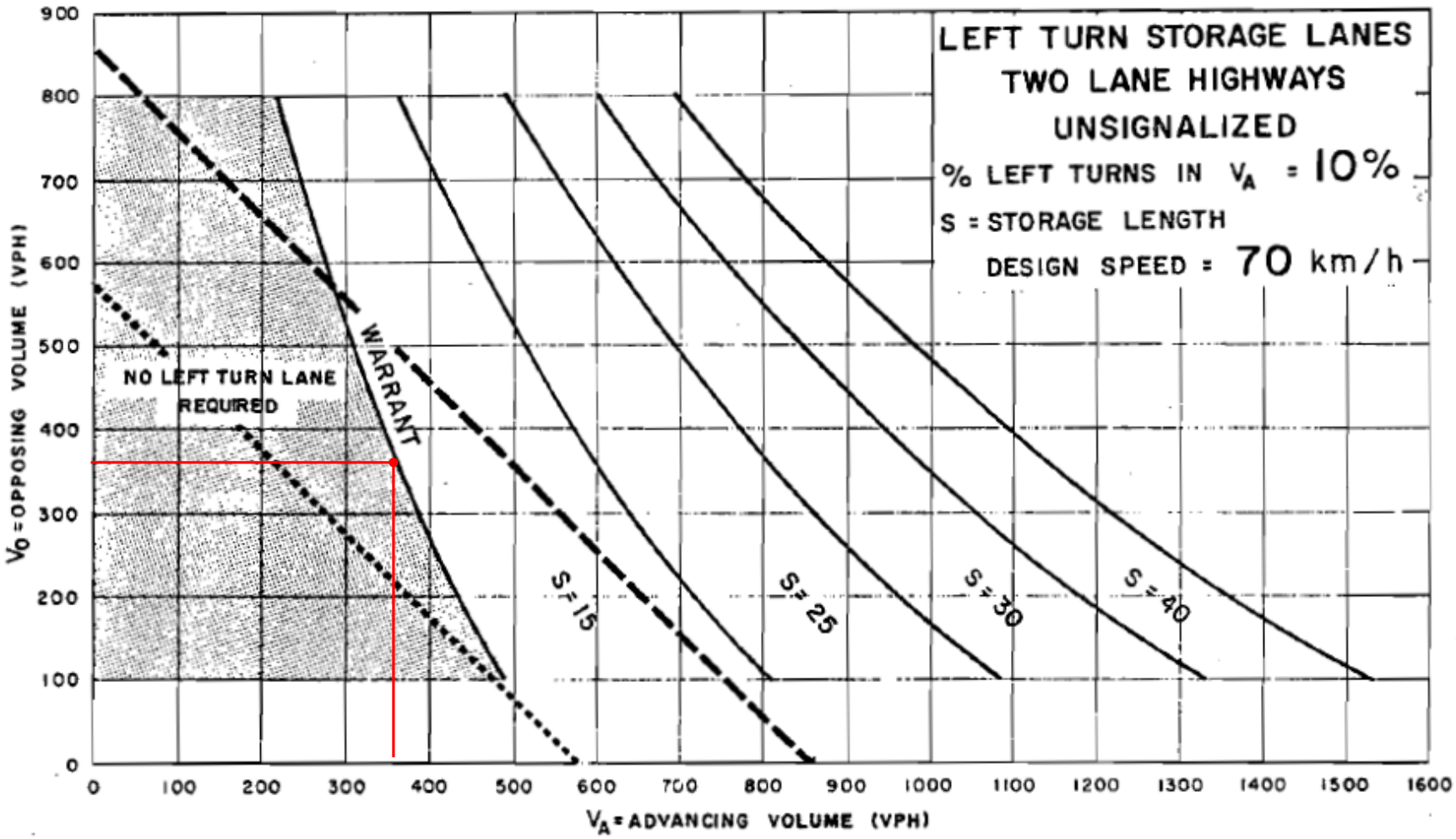

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 10%
S = STORAGE LENGTH
DESIGN SPEED = 70 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600

