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Exhibit B

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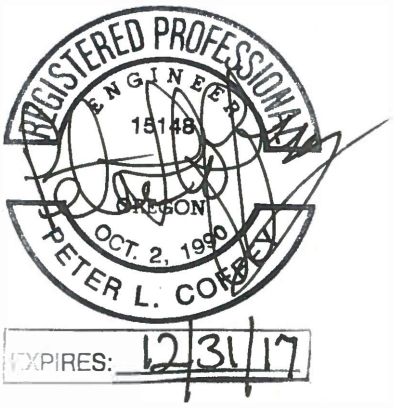
MEMORANDUM



DATE: January 6, 2016

TO: Andrew Aebi, PBOT

FROM: Peter Coffey, P.E.
Jennifer Bachman, P.E.

SUBJECT: South Portal Partnership: Future Alternatives Transportation Analysis, Recommended Alternative, and Project Phasing **P14153-000**

This memorandum documents the analysis results for three alternatives to improve transportation conditions at the South Portal of the South Waterfront District, and provides a new recommended alternative and project phasing. The South Waterfront District encompasses an area in southwest Portland east of Interstate 5, roughly between the Marquam Bridge and SW Bancroft Street. Access to and from the South Waterfront District is limited. This study focuses on improving access to the south end of the district, also referred to as the South Portal.

In 2006, a Recommended Alternative was selected as part of the South Waterfront Analysis.[1] This South Portal Partnership project will determine whether a different alternative can be implemented at a lower cost, with fewer right-of-way impacts, and within a shorter timeframe while still achieving the project goals.[2]

The project team developed three alternatives for analysis and consideration, and then created a recommended alternative. These alternatives, which incorporate feedback from stakeholder interviews and an open house conducted on November 19, 2014, are:

- **Alternative 1 (Macadam-Bancroft Concept)** prohibits eastbound vehicle though movements from SW Hood Avenue to SW Bancroft Street and includes a modified one-way grid that changes the directionality of the east-west streets between SW Curry Street and SW Thomas Street. It does not add new connections at the South Portal.
- **Alternative 2 (Macadam-Bancroft Concept with Moody Extension)** also prohibits eastbound vehicle though movements from SW Hood Avenue to SW Bancroft Street, but retains the existing directionality of the east-west streets. Alternative 2 also includes an extension of SW Moody Avenue south to SW Hamilton Court, providing a new connection to the district.
- **Alternative 3 (Moody and Bond Extension)** is the recommended alternative from the 2006 South Waterfront Analysis, and includes relocating the SW Hood Avenue interface with SW

[1] *South Waterfront South Portal Transportation Analysis* report, 2006
[2] Goals are documented in the *South Portal Partnership: Project Goals and Evaluation Criteria* memorandum. Prepared for PBOT by DKS Associates. Draft December 31, 2014.

Macadam Avenue to a redesigned intersection at SW Hamilton Street**.** Alternative 3 retains the existing directionality of east-west streets, but extends SW Moody Avenue and SW Bond Avenue to SW Hamilton Street, providing a new connection to the district.

Based on initial screening of the three alternatives, the project team created a recommended alternative that is closely related to Alternative 2 with a few modifications including the Lowell Street extension and maintains the existing one-way street network, as shown in Figure 1.

This memorandum presents the following sections:

1) Summary of Key Findings
2) Study Area Intersections
3) Alternatives Overview
4) Traffic Volume Development Year 2035
5) Traffic Operations for the Three Alternatives (A.M. Peak Hour Year 2035)
6) Evaluation Criteria and Alternative Comparisons
7) Other Street Improvement Considerations
8) Initial Screening Conclusions
9) Overview of Recommended Alternative
10) Recommended Alternative Analysis (Year 2035)
11) Dual Westbound Left Analysis at Macadam/Bancroft
12) Additional Analysis at Moody/Bancroft and Moody Extension
13) Interim Year Analysis at SW Macadam Avenue/SW Bancroft Street
14) Rail Operations on Moody Avenue
15) Project Phasing
16) Conclusion

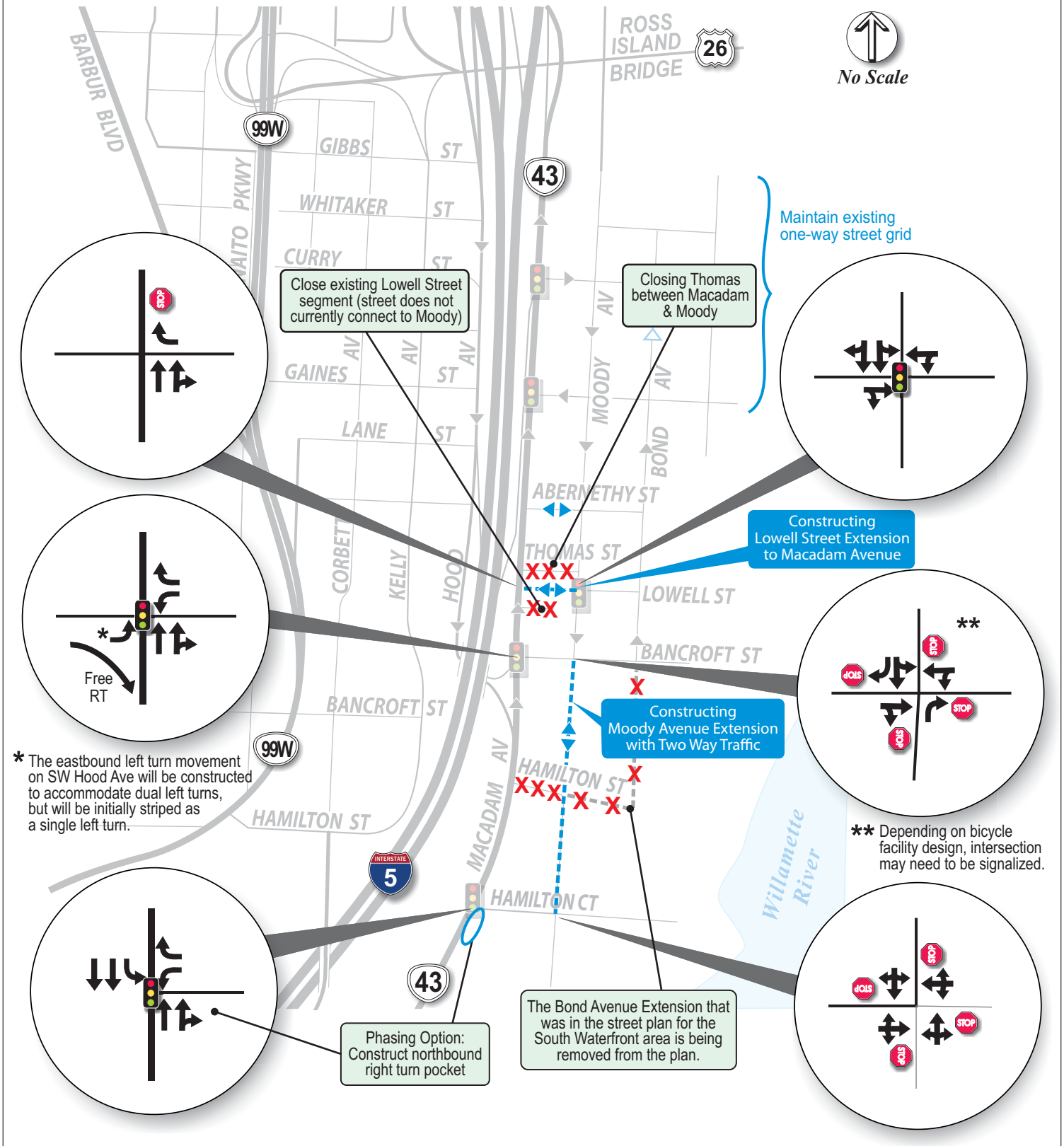


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Figure **1**

Recommended Alternative:
Macadam-Bancroft Concept
with Moody & Lowell Extensions

SECTION 1: SUMMARY OF KEY FINDINGS

Evaluation and comparison of the three alternatives revealed the following key findings:

- **Traffic Operations at key South Portal Intersections.** Alternative 3 provides the lowest intersection v/c ratios of the three options, which indicates it offers the greatest capacity. In alternative 3, all intersection v/c ratios are 0.90 or less during the 2035 a.m. peak hour. Alternative 2 had the next lowest v/c ratios and alternative 1 had the highest v/c ratios at the study intersections. Both alternatives 1 and 2 had v/c ratios greater than 1.0 at key intersections.

- **Costs, Impacts, and Timeline.** The lowest cost option with the fastest possible implementation timeline and fewest impacts is Alternative 1. Alternative 2 increases cost somewhat due to the Moody Avenue extension, which also increases the implementation timeline. The alternative with the highest cost is Alternative 3. The estimated cost of Alternative 3 is $50 million,[3] significantly more than the other two alternatives. This alternative also has the most right-of-way impacts and would require the longest timeline to construct.

- **New Connections.** Alternatives 2 and 3 both provide new access to the South Waterfront District by extending SW Moody Avenue (and also SW Bond Avenue in Alternative 3) and providing a new connection at SW Hamilton Court (Alternative 2) or SW Hamilton Street (Alternative 3). Alternative 1 on the other hand does not add a new connection to the district.

- **SW Lowell Street Extension.** Extending SW Lowell Street and vacating SW Thomas Street between SW Macadam Avenue and SW Moody Avenue improves connectivity into and within the district, especially for Alternatives 1 and 2. By extending SW Lowell Street, out of direction travel is avoided by northbound vehicles on SW Macadam Avenue bound for northbound on SW Bond Avenue. In addition, under Alternatives 1 and 2 if SW Lowell Street is not extended, then two intersections would be closely spaced on SW Moody Avenue (at SW Thomas Street and SW Lowell Street), which is not desirable and would require installation of a traffic signal at the SW Moody Avenue/SW Thomas Street intersection. See "Section 7: Other Street Improvement Considerations" for more information.

- **Moody Avenue Extension**. Extending SW Moody Avenue from SW Bancroft Street to SW Hamilton Court benefits the South Waterfront district by providing an additional access to and from the district. At the SW Moody Avenue/SW Bancroft Street intersection, the extension improves operations and alleviates southbound vehicles queueing. With the extension in place the southbound lane geometry would change to a southbound right turn lane and a shared southbound through/left lane. See "Section 12: Additional Analysis at Moody/Bancroft and Moody Extension" section of this memorandum for more information.

[3] South Waterfront South Portal. Tables 9 and 10. Prepared by Kittelson and Associates. September 2006.

- **Dual vs Single Eastbound Left at SW Macadam Avenue/SW Bancroft Street.** Alternatives 1 and 2 analyzed the SW Macadam Avenue/SW Bancroft Street intersection with both a single eastbound left and dual eastbound lefts (with the second left turn lane just 75 feet in length) from SW Hood Avenue to SW Macadam Avenue. During the a.m. peak hour in 2035 dual eastbound lefts improve alternative 2 from a v/c ratio of 1.15 to 1.06, and they improve alternative 1 from a v/c ratio of 1.19 to 1.10. An interim year analysis was completed for the recommended alternative during the a.m. peak hour. The results show that the single eastbound left at SW Macadam Avenue/SW Bancroft Street provides a v/c ratio of less than 1.0 until approximately year 2025. See "Section 5: Traffic Operations" for further information.

- **Consideration of Dual Westbound Lefts from SW Bancroft Street to Southbound on SW Macadam Avenue.** Initial screening evaluated dual westbound left turns from SW Bancroft Street to southbound on SW Macadam Avenue. However, with the signal phasing for the recommended alternative, dual westbound lefts do not offer any significant improvements to the intersection capacity. Furthermore, constructing dual westbound lefts would require an additional signal where the southbound movement from SW Hood Avenue joins with SW Macadam Avenue, which is currently a free movement. The one advantage the dual westbound lefts provide is increased storage for the westbound movement. Based on these results, dual westbound left turns are not recommended at the SW Bancroft Street/SW Macadam Avenue intersection. See "Section 11: Dual Westbound Left Analysis at Macadam/Bancroft" for more information.

- **East-West Grid Options.** Modifying the east-west grid network has both pros and cons. **The pros of modifying the grid include**: it may discourage the northbound right turn from the I-5 off-ramp onto SW Curry Street, it eliminates the need for a traffic signal at SW Macadam Avenue/SW Gaines Street, and it decreases the v/c ratio at the SW Macadam Avenue/SW Curry Street intersection. **The cons of modifying the grid include**: it limits the turning radius at SW Moody Avenue/SW Gaines Street which would prohibit trucks over 55 feet long from entering the district at SW Gaines and turning right on SW Moody, it increases delay at the SW Macadam Avenue/SW Curry Street intersection (the operation results are due to changes in traffic volumes through the intersection and changes to the number of signal phases necessary for operations), and implementation may be costly. Based on these pros and cons, the recommended alternative maintains the existing east-west grid network. See "Section 7: Other Street Improvement Considerations" for more information.

SECTION 2: STUDY AREA INTERSECTIONS

The study area focuses on SW Macadam Avenue and SW Moody Avenue between SW Curry Street and SW Hamilton Court in the South Waterfront District. Within the study area, the Project Team identified nine study intersections:

- SW Macadam Avenue/SW Curry Street
- SW Macadam Avenue/SW Gaines Street
- SW Macadam Avenue/SW Abernethy Street
- SW Macadam Avenue/SW Thomas Street

- SW Macadam Avenue/SW Bancroft Street
- SW Macadam Avenue/SW Hamilton Court
- SW Moody Avenue/SW Curry Street
- SW Moody Avenue/SW Gaines Street
- SW Moody Avenue/SW Bancroft Street

SECTION 3: ALTERNATIVES OVERVIEW

The three alternatives are described in the following sections as well as in the "Alternatives" Memorandum.[4]

Alternative 1- Macadam-Bancroft Concept

The Macadam-Bancroft Concept Alternative would:

- Modify traffic control at the SW Macadam Avenue/SW Bancroft Street intersection to prohibit eastbound vehicle through movements from SW Hood Avenue to SW Bancroft Street.
- Modify one-way network for east/west streets between SW Thomas Street and SW Curry Street.
- Vacate existing SW Thomas Street between SW Macadam Avenue and SW Moody Avenue.
- Extend SW Lowell Street west from SW Moody Avenue to SW Macadam Avenue.

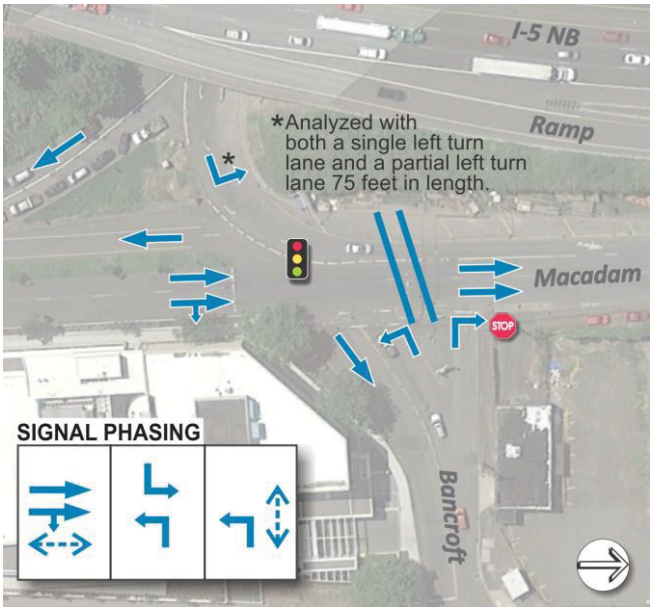

Figure 2: Lane Configuration and Phasing for Alternatives 1 and 2

Currently, the modified traffic control at the SW Macadam Avenue/SW Bancroft Street intersection prohibits eastbound vehicle through movements from SW Hood Avenue to SW Bancroft Street. In Alternative 1, this movement would instead be served by a left turn onto SW Macadam Avenue. Vehicles would then enter the district using either SW Lowell Street (the realigned SW Thomas Street) or SW Gaines Street. Removing the eastbound through movement allows a reduction in the number of phases served by the traffic signal,[5] and reallocates green time to other critical movements.[6]

Figure 2 shows the proposed signal phasing. The pedestrian crossing on the north leg of the intersection would remain and the pedestrian phase will occur during the westbound left-turning Bancroft Street movement. The westbound to northbound right turn movement from SW Bancroft Street to northbound SW Macadam Avenue would remain stop sign controlled as it is today.

The Macadam-Bancroft Concept also includes modifications to the east/west streets between SW Macadam Avenue and SW Moody Street north of SW Bancroft Street to better serve existing uses. Under this alternative,

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[4] South Portal Partnership: Alternatives Memorandum. Prepared for the City of Portland by DKS Associates, January 26, 2015.
[5] The traffic signal phasing at the SW Macadam Avenue/SW Bancroft Street intersection would be modified from separate phases in the east/west direction (split phase operation) to a single phase serving east/west movements.
[6] Green time would be reallocated to the northbound Macadam Avenue through phase and the westbound Bancroft Street phase.

vehicles would access the district via SW Lowell Street (made possible by extending SW Lowell Street west from SW Moody Avenue to SW Macadam Avenue and vacating SW Thomas Street between those two blocks) and SW Gaines Street (one-way eastbound between SW Macadam Avenue and SW Moody Avenue) and vehicles would exist the district via SW Abernethy Street and SW Curry Street (one-way westbound between SW Macadam Avenue and SW Moody Avenue).

The project team analyzed the west leg of the SW Macadam Avenue/SW Bancroft Street intersection with a single eastbound left turn and dual left turn lanes, the second left turn lane being 75 feet in length, and referred to as a "partial" second left turn lane.

A conceptual layout was used to determine that the proposed turning paths at the SW Macadam Avenue/SW Bancroft Street intersection are feasible. The concept included dual eastbound left turns from SW Hood Avenue onto SW Macadam Avenue and a single westbound left from SW Bancroft Street to SW Macadam Avenue. The design vehicles and assumptions are included on the conceptual layout included in the Appendix.

Figure 3 illustrates the roadway network assumptions for Alternative 1, the Macadam-Bancroft Concept.

Alternative 2 - Macadam-Bancroft Concept with Moody Extension

The Macadam-Bancroft Concept with Moody Extension (Alternative 2) builds on the Macadam-Bancroft Concept (Alternative 1) and would:

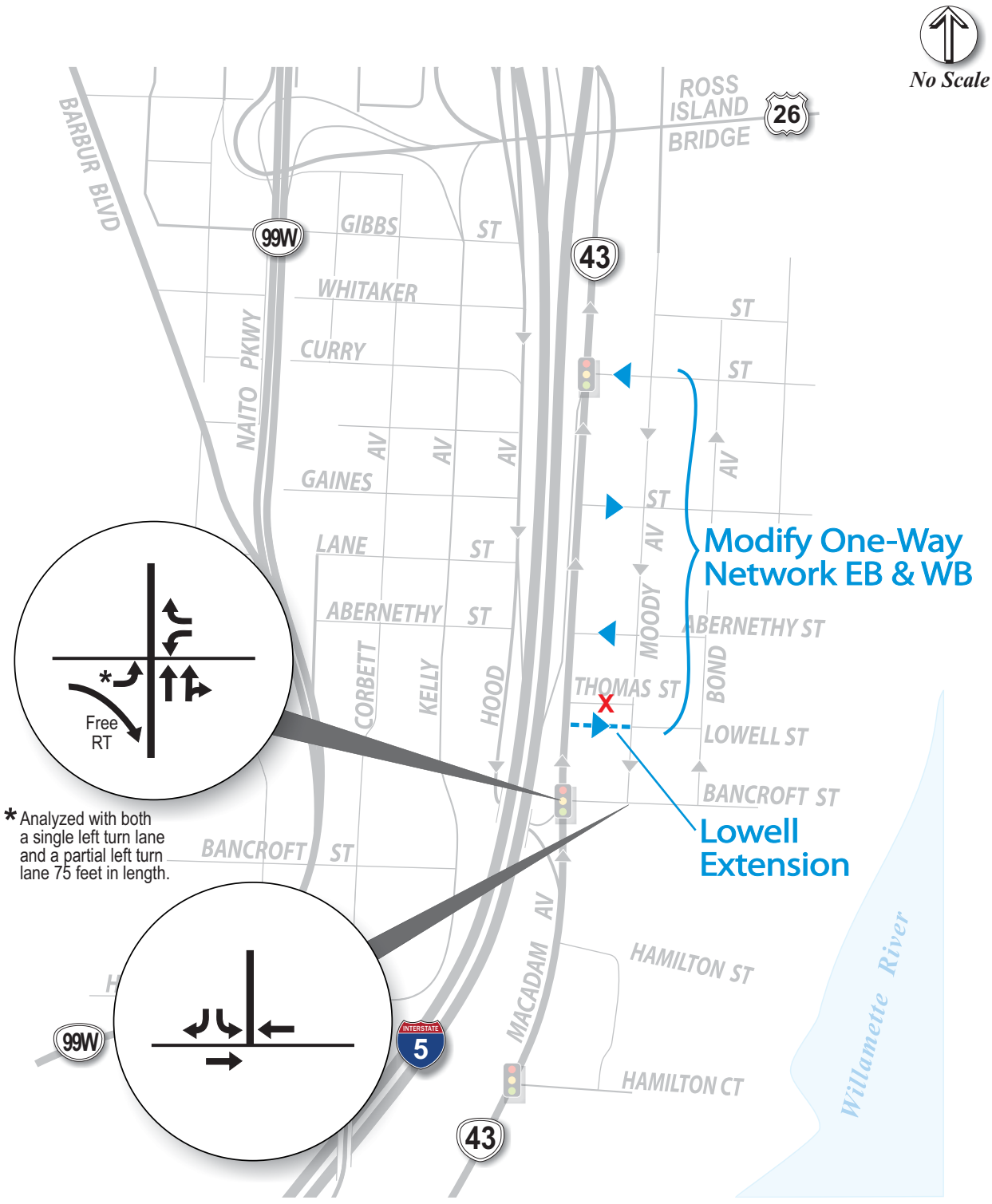
- Modify traffic control at the SW Macadam Avenue/SW Bancroft Street intersection to prohibit eastbound vehicle through movements from SW Hood Avenue to SW Bancroft Street (same as Alternative 1).
- Retain existing street network north of SW Bancroft Street (no changes to one-way directions).
- Extend SW Moody Avenue south to create a north-south connection between SW Bancroft Street and SW Hamilton Court.
- Remove SW Hamilton Street between SW Macadam Avenue and SW Moody Avenue.
- Maintain existing SW Lowell Street alignment.

