



**499 ISLAND HIGHWAY WEST
NETWORK ASSESSMENT**

Parksville, BC



DATE: June 8, 2011

File: 1238

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EXECUTIVE SUMMARY

This study reviewed the impact of the proposed “Family Place Parksville” development, a redevelopment of 499 Island Highway West, on the surrounding road network. The study also assessed options for providing access to the neighbourhood north of Highway 19A; and included a review of the City’s current long-term plans to connect Temple Street to Finholm Street through the property. This extension would create a four legged intersection providing full movement access to north and south of Highway 19A. However, in order to accomplish this, a portion of the property at 499 Island Highway would be required. The intent of this report is to provide technical transportation information on two options for the section of road network between Moilliet Street and Bay Avenue along the Highway 19A corridor.

Extending Temple Street through the property at 499 Island Highway to Finholm Street has been identified as ‘desirable’ in the City’s Master Transportation Planning for nearly thirty (30) years. School District #69 owns the property at 499 Island Highway. The redevelopment at 499 Island Highway does not require rezoning and the City can’t require the School District to provide the land to complete the Temple Street to Finholm Street connection.

Between Moilliet Street and Bay Avenue there are five unsignalized ‘T’ intersections within 500m of each other, three on the north side and two on the south side of Highway 19A. This section of Highway 19A lacks turning lanes on Highway 19A and has poor Levels of Service (LOS) on the side streets. This current situation with a high number of intersections within close proximity, all with poor LOS, the choice of which intersection(s) to signalize is important to avoid creating additional congestion and associated safety impacts. There are limited pedestrian, crosswalk, cycling, and transit facilities within this section of Highway 19A.

The Family Place Parksville development will replace the existing School District operations, maintenance, and IT buildings with new office space for School District #69 IT staff, Vancouver Island Health Authority (VIHA) staff and Ministry of Children and Family Development (MCFD) staff and VIHA and MCFD programs. The current Munchkinland program will remain onsite after the redevelopment. The redevelopment of the site will generate an additional 27 trips in the am peak hour (total of 59 vehicles/hour) and 26 trips in the pm peak hour.

Two road network / traffic control configurations were identified for analysis in detail:

- (1) signalize Bay Avenue and Moilliet Street
- (2) extend Temple Street to Finholm Street and signalize.

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Option 1 creates consistent intersection spacing that allows adjacent signals to be timed for progression and provides improved access to Highway 19A on the north and south sides of the highway.

Option 2 provides a direct connection from the Temple Street neighbourhood to Highway 19A; however, on the south side Finholm Street only connects to Hirst Avenue. This option requires property through 499 Island Highway West which would impact a proposed parking lot on site, sever the site, and separate the majority of onsite parking from the main proposed building. The review of Option 2 was solely intended to theoretically evaluate if the option would improve traffic flow and access in the area. There is neither requirement nor intention, to dedicate that roadway through the School District property.

Other options including extending Dogwood Street to Moilliet Street and implementing roundabouts were reviewed but determined to have significant barriers such as a lack of properties and limited improvement to network connectivity.

It is understood that the ultimate plan for Highway 19A is to complete the four to five lane cross section on Highway 19A; however, this review was undertaken assuming the existing through lanes on Highway 19A remain in place.

The existing road network and the two options for the road network were analyzed using Synchro software. In the am peak hour and pm peak hour there is no significant difference in delays or queue lengths between the two road network options at Pym Street/Highway 19A, Moilliet Street/Highway 19A and Dogwood Street/Highway 19A. Option 2 provides the most improvement to the intersection of Bay Avenue/Highway 1 by restricting it to right in/right out; however option 1 also provides significant improvement over existing conditions. The signalization of Finholm Street as part of the extension of Temple Street provides the most improvement for the northbound direction; however a significant eastbound queue is created. In the long term (2021) all of the side street movements will be at a LOS F in both peak hours under existing conditions. In the long term option 2 performs slightly better than option 1 and substantially better than the existing road network.

Both options provide improved ability for transit to re-enter the highway from a stop; however option 2 provides a bus stop closer to Family Place Parksville front door. Option 2 also provides an opportunity for a future transit route that would use Temple Street to Finholm Street. Both options also provide signalized pedestrian crossings. Option 2 provides pedestrian crossings that are more direct and slightly shorter to Family Place while Option 1 provides more direct access to the Temple Store. Both

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options provide for cyclists travelling north-south; however, option 2 is a slightly more direct north-south route.

The customer benefits for option 1 are less than the cost of the project based on a 10 year timeline. Option 2's customer benefits (travel time and reduced cost to society from collisions) are more than twice the cost of the project. However, option 2 requires 1,800m² of property from 499 Island Highway West which is not available unless the owner chooses to provide the property, while option 1 does not require any property.

Left turn lanes at the appropriate long term option location(s) should be implemented in the short term until the selected option can be fully implemented. If option 1 is selected the traffic signal at Bay Avenue/Highway 1 should be implemented within the short term along with the appropriate left turn lanes. In the long term the City should implement one of the options as well as widen Highway 19A to a five lane cross section. The widening of Highway 19A to a five lane cross section with side street improvements is the ultimate plan for this section of the corridor, notwithstanding multiple pieces of property are required to accomplish this plan.

The City should provide bicycle facilities and sidewalks along this section of Highway 19A (excluding any frontage improvements to be done as part of the Family Place Parksville development.) Sidewalks, bicycle facilities, and provisions for a transit pullout and stop along this section of Highway 19A should be provided either through development frontage improvements and /or a combination of capital improvement projects to support safe multi-modal transportation in this area including strengthened linkages to the waterfront.

1.0 INTRODUCTION

Boulevard Transportation Group was retained by the City of Parksville to undertake a traffic study to review road network options relative to a proposed redevelopment of 499 Island Highway (School District site). The study reviews the impact of the redevelopment on the surrounding road network and assesses the options for providing access to the neighbourhood north of Highway 19A and the City's current long term plans to connect Temple Street to Finholm Street through the property at 499 Island Highway. This study will explore long term network connections in the area between Moilliet Street and Bay Avenue and their impact on safety, network connectivity, all modes of traffic, and access to the site. The intent of this report is to provide technical transportation information on two options for the section of road network between Moilliet Street and Bay Avenue along the Highway 19A corridor. A review of a roadway through 499 Island Highway is intended as a theoretical review. It is understood that the ultimate plan for Highway 19A is to complete the four to five lane cross section on Highway 19A.

1.1 Background

The 1983 Master Transportation Plan (and subsequent Master Transportation Plans) identified the extension of Temple Street through the property at 499 Island Highway to Finholm Street as desirable by the City of Parksville. This extension would create a four legged intersection that provides full movement access to north and south Highway 19A. In order to accomplish this however, property from 499 Island Highway is required.

Over the past 10 years this section of Highway 19A has been reviewed on numerous occasions to deal with the lack of turning lanes on Highway 19A and the poor Levels of Service (LOS) on the side streets. These reviews identified potential interim options such as restricting side streets to right in/right out and adding left turn lanes. The challenge with implementing the short term options is that without a firm long term network plan for the area short term improvements may be redundant and have to be re-constructed at a later date. In addition, restrictions on turn movements will shift traffic to an adjacent 'T' intersection (Moilliet Street and Dogwood Street) resulting in the same issues as the intersection being restricted. There is a desire to improve access between the Temple Street neighbourhood and the neighbourhoods to the south of Highway 19A (and east of Wembley Mall). This would improve network connectivity and help to distribute traffic.

The poor LOS on the side streets is due to the high volume of traffic on the highway where gaps are limited. As traffic volumes continue to grow on the highway, waits on the side streets become longer. As delays increase there is a desire to signalize intersections to provide improved access. With the

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high number of intersections within close proximity, all with poor LOS, the choice on which intersection(s) to signalize is important so as not to create additional congestion and safety impacts due to the close spacing of the intersections.

A simplified multiple accounts evaluation is used in this report to assess the financial, safety, and community impacts of two road network options.

The property at 499 Island Highway is owned by School District 69 and currently operated as a base for operations, maintenance, and IT staff. The School District has partnered with various provincial ministries and begun planning to redevelop the site as an enhanced asset for the School District. The proposed redevelopment will include office space for School District 69 IT staff, Vancouver Island Health Authority (VIHA) staff and programs, and Ministry of Children and Family Development (MCFD) staff and programs. The current Munchkinland program will remain on site after the redevelopment.

1.2 Study Area



Figure 1 – Study Area

The study area for this development is along Highway 19A between Moilliet Street and Pym Street with a focus on the four ‘T’ intersections within the vicinity of 499 Island Highway.

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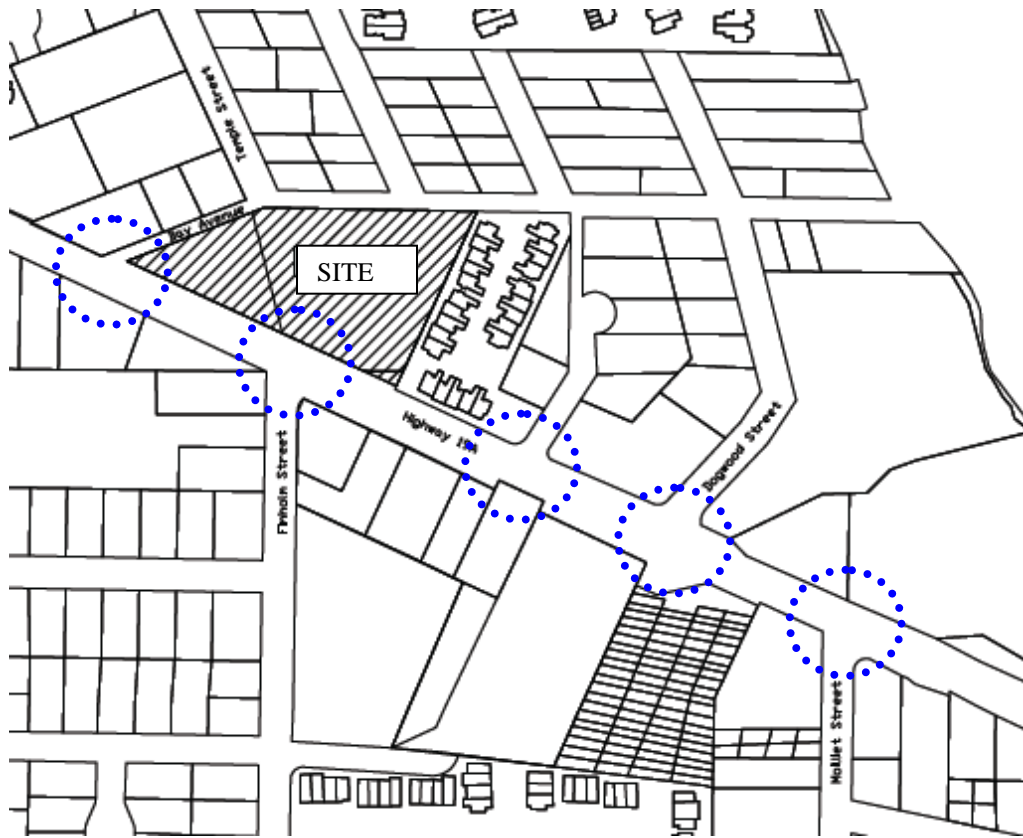


Figure 2 - 'T' Intersections in Study Area

2.0 EXISTING NETWORK

2.1 Roads

Between Moilliet Street and Bay Avenue there are five unsignalized 'T' intersections within 500m of each other, three on the north side and two on the south side of Highway 19A. Roscow Street is a local road that provides access to seven single family lots on the north side of Highway 19A. Since Roscow Street does not connect to the surrounding road network it has not been included in this review. The remaining four side streets are also classified as local roads.