Figure EA-10

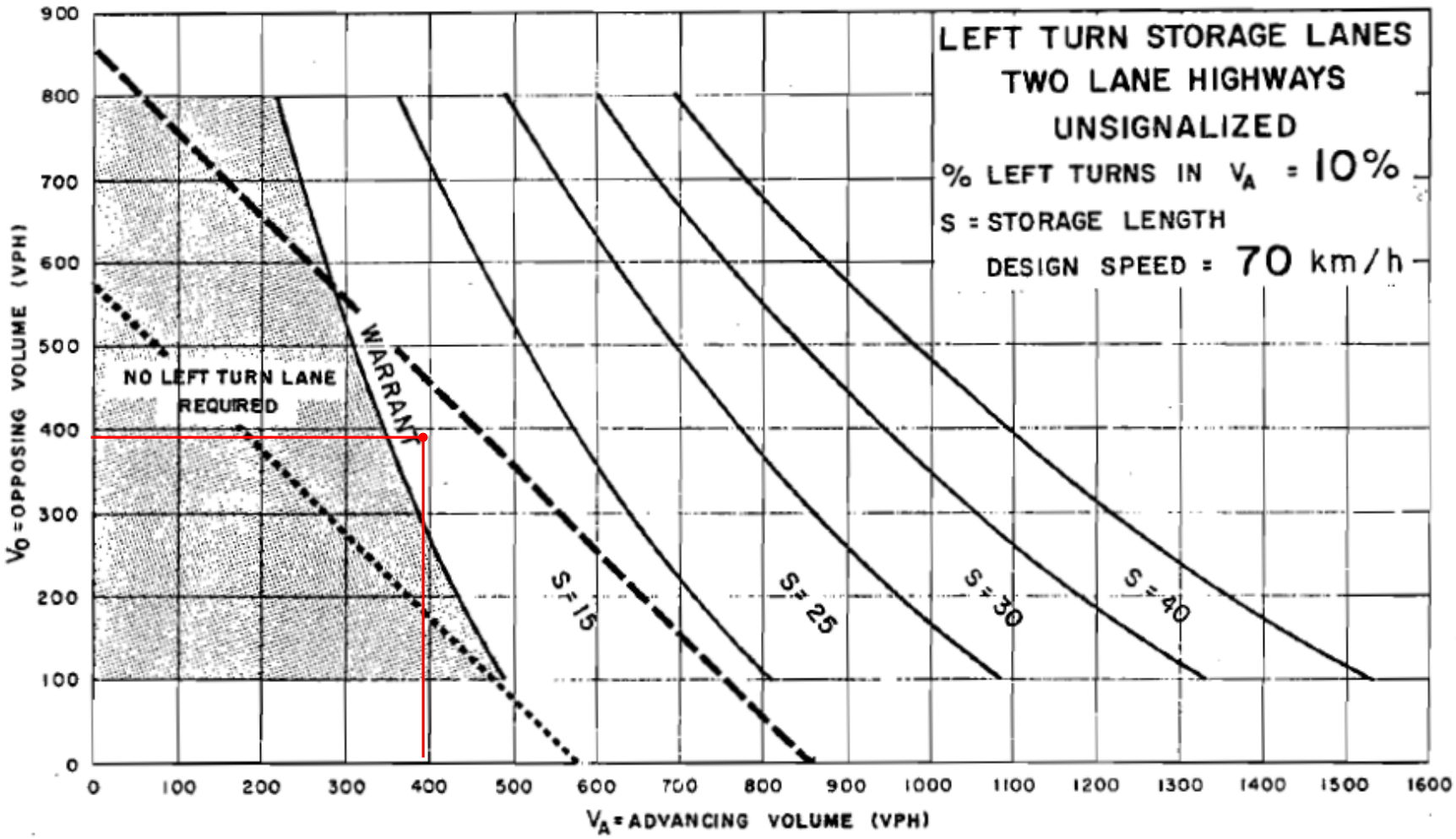

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 10%
S = STORAGE LENGTH
DESIGN SPEED = 70 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600