The SW Moody Street extension allows for greater north-south connectivity within the South Waterfront District. Currently, SW Macadam Avenue is the only vehicular connection between the north and south portions of the study area. Extending SW Moody Street south of SW Bancroft Street would provide a new connection with one travel lane in each direction while maintaining the existing shared use path for pedestrian and bicycle access through the extension area.

This alternative removes SW Hamilton Street between SW Macadam Avenue and SW Moody Street because of the existing street's steep grade and close spacing to the SW Bancroft Street traffic signal. The SW Moody Avenue Extension would provide access to properties currently on SW Hamilton Street.

Similar to Alternative 1, the project team analyzed the west leg of the SW Macadam Avenue/SW Bancroft Street intersection with a single left turn lane and a partial second left turn lane (75 feet in length).

Figure 4 illustrates the roadway network assumptions for Alternative 2, the Macadam-Bancroft Concept with Moody Extension.



LEGEND

- ◀ - Existing One-Way Street
- ◀ - Proposed One-Way Street
- ---- - Proposed Roadway
- X - Remove Roadway

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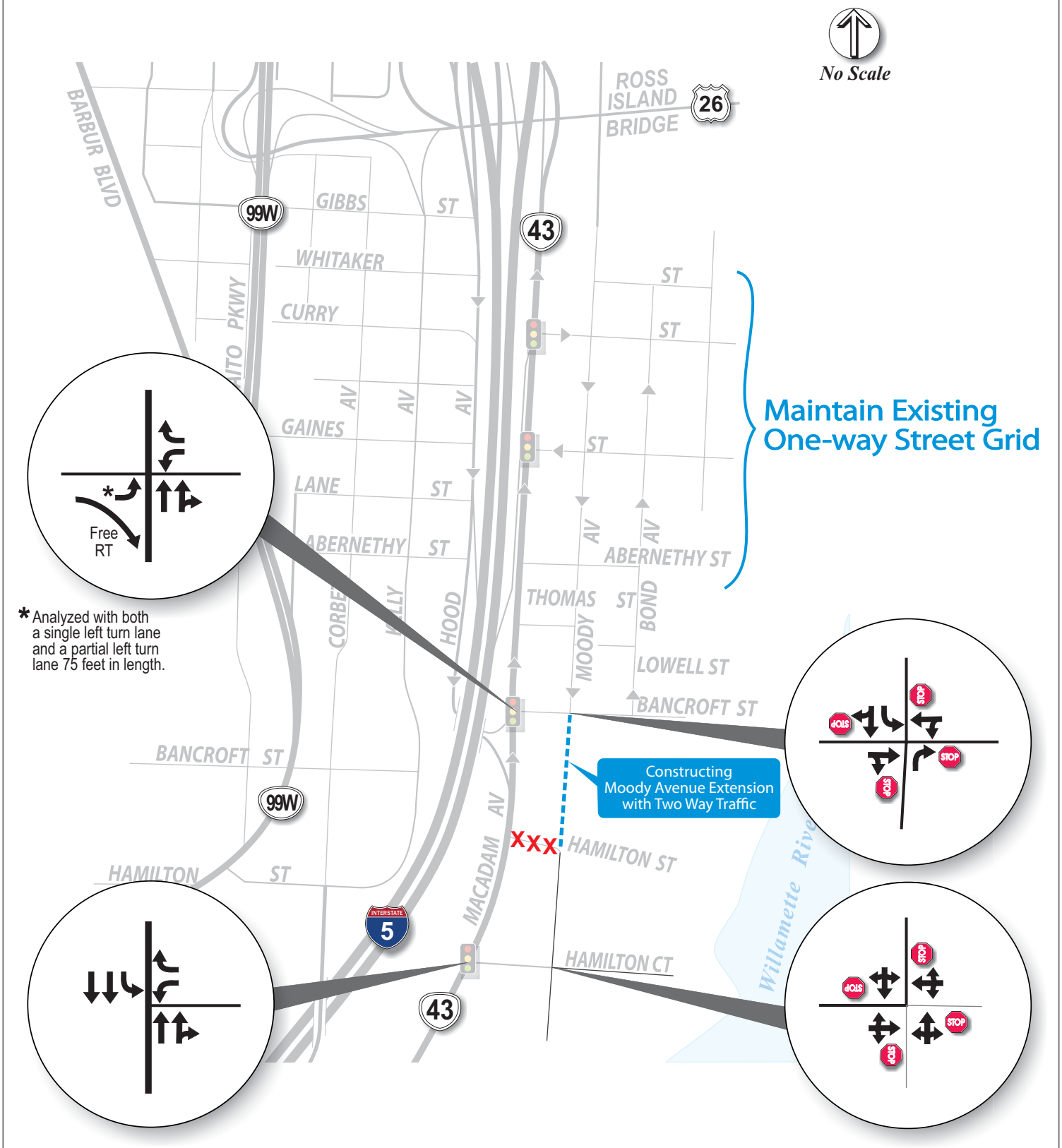
Figure 3

Alternative 1: Macadam - Bancroft Concept



LEGEND

- ◀ - Existing One-Way Street
- ◀ - Proposed One-Way Street
- - - - Proposed Roadway
- X - Remove Roadway
- STOP - Stop Sign

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Figure 4

Alternative 2: Macadam - Bancroft Concept with Moody Extension

Alternative 3: Moody and Bond Extension

The Moody and Bond Extension (Alternative 3) is the 2006 South Portal Recommended Alternative. This alternative is currently reflected in City of Portland planning documents (for example, the Transportation System Plan) and represents the alternative adopted by City Council. This alternative provides a comparison to the other alternatives to determine whether it still represents the most viable solution.

The Moody and Bond Extension Alternative includes the following elements:

- Remove SW Hood Avenue access at the SW Macadam Avenue/SW Bancroft Street intersection.
- Realign SW Hood Avenue so it connects to SW Macadam Avenue at SW Hamilton Street. SW Hamilton Street becomes a new access point to the South Waterfront District.
- Retain existing street network north of SW Bancroft Street without changes to one-way streets.
- Extend SW Moody Avenue south to create a southbound connection between SW Bancroft Street and SW Hamilton Street.
- Extend SW Bond Avenue to create a northbound connection between SW Bancroft Street and SW Hamilton Street.
- Extend SW Hamilton Street east to connect to the extended SW Bond Avenue.
- Accommodate the southbound SW Hood Avenue to northbound SW Macadam Avenue through a U-turn movement at the SW Hamilton Street signalized intersection.

Figure 5 illustrates the roadway network assumptions for Alternative 3, the Moody and Bond Extension.

SECTION 4: TRAFFIC VOLUME DEVELOPMENT YEAR 2035

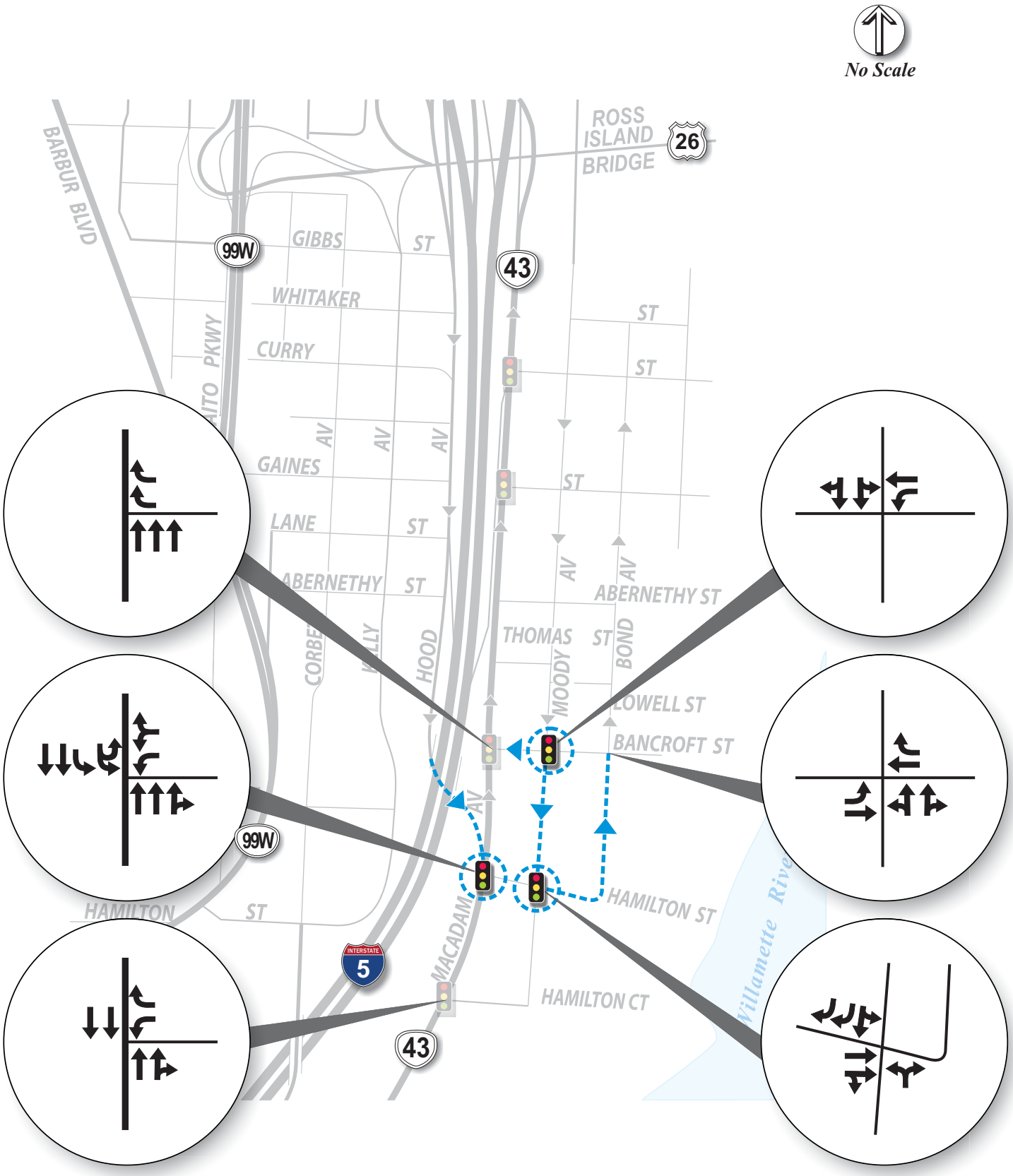
Developing 2035 a.m. peak hour traffic volumes is necessary to evaluate the performance of each alternative. This section documents the data and methodology the project team used to develop future year traffic volumes.

Travel Demand Model

The project team based forecasting traffic volumes for project alternatives on current travel demand models from the City of Portland. The city's models include a base year of 2010 and a future year of 2035, with the 2035 network reflecting citywide and regional transportation projects that are likely to be funded by 2035. To forecast future traffic volumes for the alternatives, the project team modified the 2035 model network to reflect the roadway connections and capacity changes for each of the three alternatives. These modifications yielded three new model runs for the a.m. peak hour, providing the basis for the forecasting work described below.

The City of Portland's travel demand model uses the Gamma land use forecast for regional population and employment, which assumes less region-wide growth over the 20-year planning horizon than previous models, such as that used for the North Macadam Transportation Development Strategy[7].

[7] North Macadam Transportation Development Strategy. Prepared for the City of Portland by DKS Associates. April 2009.


No Scale
ROSS ISLAND BRIDGE
26
BARBUR BLVD
99W
GIBBS ST
43
WHITAKER ST
CURRY ST
GAINES AV
LANE ST
ABERNETHY ST
CORBETT
HOOD
MOODY
BOND
THOMAS ST
LOWELL ST
BANCROFT ST
HAMILTON ST
HAMILTON
INTERSTATE 5
MACADAM AV
HAMILTON CT
Willamette River
LEGEND
- Existing One-Way Street
- Proposed One-Way Street
- Proposed Roadway
- New Traffic Signal
DKS
Figure 5
Alternative 3:
Moody and Bond Extension
(2006 South Portal Recommended Alternative)

Forecasting Methodology

City of Portland staff provided model plots for base year (2010) and future year No Build (2035) traffic assignments.[8] City staff also provided model plots for the future year alternatives.[9] These included volume plots, which show volume on all network links, and volume-difference plots, which show how traffic volumes and patterns for each 2035 alternative differ from the 2035 No Build condition.

The project team reviewed network plots to verify that model network characteristics, such as roadway capacity and allowed movements, were consistent with the existing network and assumed future improvements under each alternative. It also refined the transportation analysis zone (TAZ) connectors in the study area to reflect correct loading for each network alternative.

The project team developed future traffic volumes using two methods—a combination of difference and growth methods between base year and future year alternative models to estimate traffic growth and the straight-line method to estimate the proportion of growth from the project's base year (2014) to the forecast year (2035).

In reviewing base year traffic counts for this project and comparing to historical traffic counts along SW Macadam Avenue, it appears likely that 2014 traffic volumes are low due to Sellwood Bridge construction. For forecasting purposes, the project team increased the base northbound and southbound volumes on Macadam Avenue to reflect likely conditions after Sellwood Bridge construction is complete. AM peak hour volumes were increased by 100 vehicles northbound and 50 vehicles southbound.

The project team added the identified traffic growth for each alternative to the turning movement volumes developed for the Existing Conditions Memorandum,[10] and it then compared these to future No Build conditions to ensure consistency between forecasts. The project team post-processed the model outputs to better reflect anticipated turning movements, consistent with standard practice for traffic forecasting as outlined in National Cooperative Highway Research Program (NCHRP) Report 255.[11] The 2035 a.m. peak hour traffic volumes for the three alternatives are shown in Figure 6, Figure 7, and Figure 8.

The future year traffic volumes developed for this project are based on year 2035 land use and mode split assumptions developed by the City of Portland and Metro. Based on recent economic trends and other factors and compared to previous analysis for the South Waterfront District,[12] the 2035 land use assumptions for employment growth have decreased by approximately 35 percent and for household growth by approximately five percent. In addition, a lower motor vehicle mode split is assumed based on recent travel behavior survey data. These changes resulted in up to a 30 percent decrease in projected 2035 traffic volumes (during the p.m. peak hour) entering/exiting the South Waterfront district compared to previous studies.

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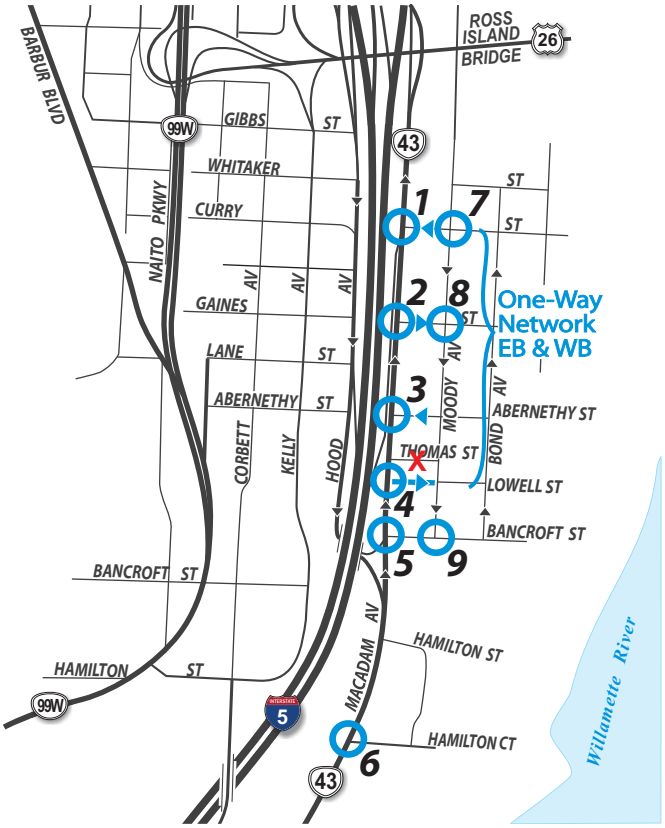
[8] Model plots provided by Ningsheng Zhou, City of Portland, on November 21, 2014.
[9] Model plots provided by Ningsheng Zhou, City of Portland, on January 14, 2015.
[10] South Portal Partnership: Existing Transportation Conditions Analysis. Prepared for City of Portland by DKS Associates. November 20, 2014.
[11] *National Cooperative Highway Research Program Report 255, Highway Traffic Data for Urbanized Area Project Planning and Design,* Pedersen and Samdahl, Transportation Research Board, 1982.
[12] *North Macadam Transportation Strategy*. Prepared for City of Portland by DKS Associates. April 2009.

Key Map

No Scale



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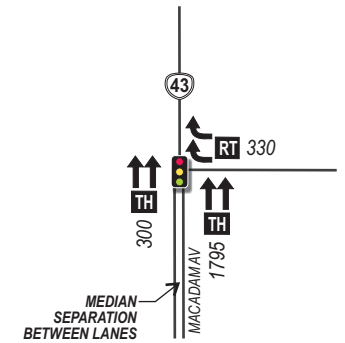

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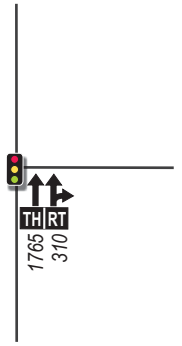
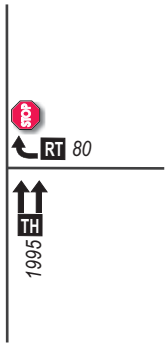
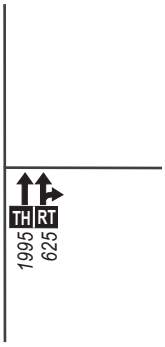


3. Macadam Ave. & Abernethy St.

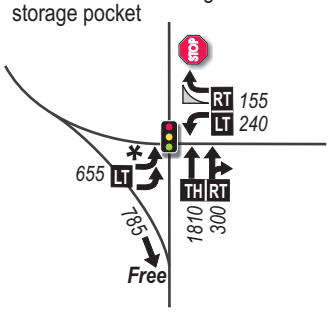


4. Macadam Ave. & Lowell St.

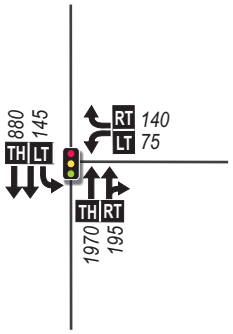


5. Macadam Ave. & Bancroft St.

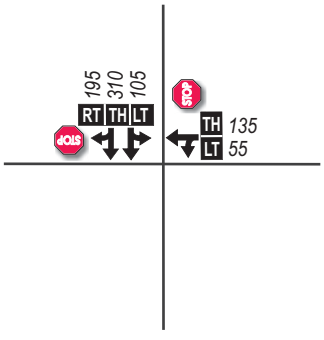
* "Partial" second left turn lane with a 75 foot long storage pocket



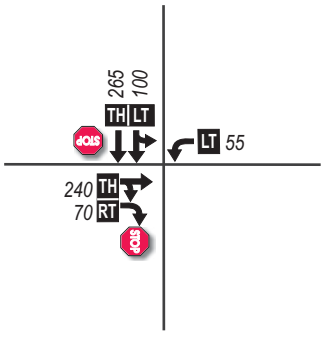
6. Macadam Ave. & Hamilton Ct.



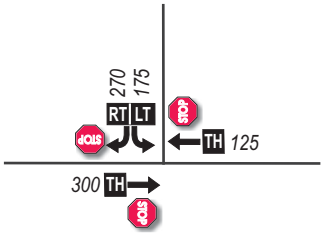
7. Moody Ave. & Curry St.