Dogwood Street and Bay Avenue both connect to Highway 19A and provide access to the north side of Highway 19A. The two streets connect to each other and provide access to the Bayside Inn and the Temple Street neighbourhood. Both intersections with the highway are full movement with stops on the side streets. At Dogwood Street, Highway 19A has four lanes, two per direction, and a centre median east of the intersection. The median allows for an existing short 15m eastbound left turn lane on Highway 19A. On Dogwood Street a single left/right lane is provided. Just west of Dogwood Street Highway 19A transitions from a five lane cross section to a two lane cross section. Therefore at Bay

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Avenue/Highway 19A there are no separate turn lanes on any leg. The Temple Store (convenience store) is located on the northwest corner of Bay Avenue/Highway 19A. The parking for the store, on Bay Avenue, blends into Bay Avenue creating a large asphalt area at the intersection. The asphalt extends and surrounds a utility pole within the parking area. Vehicles are parked at the store within this asphalt area at various angles and positions.

On the south side of Highway 19A the two ‘T’ intersections are Moilliet Street and Finholm Street. Highway 19A has a five lane cross section at Moilliet Street with two travel lanes per direction and eastbound and westbound left turn lanes. This intersection has a pedestrian signal to allow pedestrians to cross the west leg of the intersection in a controlled manner. Moilliet Street is a two lane road with no turn lanes at the intersection. Finholm Street/Highway 19A is a stop controlled intersection with no turn lanes on any approach. Only Moilliet Street extends directly south to Despard Avenue; however, both roads are used by the local community to access the Highway 19A (Inland Island Highway). Both of these roads are classified as local roads; regardless, Moilliet functions as a minor collector.

Roscow Street is located between Dogwood Street and Finholm Street on the north side of Highway 19A. This two lane road is a local cul-de-sac road which provides access to six houses and an apartment complex. Since Roscow Street is a cul-de-sac the intersection of Highway 19A/Roscow Street is the only access point for this street. There is half of a road right of way from Roscow Street to Bay Avenue, which could be expanded in the future to a full width right of way to provide a second access point to Roscow Street from Bay Avenue.

The following table outlines the intersections spacings from McMillan Street to Pym Street. This is important information used to assess which intersections could be signalized as spacing plays a major role in efficient flow on the highway.

Table 1: Intersection Spacing along Highway 19A

Intersection from	Intersection to	Spacing (Approx.)
McMillan Street	Moilliet Street	530m
Moilliet Street	Dogwood Street	120m
Dogwood Street	Finholm Street	255m
Finholm Street	Bay Avenue	125m
Bay Avenue	Pym Street	625m

2.2 Transit

Only the #90 (Intercity Connector) bus travels along Highway 19A in the vicinity of the site. There is a marked bus stop located to the east of Finholm Street for eastbound travel; however, there is no marked bus stop in the westbound direction. The City should have a bus stop (with a sign) installed for westbound traffic between Finholm Street and Bay Avenue. There are no bus stop pull out areas other than the shoulder of the road. The #90 bus travels between Wembley Mall and Woodgrove Centre (Nanaimo) with a stop at the transit exchange on Jensen Avenue in Parksville. The Jensen Avenue and Wembley Mall stops allow passengers to transfer to the intra-city bus (within Parksville) and the #89 bus to Qualicum. There are 10 buses per weekday, per direction on the #90 route. The #88 (Parksville) route travels a portion of the Temple Street neighbourhood using Stanhope Road and Pym Street to access southeast Parksville and downtown. Discussions between the City, RDN, and Transit could be held to change the bus route(s) to provide better service to this area of Parksville.



Map of Existing Transit Routes in Parksville

2.3 Pedestrians

There is a limited network in terms of sidewalks within the vicinity of the site. There are sidewalks on Dogwood Street, Moilliet Street and portions of Bay Avenue; however the remainder of the area has paved shoulders on Highway 19A and no marked shoulders on the side streets. On the north side of Highway 19A there is a worn path in the grassed boulevard between Bay Avenue and Dogwood Street.

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As this area is close to downtown (approximately 900m between McMillan Street and Finholm Street) and in a suburban environment, sidewalks could be considered on all these roads. Sidewalks should be installed along this section of Highway 19A. The location of the sidewalks will need to consider the ultimate road cross section and the impact to the trees along the north side of Highway 19A.

Crosswalks, by definition, are the lateral projections of the walking paths at any intersection. Marked crosswalks indicate where pedestrians may be more frequent. They are not a safety device. The only marked crosswalks are at Moilliet Street (pedestrian only signal) and Pym Street (full traffic signal). The Temple Store is a key pedestrian generator, particularly students from Ballenas Secondary School on Pym Street and from neighbourhoods to the south. The presence of stairs at the end of Bay Avenue providing beach access also creates a draw for pedestrians to Bay Avenue. Students and adults have been observed crossing the highway at Bay Avenue. The installation of a crosswalk or pedestrian signal at Bay Avenue as an interim option should not be implemented unless a warrant process is undertaken. The need for an improved pedestrian crossing at Bay Avenue would be reviewed at detail design stage.

Collision data for this section of Highway 19A is not available to determine if there have been any collisions due to pedestrians crossing Highway 19A.

2.4 Cycling

Similar to the pedestrian network, there are no separated or marked bicycle facilities within the vicinity. Legally, cyclists are required to be on the road; however, many use the paved shoulders **illegally** sharing with pedestrians.

3.0 FAMILY PLACE DEVELOPMENT

The Family Place project will replace the existing facilities at 499 Island Highway. To determine the am and pm peak hour traffic impacts of the project, trips for the existing and proposed land use were generated using the ITE Trip Generation Manual (8th Edition). Since the land uses on the site do not exactly match any of the land uses within the manual, a variety of similar land uses were reviewed to identify the most appropriate trip rates. The land uses in the ITE manual that were reviewed are:

- day care (565)
- clinic (630)
- church (560)
- synagogue (561)
- library (590)

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- general office (710)
- government office (730)
- single tenant office (715)
- medical-dental office (720)

Based on the review of these land uses the following trip rates were used to determine trip generation for existing and proposed land use at 499 Island Highway.

Table 2 – Existing AM Peak Hour Trip Generation

Site Land Use	Trip Rate Land Use	Units/Employees	Trip Rate
Munchkin Land	25% of Day care (565)	2,824 sq. ft.	3.12 per 1,000 sq. ft.
VIHA Clients	Clinic (630)	2,963 sq. ft. / 3 staff	0.9 per employee
SD69 Staff	General Office (710)	12,787 sq. ft	1.55 per 1,000 sq. ft.

Table 3 – Existing PM Peak Hour Trip Generation

Site Land Use	Trip Rate Land Use	Units/Employees	Trip Rate
Munchkin Land	25% of Day care (565)	2,824 sq. ft.	3.12 per 1,000 sq. ft.
VIHA Clients	Clinic (630)	2,963 sq. ft.	5.18 per 1,000 sq. ft.
SD69 Staff	General Office (710)	12,787 sq. ft	1.49 per 1,000 sq. ft.

Table 4 – Proposed Family Place AM Peak Hour Trip Generation

Site Land Use	Trip Rate Land Use	Units/Employees	Trip Rate
Munchkin Land	25% of Day care (565)	2,824 sq. ft.	3.12 per 1,000 sq. ft.
VIHA & MCFD Clients	Clinic (630)	12,068 sq. ft. / 30 staff	0.9 per employee
SD69, VIHA & MCFD Staff	General Office (710)	15,031 sq. ft.	1.55 per 1,000 sq. ft.

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Table 5 – Proposed Family Place PM Peak Hour Trip Generation

Site Land Use	Trip Rate Land Use	Units/Employees	Trip Rate
Munchkin Land	25% of Day care (565)	2,824 sq. ft.	3.12 per 1,000 sq. ft.
VIHA & MCFD Clients	Clinic (630)	12,068 sq. ft. / 30 staff	5.18 per 1,000 sq. ft.
SD69, VIHA & MCFD Staff	General Office (710)	15,031 sq. ft.	1.49 per 1,000 sq. ft.

Based on the above trip rates Table 6 shows existing and post redevelopment trips in and out of the site. The proposed land-use is expected to generate 27 more trips entering and exiting the site compared to existing land use trips.

Table 6: AM Peak Hour Trip Generation

Land Use	Trips In		Trips Out		Total Trips	
	Existing	Family Place	Existing	Family Place	Existing	Family Place
Munchkin Land	5	5	4	4	9	9
Clients	2	14	1	13	3	27
Staff	18	20	2	3	20	23
Totals	25	39	6	20	32	59

Table 7 indicates the proposed land use will generate an additional 26 trips entering and exiting the site compared to trips generated by the existing land use.

Table 7: PM Peak Hour Trip Generation

Land Use	Trips In		Trips Out		Total Trips	
	Existing	Family Place	Existing	Family Place	Existing	Family Place
Munchkin Land	4	4	5	5	9	9
Clients	7	15	9	22	16	37
Staff	3	4	16	20	19	24
Totals	14	23	30	47	44	70

Trip generation data received from School District 69 confirmed that these values are appropriate for analysis purposes.

4.0 ROAD NETWORK OPTIONS

Two road network / traffic control configurations were identified for detailed analysis:

- (1) signalize Bay Avenue and Moilliet Street
- (2) extend Temple Street to Finholm Street and signalize

The intent in reviewing these options is to determine the long term intersection improvement option. The road network improvements focus on intersection improvements without additional highway through lanes; however the ultimate (long term) plan for the corridor includes expanding to a five lane cross section when property is available to complete Highway 19A with two lanes per direction.

4.1 Option 1 – Signalize Bay Avenue and Moilliet Street

This option would signalize two of the four existing ‘T’ intersections along this section of Highway 19A. Each signal would provide improved access to one side of the highway. An eastbound left turn lane would be required to be constructed at Bay Avenue/Highway 19A to separate left and through traffic. The other two intersections (Dogwood Street and Finholm Street) would become right in/right out to limit left turns. This option creates signal spacings (from McMillan Street to Pym Street) of 530m, 500m, and 625m. Consistent intersection spacing allows adjacent signals to be timed for progression; however, due to the two lane section and the potential queues at the signal, progression may not be achieved with consistent intersection spacing. (Note option 1 was not analyzed as a synchronized system.)

Moilliet Street provides a direct connection between Despard Avenue and Highway 19A; however, on the north side Bay Avenue provides a slightly circuitous route to the Temple Street neighbourhood. This option creates a section of Highway 19A that will operate as part of the collector road system since vehicles travelling north-south will need to turn from one intersection to the next to complete the north-south manoeuvre. This is estimated at 47 vehicles per hour.

This option provides for a new pedestrian crossing of Highway 19A at Bay Avenue that is controlled by a traffic signal. The new crossing will allow transit users to safely cross Highway 19A. The signal provides improved access for bicycles turning on to the Highway and transit to re-enter the highway from a stop. Cyclists will still be required to make several turns to travel between the north and south neighbourhoods.

Two sub-option opportunities are available in Option 1 including signalizing Moilliet Street and Finholm Street instead of Bay Avenue and Moilliet Street and synchronizing (coordinating) the signals

along Highway 19A. Sub-options should be reviewed during the design stage to determine the most appropriate configuration for Option 1. However, signalization of both Moilliet Street and Finholm Street does not improve connectivity to the Temple Street area and would require motorists from the Dogwood Street/Bay Avenue area to loop back to Pym Street to turn onto Highway 19A or continue south on Pym Street.

4.2 Option 2 – Extend Temple Street to Finholm Street

This option would realign Bay Avenue to connect to Finholm Street at Highway 19A. This new intersection would be signalized, while the other three ‘T’ intersections (Bay Avenue, Dogwood Street and Moilliet Street) would become right in/right out. This option creates a 905m signal spacing from McMillan Street and 750m from Pym Street. This option provides a direct connection from the Temple Street neighbourhood to Highway 19A; however, on the south side Finholm Street only connects to Hirst Avenue and not all the way south to Despard Avenue without using Hirst Avenue to Chestnut Street or Moilliet Street. Moilliet Street is currently functioning as a collector road, but by making Moilliet Street right in/right out there may be a reduction in traffic using this road reducing its function to a local road level. Finholm Street may be required to be upgraded to a collector road standard. This option requires property through 499 Island Highway West which would impact a proposed parking lot on site, sever the site, and separate the majority of onsite parking from the main proposed building. The School District is not interested in providing any property from 499 Island Highway to accommodate this option.