Figure EA-10

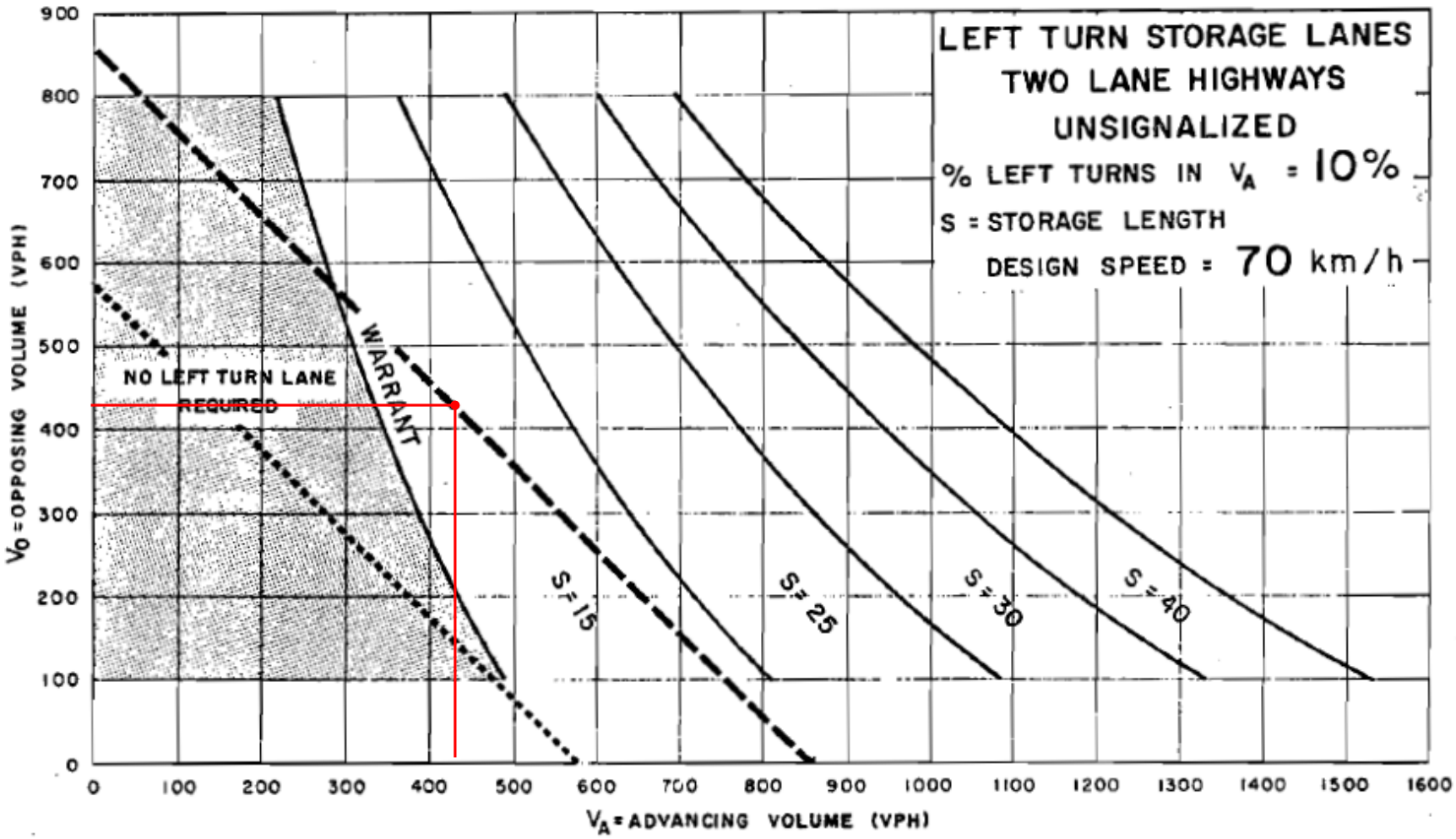

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 10%
S = STORAGE LENGTH
DESIGN SPEED = 70 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600

Figure EA-10