8. Moody Ave. & Gaines St.



9. Moody Ave. & Bancroft St.



LEGEND

- # - Study Intersection
- Proposed One-Way Street
- Proposed Roadway
- X - Remove Roadway
- Traffic Signal
- STOP - Stop Sign
- Lane Configuration
- AM (PM) - Peak Hour Traffic Volumes
- LT TH RT - Volume Turn Movement (Left • Thru • Right)

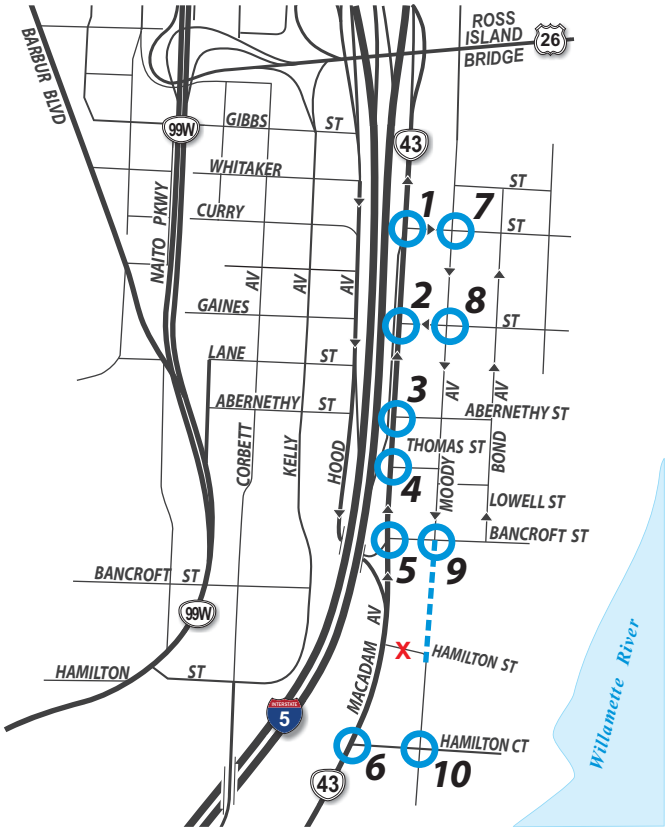
DKS

Figure 6

2035 Future AM Peak Hour Traffic Volumes
Alternative 1: Macadam - Bancroft Concept

Key Map

No Scale



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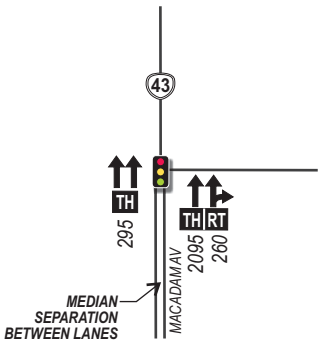

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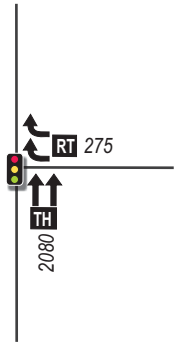

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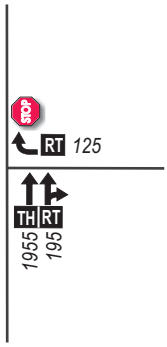
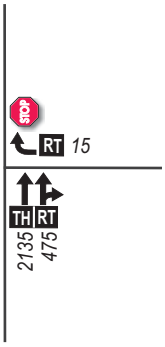
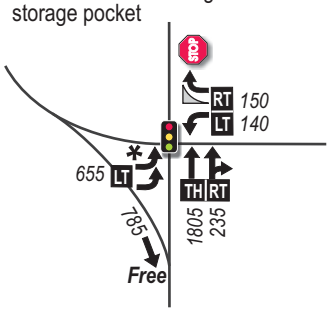


4. Macadam Ave. & Thomas St.

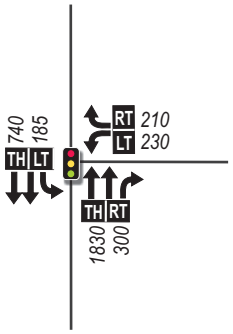


5. Macadam Ave. & Bancroft St.

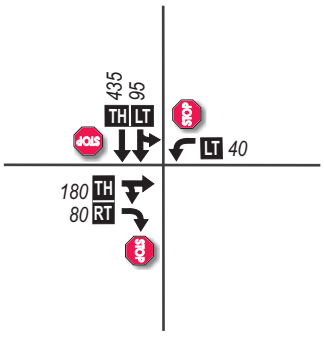
* "Partial" second left turn lane with a 75 foot long storage pocket



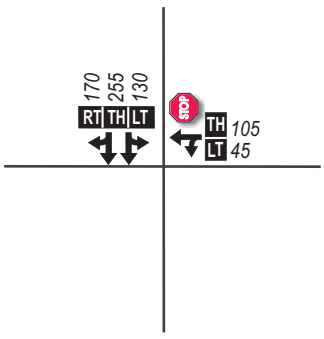
6. Macadam Ave. & Hamilton Ct.



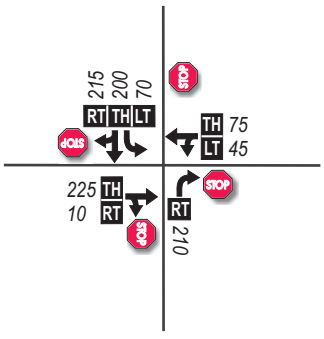
7. Moody Ave. & Curry St.



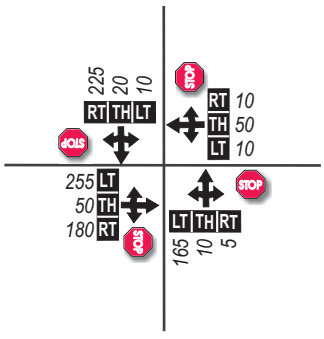
8. Moody Ave. & Gaines St.



9. Moody Ave. & Bancroft St.



10. Moody Ave. & Hamilton Ct.



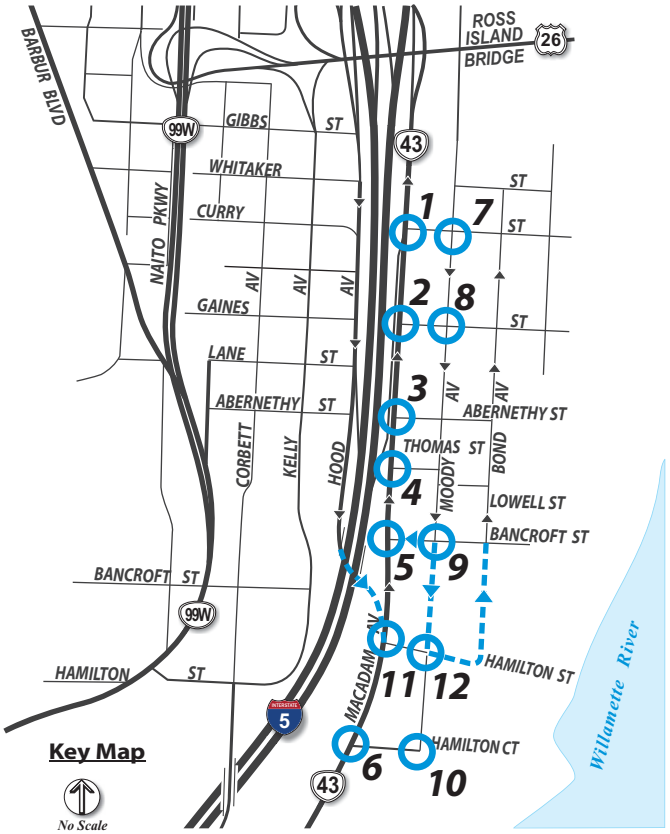
LEGEND

- # - Study Intersection
- Proposed Roadway
- Proposed One-Way Street
- X - Remove Roadway
- Traffic Signal
- STOP - Stop Sign
- Lane Configuration
- AM (PM) - Peak Hour Traffic Volumes
- LT TH RT (Left•Thru•Right) - Volume Turn Movement

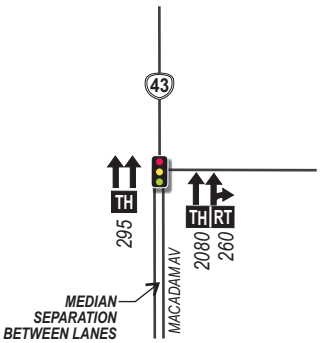
DKS

Figure **7**

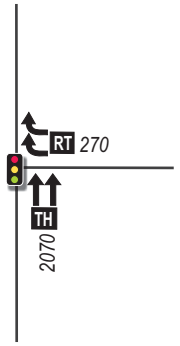
2035 Future AM Peak Hour Traffic Volumes
Alternative 2: Macadam - Bancroft Concept with Moody Extension



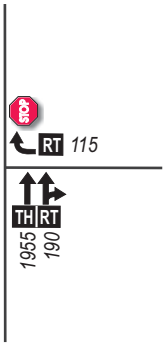
1. Macadam Ave. & Curry St.



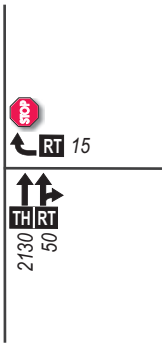
2. Macadam Ave. & Gaines St.



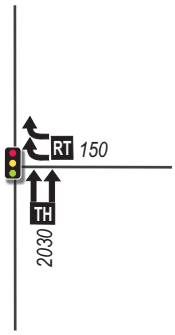
3. Macadam Ave. & Abernethy St.



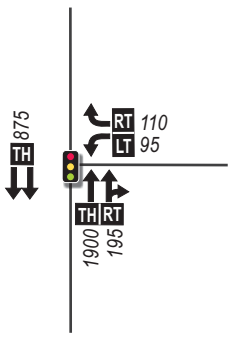
4. Macadam Ave. & Thomas St.



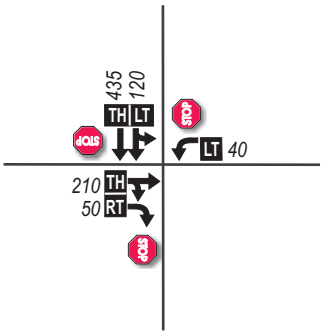
5. Macadam Ave. & Bancroft St.



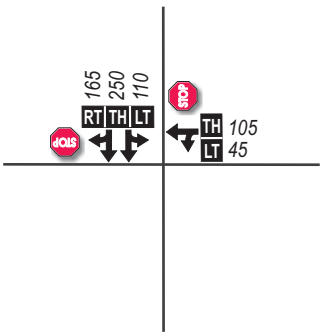
6. Macadam Ave. & Hamilton Ct.



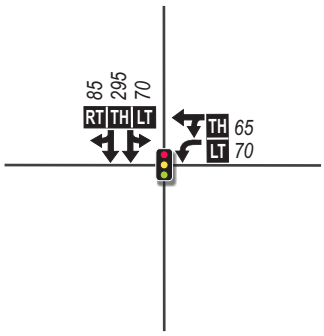
7. Moody Ave. & Curry St.



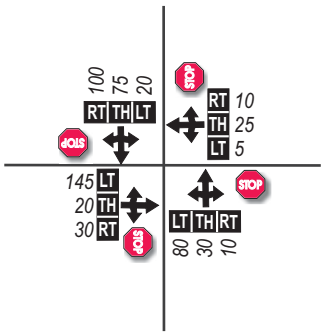
8. Moody Ave. & Gaines St.



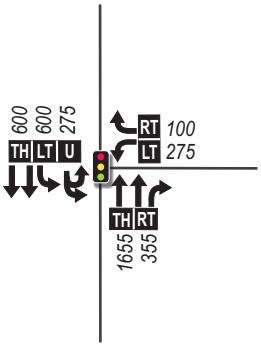
9. Moody Ave. & Bancroft St.



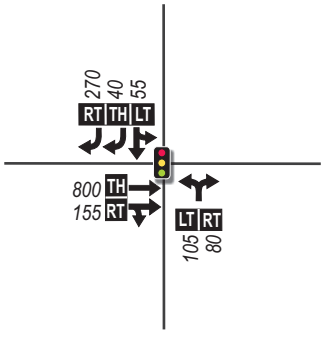
10. Moody Ave. & Hamilton Ct.



11. Macadam Ave. & Hamilton St. - Hood Ave



12. Moody Ave. & Hamilton St.



LEGEND

- # - Study Intersection
- Proposed Roadway
- Proposed One-Way Street
- Traffic Signal
- STOP - Stop Sign
- Lane Configuration
- AM (PM) - Peak Hour Traffic Volumes
- U LT TH RT - Volume Turn Movement (U-Turn • Left • Thru • Right)

DKS

Figure **8**

2035 Future AM Peak Hour Traffic Volumes
Alternative 3: Moody and Bond Extension

SECTION 5: TRAFFIC OPERATIONS

The project team analyzed future year 2035 traffic operating conditions at the study intersections for a.m. peak hour based on 2000 Highway Capacity Manual (HCM) methodology for signalized intersections, and 2010 HCM methodology for unsignalized intersections.[13,14]

Mobility Standards

Level of service (LOS) and volume-to-capacity (v/c) ratios are two commonly used performance measures that provide a measure of intersection operations. Agencies often incorporate these performance measures into their mobility standards. Descriptions are provided below:

- Level of Service (LOS): A "report card" rating (A through F) based on the average delay (seconds per vehicle) experienced by vehicles at the intersection. LOS A, B, and C indicate conditions where traffic moves without significant delays over periods of peak hour travel demand. LOS D and E are progressively worse operating conditions. LOS F represents conditions where average vehicle delay has become excessive and demand is near or over capacity; this condition is typically evident in long vehicle queues.
- Volume-to capacity (v/c) ratio: A decimal representation (between 0.00 and 1.00) of the proportion of capacity that is being used. The project team determines v/c ratio by dividing the peak hour traffic volumes by the hourly capacity of a given facility. A lower ratio indicates smooth operations and minimal delays. As the ratio approaches 1.00, congestion increases and performance is reduced. At 1.00, demand is greater than capacity and the facility is oversaturated—this results in excessive queues and long delays.

Jurisdictional Operating Standards

Agencies establish targets for intersection operations on their facilities, known as mobility targets. The Oregon Department of Transportation (ODOT) mobility targets for state facilities are v/c-based and apply to intersections along SW Macadam Avenue. The v/c mobility target for signalized intersections along SW Macadam Avenue is 1.10 for the first hour and 0.99 for the second hour. For unsignalized approaches to SW Macadam Avenue, the mobility target is 0.99 v/c.[15]

The City of Portland owns and operates intersections along SW Moody Avenue. Portland mobility targets are based on the Metro 2000 Regional Transportation Plan (RTP), which focuses on assessing link performance. These link performance targets are LOS-based, which do not translate to LOS intersection targets. Therefore, the project team matched equivalent v/c ratio targets to the LOS link performance targets, which translate well into intersection targets.

Portland mobility targets are referred to as "preferred operating standards" and "acceptable operating standards." This study compares SW Moody Avenue operations to the preferred operating standard to identify deficiencies, but it will recommend improvements to at least meet the acceptable operating standard. For this

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[13] *2010 Highway Capacity Manual*, Transportation Research Board, Washington DC, 2010.
[14] *2000 Highway Capacity Manual*, Transportation Research Board, Washington DC, 2000.
[15] 1999 Oregon Highway Plan, Policy 1F Revisions, Adopted December 2011.

memorandum, the preferred operating standard is the mobility target, that is, a 0.99 v/c ratio target for intersections along SW Moody Avenue.[16]

Alternative 1 – Macadam-Bancroft Concept

The following two sections discuss the assumptions and operational results for Alternative 1.

Assumptions

The project team incorporated the following assumptions into the analysis for Alternative 1:

- Maintained the existing 110 second cycle length at all signalized study intersections.
- At the SW Macadam Avenue/SW Curry Street intersection, prohibited westbound right turn movement (from SW Curry Street) on red.
- At the SW Macadam Avenue/SW Bancroft Street intersection:
    - Prohibited eastbound left turn movements on red
    - Increased the total eastbound saturation flow rate by 30% to account for the option with the partial second eastbound left (a 75 foot long second left turn pocket). For the single eastbound left option, no saturation flow rate adjustments were made.
    - Maintained the existing pedestrian phases on the north and east legs
    - Operated eastbound and westbound left turn movements simultaneously
- At the SW Macadam Avenue/SW Hamilton Court intersection:
    - Maintained separate turn lanes for the westbound right and westbound left turn lane (volumes are nearly balanced)
    - Operated the pedestrian phase with the westbound movement (same as existing operations)

Operational Results

All of the study intersections, except one, fall well within the mobility targets in Alternative 1. The SW Macadam Avenue/SW Bancroft Street intersection just barely meets the mobility target when analyzed with a partial second eastbound left turn lane[17]. With this partial turn lane, the intersection operates right at the mobility target of 1.10 v/c; without the partial second left turn lane, the intersection v/c ratio is 1.19. Although both of these v/c ratios are over capacity, the 1.10 v/c ratio with the partial turn lane does meet the intersection mobility target.

Adding the partial second eastbound left turn lane raises a potential weaving issue on SW Macadam Avenue. If a vehicles makes the eastbound left turn from the inner most left turn lane on SW Hood Avenue, and is destined for the South Waterfront District, the driver needs to weave into the right lane on SW Macadam Avenue to turn into the District. Based on existing count data, roughly half of the eastbound traffic on SW Hood Avenue is destined for the South Waterfront District and half is headed northbound on SW Macadam Avenue. Alternative 1 could be designed with a single eastbound left turn, and the partial second eastbound left turn lane could be phased in at a later date when capacity issues arise.

Table 1 provides the traffic operational results for Alternative 1 (HCM reports are included in the appendix).

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[16] *Portland Transportation System Plan*, Chapter 2g. City of Portland. 2007.

[17] The partial second eastbound left assumes a second eastbound left turn lane 75 feet long that enables an additional three to four vehicles to travel through the intersection each cycle.

Table 1: Alternative 1 Traffic Operations (Macadam-Bancroft Concept) AM Peak Hour Year 2035

Intersection		Intersection Control	Mobility Target	AM Peak Hour		
				Delay	LOS	V/C
1	Macadam Ave/Curry St	Signalized	0.85 v/c*	29.4	C	0.84
2	Macadam Ave/Gaines St	Unsignalized	0.99 v/c	Gaines is one-way eastbound		
3	Macadam Ave/Abernethy St	Unsignalized	0.99 v/c	29.9	A/D	0.37
4	Macadam Ave/Lowell St	Unsignalized	0.99 v/c	Lowell is one-way eastbound		
5	Macadam Ave/Bancroft St	Signalized	1.10 v/c	--	--	--
	With partial dual EBLs			74.3	E	1.10
	With single EBL			111.7	**F**	**1.19**
6	Macadam Ave/Hamilton Ct	Signalized	1.10 v/c	27.3	C	0.89
7	Moody Ave/Curry St	Unsignalized	0.99 v/c **	12.8	B/B	0.52
8	Moody Ave/Gaines St***	Unsignalized	0.99 v/c **	26.8	A/E	0.67
9	Moody Ave/Bancroft St	Unsignalized	0.99 v/c **	14.8	B/B	0.54

Bolded and Shaded indicates intersection exceeds mobility target

Two-Way Stop:
Delay = Delay of Worst Movement
LOS = Level of Service of Minor Street
v/c = Volume-to-Capacity Ratio of Worst Movement

Signalized:
Delay = Average Delay for Intersection
LOS = Level of Service for Intersection
v/c = Volume-to-Capacity Ratio for Intersection

* The mobility target can be increased to 0.90 if it is determined that queuing would not be an issue for the off-ramp (OHP)
**Preferred Operating Standard; Acceptable Operating Standard is 1.10 v/c
***Due to lane configuration, this unsignalized intersection was analyzed using the 2000 HCM methodology

Alternative 2 – Macadam-Bancroft Concept with Moody Extension

The following two sections discuss the assumptions and operational results for Alternative 2, the Macadam-Bancroft Concept with Moody Extension.

Assumptions

The project team incorporated these assumptions into the analysis for Alternative 2:

- Maintained the existing 110 second cycle length at all signalized intersections.
- At the SW Macadam Avenue/SW Bancroft Street intersection:
  - Prohibited eastbound left turn movement on red
  - Increased the total eastbound saturation flow rate by 30% to account for the option with the partial second eastbound left (a 75 foot long second left turn pocket). For the single eastbound left option, no saturation flow rate adjustments were made.
  - Maintained the existing pedestrian phases on the north and east legs
  - Operated eastbound and westbound lefts turn movement simultaneously
- At the SW Macadam Avenue/SW Hamilton Court intersection:
  - Maintained separate turn lanes for the westbound right and westbound left turn lane (volumes are nearly balanced)
  - Operated the pedestrian phase with the westbound movement (same as existing operations)
- At the SW Moody Avenue/SW Bancroft Street intersection:

- SW Moody Avenue extends from SW Hamilton Street and connects through to SW Bancroft Street, adding a leg to the intersection
- The intersection is stop controlled

Operational Results

In Alternative 2, the SW Macadam Avenue/SW Bancroft Street intersection performs better than in Alternative 1, but still needs the partial second eastbound left turn lane[18] to meet the mobility target.