This option would create a new pedestrian crossing of Highway 19A that is controlled by a traffic signal and will provide crossing opportunities for transit users. Cyclists will have a more direct route from north to south and can utilize the signal to facilitate access to the highway. Transit can utilize the signal to re-enter the flow of traffic easier.

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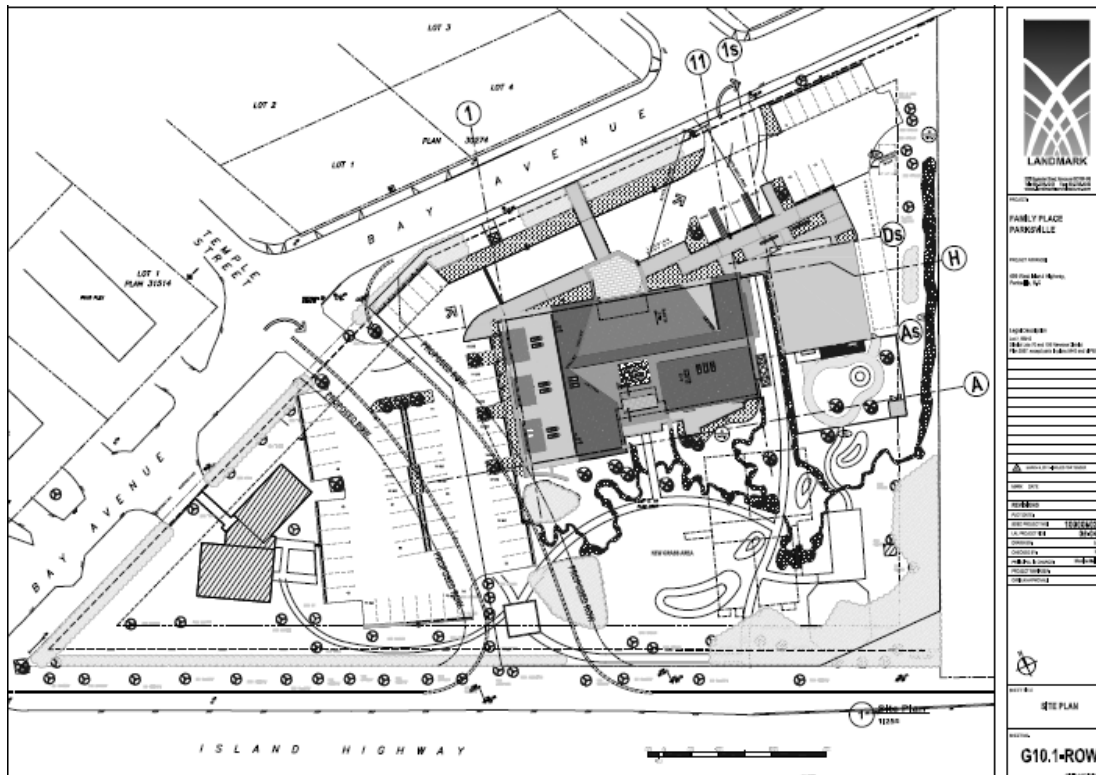


Figure 3: Proposed Family Place Development with Road Right of Way for Temple Street Extension

4.3 Option 3 – Four Laning

This option was not fully analyzed since the addition of two extra travel lanes plus turn lanes at each intersection over a 750m length and no side street improvements would be at a significant cost with no significant improvement to side streets in the short term and continued failing LOS in the long term with the existing network. In addition, there are right-of-way restrictions along the corridor which prevent the full widening from occurring in the short term. This option would improve highway queues if combined with options 1 or 2 in the short and long term.

4.4 Option 4 – Dogwood Extension to Moilliet Street

This option was not fully analyzed since this option may require property from at least two properties (240 Dogwood Street – Bayside Inn and 375 Island Highway West – Paradise Fun Park). Neither of these two property owners has indicated they are seeking rezoning in the near future nor are they willing to provide a right-of-way through their property at this time. This is not a viable option in the short-term although it may be in the future depending on redevelopment in the area. This option would allow for a north-south connection between the Temple Street neighbourhood and the southeast

neighbourhood / Despard Avenue area with a slightly circuitous route from Temple Street to Bay Avenue to Dogwood Street.

4.5 Option 5 – Roundabouts

Option 5 reviewed Options 1 and 2 as roundabouts rather than signalized intersections. The existing right of way at Moilliet Street, Finholm Street, and Bay Avenue on Highway 19A is not sufficient to accommodate single lane roundabouts, Also, in the long term (2021), traffic volumes on Highway 19A will be sufficiently high to require additional property to accommodate two lane roundabouts. Option 5 was determined to not be a viable option.

5.0 TRIP REASSIGNMENT

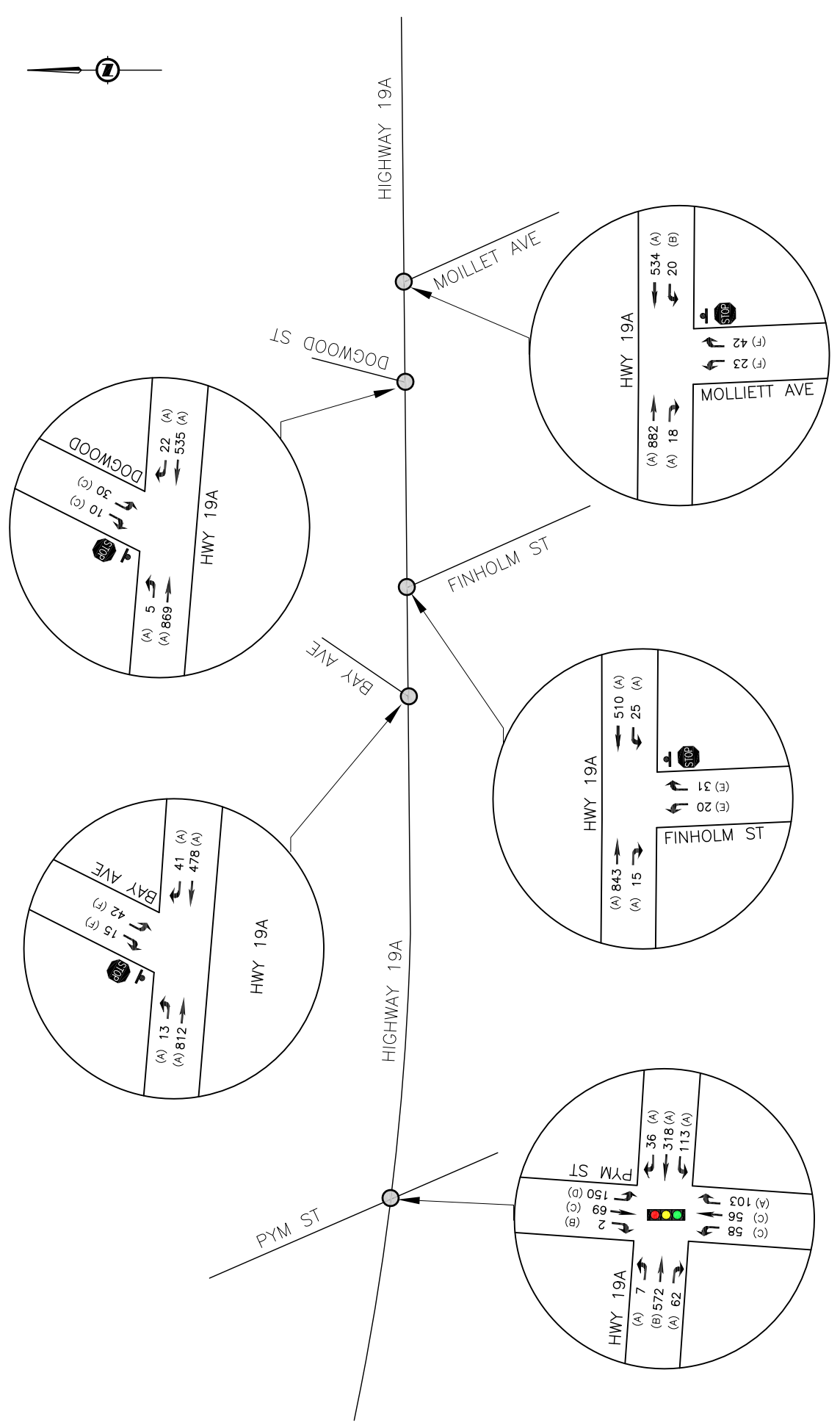
Using the City of Parksville’s city wide VISUM model, origin/destination data for the area between Dogwood Street and Wright Road was identified. Forty four percent (44%) of the Temple Street neighbourhood is north of Stanhope Road, 26% is between Stanhope Road and Bay Avenue, 17% is in the Bay Avenue area and 13% in the Dogwood Street area.

For the option 1 reassignment all Dogwood Street left turning traffic was shifted to Bay Avenue and all of Finholm Street left turning traffic was shifted to Moilliet Street. Of the pm peak hour northbound through traffic at Pym Street/Highway 19A 30% of the traffic (30vph) was reassigned to Moilliet Street based on the location of the land use. Similarly 9% of the southbound left turning traffic using Pym Street/Highway 19A was shifted to Bay Avenue based on the land use in the area and the improved access to Highway 19A.

For option 2, all of the left turns between Moilliet Street and Bay Avenue were reassigned to the new intersection of Finholm Street/Temple Street Extension/Highway 19A. The same percentages (30% northbound through and 9% southbound left) were shifted from Pym Street/Highway 19A to Finholm Street/Highway 19A. Thirty percent (30%) of existing northbound and southbound lefts onto the highway were shifted to through movements at Finholm Street/Highway 19A.

6.0 ANALYSIS

The existing road network and the two options for the road network were analyzed using Synchro software. See **Figures 4 to 9** for existing, option 1 and option 2 am and pm peak hour volumes and LOS.