Similar to Alternative 1, adding the partial second eastbound left turn lane raises a potential weaving issue on SW Macadam Avenue. If a vehicle makes the eastbound left turn from the inner most left turn lane on SW Hood Avenue, and is destined for the South Waterfront District, the driver needs to weave into the right lane on SW Macadam Avenue to turn into the District. Based on existing count data, roughly half of the eastbound traffic on SW Hood Avenue destined for the South Waterfront District and half is headed northbound on SW Macadam Avenue. Alternative 2 could be designed with a single eastbound left turn, and the partial second eastbound left turn lane could be phased in at a later date when capacity issues arise.

At the SW Macadam Avenue/SW Hamilton Court intersection a northbound right turn lane improves operations at that intersection from a v/c ratio of 1.02 to 0.90. Alternative 2 assumes that the pedestrian crossing is moved to the north leg of the intersection so that the additional roadway width created by the northbound right turn pocket does not impact the pedestrian crossing length or necessary phase time.

One interesting result of the Alternative 2 analysis is at the SW Macadam Avenue/SW Curry Street intersection. Compared to changing the one-way grid as in Alternative 1, maintaining the existing one-way street grid (keeping SW Curry Street eastbound only) actually results in a higher v/c ratio but a lower intersection delay. In Alternative 1, the v/c ratio was 0.84 with a delay of 29.4 seconds. In Alternative 2, the v/c increases to 0.88, but the delay is roughly half at 14.4 seconds. These results are due to changes in total traffic volumes flowing through the intersection and the number of phases the traffic signal needs. Maintaining the existing one-way grid in Alternative 2 allows for a two-phase signal operation, which results in less delay than a signal with more phases. Changing the one-way grid system as analyzed in Alternative 1 reduces the total traffic volume flowing through the SW Macadam Avenue/SW Curry Street intersection, with vehicles entering the district on SW Gaines Street, thus reducing the v/c ratio.

Although the v/c ratio at this intersection is above the mobility target, a queuing analysis provided in Table 9 (later in this memorandum) indicates that the vehicle queue does not exceed available storage. At this intersection, there is over a quarter-mile of available vehicle storage. The queueing analysis indicates that the vehicle queue will not exceed available storage and will not interfere with freeway operations, making a v/c ratio up to 0.90 acceptable.

At the SW Moody Avenue/SW Bancroft Street intersection the v/c ratio increases compared to alternative 1 (from 0.54 to 0.81) during the a.m. peak hour in year 2035. This v/c ratio assumes the southbound lanes are allocated as a shared southbound right/through lane and a southbound left turn lane. Operations at this intersection improve if the southbound lanes are allocated as a southbound right turn lane and a separate

[18] The partial second eastbound left assumes a second eastbound left turn lane 75 feet long that enables an additional three to four vehicles to travel through the intersection each cycle.

southbound through/left turn lane as proposed in the recommended alternative (see the "Recommended Alternative Analysis" section in this memorandum).

Table 2 provides the traffic operational results for Alternative 2 (HCM reports are included in the appendix).

Table 2: Alternative 2 Traffic Operations (Macadam-Bancroft Concept with Moody Extension) AM Peak Hour Year 2035

Intersection		Intersection Control	Mobility Target	AM Peak Hour		
				Delay	LOS	V/C
1	Macadam Ave/Curry St	Signalized	0.85 v/c*	14.4	B	**0.88**
2	Macadam Ave/Gaines St	Signalized	1.10 v/c	13.9	B	0.78
3	Macadam Ave/Abernethy St	Unsignalized	0.99 v/c	51.6	F	0.66
4	Macadam Ave/Thomas St	Unsignalized	0.99 v/c	36.9	E	0.13
5	Macadam Ave/Bancroft St	Signalized	1.10 v/c	--	--	--
	With partial dual EBLs			58.7	E	1.06
	With single EBL			103.3	F	**1.15**
6	Macadam Ave/Hamilton Ct	Signalized	1.10 v/c	--	--	--
	With a shared NBTH/RT			53.5	D	1.02
	With a separate NBRT lane			27.4	C	0.90
7	Moody Ave/Curry St	Unsignalized	0.99 v/c **	14.0	B/B	0.50
8	Moody Ave/Gaines St***	Unsignalized	0.99 v/c **	25.9	A/D	0.48
9	Moody Ave/Bancroft St	Unsignalized	0.99 v/c **	29.0	B/D	0.81
10	Moody Ave/Hamilton Ct	Unsignalized	0.99 v/c **	24.8	B/C	0.78

Bolded and Shaded indicates intersection exceeds mobility target

Two-Way Stop:	**Signalized:**
Delay = Delay of Worst Movement	Delay = Average Delay for Intersection
LOS = Level of Service of Minor Street	LOS = Level of Service for Intersection
v/c = Volume-to-Capacity Ratio of Worst Movement	v/c = Volume-to-Capacity Ratio for Intersection

* The mobility target can be increased to 0.90 if it is determined that queuing would not be an issue for the off-ramp (OHP)
**Preferred Operating Standard; Acceptable Operating Standard is 1.10 v/c
***Due to lane configuration, this unsignalized intersection was analyzed using the 2000 HCM methodology

Alternative 3 – Moody and Bond Extension

The following two sections discuss the assumptions and operational results for Alternative 3, the Moody and Bond Extension.

Assumptions

The project team incorporated the following assumptions into the analysis for Alternative 3:

- Maintained the existing 110 second cycle length at all signalized intersections
- At the SW Macadam Avenue/SW Bancroft Street intersection:
  - Prohibited the pedestrian crossing across SW Macadam Avenue
- At the SW Macadam Avenue/SW Hamilton Street intersection:
  - Adjusted saturation flow of the southbound left turn movement from SW Hood Avenue to account for the U-turns[19]
  - Assumed 400 feet of storage for the dual southbound left turn lanes (and U-turn movement) on SW Hood Avenue at SW Macadam Avenue/SW Hamilton Street
  - Operated the pedestrian phase (across SW Macadam Avenue) with the westbound movement
- At the SW Macadam Avenue/SW Hamilton Court intersection:
  - Operated the pedestrian phase across SW Macadam Avenue with the westbound movement (same as existing operations)

Operational Results

All of the study intersections, except SW Macadam Avenue/SW Curry Street, meet mobility targets. Similar to the discussion about this intersection in Alternative 2, it is possible that changing the one-way grid to match Alternative 1 could improve operations at that intersection. However, if queuing analysis indicates that the vehicle queue does not interfere with freeway operations, the v/c ratio of 0.87 is acceptable.

Table 3 provides the traffic operational results for Alternative 3 (HCM reports are included in the appendix).

[19] *Effects of Increased U-Turns at Intersections on Divided Facilities and Median Divided Versus Five Lane Undivided Benefits.* North Carolina State University. August 2004. Research conducted for the North Carolina Department of Transportation

Table 3: Alternative 3 Traffic Operations (Moody and Bond Extension – 2006 South Portal Recommended Alt) AM Peak Hour Year 2035

Intersection		Intersection Control	Mobility Target	AM Peak Hour		
				Delay	LOS	V/C
1	Macadam Ave/Curry St	Signalized	0.85 v/c*	18.4	B	**0.87**
2	Macadam Ave/Gaines St	Signalized	1.10 v/c	18.4	B	0.78
3	Macadam Ave/Abernethy St	Unsignalized	0.99 v/c	46.8	A/E	0.60
4	Macadam Ave/Thomas St	Unsignalized	0.99 v/c	26.3	A/D	0.09
5	Macadam Ave/Bancroft St	Signalized	1.10 v/c	6.1	A	0.57
6	Macadam Ave/Hamilton Ct	Signalized	1.10 v/c	9.2	A	0.76
7	Moody Ave/Curry St	Unsignalized	0.99 v/c **	13.9	B/B	0.50
8	Moody Ave/Gaines St***	Unsignalized	0.99 v/c **	6.4	A/C	0.44
9	Moody Ave/Bancroft St	Signalized	1.10 v/c	15.2	B	0.23
10	Moody Ave/Hamilton Ct	Unsignalized	0.99 v/c **	9.8	A/A	0.29
11	Macadam Ave/Hamilton St	Signalized	1.10 v/c	37.4	D	0.90
12	Moody Ave/Hamilton St	Signalized	1.10 v/c	28.0	C	0.50

Bolded and Shaded indicates intersection exceeds mobility target

Two-Way Stop:
Delay = Delay of Worst Movement
LOS = Level of Service of Minor Street
v/c = Volume-to-Capacity Ratio of Worst Movement

Signalized:
Delay = Average Delay for Intersection
LOS = Level of Service for Intersection
v/c = Volume-to-Capacity Ratio for Intersection

* The mobility target can be increased to 0.90 if it is determined that queuing would not be an issue for the off-ramp (OHP)
**Preferred Operating Standard; Acceptable Operating Standard is 1.10 v/c
***Due to lane configuration, this unsignalized intersection was analyzed using the 2000 HCM methodology

SECTION 6: EVALUATION CRITERIA AND ALTERNATIVES COMPARISON

Using the evaluation criteria documented in the "Project Goals and Evaluation Criteria" Memorandum,[20] the project team assessed each of the alternatives compared to the criteria. The evaluation criteria is shown in Table 4. These symbols are used to show the good, fair, and poor ratings:

Good	Fair	Poor
●	◒	○

[20] South Portal Partnership: Project Goals and Evaluation Criteria technical memorandum." Prepared for City of Portland by DKS Associates. January 28, 2015.

Table 4: Evaluation Criteria

Criteria	Measurement	Existing[3]	Alternative (Year 2035)			
		2014	No Build	1	2	3
Traffic operations are for the a.m. peak hour of the identified year				--	--	--
SW Macadam Avenue/SW Bancroft	Good: Meets mobility standard and well within vehicle operation capacity (v/c ≤ 0.90) Fair: Meets mobility standard, but near capacity (v/c > 0.90) Poor: Does not meet mobility standard	0.79	○ 1.32	○[1] 1.19	○[1] 1.15	● 0.57
SW Moody Avenue/SW Bancroft Avenue		0.67	○ 1.30	● 0.54	● 0.81	● 0.23
SW Macadam Avenue/SW Curry Street[4]		0.71	◒ 0.87	● 0.84	◒ 0.88	◒ 0.87
SW Macadam Avenue/SW Hamilton Court		0.72	● 0.88	● 0.89	●[2] 0.90	● 0.76
SW Macadam Avenue/SW Hamilton Street		n/a	n/a	n/a	n/a	● 0.90
Connectivity of internal district streets	Good: Improved accessibility Fair: Moderate accessibility opportunities Poor: Limited accessibility opportunities	n/a	○	○	◒	●
Geometric/Safety design of intersections on SW Macadam Avenue	Good: Significant safety improvement Fair: No significant safety improvement Poor: Decreases safety	n/a	◒	◒	◒	◒
Project costs	Good: Relatively inexpensive Fair: Moderately inexpensive Poor: Expensive (over $40 million)	n/a	◒	◒	●	○
ROW and property impacts	Good: Minimal or no impact Fair: Some impact Poor: Significant impact	n/a	●	◒	◒	○

Criteria	Measurement	Existing[3]	Alternative (Year 2035)			
		2014	No Build	1	2	3
Promotes multi-modal transportation system	Good: Provides improved multi-modal connection Fair: No changes to multi-modal connection Poor: Adverse changes to multi-modal connections	n/a	◒	◒	◒	◒
District access at South Portal	Good: Increases access points into district Fair: No change to access points into district Poor: Decreases access points into district	n/a	◒	○	●	●
Implementation Timeline	Good: Within 1-2 years Fair: Within 5 years Poor: More than 5 years	n/a	n/a	●	◒	○

[1]Assumes a single eastbound left turn lane. With a partial second left turn lane 75 feet in length, alternative 1 v/c = 1.10 and alternative 2 v/c = 1.06
[2]Assumes the addition of a northbound right turn lane
[3] Operations based on "permanent configuration" as noted in the Final Existing Conditions Memorandum
[4] Operational standard at this intersection is v/c < 0.85 unless queuing analysis shows there is no impact to freeway operations in which case the v/c ratio can increase to 0.90

SECTION 7: OTHER STREET IMPROVEMENT CONSIDERATIONS

In addition to the three main alternatives, the project team analyzed the impacts of two other street reconfigurations:

- SW Lowell Street Extension
- Changes to One-Way Street Grid

These reconfigurations could be adopted into any of the three alternatives. The following two sections discuss the impacts of these reconfigurations.

SW Lowell Street Extension

Extending and realigning SW Lowell Street would improve connectivity within the South Waterfront. This project would extend SW Lowell Street west from SW Moody Avenue to SW Macadam Avenue and vacate SW Thomas Street (as illustrated in Figure 9). The current portion of SW Lowell Street between SW Moody Avenue and SW Macadam Avenue is a private roadway that does not align with SW Lowell Street east of SW Moody Avenue.

The realignment would improve directness of travel for drivers originating from northbound SW Macadam Avenue, and bound for northbound SW Bond Avenue. With the existing alignment, drivers destined for SW Bond Avenue must travel out of direction, turning right on SW Thomas Avenue, right on SW Moody Avenue, then left onto SW Lowell Street (a signalized intersection) before turning left onto SW Bond Avenue. Because the

eastbound through movement from SW Hood Avenue into the South Waterfront is prohibited under all alternatives, SW Thomas Street becomes a key gateway into the district and traffic volumes using the currently circuitous route to SW Bond Avenue would increase significantly.

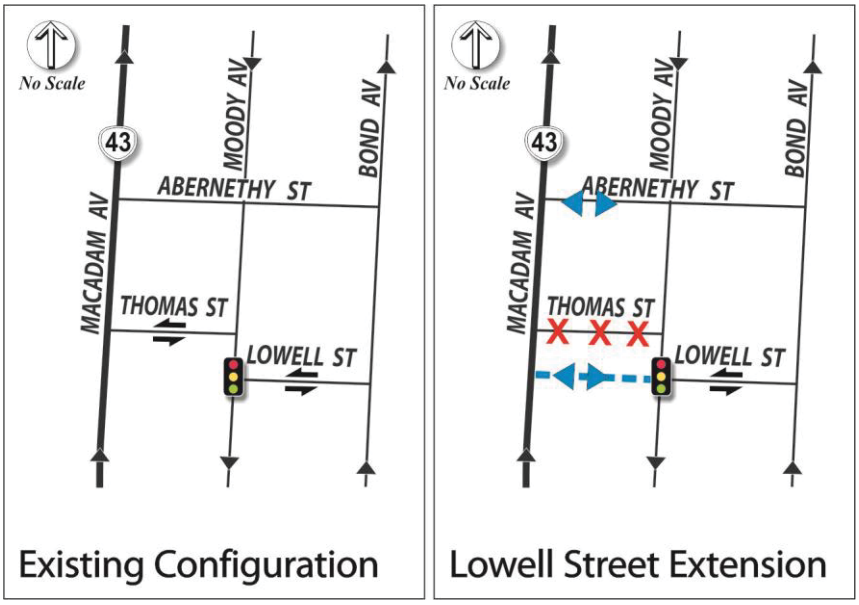


Figure 9: Lowell Street Extension

If SW Lowell Street is not realigned, a traffic signal would be desirable at the SW Moody Avenue/SW Thomas Street intersection to safely accommodate the weave created by vehicles turning right onto SW Moody Avenue and that then must quickly move to the left lane if they are headed to SW Bond Avenue. The traffic signal would also be desirable to avoid a southbound vehicle queue on SW Moody Avenue that extends from SW Lowell Street and blocks SW Thomas Street.

Using the traffic volumes generated for Alternative 2, the project team compared the operations of maintaining the existing alignment (and adding a traffic signal at SW Thomas Avenue/SW Moody Avenue) to realigning the segment of SW Lowell Street between SW Macadam Avenue and SW Moody Avenue. The comparison is presented in Table 5.

Table 5: Benefits of Realigning Lowell Street

Comparison Element	Maintain Existing Alignment	Realign SW Lowell Street
Number of vehicles that require out of direction travel during a.m. peak hour (year 2035)	300	0
Number of turns required for a vehicle destined for northbound on SW Bond Avenue from SW Macadam Avenue	4 (right, right, left, left)	2 (right, left)

Changes to the One-Way Street Grid

Alternative 1 evaluated the effects of changing the one-way (eastbound-westbound) street grid north of SW Bancroft Street. Table 6 shows these changes to the one-way grid.

Table 6: One-Way (East-West) Street Grid between SW Macadam Avenue and SW Moody Avenue

Street	Existing Travel (Alternative 2)	Modified Grid (Alternative 1)
SW Thomas Street	Two-way	Vacated
SW Lowell Street	Private Street (does not exist)	One-way eastbound (realigned)
SW Abernethy Street	Two-way[1]	One-way westbound
SW Gaines Street	One-way westbound	One-way eastbound
SW Curry Street	One-way eastbound	One-way westbound
[1] Access from SW Macadam Avenue is currently restricted due to ongoing construction		

Based on the analysis, the Modified Grid results in the following differences:

- **Increases delay, but decreases v/c ratio at the SW Macadam Avenue/SW Curry Street intersection**: Modifying the one-way grid system as analyzed in Alternative 1 reduces the v/c ratio at this intersection but increases the average delay per vehicle. These results are due to changes in total traffic volumes flowing through the intersection and the number of phases the traffic signal needs. Maintaining the existing one-way grid in Alternative 2 allows for a two-phase signal operation, which results in less delay than a signal with more phases. Changing the one-way grid system as analyzed in Alternative 1 reduces the total traffic volume flowing through the SW Macadam Avenue/SW Curry Street intersection, with vehicles entering the district on SW Gaines Street, thus reducing the v/c ratio.
- **May discourage right turns from the I-5 off-ramp lane into the district**: Changing SW Curry Street to one-way westbound may discourage drivers from the I-5 off-ramp from making a right turn into the district. Although that right turn is currently prohibited, staff from the City of Portland indicated that occasionally drivers still make that movement. If SW Curry Street is converted to a one-way westbound, the consequences of a driver attempting to turn right from the I-5 off-ramp would be even more severe than with the current one-way eastbound designation.
- **Eliminates the need for a traffic signal at SW Macadam Avenue/SW Gaines Street**: Changing SW Gaines Street to one-way eastbound eliminates the need for a traffic signal at this intersection. The addition of a northbound right turn lane could improve operations by moving the slower right turning vehicles out of the through travel lanes. The project team will explore this option further during the queuing analysis if the Modified Grid is an element of the preferred alternative.

SECTION 8: INITIAL SCREENING CONCLUSIONS

Based on traffic operation analysis, Alternatives 2 and 3 best meet the jurisdictional mobility standards for the South Portal intersections, and both add a new connection to the district by extending SW Moody Avenue and

connecting to either SW Hamilton Court or SW Hamilton Street. Alternative 1 is right at the mobility target of 1.10 at SW Macadam Avenue/SW Bancroft Street (with the partial second eastbound left), and does not add a new access to the district.

Cost-wise, Alternatives 1 and 2 are significantly less than Alternative 3. Alternative 2 will require some right-of-way acquisition to extend SW Moody Avenue to SW Hamilton Court. However, Alternative 3 requires not only the SW Moody Avenue extension, but also realigning SW Hood Avenue and extending SW Bond Avenue. The estimated cost of Alternative 3 is $50 million[21] (in 2006 dollars).

SECTION 9: OVERVIEW OF THE RECOMMENDED ALTERNATIVE

Future No Build analysis reveals that traffic operations at the SW Macadam Avenue/SW Bancroft Street intersection are significantly over capacity by year 2035 with a v/c ratio that does not meet mobility standards. Reducing the number of signal phases at this intersection and prohibiting the eastbound through movement (SW Hood Avenue to SW Bancroft Avenue) into the district, offers significant benefit to vehicle capacity that allows the intersection to meet mobility standards for a fraction of the cost of Alternative 3. Pursuing this improvement at SW Macadam Avenue/SW Bancroft Street (as in Alternatives 1 and 2) makes it necessary to provide a fully-improved street providing direct ingress to South Waterfront north of and in close proximity to SW Bancroft St. For this reason, we recommend including a SW Lowell Street Extension (between SW Macadam Avenue and SW Moody Avenue) as part of the recommended alternative.