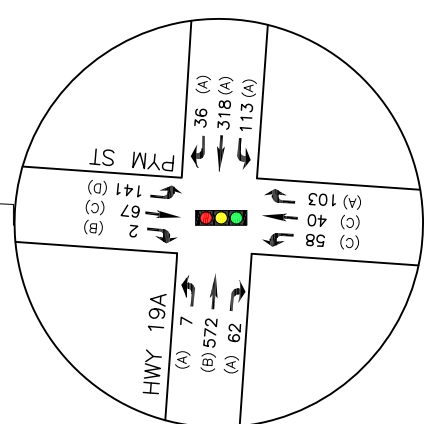
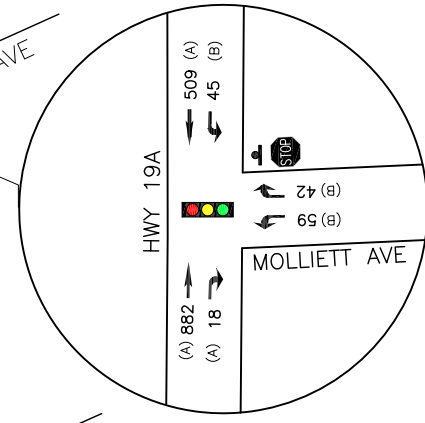
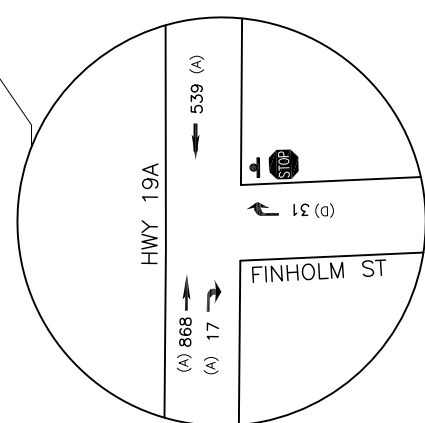
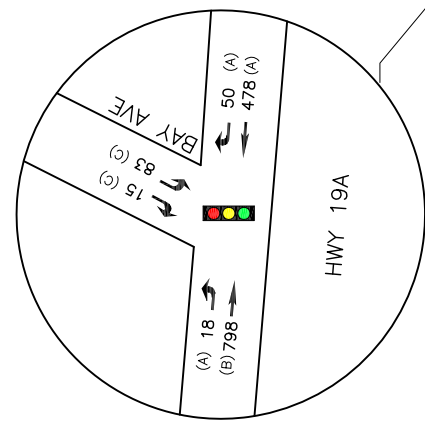
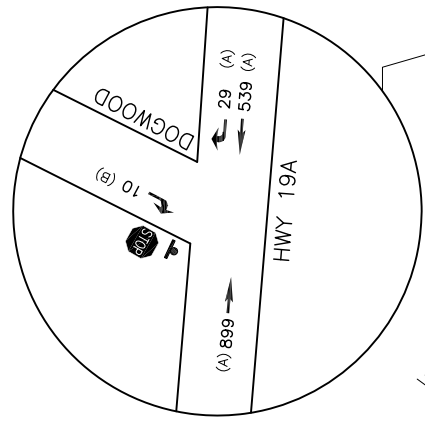
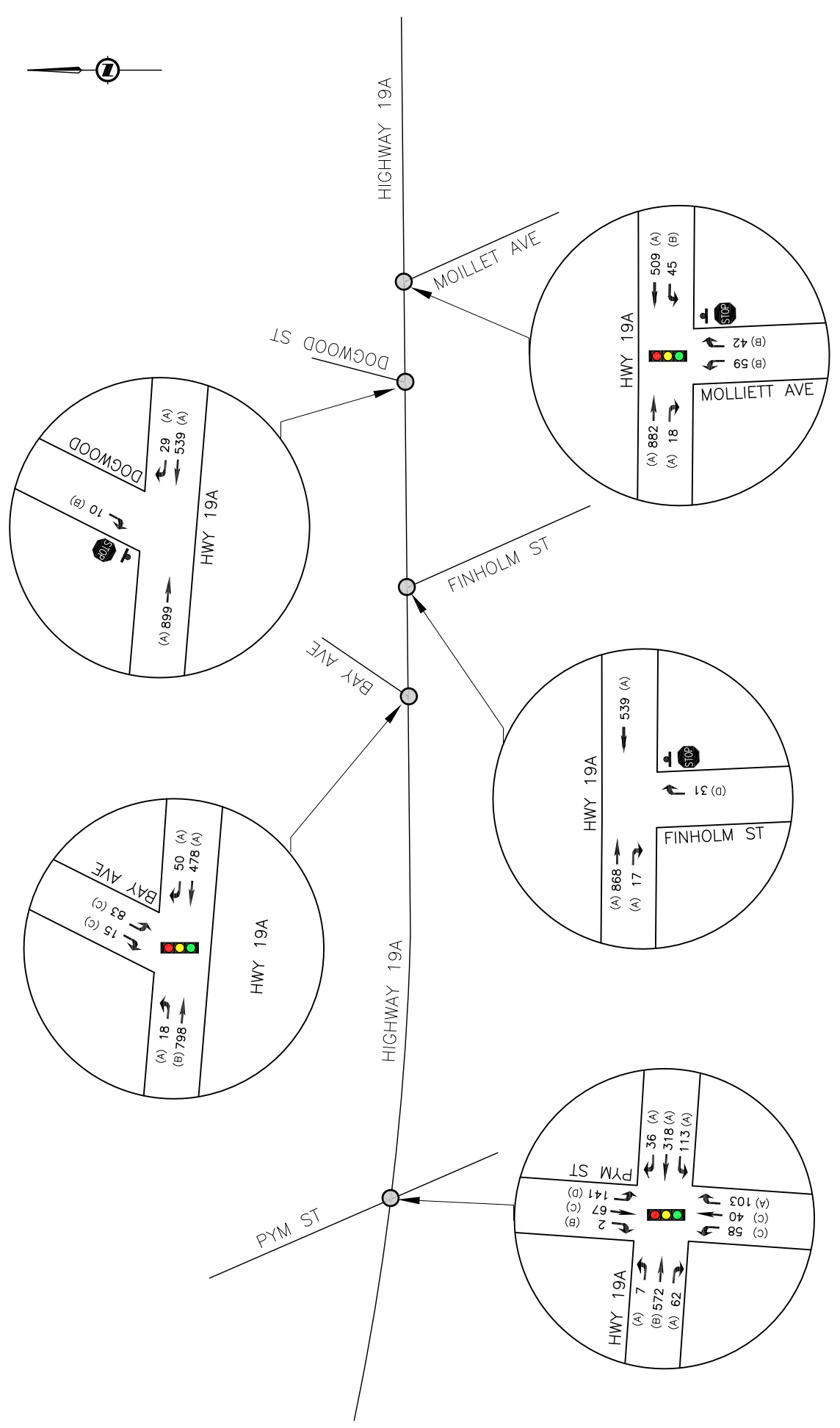
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2011 EXISTING NETWORK
AM PEAK HR VOLUMES & LOS

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DATE: MAR 25-11	DRAWING NO: 1238_FIG 4	REV.

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Boulevard

FIGURE 4



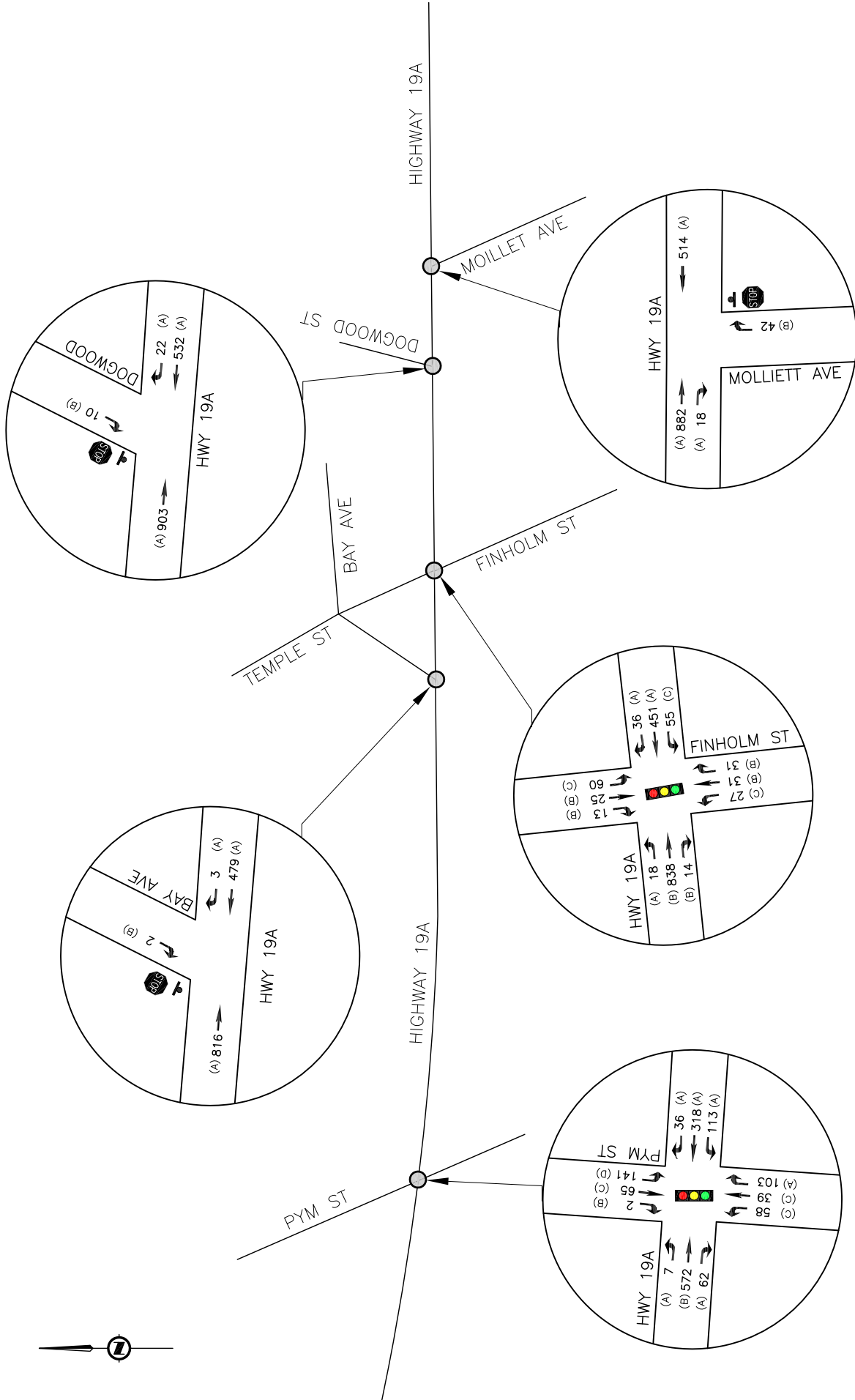
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TRANSPORTATION GROUP

Boulevard

FIGURE 5



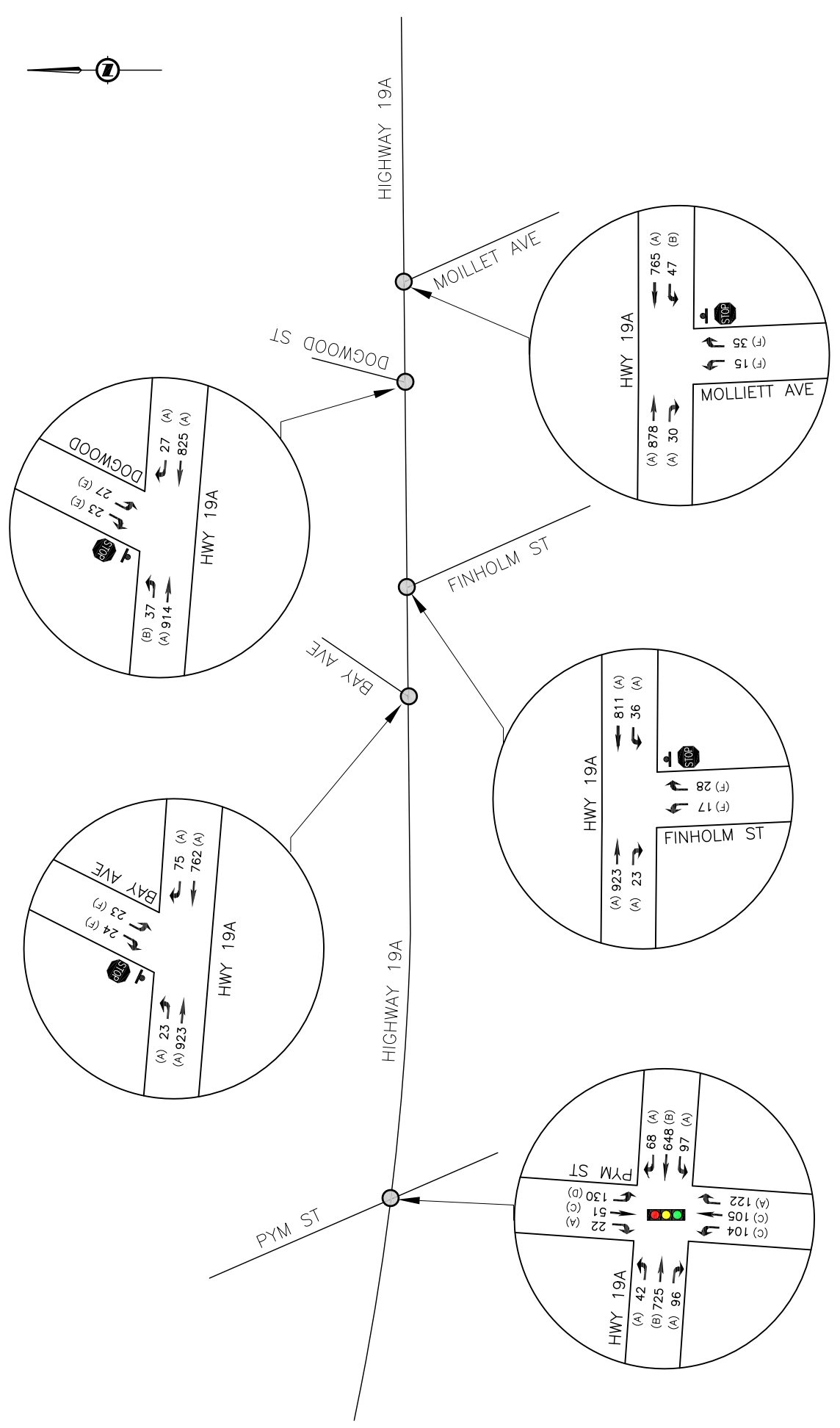
TITLE: 499 ISLAND HIGHWAY
2011 OPTION 2 NETWORK
AM PEAK HR VOLUMES & LOS

DESIGNED: NK	DRAWN: mjo	SCALE: NOT TO SCALE
DATE: MAR 25-11	DRAWING NO: 1238_FIG 6	REV.