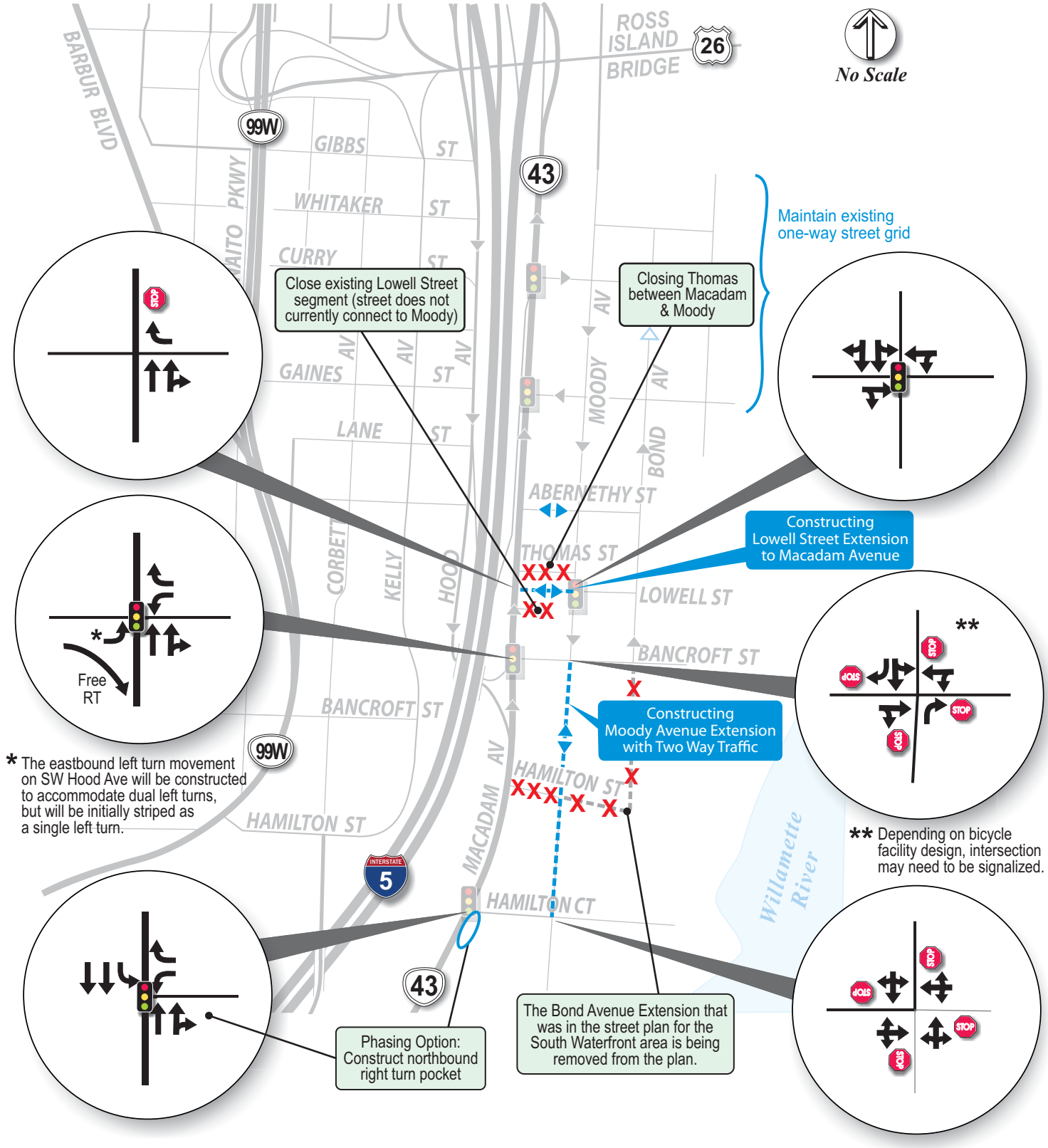
Extending SW Moody Avenue south of SW Bancroft Street to SW Hamilton Court as a two-way street provides additional capacity benefit to the SW Macadam Avenue/SW Bancroft Street intersection, providing an additional access point to the district and much needed circulation between properties north and south of SW Bancroft Street. A two-way SW Moody Avenue extension eliminates the immediate need for a SW Bond Street extension south of SW Bancroft Street. It also provides the vitally important role to establish legal street frontages, new public water mains and fire hydrants to developing properties between SW Bancroft Street and SW Hamilton Court, while also knitting together the portions of South Waterfront District currently split by SW Bancroft Street where the public right-of-way ends.

The recommended alternative includes the following elements and is illustrated in Figure 10:

- Alternative 2 at the SW Macadam Avenue/SW Bancroft Street intersection, constructed to accommodate the “partial” second eastbound left turn lane with a 75 foot long pocket on the SW Hood Avenue approach to SW Macadam Avenue, but initially striped as a single left turn lane.
- Extend SW Lowell Street from SW Moody Avenue to SW Macadam Avenue, and modify the existing signalized intersection at SW Moody Avenue/SW Lowell Street.
- Extend SW Moody Avenue south of SW Bancroft Street as a two-way street that connects to SW Hamilton Court.

[21] South Waterfront South Portal. Tables 9 and 10. Prepared by Kittelson and Associates. September 2006.

- Construct the southbound approach at the SW Moody Avenue/SW Bancroft Street intersection as a southbound right turn lane and shared southbound through/left turn lane. Note that depending on bicycle facility design, this intersection may need to be signalized (see "Section 12" in this memorandum for more information).
- Maintain the existing one-way street grid for east-west streets between SW Bancroft Street and SW Curry Street.
- Close SW Thomas Street between SW Macadam Avenue and SW Moody Avenue (the SW Lowell Street extension will replace it).
- Close the partial segment of SW Lowell Street that connects to SW Macadam Avenue, but does not connect through to SW Moody Avenue.
- Construct a northbound right turn lane at the SW Macadam Avenue/SW Hamilton Court intersection. This right turn lane could be phased in after completion of the Lowell Street and Moody Avenue extensions. Without the right turn lane the intersection is over capacity (v/c ratio of 1.02) yet meets the mobility target (v/c ratio of 1.10 or less). Constructing a right turn lane will improve operations at the intersection to v/c ratios of 0.90 and 0.80 during the future year a.m. and p.m. peak hours respectively.
- Remove the SW Bond Avenue extension from the South Waterfront Street Plan.



LEGEND

- Existing One-Way Street
- Proposed Roadway Directionality
- Proposed Roadway
- Remove Roadway
- Lane Configuration
- Stop Sign
- Signalized Study Intersection
- Planned Roadway to be Removed from Future Street Plan

DKS

Figure **10**

Recommended Alternative:
Macadam-Bancroft Concept
with Moody & Lowell Extensions

SECTION 10: RECOMMENDED ALTERNATIVE ANALYSIS

The project design team completed further analysis on the recommended alternative. This section of the memorandum describes the peak hour traffic volume development for the recommended alternative in year 2035, as well as the traffic operations and vehicle queuing results for both the a.m. and p.m. peak hours in year 2035.

Traffic Volumes – Recommended Alternative

Previously, the project team developed a.m. peak hour traffic volumes for year 2035 for each of the three alternatives. For the recommended alternative, the a.m. peak hour traffic volumes developed for Alternative 2 were adjusted to reflect the Lowell Street extension.

Developing p.m. peak hour volumes for the recommended alternative in year 2035 used the same methodology as the a.m. peak hour volumes as described in the "Traffic Volumes" section of this memorandum, with the following amendments:

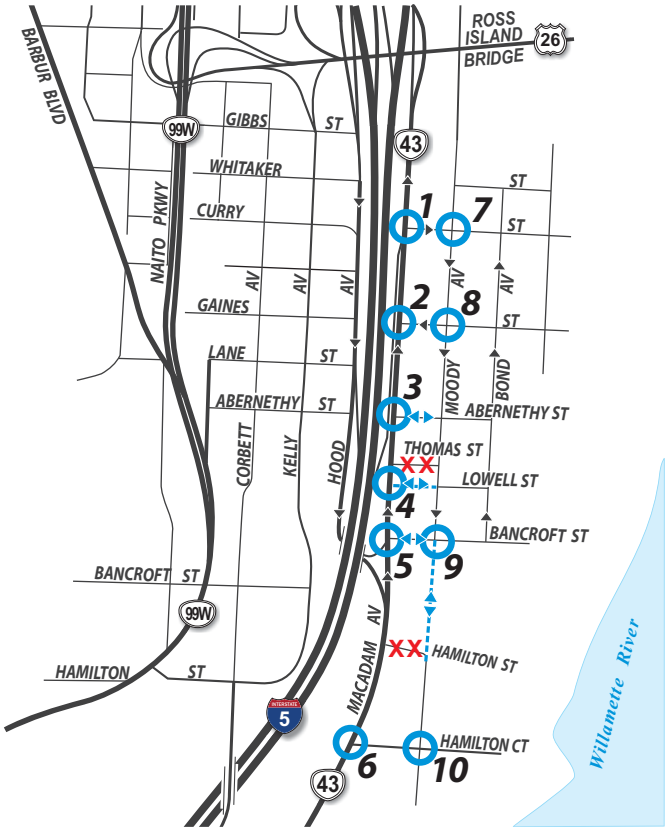
- City staff provided additional model plots for the recommended alternative. [22] These included volume plots, which show volume on all network links, volume-difference plots, which show how traffic volumes and patterns for the 2035 recommended alternative differ from the 2035 No Build condition.
- In reviewing base year traffic counts for this project and comparing to historical traffic counts along SW Macadam Avenue, it appears likely that 2014 traffic volumes are low due to Sellwood Bridge construction. For forecasting purposes, the project team increased the base northbound and southbound volumes on Macadam Avenue to reflect likely conditions after Sellwood Bridge construction is complete. PM peak hour volumes were increased by 50 vehicles northbound and 150 vehicles southbound.

The 2035 a.m. and p.m. peak hour traffic volumes for the recommended alternative are shown in Figure 11.

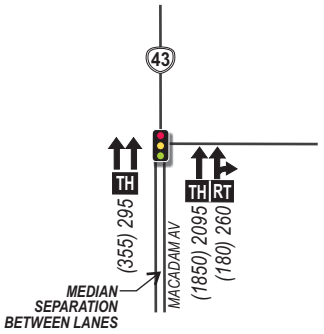
[22] Model plots provided by Ningsheng Zhou, City of Portland, on December 23, 2014 and January 14, 2015.

Key Map

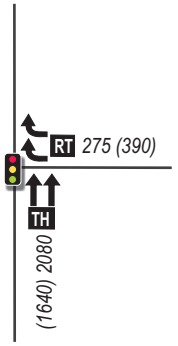
No Scale



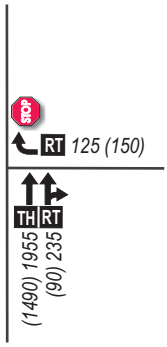
1. Macadam Ave. & Curry St.



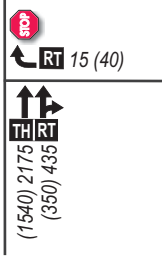
2. Macadam Ave. & Gaines St.



3. Macadam Ave. & Abernethy St.

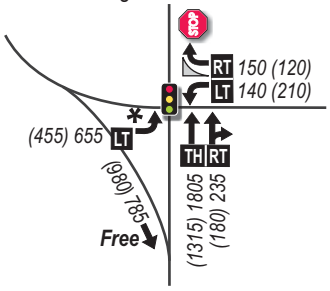


4. Macadam Ave. & Lowell St.
(with Lowell St. extension)

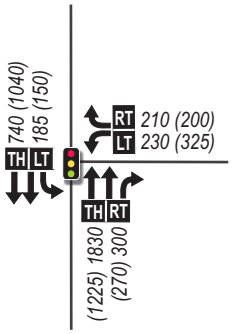


5. Macadam Ave. & Bancroft St.

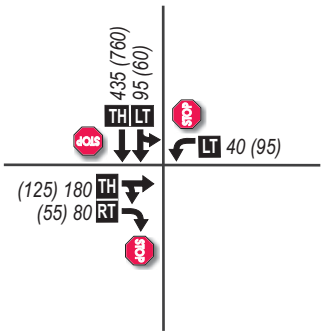
* Analyzed with both a single left turn lane and a partial left turn lane 75 feet in length.



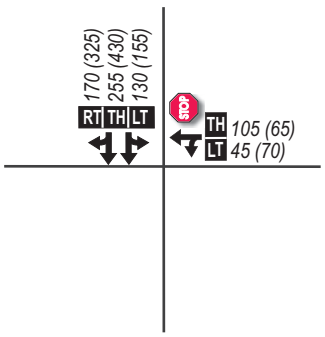
6. Macadam Ave. & Hamilton Ct.



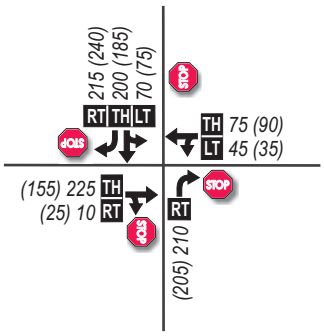
7. Moody Ave. & Curry St.



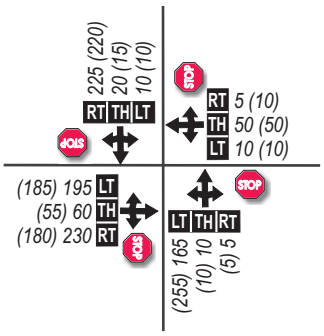
8. Moody Ave. & Gaines St.



9. Moody Ave. & Bancroft St.



10. Moody Ave. & Hamilton Ct.



LEGEND

- # - Study Intersection
- Proposed Roadway Directionality
- Existing Roadway Directionality
- Proposed Roadway
- X - Remove Roadway
- Lane Configuration
- AM (PM) - Peak Hour Traffic Volumes
- Traffic Signal
- STOP - Stop Sign
- LT TH RT - Volume Turn Movement (Left Thru Right)

DKS

Figure 11

2035 Future AM/PM Peak Hour Traffic Volumes Recommended Alternative

Intersection Operations for the Recommended Alternative – Year 2035

During the a.m. peak hour, intersection operation results are almost identical as analyzed under Alternative 2. All the intersections meet the target mobility standard for the future analysis year as shown in Table 7 (assuming a partial second eastbound left turn at the SW Macadam Avenue/SW Bancroft Street intersection). Based on a vehicle queuing analysis, which is discussed in the following section of this memorandum, the SW Macadam Avenue/SW Curry Street intersection meets the requirement for an increased v/c mobility target of 0.90[23], thereby meeting the mobility target.

Intersection operation results for the 2035 a.m. peak hour are shown in Table 7 for the recommended alternative. Highway Capacity Manual reports for the intersection operations are included in the Appendix.

Note that if a partial second eastbound left turn lane at SW Macadam Avenue/SW Bancroft Street is omitted from the alternative, operations at that intersection increase to a v/c ratio of 1.15 during the a.m. peak hour and will not meet the mobility target.

During the 2035 p.m. peak hour traffic operations at all study area intersections also meet the mobility targets. Due to commuter patterns through the study area, the traffic volumes at most of the intersections are lower during the p.m. peak hour than the a.m. peak hour. The two exceptions are SW Moody Avenue/SW Curry Street and SW Moody Avenue/SW Gaines Street intersections. SW Moody Avenue is one-way southbound, so during the p.m. peak hour volumes increase on SW Moody Avenue with traffic exiting the district.

Intersection operation results for the 2035 p.m. peak hour are shown in Table 8 for the recommended alternative. Highway Capacity Manual reports for the intersection operations are included in the Appendix.

[23] Oregon Highway Plan, Policy 1F Revisions. Adopted December 21, 2011.

Table 7: AM Peak Hour Intersection Operations – Year 2035 Recommended Alternative

Intersection		Intersection Control	Mobility Target	AM Peak Hour		
				Delay	LOS	V/C
1	Macadam Ave/Curry St	Signalized	0.85 v/c*	14.4	B	0.88
2	Macadam Ave/Gaines St	Signalized	1.10 v/c	13.9	B	0.78
3	Macadam Ave/Abernethy St	Unsignalized	0.99 v/c	55.6	F	0.68
4	Macadam Ave/Lowell Street (Lowell Street extension)	Unsignalized	0.99 v/c	36.9	E	0.13
5	Macadam Ave/Bancroft St	Signalized	1.10 v/c	--	--	--
	Partial 2nd EB left turn lane			61.7	E	1.06
	Single EB left turn lane			91.9	F	1.15
6	Macadam Ave/Hamilton Ct (with a NBRT turn lane)	Signalized	1.10 v/c	27.3	C	0.90
6a	Macadam Ave/Hamilton Ct (without a NBRT turn lane)	Signalized	1.10 v/c	53.5	D	1.02
7	Moody Ave/Curry St	Unsignalized	0.99 v/c **	13.8	B/B	0.50
8	Moody Ave/Gaines St***	Unsignalized	0.99 v/c **	25.9	A/D	0.48
9	Moody Ave/Bancroft St	Unsignalized	0.99 v/c **	17.8	B/C	0.58
10	Moody Ave/Hamilton Ct	Unsignalized	0.99 v/c **	23.2	B/C	0.76
11	Moody Ave/Lowell Street (Lowell Street extension)	Signalized	1.10 v/c	7.2	A	0.56

Bolded and Shaded indicates intersection exceeds mobility target

Two-Way Stop:
Delay = Delay of Worst Movement
LOS = Level of Service of Minor Street
v/c = Volume-to-Capacity Ratio of Worst Movement

Signalized:
Delay = Average Delay for Intersection
LOS = Level of Service for Intersection
v/c = Volume-to-Capacity Ratio for Intersection

* The mobility target can be increased to 0.90 if it is determined that queuing would not be an issue for the off-ramp (per OHP Policy 1F)
**Preferred Operating Standard; Acceptable Operating Standard is 1.10 v/c
***Due to lane configuration, this unsignalized intersection was analyzed using the 2000 HCM methodology

Table 8: PM Peak Hour Intersection Operations – Year 2035 Recommended Alternative

Intersection		Intersection Control	Mobility Target	PM Peak Hour		
				Delay	LOS	V/C
1	Macadam Ave/Curry St	Signalized	0.85 v/c*	13.7	B	0.83
2	Macadam Ave/Gaines St	Signalized	1.10 v/c	15.0	B	0.73
3	Macadam Ave/Abernethy St	Unsignalized	0.99 v/c	36.0	E	0.61
4	Macadam Ave/Lowell Street (Lowell Street extension)	Unsignalized	0.99 v/c	26.2	D	0.21
5	Macadam Ave/Bancroft St	Signalized	1.10 v/c	--	--	--
	Partial 2nd EB left turn lane			18.2	B	0.79
	Single EB left turn lane			23.9	C	0.87
6	Macadam Ave/Hamilton Ct (with a NBRT turn lane)	Signalized	1.10 v/c	23.8	C	0.80
7	Moody Ave/Curry St	Unsignalized	0.99 v/c **	31.6	B/D	0.85
8	Moody Ave/Gaines St***	Unsignalized	0.99 v/c **	49.7	A/E	0.67
9	Moody Ave/Bancroft St	Unsignalized	0.99 v/c **	14.8	B/B	0.50
10	Moody Ave/Hamilton Ct	Unsignalized	0.99 v/c **	20.6	B/C	0.71
11	Moody Ave/Lowell Street (Lowell Street extension)	Signalized	1.10 v/c	7.4	A	0.54

Bolded and Shaded indicates intersection exceeds mobility target

Two-Way Stop:
Delay = Delay of Worst Movement
LOS = Level of Service of Minor Street
v/c = Volume-to-Capacity Ratio of Worst Movement

Signalized:
Delay = Average Delay for Intersection
LOS = Level of Service for Intersection
v/c = Volume-to-Capacity Ratio for Intersection

* The mobility target can be increased to 0.90 if it is determined that queuing would not be an issue for the off-ramp (per OHP Policy 1F)
**Preferred Operating Standard; Acceptable Operating Standard is 1.10 v/c
***Due to lane configuration, this unsignalized intersection was analyzed using the 2000 HCM methodology

Vehicle Queuing

The project team performed vehicle queuing analysis at four key project intersections during both the a.m. and p.m. peak hour operations in future year 2035:

- SW Macadam Avenue/SW Curry Street – for the I-5 off ramp
- SW Macadam Avenue/SW Bancroft Street – all movements
- SW Moody Avenue/SW Bancroft Street – all movements (a stop controlled intersection)
- SW Moody Avenue/SW Lowell Street – for the eastbound movement

SimTraffic 8 was used to estimate the 95th percentile queues following the ODOT Analysis Procedure Manual methodology[24]. The SimTraffic models were calibrated to match existing a.m. and p.m. peak hour traffic conditions[25].

The 50th percentile and 95th percentile vehicle queues are summarized in Table 9 and included in the Appendix. The vehicle queues are rounded to the nearest 25-foot increment. Additionally, the summary table includes the available storage lengths for each movement. The storage length is the storage pocket length for turn lanes, and is the distance to the next intersection for through movements.

Vehicle queues tend to be longer during the a.m. peak hour, which correlates to the higher volumes during the a.m. peak hour.

For the I-5 off ramp, the vehicles queues were well within the available storage area, which indicate the mobility target at the SW Macadam Avenue/SW Curry Street intersection becomes a v/c ratio of 0.90 (instead of 0.85) according to the Oregon Highway Plan. With the increased mobility target, that intersection meets standards for future year operations during the a.m. and p.m. peak hours (see Table 7 and Table 8).