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FIGURE 6



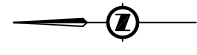
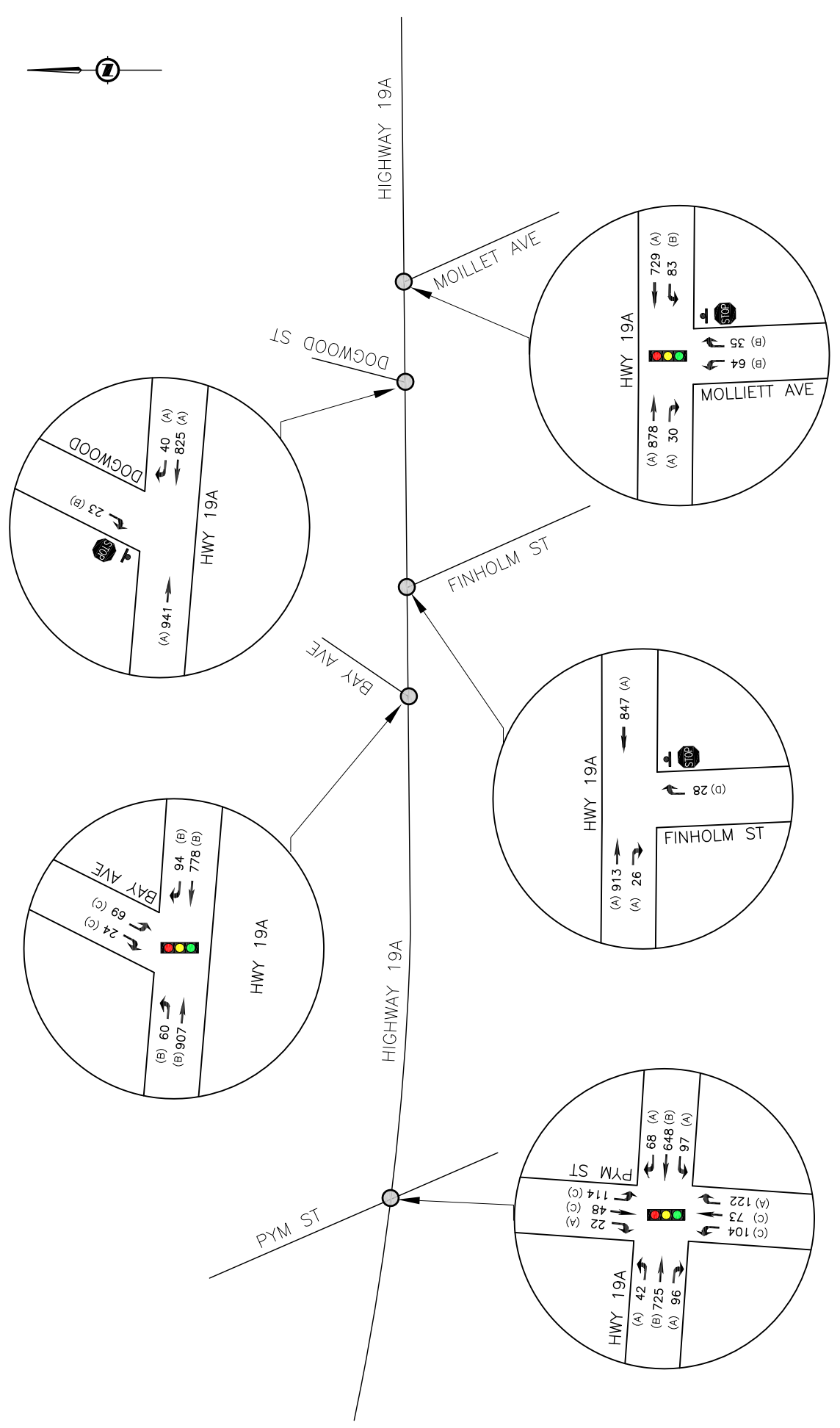
TITLE: 499 ISLAND HIGHWAY
2011 EXISTING NETWORK
PM PEAK HR VOLUMES & LOS

DESIGNED: NK	DRAWN: mjo	SCALE: NOT TO SCALE
DATE: MAR 25-11	DRAWING NO: 1238_FIG 7	REV.

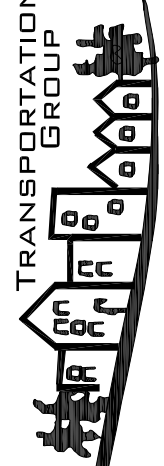
TRANSPORTATION GROUP

Boulevard

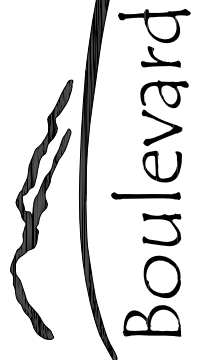
FIGURE 7



499 ISLAND HIGHWAY 2011 OPTION 1 NETWORK PM PEAK HR VOLUMES & LOS		DRAWN: mjo SCALE: NOT TO SCALE
DESIGNED: NK	DATE: MAR 25-11	DRAWING NO: 1238_FIG 8 REV.

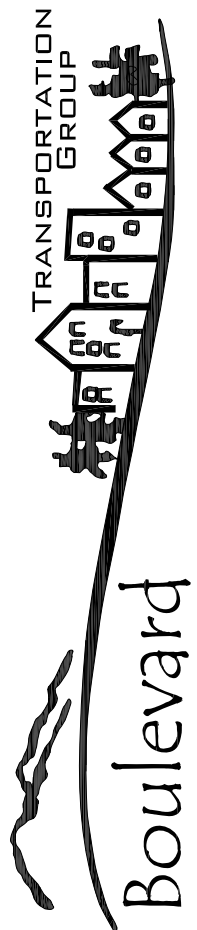


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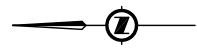
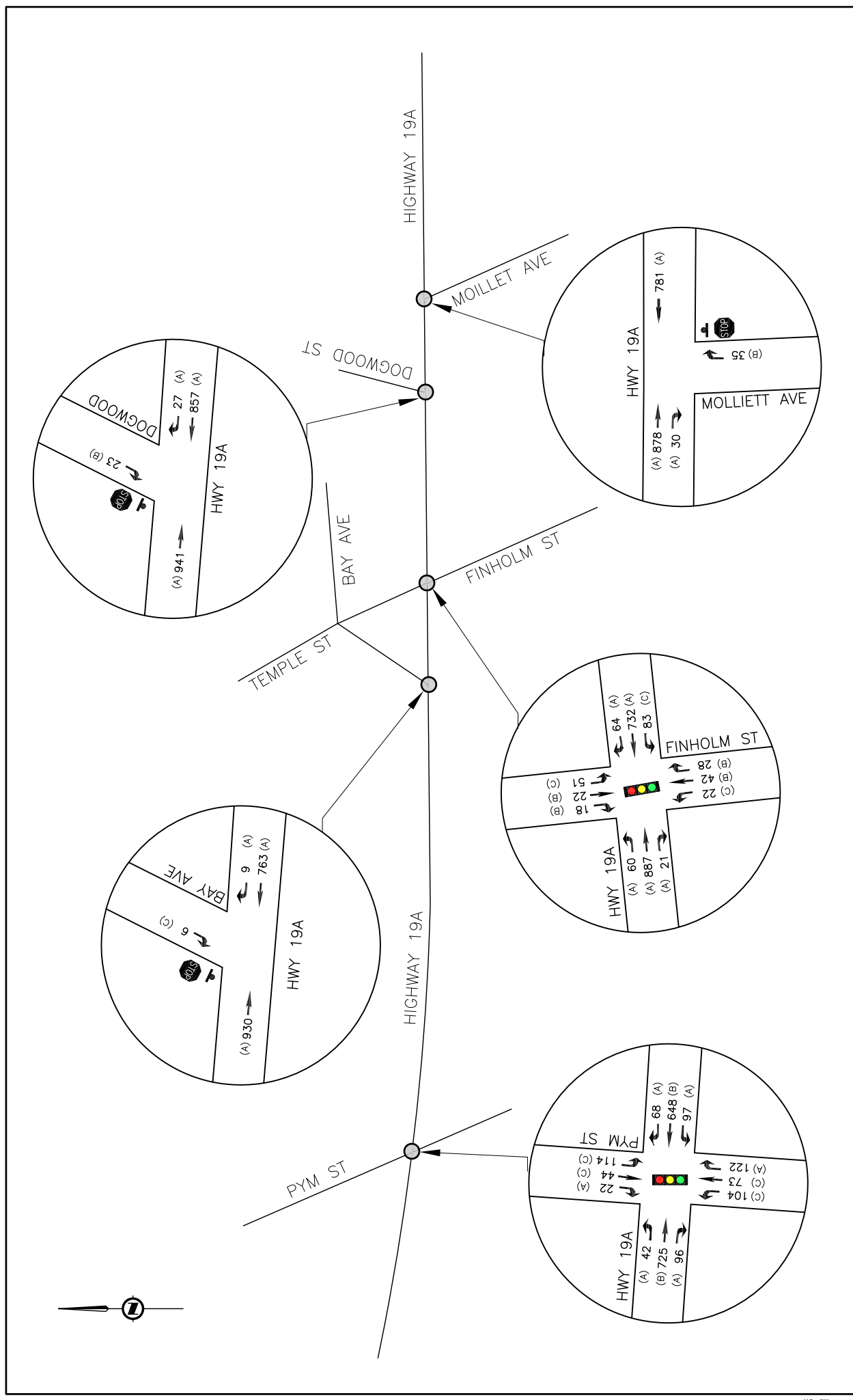
FIGURE 8



TITLE: **499 ISLAND HIGHWAY**
 2011 OPTION 2 NETWORK
 PM PEAK HR VOLUMES & LOS

DESIGNED: NK	DRAWN: mjo	SCALE: NOT TO SCALE
DATE: MAR 25-11	DRAWING NO: 1238_FIG 9	REV.

FIGURE 9



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Synchro and SimTraffic form a two-part software program that model and simulate traffic conditions. Synchro uses the Highway Capacity Manual methodology, while SimTraffic integrates established driver behaviours and characteristics to simulate actual conditions by randomly assigning vehicles travelling through the road network. Synchro analysis results yield measures of effectiveness – Level of Service (LOS), queue lengths and delays. Delays and the type of traffic control are used to determine the LOS letter grade, from LOS A (excellent operations) to LOS F (unstable/failing). LOS C or better is considered acceptable operations, while LOS D is considered to be on the threshold between acceptable and unacceptable operations. A full description of Synchro and SimTraffic is included as **Appendix A**.