The longest vehicle queues occur at the SW Macadam Avenue/SW Bancroft Street intersection in the northbound and eastbound directions. During the 2035 a.m. peak hour this intersection is over capacity with a v/c ratio of 1.06 (assuming a partial second eastbound left turn lane), and specifically the northbound and eastbound approaches are over capacity with approach v/c ratios of 1.08 and 1.10 respectively. When an intersection and in particular an approach is over capacity, significant vehicle queuing can result. In this case, during the a.m. peak hour the 50th and 95th percentile northbound vehicle queues both stretch beyond the adjacent signalized intersection at SW Hamilton Court, and the 50th and 95th percentile eastbound vehicle queues on SW Hood Avenue reach beyond the gore point to the I-5 entrance ramp (approximately 1,450 feet away from SW Macadam Avenue). During the p.m. peak hour, those vehicles queues generally remain within the available storage area with the exception of the 95th percentile northbound vehicle queue also extends beyond the Hamilton Court intersection.

Although the recommended alternative results in vehicle queuing at the SW Macadam Avenue/SW Bancroft Street intersection that exceeds available storage for the northbound and eastbound approaches, the vehicle queues would be significantly greater under No Build conditions based on the higher v/c ratio under No Build conditions.

At the SW Moody Avenue/SW Bancroft Street intersection no vehicle queues exceed available storage. The southbound lanes will be constructed as a southbound right turn lane and a shared southbound through/left turn lane. This lane allocation balances the southbound traffic volume, and allows vehicles continuing south on the new Moody Avenue extension to do so without being blocked by vehicles waiting to turn right onto SW Bancroft Street.

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[24] *Analysis Procedure Manual,* Oregon Department of Transportation, Transportation Planning Analysis Unit. April 2006.
[25] Existing a.m. traffic operations were observed on December 17, 2014 from 7:00 a.m. to 9:00 a.m., existing p.m. peak hour traffic operations were observed on January 15, 2015.

Table 9: Vehicle Queuing Results – Recommended Alternative Year 2035

Intersection	Direction	Movement	Available Storage (ft)	AM Peak Hour Queue Length (ft)		PM Peak Hour Queue Length (ft)	
				50th Percentile	95th Percentile	50th Percentile	95th Percentile
Macadam Ave/Curry St	NB (from I-5)	TH	1,800	125	200	150	225
Macadam Ave/Bancroft St (with partial second EB left)	NB	TH/RT	1,025	**>1,500***	**>2,000***	900	**>2,000**
	EB	LT	1,450**	**>1,450***	**>2,000***	275	425
	WB	LT	180	150	**250**	150	**225**
		RT	100	125	**175**	100	**175**
Moody Ave/Bancroft St	SB	RT	270***	75	125	75	175
		TH/LT	270***	75	125	75	150
	EB	TH/RT	175	75	125	75	125
	WB	TH/LT	200	50	100	75	125
	NB	RT	1,150	50	100	50	100
Moody Ave/Lowell St	EB	TH/RT	200	100	150	100	150

Bolded and Shaded indicates queuing exceeds available storage
*During the a.m. peak hour this intersection has a v/c ratio greater than 1.0, and specifically the EB and NB movements both have v/c ratio greater than 1.0. This indicates the intersection is over capacity and significant vehicle queuing is likely. When an intersection is over capacity, the vehicle queue lengths reported by the simulation software vary. The values shown in table are intended to reveal that the vehicle queue is longer than the available storage, but the exact length of the vehicle queue cannot be defined with a high degree of accuracy.
**Distance from the intersection to the gore area of the I-5 entrance ramp
***Assumes Lowell is realigned to the north. Without the realignment the current distance to Lowell is 210 feet.

SECTION 11: DUAL WESTBOUND LEFT ANALYSIS AT MACADAM/BANCROFT

Improving access to and from the South Waterfront district is a primary goal of the South Portal project. To ensure that the recommended alternative provided the optimal exodus, the project team tested the operations of dual westbound lefts from SW Bancroft Street to SW Macadam Avenue. In the interest of fully understanding the effects of dual westbound lefts and how the Moody Avenue extension could impact the results, the project team tested the intersection with and without the Moody Avenue extension, in case the extension cannot be constructed concurrently with the other improvements.

Assumptions

The following assumptions were used to test the dual westbound left turns:

- Dual westbound lefts and single eastbound left at SW Macadam Avenue/SW Bancroft Street
- Maintain two-way traffic on SW Bancroft Street between SW Macadam Avenue and SW Moody Avenue
- Maintain northbound right onto SW Bancroft Street (requires some ROW acquisition and other modifications)

- Install a traffic signal for the movement from SW Hood Avenue to southbound on SW Macadam Avenue (currently a free flow movement)
- Vehicle volumes exiting the district making a westbound left are approximately 240 and 310 (am and pm peak respectively – assumes reallocating about 100 vehicles from SW Hamilton Court to SW Bancroft Street with the dual westbound lefts)

Figure 12 shows the traffic volumes and lane geometry used for this analysis.

Conclusions

Adding dual westbound lefts offers minimal capacity improvement to the intersection as documented in Table 10. One reason is that the signal phasing for the recommended alternative changes to a two phase signal in the future, allowing the westbound phase to stay green during the eastbound phase, instead of the split phase timing it currently operates[26]. Changing the signal phasing significantly increases the amount of green time for the westbound movement. Additionally, the eastbound traffic volumes are much higher than the westbound volumes so the eastbound traffic will hold the phase in green even if the westbound traffic gaps out[27].

Another factor to consider is that with the dual westbound lefts, a second traffic signal will be necessary where SW Hood Avenue and SW Macadam Avenue join. The SW Hood Avenue movement to SW Macadam Avenue is currently a free movement (with a lane that continues onto SW Macadam Avenue) and carries approximately three to four times the traffic volume as the westbound left movement in question. If a traffic signal is installed at the SW Hood Avenue/SW Macadam Avenue junction, it would need to be timed in coordination with the signal at SW Macadam Avenue/SW Bancroft Street. Adding this signal actually decreases the amount of green time available to the westbound left movement due to coordinating and balancing capacity with the SW Hood Avenue traffic, and increases delay for the traffic on SW Hood Avenue.

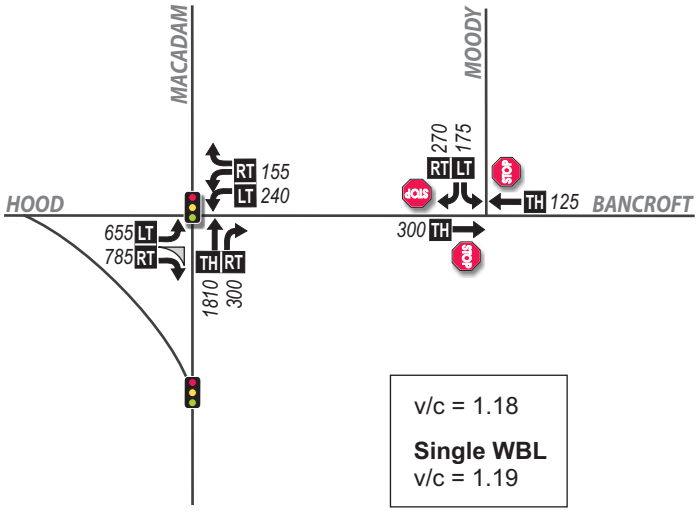
Table 10: Dual Westbound Left Capacity Results

	AM 2035		PM 2035	
	Single WBL	Dual WBLs	Single WBL	Dual WBLs
WITHOUT Moody Avenue Extension				
Bancroft/Macadam	1.19	1.18	0.91	0.89
New signal – SB Hood/Macadam	n/a	0.70	n/a	0.84
WITH Moody Avenue Extension				
Bancroft/Macadam	1.15	1.15	0.87	0.86
New signal – SB Hood/Macadam	n/a	0.68	n/a	0.84

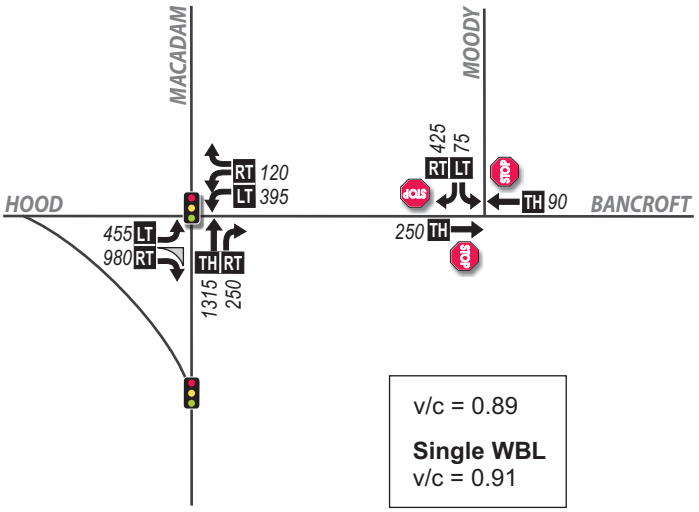
[26] Split phase timing is when opposing approaches are timed consecutively instead of concurrently.
[27] A gap out is when a signal phase terminates due to lake of vehicle calls within a specific time period.

WITHOUT Moody Extension

AM 2035

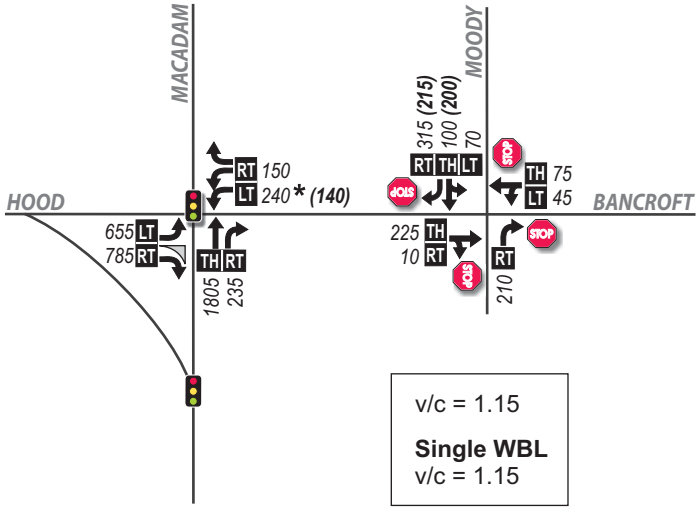


PM 2035

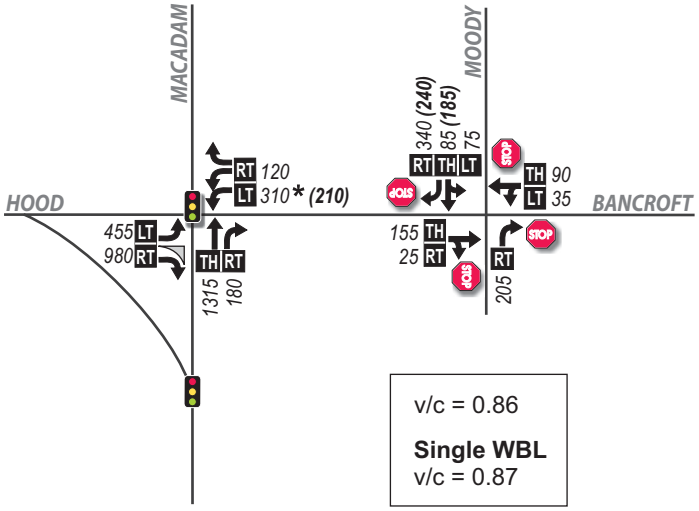


WITH Moody Extension - Dual Left Vols

AM 2035



PM 2035



* Assumes a shift at 100 vehicles using the WBL at Hamilton/Macadam to the dual WBL Bancroft/Macadam

LEGEND

- Traffic Signal
- STOP - Stop Sign
- ← - Lane Configuration
- LT TH RT (Left•Thru•Right) - Volume Turn Movement
- 0000 - Traffic Volumes
- (0000) - Volume for Single WBL Analysis

DKS

No Scale

Figure 12

2035 Traffic Volumes for Dual Westbound Left Traffic Analysis

SECTION 12: ADDITIONAL ANALYSIS AT MOODY/BANCROFT AND MOODY EXTENSION

Additional analysis was completed at the SW Moody Avenue/SW Bancroft Street intersection to determine whether all-way stop control is appropriate in the future. It is currently all-way stop controlled and the recommended alternative continues to identify the intersection as stop control, even with the Moody Avenue extension in place. Based on mobility criteria, the all-way stop controlled intersection meets future mobility requirements, however, there are other factors this memorandum explores that could indicate the intersection needs a traffic signal to operate sufficiently in the future.

The following three sub-sections evaluate three other elements that could indicate a traffic signal is preferred at this intersection: signal warrant analysis, eastbound vehicle queueing, and bicycle operations. In summary, the eastbound vehicle queuing and signal warrant analysis do not indicate a traffic signal is necessary, however, depending on how the intersection is designed for bicycles, a traffic signal may be necessary to facilitate bicycle operations through the intersection.

Signal Warrant Analysis

The MUTCD[28] provides nine signal warrants to analyze whether a traffic signal may be appropriate at a given location. A signal warrant analysis can be used as one way to justify the installation of a traffic signal, but should not dictate the decision. Ultimately, the decision needs to be based on several factors including engineering judgement.

The project team evaluated the SW Moody Avenue/SW Bancroft Street intersection to determine whether future year traffic volumes meet criteria for any of the traffic signal warrants. Two signal warrants were evaluated: peak hour and eight-hour warrants.

The future year 2035 traffic volumes were applied to the peak hour warrant criteria, and the warrant was not met.

For the eight-hour vehicle volume warrant, the future year peak hours were scaled by a factor of 65%. Twenty-four hour tube counts were taken on SW Macadam Avenue, and the 65% factor is consistent with the existing relationship between peak hour and eighth highest hour of vehicle volumes. The intersection was evaluated both with and without the Moody extension, and in each case the highest peak hour (a.m. or p.m.) was scaled by 65%.

Both with and without the Moody Avenue extension in place, the vehicle volumes do not meet the eight-hour signal warrant conditions. There are several combinations of conditions to consider with the eight-hour vehicle volume traffic signal warrant. In both scenarios (with and without the Moody Avenue extension) the minor street traffic volume was above the warrant threshold, however, the major street was always below the volume threshold, which indicates the intersection does not meet the eight-hour vehicle volume signal warrant.

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[28] Manual for Uniform Traffic Control Devices (MUTCD), 2009 Edition. Chapter 4.

Eastbound Vehicle Queuing at Moody/Bancroft

If eastbound vehicle queues spillback from the SW Moody Avenue/SW Bancroft Street intersection to SW Macadam Avenue, that could indicate the need for a traffic signal at the SW Moody Avenue/SW Bancroft Street intersection. The analysis compared two scenarios, with and without the Moody Avenue extension, in case the Moody Avenue extension cannot be constructed at the same time as the other improvements.

SimTraffic 8 was used to estimate the 95th percentile queues following the ODOT Analysis Procedure Manual methodology[29].

The 50th percentile and 95th percentile vehicle queues are summarized in Table 11 and included in the Appendix. The vehicle queues are rounded to the nearest 25-foot increment. Additionally, the summary table includes the available storage lengths for each movement. The storage length is the storage pocket length for turn lanes, and is the distance to the next intersection for through movements.

Assumptions

Both configurations assume:

- All-way stop control at the SW Moody Avenue/SW Bancroft Street intersection
- Single eastbound and westbound lefts at the SW Macadam Avenue/SW Bancroft Street intersection

Without the Moody Avenue extension in place we assumed the following:

- Southbound approach on Moody is two lanes (right turn lane and left turn lane)
- Vehicle volumes represent those developed for Alternative 1 (without Moody extension) as shown in Figure 14.

With the Moody Avenue extension in place (between SW Bancroft Street and SW Hamilton Court) we assumed the following:

- Southbound approach on Moody is two lanes (right turn lane and shared through/left turn lane)
- Vehicle volumes represent those developed for the recommended alternative as shown in Figure 13.

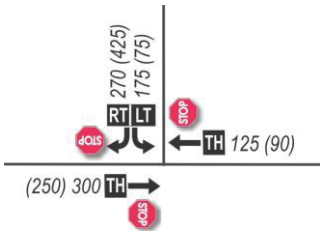


Figure 14: AM and (PM) Peak Hour Volumes in Year 2035 at Moody/Bancroft without the Moody Ave extension

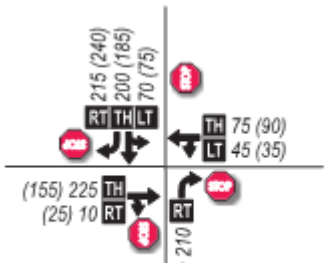


Figure 13: AM and (PM) Peak Hour Volumes in Year 2035 at Moody/Bancroft WITH the Moody Ave extension

[29] *Analysis Procedure Manual,* Oregon Department of Transportation, Transportation Planning Analysis Unit. April 2006.

Conclusions

Eastbound queuing at the SW Moody Avenue/SW Bancroft Street intersection does not spillback to SW Macadam Avenue in any of the scenarios, as shown in Table 11. The eastbound vehicle queues are slightly longer in the scenario without the Moody Avenue extension. In that scenario eastbound traffic volumes on SW Bancroft Street are higher than with the Moody Avenue extension, since SW Hamilton Court does not provide access to the district in that scenario.

Aside from the eastbound queuing question, Table 11 illustrates the critical role the Moody Avenue extension plays. Without the Moody Avenue extension the southbound vehicle queuing at this intersection exceeds available storage and spills back through the traffic signal at SW Moody Avenue/SW Lowell Street. Constructing the Moody Avenue extension helps distribute traffic exiting the district between SW Bancroft Street and SW Hamilton Court. With the Moody Avenue extension in place, roughly half of the vehicles that previously made the southbound right movement, shift to a southbound through movement in a separate lane. The southbound vehicle queueing analysis for the recommended alternative (which includes the Moody Avenue extension) indicates shorter southbound queues that do not exceed available storage.

Table 11: SW Moody Ave/SW Bancroft Street Vehicle Queuing

	Movement	Available Storage (ft)	Vehicle Queue Lengths (ft)	
			50th	95th
WITHOUT Moody Avenue Extension				
AM 2035	Eastbound	175	100	150
	Southbound Right*	270	150	**400**
PM 2035	Eastbound	175	100	150
	Southbound Right*	270	**275**	**450**
WITH Moody Avenue Extension				
AM 2035	Eastbound	175	75	125
	Southbound Right*	270	75	125
PM 2035	Eastbound	175	75	125
	Southbound Right*	270	75	175

*Assumes Lowell is realigned to the north. Without the realignment the current distance to Lowell is 210 feet.
BOLD and Shaded cells indicate the vehicle queue exceeds the available storage

Bicycle Operations

Depending on the final bicycle facility design at the SW Moody Avenue/SW Bancroft Street intersection, a traffic signal may be necessary. However, due to pending developments, it is too early to finalize the bicycle facility design. One pending development is that the SW Moody Avenue extension will likely include a rail component (see Section 14 in this memorandum), yet that rail component is currently unresolved. The rail decision will influence the roadway cross section, which in turn influences the bicycle facility design. Ultimately, the design

will safety accommodate bicyclists through the intersection, but without all of the pieces resolved, it is uncertain whether the intersection will require a traffic signal.

Initial traffic analysis shows that signalizing the SW Moody Avenue/SW Bancroft Street intersection could improve operations.

SECTION 13: INTERIM YEAR ANALYSIS AT SW MACADAM AVENUE/SW BANCROFT STREET

The project team completed additional analysis at the intersection of SW Macadam Avenue/SW Bancroft Street to determine how much the dual eastbound left turn benefits intersection operations and how much longer the intersection will operate within jurisdictional standards. We compared a.m. peak hour operations and vehicle queueing for 2020, 2025, 2030, and 2035 both with and without the dual eastbound left turn from Hood Avenue.

Comparing the eastbound vehicle queue length on SW Hood Avenue with a single versus dual eastbound left turn lanes reveals that the dual eastbound left turn lane reduces the 95th percentile vehicle queue length by at least 300 feet. As the intersection nears capacity and then goes over capacity, reduction in vehicle queuing due to dual eastbound left increases.

Installation of the dual eastbound left turn lane will increase the time before the 95th percentile vehicle queue extends past the I-5 entrance ramp gore area on SW Hood Avenue, approximately 1,450 feet in advance of the intersection.

With the single eastbound left the intersection reaches a v/c ratio by about 2025. With the partial dual eastbound lefts the intersection remains at a v/c ratio of less than 1.0 until approximately 2030.

Table 12 shows the intersection operations for the AM peak hour at SW Macadam Avenue/SW Bancroft Street during interim years as indicated (both with and without a dual eastbound left).

Table 13 shows the 50th and 95th percentile vehicle queue lengths for each scenario. The vehicle queuing analysis was completed following the ODOT Analysis Procedure Manual methodology.[30]

[30] *Analysis Procedure Manual,* Oregon Department of Transportation, Transportation Planning Analysis Unit. April 2006.

Table 12: Intersection Operations at SW Macadam Ave/SW Bancroft St – Interim Years, AM Peak Hour

Intersection		Intersection Control	Mobility Target	AM Peak Hour		
				Delay	LOS	V/C
	Year 2020					
	With partial dual EBLs	Signalized	1.10 v/c	21.1	C	0.87
	With single EBL	Signalized	1.10 v/c	30.1	C	0.94
	Year 2025					
	With partial dual EBLs	Signalized	1.10 v/c	28.4	C	0.93
	With single EBL	Signalized	1.10 v/c	46.4	D	1.01
	Year 2030					
	With partial dual EBLs	Signalized	1.10 v/c	42.8	D	1.00
	With single EBL	Signalized	1.10 v/c	70.0	E	1.08
	Year 2035					
	With partial dual EBLs	Signalized	1.10 v/c	61.7	E	1.06
	With single EBL	Signalized	1.10 v/c	91.9	F	1.15

Bolded and Shaded indicates intersection exceeds mobility target

Two-Way Stop:
Delay = Delay of Worst Movement
LOS = Level of Service of Minor Street
v/c = Volume-to-Capacity Ratio of Worst Movement

Signalized:
Delay = Average Delay for Intersection
LOS = Level of Service for Intersection
v/c = Volume-to-Capacity Ratio for Intersection

Table 13: Vehicle Queueing Analysis – Interim Years at SW Macadam Ave/SW Bancroft St AM Peak Hour

Intersection/ Year	Movement	Available Storage (ft)	Dual EBL AM Peak Hour Queue Length (ft)		Single EBL AM Peak Hour Queue Length (ft)	
			50th Percentile	95th Percentile	50th Percentile	95th Percentile
Macadam Ave/Bancroft St						
2020	EB left	1,450**	475	850	600	1150
2025			875	**1575**	1050*	**1850***
2030			1450	**2275**	**1700***	**2750***
2035			**>1450***	**>2,000***	**>1450***	**>2,000***

Bolded and Shaded indicates queuing exceeds available storage
*During the a.m. peak hour this intersection has a v/c ratio greater than 1.0, and specifically the EB movement v/c ratio is greater than 1.0. This indicates the intersection is over capacity and significant vehicle queuing is likely. When an intersection is over capacity, the vehicle queue lengths reported by the simulation software vary. The values shown in table are intended to reveal that the vehicle queue is longer than the available storage, but the exact length of the vehicle queue cannot be defined with a high degree of accuracy.
**Distance from the intersection to the gore area of the I-5 entrance ramp

SECTION 14: RAIL OPERATIONS ON MOODY AVENUE EXTENSION

As part of the Moody Avenue extension, it is assumed that rail will operate along the new roadway. The rail operator will likely be either be the Willamette Shore Trolley or the Portland Streetcar; the rail component of this project is still in the developmental phase. If the Willamette Shore Trolley line is selected, the resulting modifications are currently unknown. However, if the selected rail operator becomes the Portland Streetcar, initial design efforts indicate there will be some modifications to the recommended alternative. If Portland Streetcar operates along SW Moody Avenue, the proposed modifications are shown in Figure 15 and described below:

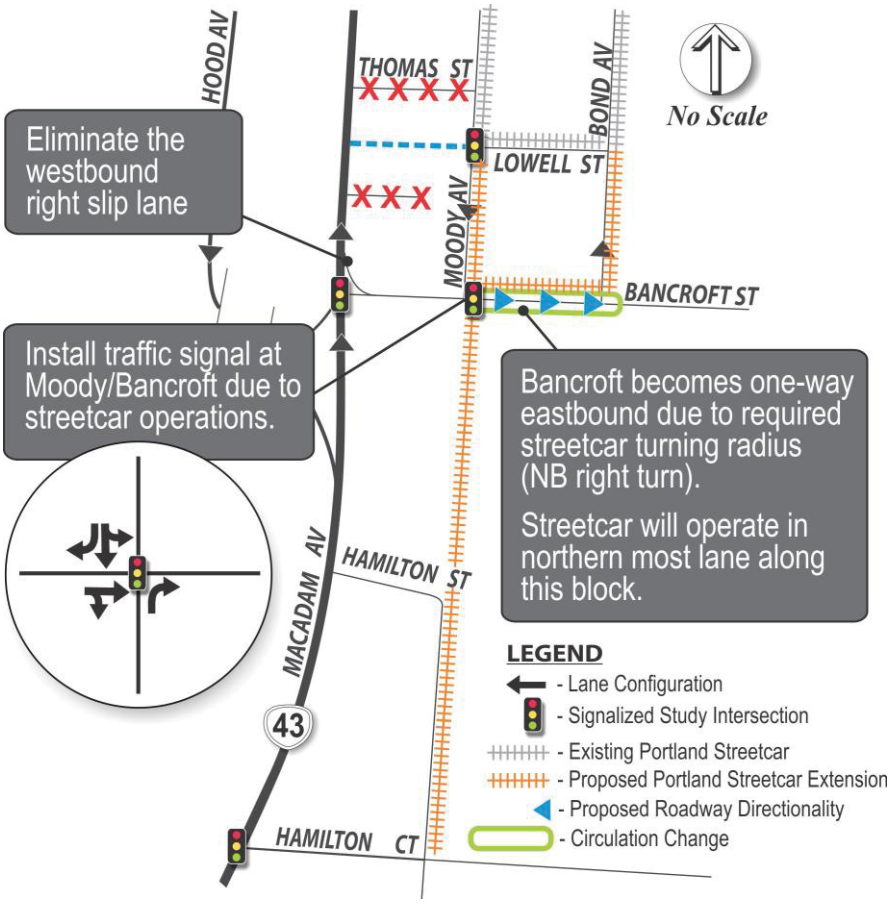


Figure 15: Modifications to the Recommended Alternative is Portland Streetcar Operates along Moody Avenue

- Convert SW Bancroft Street to one-way eastbound between SW Moody Avenue and SW Bond Avenue. The one-way circulation change is necessary because the Streetcar will make a northbound right turn from SW Moody Avenue to SW Bancroft Street. The streetcar turning radius places the streetcar in the northern most lane on SW Bancroft Street, requiring that block of SW Bancroft Street to be one-way.
- Install a traffic signal at the SW Moody Avenue/SW Bancroft Street intersection to safety facilitate the streetcar turn.
- Remove the westbound right slip lane at the SW Macadam Avenue/SW Bancroft Street intersection. By turning the block of SW Bancroft Street one-way eastbound between SW Moody Avenue and SW

Bond Avenue, the westbound right traffic volume at the SW Macadam Avenue/SW Bancroft Street intersection would be minimal, allowing for the removal of the slip lane. Traffic exiting the district heading northbound on SW Macadam Avenue would use either SW Lowell Street or SW Abernethy Street. It is important to note that as long as SW Bancroft Street remains two-way between SW Moody Avenue and SW Bond Avenue, the westbound right slip lane at the SW Macadam Avenue/SW Bancroft Street intersection is necessary.

Preliminary engineering analysis indicates that with these modifications the intersections operate similar to the recommended alternative and meet the project goals. Once the final decision as to the rail operator is determined, the modifications to the recommended alternative can be formally documented and analyzed.

SECTION 15: PROJECT PHASING

For the recommended alternative, three of the elements are required for "opening day" operations:

- SW Macadam Avenue/SW Bancroft Street improvement (constructed to accommodate the partial dual eastbound left turn, but striped for a single eastbound left)
- SW Lowell Street extension
- SW Moody Avenue extension

The northbound right turn lane at SW Macadam Avenue/SW Hamilton Court could be constructed during a later phase. The northbound right turn lane will improve operations at the SW Macadam Avenue/SW Hamilton Court intersection, yet the intersection still meets the mobility target during the peak hours in 2035 without the turn lane.

Similarly, the partial eastbound left turn lane on SW Hood Avenue could be restriped to two left turn lanes if capacity issues arise in the future.

SECTION 16: CONCLUSION

The new recommended alternative, as shown in Figure 10, achieves the project objectives for improved connectivity, improved intersection operations, and improved district access at a lower cost and lower right of way impact than the currently adopted alternative.

South Portal Partnership
Memorandum Future Year 2035 Alternatives Transportation Analysis
December 22, 2015

APPENDIX

- Appendix A: Alternative 1 – AM Peak Hour Year 2035 Highway Capacity Manual Reports
- Appendix B: Alternative 2 – AM Peak Hour Year 2035 Highway Capacity Manual Reports
- Appendix C: Alternative 3 – AM Peak Hour Year 2035 Highway Capacity Manual Reports
- Appendix D: Recommended Alternative – AM Peak Hour Year 2035 Highway Capacity Manual Reports
- Appendix E: Recommended Alternative – PM Peak Hour Year 2035 Highway Capacity Manual Reports
- Appendix F: Vehicle Queuing Analysis – Recommended Alternative AM Peak Hour Year 2035
- Appendix G: Vehicle Queuing Analysis – Recommended Alternative PM Peak Hour Year 2035
- Appendix H: Interim Year Capacity Analysis – AM Peak Hour
- Appendix I: Interim Year Queuing Analysis
- Appendix J: Moody/Bancroft Additional Analysis – Queuing Without Moody Ave Extension (AM and PM 2035)
- Appendix K: Moody/Bancroft Additional Analysis – Queuing WITH Moody Ave Extension (AM and PM 2035)
- Appendix L: Moody/Bancroft Additional Analysis – Eight Hour Signal Warrant Analysis
- Appendix M: Macadam/Bancroft Dual Westbound Left Queuing Analysis and Capacity Analysis
- Appendix N: South Portal Property Owner and Improvement Overview Map
- Appendix O: Leading Zero Addressing Issue

Appendix A:

Alternative 1 – AM Peak Hour Year 2035

Highway Capacity Manual Reports

HCM Signalized Intersection Capacity Analysis
1: SW Macadam Ave & I-5 NB Off Ramp/SW Curry St

ALT 1_2035 - AM (Macadam Bancroft Concept)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	300	0	0	0	0	330	0	1765	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	5.3					4.0		6.3				
Lane Util. Factor	0.97					0.88		0.95				
Frpb, ped/bikes	1.00					1.00		1.00				
Flpb, ped/bikes	1.00					1.00		1.00				
Frt	1.00					0.85		1.00				
Flt Protected	1.00					1.00		1.00				
Satd. Flow (prot)	3540					2771		3539				
Flt Permitted	1.00					1.00		1.00				
Satd. Flow (perm)	3382					2771		3539				
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	309	0	0	0	0	340	0	1820	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	309	0	0	0	0	340	0	1820	0	0	0	0
Confl. Peds. (#/hr)									2			
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	9%	0%	0%	0%	0%	0%	0%	2%	3%	0%	0%	0%
Turn Type	Prot					Prot		NA				
Protected Phases	4					3		2				
Permitted Phases												
Actuated Green, G (s)	11.7					17.1		65.6				
Effective Green, g (s)	11.7					17.1		65.6				
Actuated g/C Ratio	0.11					0.16		0.60				
Clearance Time (s)	5.3					4.0		6.3				
Vehicle Extension (s)	2.0					3.0		2.0				
Lane Grp Cap (vph)	376					430		2110				
v/s Ratio Prot	c0.09					c0.12		c0.51				
v/s Ratio Perm												
v/c Ratio	0.82					0.79		0.86				
Uniform Delay, d1	48.1					44.7		18.5				
Progression Factor	1.00					1.00		0.98				
Incremental Delay, d2	12.9					9.6		1.4				
Delay (s)	61.0					54.3		19.4				
Level of Service	E					D		B				
Approach Delay (s)		61.0			54.3			19.4			0.0	
Approach LOS		E			D			B			A	

Intersection Summary			
HCM 2000 Control Delay	29.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	15.6
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	1.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	80	1995	0	0	0
Conflicting Peds, #/hr	0	0	0	3	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	5	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	0	6	2	8	0	0
Mvmt Flow	0	84	2100	0	0	0

Major/Minor	Minor1		Major1	
Conflicting Flow All	2100	1049	0	0
Stage 1	2100	-	-	-
Stage 2	0	-	-	-
Critical Hdwy	7.5	6.9	-	-
Critical Hdwy Stg 1	7.5	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-
Pot Cap-1 Maneuver	30	227	-	-
Stage 1	30	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	30	227	-	-
Mov Cap-2 Maneuver	30	-	-	-
Stage 1	30	-	-	-
Stage 2	-	-	-	-

Approach	WB	NB
HCM Control Delay, s	29.9	0
HCM LOS	D	

Minor Lane/Major Mvmt	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	227
HCM Lane V/C Ratio	-	-	0.371
HCM Control Delay (s)	-	-	29.9
HCM Lane LOS	-	-	D
HCM 95th %tile Q(veh)	-	-	1.6

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

ALT 1_2035 - AM (Macadam Bancroft Concept)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	655	0	0	240	0	155	0	1810	300	0	0	0
Ideal Flow (vphpl)	1235	1800	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.0		4.0		5.3				
Lane Util. Factor	0.97			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	2189			1660		1449		3446				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	2189			1660		1449		3446				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	697	0	0	255	0	165	0	1926	319	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	9	0	0	0	0
Lane Group Flow (vph)	697	0	0	255	0	165	0	2236	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 7 2						
Actuated Green, G (s)	31.8			37.2		110.0		63.5				
Effective Green, g (s)	31.8			37.2		104.7		63.5				
Actuated g/C Ratio	0.29			0.34		0.95		0.58				
Clearance Time (s)	4.2			4.0				5.3				
Vehicle Extension (s)	0.5			3.0				2.0				
Lane Grp Cap (vph)	632			561		1379		1989				
v/s Ratio Prot	c0.32			c0.15				c0.65				
v/s Ratio Perm						0.11						
v/c Ratio	1.10			0.45		0.12		1.12				
Uniform Delay, d1	39.1			28.5		0.1		23.2				
Progression Factor	1.00			1.00		1.00		0.68				
Incremental Delay, d2	67.3			0.6		0.0		59.2				
Delay (s)	106.4			29.1		0.2		75.0				
Level of Service	F			C		A		E				
Approach Delay (s)		106.4			17.7			75.0			0.0	
Approach LOS		F			B			E			A	

Intersection Summary			
HCM 2000 Control Delay	74.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	112.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
6: SW Macadam Ave & SW Hamilton Ct

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	75	140	1970	195	145	880
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.3		3.5	5.3
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frpb, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1719	1538	3469		1770	3505
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1719	1538	3469		1770	3505
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	79	147	2074	205	153	926
RTOR Reduction (vph)	0	6	6	0	0	0
Lane Group Flow (vph)	79	141	2273	0	153	926
Confl. Peds. (#/hr)	14			18	18	
Confl. Bikes (#/hr)				1		
Heavy Vehicles (%)	5%	5%	2%	0%	2%	3%
Turn Type	Prot	custom	NA		Prot	NA
Protected Phases	4	4	6		5	2
Permitted Phases		5				
Actuated Green, G (s)	12.3	23.9	73.3		11.6	88.4
Effective Green, g (s)	12.3	23.9	73.3		11.6	88.4
Actuated g/C Ratio	0.11	0.22	0.67		0.11	0.80
Clearance Time (s)	4.0	4.0	5.3		3.5	5.3
Vehicle Extension (s)	1.2	1.2	1.2		0.2	1.2
Lane Grp Cap (vph)	192	390	2311		186	2816
v/s Ratio Prot	c0.05	0.04	c0.66		c0.09	0.26
v/s Ratio Perm		0.05				
v/c Ratio	0.41	0.36	0.98		0.82	0.33
Uniform Delay, d1	45.5	36.6	17.8		48.2	2.9
Progression Factor	1.00	1.00	1.00		1.02	0.80
Incremental Delay, d2	0.5	0.2	15.3		23.4	0.3
Delay (s)	46.0	36.8	33.0		72.4	2.6
Level of Service	D	D	C		E	A
Approach Delay (s)	40.0		33.0			12.5
Approach LOS	D		C			B

Intersection Summary			
HCM 2000 Control Delay	27.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.8
Intersection Capacity Utilization	84.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	12
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Vol, veh/h	0	0	0	0	0	55	135	0	0	0	0	0	0	105	310	195
Peak Hour Factor	0.92	0.91	0.91	0.91	0.92	0.91	0.91	0.91	0.92	0.91	0.91	0.91	0.92	0.91	0.91	0.91
Heavy Vehicles, %	2	1	3	4	2	2	0	4	2	0	0	0	2	0	11	0
Mvmt Flow	0	0	0	0	0	60	148	0	0	0	0	0	0	115	341	214
Number of Lanes	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0

Approach	WB	SB
Opposing Approach		
Opposing Lanes	0	0
Conflicting Approach Left		WB
Conflicting Lanes Left	0	1
Conflicting Approach Right	SB	
Conflicting Lanes Right	2	0
HCM Control Delay	10.8	12.4
HCM LOS	B	B

Lane	WBLn1	SBLn1	SBLn2
Vol Left, %	29%	40%	0%
Vol Thru, %	71%	60%	44%
Vol Right, %	0%	0%	56%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	190	260	350
LT Vol	55	105	0
Through Vol	135	155	155
RT Vol	0	0	195
Lane Flow Rate	209	286	385
Geometry Grp	2	7	7
Degree of Util (X)	0.31	0.419	0.52
Departure Headway (Hd)	5.351	5.274	4.867
Convergence, Y/N	Yes	Yes	Yes
Cap	670	683	738
Service Time	3.392	3.016	2.609
HCM Lane V/C Ratio	0.312	0.419	0.522
HCM Control Delay	10.8	11.8	12.8
HCM Lane LOS	B	B	B
HCM 95th-tile Q	1.3	2.1	3

HCM Unsignalized Intersection Capacity Analysis
8: SW Moody Ave & SW Gaines St

ALT 1_2035 - AM (Macadam Bancroft Concept)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	240	70	55	0	0	0	0	0	100	265	0
Sign Control		Stop			Stop			Free			Free	
Grade		5%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	253	74	58	0	0	0	0	0	105	279	0
Pedestrians		34			27			16				
Lane Width (ft)		12.0			11.0			0.0				
Walking Speed (ft/s)		4.0			4.0			4.0				
Percent Blockage		3			2			0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	523	550	189	593	550	27	313			27		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	523	550	189	593	550	27	313			27		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	36	91	63	100	100	100			93		
cM capacity (veh/h)	391	394	803	158	395	1027	1223			1552		

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	277	49	58	198	186
Volume Left	0	0	58	105	0
Volume Right	25	49	0	0	0
cSH	413	803	158	1552	1700
Volume to Capacity	0.67	0.06	0.37	0.07	0.11
Queue Length 95th (ft)	119	5	39	5	0
Control Delay (s)	29.8	9.8	40.6	4.2	0.0
Lane LOS	D	A	E	A	
Approach Delay (s)	26.8		40.6	2.2	
Approach LOS	D		E		

Intersection Summary				
Average Delay	15.5			
Intersection Capacity Utilization	39.7%	ICU Level of Service	A	
Analysis Period (min)	15			

Intersection	
Intersection Delay, s/veh	13.2
Intersection LOS	B

Movement	EBU	EBL	EBT	WBU	WBT	WBR	SBU	SBL	SBR
Vol, veh/h	0	0	300	0	125	0	0	175	270
Peak Hour Factor	0.92	0.85	0.85	0.92	0.85	0.85	0.92	0.85	0.85
Heavy Vehicles, %	2	0	3	2	12	0	2	9	4
Mvmt Flow	0	0	353	0	147	0	0	206	318
Number of Lanes	0	0	1	0	1	0	0	1	1

Approach	EB	WB	SB
Opposing Approach	WB	EB	
Opposing Lanes	1	1	0
Conflicting Approach Left	SB		WB
Conflicting Lanes Left	2	0	1
Conflicting Approach Right		SB	EB
Conflicting Lanes Right	0	2	1
HCM Control Delay	14.8	10.9	12.8
HCM LOS	B	B	B

Lane	EBLn1	WBLn1	SBLn1	SBLn2
Vol Left, %	0%	0%	100%	0%
Vol Thru, %	100%	100%	0%	0%
Vol Right, %	0%	0%	0%	100%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	300	125	175	270
LT Vol	0	0	175	0
Through Vol	300	125	0	0
RT Vol	0	0	0	270
Lane Flow Rate	353	147	206	318
Geometry Grp	2	2	7	7
Degree of Util (X)	0.539	0.244	0.376	0.466
Departure Headway (Hd)	5.498	5.981	6.58	5.279
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	656	600	548	683
Service Time	3.527	4.018	4.308	3.007
HCM Lane V/C Ratio	0.538	0.245	0.376	0.466
HCM Control Delay	14.8	10.9	13.2	12.6
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	3.2	1	1.7	2.5