The following outlines the results of the analysis for the three road network configurations based on 2011 traffic volumes. Am peak hour in Parksville occurs between 8:00am and 9:00am and the pm peak hour occurs between 3:00pm and 4:00pm.

6.1 AM Peak Hour

Table 8: Synchro Results - Pym Street/Highway 19A

Movement	LOS			Delay (sec)			Queue Length (m)		
	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2
NBL	C	C	C	26.2	26.6	26.6	16.2	16.2	16.2
NBT	C	C	C	23.1	22.7	22.7	16.3	12.8	12.5
NBT	A	A	A	6.4	6.5	6.5	6.4	6.4	6.4
SBL	D	D	D	38.6	37.0	37.0	37.8	35.1	35.1
SBT	C	C	C	23.6	23.8	23.7	19.0	18.8	18.2
SBR	B	B	B	13.0	13.0	13.0	0.3	0.3	0.3
EBL	A	A	A	7.3	7.1	7.1	1.5	1.5	1.5
EBT	B	B	B	14.0	13.7	13.7	45.1	45.1	45.1
EBR	A	A	A	3.5	3.5	3.5	3.7	3.7	3.7
WBL	A	A	A	7.0	6.8	6.8	12.5	12.5	12.5
WBT	A	A	A	7.4	7.2	7.2	22.5	22.5	22.5
WBR	A	A	A	2.7	2.7	2.7	0.3	0.3	0.3

There is no significant difference in delays or queue lengths between the two road network options at Pym Street/Highway 19A.

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Table 9: Synchro Results - Bay Avenue/Highway 19A

Movement	LOS			Delay (sec)			Queue Length (m)		
	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2
SB	F	C	B	57.5	21.8	12.3	21.3	18.6	0.1
EBL	---	A	---	---	5.1	---	---	3.3	---
EB	A	B	A	0.5	12.0	0.0	0.4	142.2	0.0
WB	A	A	A	0.0	6.6	0.0	0.0	66.5	0.0

At Bay Avenue/Highway 19A signalization of Bay Avenue significantly improves the southbound LOS, but creates a 140m eastbound queue. The restriction of the intersection to right in/right out provides the most improvement due to the removal of left turns and Highway 19A vehicles not having to stop.

Table 10: Synchro Results - Finholm Street/Highway 19A

Movement	LOS			Delay (sec)			Queue Length (m)		
	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2
NBL	---	---	C	---	---	21.8	---	---	8.7
NB	E	D	B	39.0	32.3	13.9	13.1	6.7	10.7
SBL	---	---	C	---	---	25.2	---	---	16.0
SB	---	---	B	---	---	16.0	---	---	8.7
EBL	---	---	A	---	---	4.6	---	---	3.2
EB	A	A	B	0.0	0.0	12.3	0.0	0.0	178.3
WBL	---	---	C	---	---	30.1	---	---	22.5
WB	A	A	A	1.3	0.0	5.9	1.2	0.0	56.6

The signalization of Finholm Street as part of the extension of Temple Street provides the most improvement for the northbound direction; however an eastbound queue of over 175m is created due to the stoppage of eastbound traffic. Restricting the intersection to right in/right out provides moderate improvement for the northbound movement.

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Table 11: Synchro Results - Dogwood Street/Highway 19A

Movement	LOS			Delay (sec)			Queue Length (m)		
	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2
SB	C	B	B	23.3	10.5	10.4	6.3	0.5	0.5
EBL	A	---	---	8.8	---	---	0.2	---	---
EBT	A	A	A	0.0	0.0	0.0	0.0	0.0	0.0
WB	A	A	A	0.0	0.0	0.0	0.0	0.0	0.0

Options 1 and 2 show the same improvement in the southbound direction due to the restriction of movements to right in/right out.

Table 12: Synchro Results - Moilliet Street/Highway 19A

Movement	LOS			Delay (sec)			Queue Length (m)		
	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2
NB	F	B	B	61.6	12.4	14.4	29.7	20.1	4.4
EB	A	A	A	0.0	7.0	0.0	0.0	48.1	0.0
WBL	B	B	---	11.1	13.3	---	1.2	9.0	---
WBT	A	A	A	0.0	5.8	0.0	0.0	23.7	0.0

Signalization of Moilliet Avenue and restricting to right in/right out creates the same improvements in LOS and delay. Signalization at Moilliet Avenue does not create significant queuing on Highway 19A due to the five lane cross section.

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6.2 PM Peak Hour

Table 13: Synchro Results - Pym Street/Highway 19A

Movement	LOS			Delay (sec)			Queue Length (m)		
	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2
NBL	C	C	C	28.4	30.0	29.9	28.6	28.6	28.6
NBT	C	C	C	25.8	25.0	25.0	25.9	19.1	19.1
NBT	A	A	A	6.3	6.7	6.7	2.1	2.1	2.1
SBL	D	C	C	41.0	34.5	34.5	35.2	30.1	30.1
SBT	C	C	C	23.5	23.9	23.7	14.4	13.8	12.9
SBR	A	A	A	9.3	9.5	9.5	4.5	4.5	4.5
EBL	A	A	A	6.2	6.2	6.2	5.0	5.0	5.0
EBT	B	B	B	14.8	13.7	13.7	60.7	60.7	60.7
EBR	A	A	A	3.2	3.2	3.2	4.8	4.8	4.8
WBL	A	A	A	7.9	7.3	7.3	10.7	10.7	10.7
WBT	B	B	B	12.6	10.7	10.7	48.8	48.8	48.8
WBR	A	A	A	3.4	3.4	3.4	6.7	6.7	6.7

In the pm peak hour the shifting of traffic in Options 1 and 2 provides an improvement in the southbound left LOS from LOS D to LOS C. Otherwise there is no significant difference between the three road network options at Pym Street/Highway 19A.

Table 14: Synchro Results - Bay Avenue/Highway 19A

Movement	LOS			Delay (sec)			Queue Length (m)		
	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2
SB	F	C	C	87.5	24.1	17.1	28.5	20.0	0.8
EBL	---	B	---	---	16.9	---	---	13.	---
EB	A	B	A	1.5	12.8	0.0	1.1	179.6	0.0
WB	A	B	A	0.0	10.7	0.0	0.0	170.3	0.0

Signalization of Bay Avenue provides significant improvement in the southbound direction but creates eastbound and westbound queues on Highway 19A that are over 170m in length. The westbound queue length will extend back past Finholm Street during the pm peak hour. The restriction of Bay Avenue to right in/right out (option 2) provides a similar improvement in LOS and delay as option 1.

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Table 15: Synchro Results - Finholm Street/Highway 19A

Movement	LOS			Delay (sec)			Queue Length (m)		
	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2
NBL	---	---	C	---	---	23.1	---	---	8.0
NB	F	D	B	64.1	33.8	16.0	19.9	7.5	13.8
SBL	---	---	C	---	---	25.9	---	---	15.0
SB	---	---	B	---	---	15.8	---	---	9.1
EBL	---	---	A	---	---	7.2	---	---	10.5
EB	A	A	A	0.0	0.0	9.1	0.0	0.0	172.4
WBL	---	---	C	---	---	25.4	---	---	33.0
WB	A	A	A	2.6	0.0	6.9	2.4	0.0	116.1

Restricting Finholm Street to right in/right out (option 1) reduces the delay by 30 seconds and improves the LOS from a LOS F to a LOS D. Signalization provides significant improvement in northbound delays without significant impact on the eastbound/westbound LOS. However the eastbound queue will be over 160m, while the westbound queue will be over 110m. The eastbound queue will extend back past Bay Avenue; however with this intersection restricted to right in/right out there will be no impacts to the Bay Avenue operations.

Table 16: Synchro Results - Dogwood Street/Highway 19A

Movement	LOS			Delay (sec)			Queue Length (m)		
	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2
SB	E	B	B	35.2	11.2	12.0	12.3	1.4	1.5
EBL	B	---	---	10.1	---	---	1.5	---	---
EBT	A	A	A	0.0	0.0	0.0	0.0	0.0	0.0
WB	A	A	A	0.0	0.0	0.0	0.0	0.0	0.0

Options 1 and 2 operate significantly better than the existing network due to the removal of left turns.

Table 17: Synchro Results - Moilliet Street/Highway 19A

Movement	LOS			Delay (sec)			Queue Length (m)		
	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2	Exist	Opt 1	Opt 2
NB	F	B	B	74.2	13.9	13.0	24.6	2.9	2.4
EB	A	A	A	0.0	6.4	0.0	0.0	48.6	0.0
WBL	B	B	---	11.0	13.0	---	2.3	16.8	---
WBT	A	A	A	0.0	5.7	0.0	0.0	36.0	0.0

Signalization and restricting Moilliet Street/Highway 19A to right in/right out creates similar traffic operations with the northbound movement improving from a LOS F to LOS B.

Roscow Street/Highway 19A was not analyzed using Synchro software; however, based on the adjacent intersection levels of service it is expected that this intersection is also operating at a poor level of service. There is limited opportunity to improve this intersection until a full road right-of-way can be obtained to connect Roscow Street to Bay Avenue.

6.3 Long Term Analysis

In the long term (2021) all of the side street movements will be at a LOS F in both peak hours under existing conditions. For option 1, the right turn movement at Finholm Street/Highway 19A will continue at a LOS F, but all other movements will be a LOS D or better. For option 2, Finholm Street/Highway 19A will have several turn movements at a LOS D and the southbound right turn at Bay Avenue will also be at a LOS D; however, all other movements are at a LOS C or better. In the long term option 2 performs slightly better than option 1 and substantially better than the existing road network.

Wherever the traffic signal is located within the two lane section of Highway 19A the eastbound queue lengths will be over 200m in length during peak hours. The addition of additional through lanes on Highway 19A, to obtain a four to five lane cross section, will significantly reduce queues on the highway at any proposed traffic signals.

7.0 INTERIM IMPROVEMENTS

Interim improvements should be undertaken once a decision on the long term option is made. The main interim improvement is the addition of left turn lanes on Highway 19A the location of which will depend on the option selected. If option 1 is selected then at a minimum a traffic signal should be installed at Bay Avenue along with left turn lanes to improve vehicle, pedestrian, and bicycle

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connectivity. Also, Dogwood Street should become right in/right out at Highway 19A. Details of Finholm Street/Highway 19A will be determined at detail design based on the selected option.

Frontage improvements along 499 Island Highway, including sidewalk, bicycle facilities, and a transit pull-out should be provided in the interim.

The City should continue to work towards collecting additional property along Highway 19A to allow for a future four to five lane cross-section along the corridor.

8.0 ULTIMATE PLANS

The ultimate improvement for this section of Highway 19A is to complete the five lane cross section on Highway 19A and implement one of the options. Additional features to be considered for the long term include sidewalks and bicycle facilities along both sides of the highway, and improved transit stops.

9.0 SUMMARY MATRIX

A summary matrix was developed to compare options 1 and 2 and the existing road network based on connectivity for vehicles, pedestrians, cyclists, transit, traffic operations, property requirements, cost of construction, amount of fuel consumed, and safety. The following table provides a summary of the comparison.

Table 18: Summary Matrix – Highway 19A Parksville

Option	Connectivity	Property	Operations	Pedestrians	Bicycles	Transit	Safety	Cost	Environment
Existing	●	●	●	●	●	●	●	●	●
Opt. 1	●	●	●	●	●	●	●	●	●
Opt. 2	●	●	●	●	●	●	●	●	●

Connectivity: identifies vehicle access between the Temple Street area and southeast areas of Parksville and access across Highway 19A.

●	Good: direct connection between each end of the neighbourhoods with no turn movements and signalized access to Highway 19A
●	Neutral: less direct connection requiring limited turn movements at signalized access points to Highway 19A
●	Poor: circuitous routing to access each end of the neighbourhoods with high number of turns including unsignalized turns onto/off of Highway 19A

Property: identifies the amount of property required to accommodate the improvements and impact to the property.

●	Good: no right of way required
●	Neutral: right of way required along property edge(s)
●	Poor: new road right of way required through property

Operations: identifies the impacts or improvements for vehicles along Highway 19A and on the side streets between Pym Street and Moilliet St

●	Good: improvements in LOS to LOS C or better
●	Neutral: improvements in LOS, but significant increase in highway queue lengths
●	Poor: multiple movements at LOS D/E/F within corridor

Pedestrians: identifies the pedestrian connectivity across Highway 19A between Moilliet Street and Pym Street. It includes the number of pedestrian crossings and the level of control at the crossings

●	Good: signalized crossing within 150m of generators (Temple Store and Family Place) and direct routing from neighbourhood
●	Neutral: signalized crossing within 150m of generators (Temple Store and Family Place) and less direct routing from neighbourhood
●	Poor: no signalized crossing within 150m of generators (Temple Store and Family Place) and direct routing from neighbourhood

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Bikes: identifies the connectivity and routing for bicycles

●	Good: signalized access to Highway 19A and direct routing to/from neighbourhood
●	Neutral: signalized access to Highway 19A and less direct routing to/from neighbourhood
●	Poor: no signalized access to Highway 19A and less direct routing to/from neighbourhood

Transit: indicates the ability to provide improved transit access and operations

●	Good: bus stop within 100m of generators, ability to re-enter traffic at a signal, ability for future direct bus route between Temple Street neighbourhood and southeast Parksville, ability for pedestrians to cross Highway 19A from bus stop
●	Neutral: bus stop within 100m of generators, ability to re-enter traffic at a signal, limited ability for future direct bus route between Temple Street neighbourhood and southeast Parksville, ability for pedestrians to cross Highway 19A from bus stop
●	Poor: bus stop within 100m of generators, limited ability to re-enter traffic, no ability for future bus route between Temple Street neighbourhood and southeast Parksville, no signalized crossing for pedestrians

Safety: identifies the amount of collisions predicted at the four 'T' intersections

●	Good: less than 1 collision per year
●	Neutral: between 1 and 2 collisions per year
●	Poor: more than 2 collisions per year

Costs: identifies the costs to implement excluding any land costs.

●	Good: less than \$100,000
●	Neutral: between \$100,000 to \$500,000
●	Poor: more than \$500,000

Environment: identifies the amount of fuel consumed within the network (of the model) and the associated greenhouse gases created that affect the environment.

●	Good: less than 700L of fuel consumed in peak hours
●	Neutral: between 700-750L of fuel consumed in peak hours
●	Poor: more than 750L of fuel consumed in peak hours

10.0 MODIFIED (SIMPLIFIED) MULTIPLE ACCOUNTS EVALUATION

While the summary matrix compares each option and the existing network within a set of criteria per category, the modified multiple accounts evaluation will compare option 1 and option 2 to the base case (existing road network) to determine the benefit-cost of each option. The benefit-cost analysis is based on a 10 year period and does not include any interim improvements or four laning of Highway 19A. See Appendix B for details of the multiple accounts evaluation calculations.

10.1 Financial Account

The cost to construct option 1 is \$450,000 while the cost to construct option 2 is \$855,000 not including any property or building removal on the proposed right of way. The cost of the property for option 2 is estimated at \$540,000 based on 1800m² of right-of-way at an average cost of \$300/m² and is added to the costs for option 2.

Resurfacing costs are based on \$45,000/lane-km. In option 1 there is the addition of an eastbound left turn lane to maintain, while in option 2 there is a new road plus the addition of left turn lanes at the intersection of Finholm Street/Highway 19A. The resurfacing costs for option 1 are \$2,025 per year while option 2 is \$14,175 per year. Assuming there will be 5 years of available life left in the surface at the end of our analysis the salvage costs were determined to be -\$810 for option 1 and -\$5,670 for option 2. It is assumed that the existing portions of Highway 19A will not be resurfaced within the next 10 years. Maintenance costs for the road are based on \$4,000 per lane-km and for signals at \$2,500 per year per signal. The salvage and maintenance costs were discounted at 6% for 10 years to bring the costs back to present value.

10.2 Customer Service Account

Travel Time

Total hourly travel time for the network was collected from the Synchro models. Synchro provides a total travel time for the network based on the hourly summary of delays and travel time. In order to determine the cost per year, the travel times were factored to daily travel times using a 10 percent pm-to-daily factor and then multiplied by 365 days and the Ministry's travel cost per hour (\$12.17/hr). In the short term option 2 and existing conditions have the same total travel time and option 1 has a higher total travel time. However, in the long term (2021) the existing network will have the highest total travel time and option 2 will continue to have the lowest travel time. Travel times were broken down to average per year cost and discounted at 6% per year.

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Collisions

Collision prediction models for three legged intersections from the Ministry of Transportation's *Collision Prediction Model Manual*, were used to predict the expected collisions for the existing situation and for options 1 and 2 over the next 10 years. The models were modified using collision modification factors from the Ministry's *Collision Modification Factors Manual* to represent the existing conditions (ie. turn lane at Dogwood Street) and each options' modifications (ie. signal, turn lane, etc). MoT's distribution of severity was utilized to breakdown the total collision into severity. Fatal collisions were based on a cost of \$6.1 million, injury collisions at \$100,000 and property damage collisions at \$7,759. The following table outlines the expected collisions for each intersection based on the existing and proposed network. Collisions were calculated for two five year periods and then averaged over each of the 5 years and then discounted at 6% per year.

Table 19: Predicted Collisions over 10 Years

Intersection	Existing	Option 1	Option 2
Moilliet	7.13	10.89	2.22
Dogwood	4.53	1.58	1.59
Finholm	7.52	1.77	8.25
Bay	7.64	7.38	0.64
Total per 10 years	26.81	21.61	12.70

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Table 20: Multiple Accounts Evaluation Summary

	Base Case Do Nothing	Option 1 Signalize Moilliet Street and Bay Avenue	Option 2 Extend Temple Street to Finholm Street and Signalize
FINANCIAL ACCOUNT			
Project Costs	\$0	\$450,000	\$1,395,000
Maintenance (discounted @ 6% / yr)	\$58,881	\$97,006	\$86,555
Salvage Value (discounted @ 6%)	\$0	-\$452	-\$3,166
Total	\$58,881	\$546,554	\$1,478,389
Incremental Cost	---	\$487,673	\$1,419,508
CUSTOMER SERVICE ACCOUNT			
Travel Time (discounted @ 6% / yr)	\$30.442 million	\$30.679 million	\$27.646 million
Safety (discounted @ 6% / yr)	\$2,501,228	\$2,031,836	\$1,190,098
Total	\$32.944 million	\$32.711 million	\$28.836 million
Incremental Benefits	---	\$232,931	\$4,107,598
SOCIAL / COMMUNITY			
Noise, Visual, Pollution		2 signals creating light and noise with stop/go traffic	1 signal creating light and noise with stop/go traffic
Community Displacement (Land)		No property requirement	1 property impacted. Requires 1,800m2 of land (not available)
Community Severance		Minor reduction in transportation barriers	Moderate reduction transportation barriers
ENVIRONMENT (2011)			
Fuel Consumption (l/pk hr)	407	439	404
CO (kg/pk hr)	7.58	8.16	7.52
NOx (kg/pk hr)	1.46	1.57	1.45
VOC (kg/pk hr)	1.75	1.88	1.73
Carbon Dioxide Produced (kg per pk hr)	976.8	1,053.6	969.6
Impacts to Habitat	None	None	None

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KEY ECONOMIC INDICATORS			
Net Present Value (NPV)	---	-\$254,742	\$2,688,090
Benefit-Cost Ratio	---	0.40	2.89

Net Present Value (NPV) indicates the magnitude of the net benefit from each option. Benefit-Cost Ratio indicates the rate of return of the benefits to costs. Ratios over 1 indicate that the benefits outweigh the costs and the higher the ratio the higher the return on investment. Benefit savings in option 1 do not outweigh the cost of the project therefore the net present value of option 1 is negative. For option 2 the 2.9 benefit-cost ratio indicates a significant benefit to the project compared to the cost of the project.

11.0 CONCLUSIONS

Both options reviewed will improve traffic conditions, pedestrian access, bicycle access, and improve transit accessibility; however Option 2 (Temple Street extension and signal) provides slightly more improvement than Option 1 (Bay Avenue and Moilliet Street signals). The simplified multiple accounts evaluation found that Option 2 has a better net present value and benefit-cost ratio than Option 1. The barrier to Option 2 is the need for approximately 1800m² of property through 499 Island Highway West that is not available.

Left turn lanes at the appropriate long term option location(s) should be implemented in the short term until either option 1 or 2 can be implemented. In the long term the City should implement one of the options or sub-options (sub-options to be reviewed at design stage) as well as widen Highway 19A to a five lane cross section. The implementation of a five lane cross section, in the long term, is a key component of the long term solution.

The City should provide bicycle facilities and sidewalks along the section of Highway 19A from Moilliet Street to Bay Avenue (excluding any frontage improvements to be done as part of the Family Place development.) Sidewalks, bicycle facilities, and provisions for a transit pullout/bus stop along this section of Highway 19A should be provided either through development frontage improvements and / or a combination of capital improvement projects to support safe multi-modal transportation in this area including strengthened linkages to the waterfront. The City could work with BC Transit and Regional District of Nanaimo to improve transit service to this area of Parksville.

APPENDIX A

Synchro Background

SYNCHRO MODELLING SOFTWARE DESCRIPTION

The traffic analysis was completed using Synchro and SimTraffic traffic modelling software. Results were measured in delay, level of service (LOS) and 95th percentile queue length. Synchro is based on the Highway Capacity Manual (HCM) methodology. SimTraffic integrates established driver behaviours and characteristics to simulate actual conditions by randomly “seeding” or positioning vehicles travelling throughout the network. The simulation is run five times (five different random seedings of vehicle types, behaviours and arrivals) to obtain statistical significance of the results.

Levels of Service

Traffic operations are typically described in terms of levels of service, which rates the amount of delay per vehicle for each movement and the entire intersection. Levels of service range from LOS A (representing best operations) to LOS E/F (LOS E being poor operations and LOS F being unpredictable/disruptive operations). LOS E/F are generally unacceptable levels of service under normal everyday conditions.

The hierarchy of criteria for grading an intersection or movement not only includes delay times, but also takes into account traffic control type (stop signs or traffic signal). For example, if a vehicle is delayed for 19 seconds at an unsignalized intersection, it is considered to have an average operation, and would therefore be graded as an LOS C. However, at a signalized intersection, a 19 second delay would be considered a good operation and therefore it would be given an LOS B. The table below indicates the range of delay for LOS for signalized and unsignalized intersections.

Table A1: LOS Criteria, by Intersection Traffic Control

Level of Service	Unsignalized Intersection Average Vehicle Delay (sec/veh)	Signalized Intersection Average Vehicle Delay (sec/veh)
A	Less than 10	Less than 10
B	10 to 15	11 to 20
C	16 to 25	21 to 35
D	26 to 35	36 to 55
E	36 to 50	56 to 80
F	More than 51	More than 81

APPENDIX B

Multiple Account Evaluation Calculations

Calculation of Annual Maintenance Costs

Existing Maintenance Costs

Road 2 lane - km x \$4,000 per lane-km = \$8,000

Option 1 Maintenance Costs

Road 2.045 lane-km x \$4,000 per lane-km = \$8,180

Signal 2 signals x \$2,500 = \$5,000

Total \$13,180

Option 1 Maintenance Costs

Road 2.315 lane-km x \$4,000 per lane-km = \$9,260

Signal 1 signal x \$2,500 = \$2,500

Total \$11,760

	Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021 Total
Existing	Maintenance	\$ 8,000.00	\$ 8,000.00	\$ 8,000.00	\$ 8,000.00	\$ 8,000.00	\$ 8,000.00	\$ 8,000.00	\$ 8,000.00	\$ 8,000.00	\$ 80,000.00
	discounted at 6%	\$ 7,547.17	\$ 7,119.97	\$ 6,716.95	\$ 6,336.75	\$ 5,978.07	\$ 5,639.68	\$ 5,320.46	\$ 5,019.30	\$ 4,735.19	\$ 4,467.16
Option 1	Maintenance	\$ 13,180.00	\$ 13,180.00	\$ 13,180.00	\$ 13,180.00	\$ 13,180.00	\$ 13,180.00	\$ 13,180.00	\$ 13,180.00	\$ 13,180.00	\$ 131,800.00
	discounted at 6%	\$ 12,433.96	\$ 11,730.15	\$ 11,066.18	\$ 10,439.79	\$ 9,848.86	\$ 9,291.38	\$ 8,765.45	\$ 8,269.30	\$ 7,801.22	\$ 7,359.64
Option 2	Maintenance	\$ 11,760.00	\$ 11,760.00	\$ 11,760.00	\$ 11,760.00	\$ 11,760.00	\$ 11,760.00	\$ 11,760.00	\$ 11,760.00	\$ 11,760.00	\$ 117,600.00
	discounted at 6%	\$ 11,094.34	\$ 10,466.36	\$ 9,873.92	\$ 9,315.02	\$ 8,787.76	\$ 8,290.34	\$ 7,821.07	\$ 7,378.37	\$ 6,960.73	\$ 6,566.72

Calculation of Travel Time Costs

Total Travel Time (hr) were collected from the 2011 and 2021 Pm Synchro Models
 It was assumed that the 2011 travel time would be used from 2011 to 2016 and the 2021 travel time from 2017-2021

Existing (Base)	Travel Time	Peak-Daily Factor	Days per Year	Travel Cost/hr	Cost/Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021 Total
2011	79	10	365	\$ 12.17	\$ 3,509,219.50										
2021	112	10	365	\$ 12.17	\$ 4,975,096.00										
Option 1															
2011	84	10	365	\$ 12.17	\$ 3,731,322.00										
2021	107	10	365	\$ 12.17	\$ 4,752,993.50										
Existing (Base)															
2011	79	10	365	\$ 12.17	\$ 3,509,219.50										
2021	92	10	365	\$ 12.17	\$ 4,086,686.00										
Existing															
Year															
Travel Time															
discounted at 6%	\$ 3,509,219.50	\$ 3,310,584.43	\$ 3,123,192.86	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,507,246.36	\$ 4,975,096.00	\$ 4,975,096.00	\$ 4,975,096.00	\$ 42,421,577.50
Travel Time	\$ 3,731,322.00	\$ 3,520,115.09	\$ 3,320,863.30	\$ 3,731,322.00	\$ 3,731,322.00	\$ 3,731,322.00	\$ 3,731,322.00	\$ 3,731,322.00	\$ 3,731,322.00	\$ 3,731,322.00	\$ 4,752,994.00	\$ 4,752,994.00	\$ 4,752,994.00	\$ 4,752,994.00	\$ 42,421,580.00
discounted at 6%	\$ 3,509,219.50	\$ 3,310,584.43	\$ 3,123,192.86	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 4,752,994.00	\$ 4,752,994.00	\$ 4,752,994.00	\$ 4,752,994.00	\$ 42,421,580.00
Travel Time	\$ 3,509,219.50	\$ 3,310,584.43	\$ 3,123,192.86	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 4,086,686.00	\$ 4,086,686.00	\$ 4,086,686.00	\$ 4,086,686.00	\$ 37,979,527.50
discounted at 6%	\$ 3,310,584.43	\$ 3,123,192.86	\$ 2,946,408.36	\$ 3,509,219.50	\$ 2,946,408.36	\$ 2,946,408.36	\$ 2,946,408.36	\$ 2,946,408.36	\$ 2,946,408.36	\$ 2,946,408.36	\$ 2,982,087.24	\$ 2,982,087.24	\$ 2,982,087.24	\$ 2,982,087.24	\$ 30,678,795.46
Travel Time	\$ 3,509,219.50	\$ 3,310,584.43	\$ 3,123,192.86	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 3,509,219.50	\$ 4,086,686.00	\$ 4,086,686.00	\$ 4,086,686.00	\$ 4,086,686.00	\$ 37,979,527.50
discounted at 6%	\$ 3,310,584.43	\$ 3,123,192.86	\$ 2,946,408.36	\$ 3,509,219.50	\$ 2,946,408.36	\$ 2,946,408.36	\$ 2,946,408.36	\$ 2,946,408.36	\$ 2,946,408.36	\$ 2,946,408.36	\$ 2,880,952.37	\$ 2,880,952.37	\$ 2,880,952.37	\$ 2,880,952.37	\$ 27,645,865.74

2011 Collision Prediction Models

From MoT's Collision Prediction Model Manual

$$E = a_0 \times V_1^{a_1} \times V_2^{a_2}$$

V = annual average daily traffic

assume 10% of pm = daily

3 legged unsignalized	
a0	0.000023
a1	0.8141
a2	0.6348
k	55.5

Volumes (Daily)

Existing

	moilliet	dogwood	finholm	bay
v1	17400	18000	17930	17830
v2	500	500	450	470

Option 1

	moilliet	dogwood	finholm	bay
v1	17410	18060	17860	18390
v2	1000	230	280	930

option 2

	moilliet	dogwood	finholm	bay
v1	17100	18250	18470	17020
v2	350	230	1830	60

CPM	Unmodified		
	Exist.	Opt. 1	Opt. 2
Moilliet	3.37	5.23	2.65
Dogwood	3.46	2.12	2.14
Finholm	3.23	2.38	8.05
Bay	3.30	5.22	0.86
	13.36	14.95	13.70

Modification Factors

Existing

Left turn signal at Moilliet = 0.82

Left turn lane at Dogwood = 0.56

Option 1

Install a signal at Moilliet = 0.85

Exclude left turns at Dogwood & Finholm = 0.32

Install a signal and left turn at Bay = 0.85 x 0.72

Option 2

Exclude left turns at Moilliet, Dogwood, Bay = 0.32

Install signal and left turns on both approaches = 0.85 x 0.52

CPM	Modified		
	Exist.	Opt. 1	Opt. 2
Moilliet	2.76	4.45	0.85
Dogwood	1.94	0.68	0.68
Finholm	3.23	0.76	3.56
Bay	3.30	3.20	0.28
totals / 5yr	11.23	9.08	5.37

Fatals = 1.4%
 Injuries = 39.2%
 PDO = 59.4%

Existing	# per 5 yrs	cost	
Fat	0.16	\$ 6,063,419	970,147.04
Inj	4.40	\$ 100,000	440,000.00
PDO	6.67	\$ 7,759	51,752.53
			1,461,899.57

Option 1	# per 5 yrs	cost	
Fat	0.13	\$ 6,063,419	788,244.47
Inj	3.56	\$ 100,000	356,000.00
PDO	5.40	\$ 7,759	41,898.60
			1,186,143.07

Option 2	# per 5 yrs	cost	
Fat	0.08	\$ 6,063,419	485,073.52
Inj	2.10	\$ 100,000	210,000.00
PDO	3.19	\$ 7,759	24,751.21
			719,824.73

2021 Collision Prediction Models

$$E = a_0 \times V_1^{a_1} \times V_2^{a_2}$$

V = annual average daily traffic

assume 10% of pm = daily

3 legged unsignalized	
a0	0.000023
a1	0.8141
a2	0.6348
k	55.5

Existing

	moilliet	dogwood	finholm	bay
v1	21210	21960	21750	21730
v2	800	610	550	560

Option 1

	moilliet	dogwood	finholm	bay
v1	21220	22000	21750	22420
v2	1390	280	340	1100

option 2

	moilliet	dogwood	finholm	bay
v1	20840	22240	22520	20750
v2	580	280	2190	70

Unmodified

CPM	Exist.	Opt. 1	Opt. 2
Moilliet	5.33	7.57	4.29
Dogwood	4.62	2.82	2.85
Finholm	4.29	3.16	10.61
Bay	4.34	6.83	1.12
	18.57	20.38	18.86

Modification Factors

Existing

Left turn signal at Moilliet = 0.82

Left turn lane at Dogwood = 0.56

Option 1

Install a signal at Moilliet = 0.85

Exclude left turns at Dogwood & Finholm = 0.32

Install a signal and left turn at Bay = 0.85 x 0.72

Option 2

Exclude left turns at Moilliet, Dogwood, Bay = 0.32

Install signal and left turns on both approaches = 0.85 x 0.52

Modified

CPM	Exist.	Opt. 1	Opt. 2
Moilliet	4.37	6.44	1.37
Dogwood	2.59	0.90	0.91
Finholm	4.29	1.01	4.69
Bay	4.34	4.18	0.36
totals / 5yr	15.58	12.53	7.33

Existing	# per 5 yrs	cost	
Fat	0.22	\$ 6,063,419	1,333,952.18
Inj	6.11	\$ 100,000	611,000.00
PDO	9.26	\$ 7,759	71,848.34
			2,016,800.52

Option 1	# per 5 yrs	cost	
Fat	0.18	\$ 6,063,419	1,091,415.42
Inj	4.91	\$ 100,000	491,000.00
PDO	7.44	\$ 7,759	57,726.96
			1,640,142.38

Option 2	# per 5 yrs	cost	
Fat	0.10	\$ 6,063,419	606,341.90
Inj	2.87	\$ 100,000	287,000.00
PDO	4.35	\$ 7,759	33,751.65
			927,093.55

Collision Calculations

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021 Total
Existing Collisions discounted at 6%	\$ 292,379.91	\$ 292,379.91	\$ 292,379.91	\$ 292,379.91	\$ 292,379.91	\$ 403,344.59	\$ 403,344.59	\$ 403,344.59	\$ 403,344.59	\$ 3,478,622.50
	\$ 275,830.11	\$ 260,217.08	\$ 245,487.81	\$ 231,592.28	\$ 218,483.28	\$ 284,342.02	\$ 268,247.19	\$ 253,063.38	\$ 238,739.04	\$ 2,501,227.70
Option 1 Collisions discounted at 6%	\$ 237,228.61	\$ 237,228.61	\$ 237,228.61	\$ 237,228.61	\$ 237,228.61	\$ 328,028.48	\$ 328,028.48	\$ 328,028.48	\$ 328,028.48	\$ 2,826,285.45
	\$ 223,800.58	\$ 211,132.62	\$ 199,181.72	\$ 187,907.28	\$ 177,271.02	\$ 231,247.13	\$ 218,157.67	\$ 205,809.12	\$ 194,159.55	\$ 2,031,836.09
Option 2 Collisions discounted at 6%	\$ 143,964.95	\$ 143,964.95	\$ 143,964.95	\$ 143,964.95	\$ 143,964.95	\$ 185,424.71	\$ 185,424.71	\$ 185,424.71	\$ 185,424.71	\$ 1,646,948.28
	\$ 135,815.99	\$ 128,128.29	\$ 120,875.74	\$ 114,033.72	\$ 107,578.98	\$ 130,717.10	\$ 123,318.02	\$ 116,337.76	\$ 109,752.60	\$ 1,190,098.40

	Base	Option 1	Option 2
Finance			
Capital	\$ -	\$ 450,000	\$ 1,395,000
main	\$ 58,881	\$ 97,006	\$ 86,555
Salvage	\$ -	\$ (452)	\$ (3,166)
Total	\$ 58,881	\$ 546,554	\$ 1,478,389
Incremental		\$ 487,673	\$ 1,419,508

Customer			
Travel Time	\$ 30,442,335	\$ 30,678,795	\$ 27,645,866
Safety	\$ 2,501,228	\$ 2,031,836	\$ 1,190,098
Total	\$ 32,943,562	\$ 32,710,632	\$ 28,835,964
Incremental		\$ 232,931	\$ 4,107,598
NPV		\$ (254,742)	\$ 2,688,090
B/C		0.40	2.89