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

ALT 1_2035 - single EBL at Macadam/Bancroft

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	655	0	0	240	0	155	0	1810	300	0	0	0
Ideal Flow (vphpl)	1900	1800	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.0		4.0		5.3				
Lane Util. Factor	1.00			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1736			1660		1449		3446				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1736			1660		1449		3446				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	697	0	0	255	0	165	0	1926	319	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	9	0	0	0	0
Lane Group Flow (vph)	697	0	0	255	0	165	0	2236	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 7 2						
Actuated Green, G (s)	36.8			42.2		110.0		58.5				
Effective Green, g (s)	36.8			42.2		104.7		58.5				
Actuated g/C Ratio	0.33			0.38		0.95		0.53				
Clearance Time (s)	4.2			4.0				5.3				
Vehicle Extension (s)	0.5			3.0				2.0				
Lane Grp Cap (vph)	580			636		1379		1832				
v/s Ratio Prot	c0.40			c0.15				c0.65				
v/s Ratio Perm						0.11						
v/c Ratio	1.20			0.40		0.12		1.22				
Uniform Delay, d1	36.6			24.7		0.1		25.8				
Progression Factor	1.00			1.00		1.00		0.72				
Incremental Delay, d2	106.5			0.4		0.0		101.3				
Delay (s)	143.1			25.1		0.2		119.9				
Level of Service	F			C		A		F				
Approach Delay (s)		143.1			15.3			119.9			0.0	
Approach LOS		F			B			F			A	

Intersection Summary			
HCM 2000 Control Delay	111.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.19		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	120.0%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Appendix B:

Alternative 2 – AM Peak Hour Year 2035

Highway Capacity Manual Reports

HCM Signalized Intersection Capacity Analysis
1: SW Macadam Ave & I-5 NB Off Ramp/SW Curry St

ALT 2_2035 AM (M-B Concept with Moody Extension)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	295	0	0	0	0	0	0	2095	260	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	5.3							6.3				
Lane Util. Factor	0.97							0.95				
Frpb, ped/bikes	1.00							1.00				
Flpb, ped/bikes	1.00							1.00				
Frt	1.00							0.98				
Flt Protected	1.00							1.00				
Satd. Flow (prot)	3540							3470				
Flt Permitted	1.00							1.00				
Satd. Flow (perm)	3382							3470				
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	304	0	0	0	0	0	0	2160	268	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	8	0	0	0	0
Lane Group Flow (vph)	304	0	0	0	0	0	0	2420	0	0	0	0
Confl. Peds. (#/hr)									2			
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	9%	0%	0%	0%	0%	0%	0%	2%	3%	0%	0%	0%
Turn Type	Prot							NA				
Protected Phases	4							2				
Permitted Phases												
Actuated Green, G (s)	12.3							86.1				
Effective Green, g (s)	12.3							86.1				
Actuated g/C Ratio	0.11							0.78				
Clearance Time (s)	5.3							6.3				
Vehicle Extension (s)	2.0							2.0				
Lane Grp Cap (vph)	395							2716				
v/s Ratio Prot	c0.09							c0.70				
v/s Ratio Perm												
v/c Ratio	0.77							0.89				
Uniform Delay, d1	47.5							8.6				
Progression Factor	1.00							0.70				
Incremental Delay, d2	7.9							3.2				
Delay (s)	55.4							9.2				
Level of Service	E							A				
Approach Delay (s)		55.4			0.0			9.2			0.0	
Approach LOS		E			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	14.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	83.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: SW Macadam Ave & SW Gaines St

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	0	275	2080	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	5%		0%			0%
Total Lost time (s)		4.0	5.3			
Lane Util. Factor		0.88	0.95			
Frt		0.85	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		2691	3539			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		2691	3539			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	289	2189	0	0	0
RTOR Reduction (vph)	0	27	0	0	0	0
Lane Group Flow (vph)	0	262	2189	0	0	0
Heavy Vehicles (%)	0%	3%	2%	0%	0%	0%
Turn Type		Prot	NA			
Protected Phases		4	2			
Permitted Phases						
Actuated Green, G (s)		13.7	87.0			
Effective Green, g (s)		13.7	87.0			
Actuated g/C Ratio		0.12	0.79			
Clearance Time (s)		4.0	5.3			
Vehicle Extension (s)		0.5	2.0			
Lane Grp Cap (vph)		335	2799			
v/s Ratio Prot		c0.10	c0.62			
v/s Ratio Perm						
v/c Ratio		0.78	0.78			
Uniform Delay, d1		46.7	6.3			
Progression Factor		1.00	1.17			
Incremental Delay, d2		10.4	0.8			
Delay (s)		57.1	8.2			
Level of Service		E	A			
Approach Delay (s)	57.1		8.2			0.0
Approach LOS	E		A			A

Intersection Summary			
HCM 2000 Control Delay	13.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	2.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	125	1955	195	0	0
Conflicting Peds, #/hr	0	0	0	3	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	5	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	0	6	2	8	0	0
Mvmt Flow	0	132	2058	205	0	0

Major/Minor	Minor1		Major1	
Conflicting Flow All	2161	1131	0	0
Stage 1	2161	-	-	-
Stage 2	0	-	-	-
Critical Hdwy	7.5	6.9	-	-
Critical Hdwy Stg 1	7.5	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-
Pot Cap-1 Maneuver	27	201	-	-
Stage 1	27	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	27	201	-	-
Mov Cap-2 Maneuver	27	-	-	-
Stage 1	27	-	-	-
Stage 2	-	-	-	-

Approach	WB	NB
HCM Control Delay, s	51.6	0
HCM LOS	F	

Minor Lane/Major Mvmt	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	201
HCM Lane V/C Ratio	-	-	0.655
HCM Control Delay (s)	-	-	51.6
HCM Lane LOS	-	-	F
HCM 95th %tile Q(veh)	-	-	3.9

Intersection	
Int Delay, s/veh	0.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	15	2135	475	0	0
Conflicting Peds, #/hr	0	0	0	3	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	5	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	2	2	0	0
Mvmt Flow	0	16	2321	516	0	0

Major/Minor	Minor1		Major1	
Conflicting Flow All	2579	1417	0	0
Stage 1	2579	-	-	-
Stage 2	0	-	-	-
Critical Hdwy	8.5	6.9	-	-
Critical Hdwy Stg 1	7.5	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-
Pot Cap-1 Maneuver	6	129	-	-
Stage 1	13	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	6	129	-	-
Mov Cap-2 Maneuver	6	-	-	-
Stage 1	13	-	-	-
Stage 2	-	-	-	-

Approach	WB	NB
HCM Control Delay, s	36.9	0
HCM LOS	E	

Minor Lane/Major Mvmt	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	129
HCM Lane V/C Ratio	-	-	0.126
HCM Control Delay (s)	-	-	36.9
HCM Lane LOS	-	-	E
HCM 95th %tile Q(veh)	-	-	0.4

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

ALT 2_2035 AM (M-B Concept with Moody Extension)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	655	0	0	140	0	150	0	1805	235	0	0	0
Ideal Flow (vphpl)	1235	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	0.97			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	2189			1660		1449		3463				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	2189			1660		1449		3463				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	697	0	0	149	0	160	0	1920	250	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	7	0	0	0	0
Lane Group Flow (vph)	697	0	0	149	0	160	0	2163	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	31.8			37.0		110.0		63.5				
Effective Green, g (s)	31.8			37.0		104.7		63.5				
Actuated g/C Ratio	0.29			0.34		0.95		0.58				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	632			558		1379		1999				
v/s Ratio Prot	c0.32			c0.09				c0.62				
v/s Ratio Perm						0.11						
v/c Ratio	1.10			0.27		0.12		1.08				
Uniform Delay, d1	39.1			26.6		0.1		23.2				
Progression Factor	1.00			1.00		1.00		0.44				
Incremental Delay, d2	67.3			0.3		0.0		39.7				
Delay (s)	106.4			26.9		0.2		49.9				
Level of Service	F			C		A		D				
Approach Delay (s)		106.4			13.1			49.9			0.0	
Approach LOS		F			B			D			A	

Intersection Summary			
HCM 2000 Control Delay	58.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	110.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
6: SW Macadam Ave & SW Hamilton Ct

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	230	210	1830	300	185	740
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.3		3.5	5.3
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frpb, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1719	1538	3430		1770	3505
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1719	1538	3430		1770	3505
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	242	221	1926	316	195	779
RTOR Reduction (vph)	0	154	12	0	0	0
Lane Group Flow (vph)	242	67	2230	0	195	779
Confl. Peds. (#/hr)	14			18	18	
Confl. Bikes (#/hr)				1		
Heavy Vehicles (%)	5%	5%	2%	0%	2%	3%
Turn Type	Prot	Prot	NA		Prot	NA
Protected Phases	3	3	6		5	2
Permitted Phases						
Actuated Green, G (s)	18.1	18.1	66.4		12.7	82.6
Effective Green, g (s)	18.1	18.1	66.4		12.7	82.6
Actuated g/C Ratio	0.16	0.16	0.60		0.12	0.75
Clearance Time (s)	4.0	4.0	5.3		3.5	5.3
Vehicle Extension (s)	3.0	3.0	1.2		0.2	1.2
Lane Grp Cap (vph)	282	253	2070		204	2631
v/s Ratio Prot	c0.14	0.04	c0.65		c0.11	0.22
v/s Ratio Perm						
v/c Ratio	0.86	0.27	1.08		0.96	0.30
Uniform Delay, d1	44.7	40.1	21.8		48.4	4.4
Progression Factor	1.00	1.00	1.00		1.12	0.81
Incremental Delay, d2	21.9	0.6	44.3		49.7	0.3
Delay (s)	66.6	40.7	66.1		104.1	3.9
Level of Service	E	D	E		F	A
Approach Delay (s)	54.2		66.1			23.9
Approach LOS	D		E			C

Intersection Summary			
HCM 2000 Control Delay	53.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.8
Intersection Capacity Utilization	94.5%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	13.3
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Vol, veh/h	0	0	180	80	0	40	0	0	0	0	0	0	0	95	435	0
Peak Hour Factor	0.92	0.91	0.91	0.91	0.92	0.91	0.91	0.91	0.92	0.91	0.91	0.91	0.92	0.91	0.91	0.91
Heavy Vehicles, %	2	1	3	4	2	2	0	4	2	0	0	0	2	0	11	0
Mvmt Flow	0	0	198	88	0	44	0	0	0	0	0	0	0	104	478	0
Number of Lanes	0	1	1	0	0	0	1	0	0	0	0	0	0	0	2	0

Approach	EB	WB	SB
Opposing Approach	WB	EB	
Opposing Lanes	1	2	0
Conflicting Approach Left	SB		WB
Conflicting Lanes Left	2	0	1
Conflicting Approach Right		SB	EB
Conflicting Lanes Right	0	2	2
HCM Control Delay	13.7	10.2	13.3
HCM LOS	B	B	B

Lane	EBLn1	EBLn2	WBLn1	SBLn1	SBLn2
Vol Left, %	0%	0%	100%	40%	0%
Vol Thru, %	100%	69%	0%	60%	100%
Vol Right, %	0%	31%	0%	0%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	0	260	40	240	290
LT Vol	0	0	40	95	0
Through Vol	0	180	0	145	290
RT Vol	0	80	0	0	0
Lane Flow Rate	0	286	44	264	319
Geometry Grp	7	7	6	7	7
Degree of Util (X)	0	0.465	0.081	0.414	0.499
Departure Headway (Hd)	6.041	5.858	6.661	5.646	5.635
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	0	609	541	630	634
Service Time	3.84	3.657	4.661	3.445	3.434
HCM Lane V/C Ratio	0	0.47	0.081	0.419	0.503
HCM Control Delay	8.8	13.7	10.2	12.4	14
HCM Lane LOS	N	B	B	B	B
HCM 95th-tile Q	0	2.5	0.3	2	2.8

HCM 2010 AWSC
9: SW Bancroft St & SW Moody Ave

Intersection	
Intersection Delay, s/veh	19.8
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	0	225	10	0	45	75	0	0	0	0	210
Peak Hour Factor	0.92	0.85	0.85	0.85	0.92	0.85	0.85	0.85	0.92	0.85	0.85	0.85
Heavy Vehicles, %	2	0	3	2	2	2	12	0	2	2	2	2
Mvmt Flow	0	0	265	12	0	53	88	0	0	0	0	247
Number of Lanes	0	0	1	0	0	0	1	0	0	0	0	1

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	2
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	2	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	2	1
HCM Control Delay	16.1	12.7	13
HCM LOS	C	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1	SBLn2
Vol Left, %	0%	0%	38%	100%	0%
Vol Thru, %	0%	96%	62%	0%	48%
Vol Right, %	100%	4%	0%	0%	52%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	210	235	120	70	415
LT Vol	0	0	45	70	0
Through Vol	0	225	75	0	200
RT Vol	210	10	0	0	215
Lane Flow Rate	247	276	141	82	488
Geometry Grp	5	2	2	7	7
Degree of Util (X)	0.406	0.504	0.275	0.158	0.804
Departure Headway (Hd)	5.916	6.557	7.025	7.065	6.065
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	608	550	512	511	601
Service Time	3.951	4.581	5.06	4.765	3.765
HCM Lane V/C Ratio	0.406	0.502	0.275	0.16	0.812
HCM Control Delay	13	16.1	12.7	11.1	29
HCM Lane LOS	B	C	B	B	D
HCM 95th-tile Q	2	2.8	1.1	0.6	8

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	70	200	215
Peak Hour Factor	0.92	0.85	0.85	0.85
Heavy Vehicles, %	2	9	2	4
Mvmt Flow	0	82	235	253
Number of Lanes	0	0	1	1

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	15.2
HCM LOS	C

Lane

Intersection	
Intersection Delay, s/veh	18.4
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Vol, veh/h	0	255	50	180	0	10	50	10	0	165	10	5	0	10	20	225
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	277	54	196	0	11	54	11	0	179	11	5	0	11	22	245
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	24.8	10.3	12.7	12.6
HCM LOS	C	B	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	92%	53%	14%	4%
Vol Thru, %	6%	10%	71%	8%
Vol Right, %	3%	37%	14%	88%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	180	485	70	255
LT Vol	165	255	10	10
Through Vol	10	50	50	20
RT Vol	5	180	10	225
Lane Flow Rate	196	527	76	277
Geometry Grp	1	1	1	1
Degree of Util (X)	0.342	0.78	0.133	0.423
Departure Headway (Hd)	6.293	5.324	6.294	5.491
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	567	675	573	649
Service Time	4.386	3.388	4.294	3.576
HCM Lane V/C Ratio	0.346	0.781	0.133	0.427
HCM Control Delay	12.7	24.8	10.3	12.6
HCM Lane LOS	B	C	B	B
HCM 95th-tile Q	1.5	7.5	0.5	2.1

HCM Unsignalized Intersection Capacity Analysis
8: SW Moody Ave & SW Gaines St

ALT 2_2035 AM (M-B Concept with Moody Extension)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	45	105	0	0	0	0	130	255	170
Sign Control		Stop			Stop			Free			Free	
Grade		5%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	0	47	111	0	0	0	0	137	268	179
Pedestrians		34			27			16				
Lane Width (ft)		0.0			11.0			0.0				
Walking Speed (ft/s)		4.0			4.0			4.0				
Percent Blockage		0			2			0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	721	693	274	451	782	27	481			27		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	721	693	274	451	782	27	481			27		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	89	62	100	100			91		
cM capacity (veh/h)	208	329	730	447	293	1027	1092			1552		

Direction, Lane #	WB 1	SB 1	SB 2
Volume Total	158	271	313
Volume Left	47	137	0
Volume Right	0	0	179
cSH	327	1552	1700
Volume to Capacity	0.48	0.09	0.18
Queue Length 95th (ft)	63	7	0
Control Delay (s)	25.9	4.2	0.0
Lane LOS	D	A	
Approach Delay (s)	25.9	1.9	
Approach LOS	D		

Intersection Summary				
Average Delay	7.0			
Intersection Capacity Utilization	31.9%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

ALT 2_2035 AM with a single EBL at Macadam/Bancroft

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	655	0	0	140	0	150	0	1805	235	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	1.00			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1736			1660		1449		3463				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1736			1660		1449		3463				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	697	0	0	149	0	160	0	1920	250	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	7	0	0	0	0
Lane Group Flow (vph)	697	0	0	149	0	160	0	2163	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	38.8			44.0		110.0		56.5				
Effective Green, g (s)	38.8			44.0		104.7		56.5				
Actuated g/C Ratio	0.35			0.40		0.95		0.51				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	612			664		1379		1778				
v/s Ratio Prot	c0.40			c0.09				c0.62				
v/s Ratio Perm						0.11						
v/c Ratio	1.14			0.22		0.12		1.22				
Uniform Delay, d1	35.6			21.8		0.1		26.8				
Progression Factor	1.00			1.00		1.00		0.50				
Incremental Delay, d2	81.1			0.2		0.0		98.9				
Delay (s)	116.7			21.9		0.2		112.2				
Level of Service	F			C		A		F				
Approach Delay (s)		116.7			10.7			112.2			0.0	
Approach LOS		F			B			F			A	

Intersection Summary			
HCM 2000 Control Delay	103.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	117.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
6: SW Macadam Ave & SW Hamilton Ct

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	230	210	1830	300	185	740
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.3	5.3	3.5	5.3
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.91	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1719	1538	3539	1470	1770	3505
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1719	1538	3539	1470	1770	3505
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	242	221	1926	316	195	779
RTOR Reduction (vph)	0	154	0	112	0	0
Lane Group Flow (vph)	242	67	1926	204	195	779
Confl. Peds. (#/hr)	14			18	18	
Confl. Bikes (#/hr)				1		
Heavy Vehicles (%)	5%	5%	2%	0%	2%	3%
Turn Type	Prot	Prot	NA	Perm	Prot	NA
Protected Phases	3	3	6		5	2
Permitted Phases				6		
Actuated Green, G (s)	18.1	18.1	66.0	66.0	13.1	82.6
Effective Green, g (s)	18.1	18.1	66.0	66.0	13.1	82.6
Actuated g/C Ratio	0.16	0.16	0.60	0.60	0.12	0.75
Clearance Time (s)	4.0	4.0	5.3	5.3	3.5	5.3
Vehicle Extension (s)	3.0	3.0	1.2	1.2	0.2	1.2
Lane Grp Cap (vph)	282	253	2123	882	210	2631
v/s Ratio Prot	c0.14	0.04	c0.54		c0.11	0.22
v/s Ratio Perm				0.14		
v/c Ratio	0.86	0.27	0.91	0.23	0.93	0.30
Uniform Delay, d1	44.7	40.1	19.3	10.2	48.0	4.4
Progression Factor	1.00	1.00	1.00	1.00	1.12	0.81
Incremental Delay, d2	21.9	0.6	7.1	0.6	41.6	0.3
Delay (s)	66.6	40.7	26.4	10.8	95.3	3.9
Level of Service	E	D	C	B	F	A
Approach Delay (s)	54.2		24.2			22.2
Approach LOS	D		C			C

Intersection Summary			
HCM 2000 Control Delay	27.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.8
Intersection Capacity Utilization	84.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Appendix C:

Alternative 3 – AM Peak Hour Year 2035

Highway Capacity Manual Reports

HCM Signalized Intersection Capacity Analysis
1: SW Macadam Ave & I-5 NB Off Ramp/SW Curry St

ALT 3_2035 AM (Adopted Option)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	295	0	0	0	0	0	0	2080	260	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	5.3							6.3				
Lane Util. Factor	0.97							0.95				
Frpb, ped/bikes	1.00							1.00				
Flpb, ped/bikes	1.00							1.00				
Frt	1.00							0.98				
Flt Protected	1.00							1.00				
Satd. Flow (prot)	3540							3470				
Flt Permitted	1.00							1.00				
Satd. Flow (perm)	3382							3470				
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	304	0	0	0	0	0	0	2144	268	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	6	0	0	0	0
Lane Group Flow (vph)	304	0	0	0	0	0	0	2406	0	0	0	0
Confl. Peds. (#/hr)									2			
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	9%	0%	0%	0%	0%	0%	0%	2%	3%	0%	0%	0%
Turn Type	Prot							NA				
Protected Phases	4							2				
Permitted Phases												
Actuated Green, G (s)	13.9							84.5				
Effective Green, g (s)	13.9							84.5				
Actuated g/C Ratio	0.13							0.77				
Clearance Time (s)	5.3							6.3				
Vehicle Extension (s)	2.0							2.0				
Lane Grp Cap (vph)	447							2665				
v/s Ratio Prot	c0.09							c0.69				
v/s Ratio Perm												
v/c Ratio	0.68							0.90				
Uniform Delay, d1	45.9							9.6				
Progression Factor	1.00							1.11				
Incremental Delay, d2	3.4							3.7				
Delay (s)	49.3							14.5				
Level of Service	D							B				
Approach Delay (s)		49.3			0.0			14.5			0.0	
Approach LOS		D			A			B			A	

Intersection Summary			
HCM 2000 Control Delay	18.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	82.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: SW Macadam Ave & SW Gaines St

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	0	270	2070	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	5%		0%			0%
Total Lost time (s)		4.0	5.3			
Lane Util. Factor		0.88	0.95			
Frt		0.85	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		2691	3539			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		2691	3539			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	284	2179	0	0	0
RTOR Reduction (vph)	0	28	0	0	0	0
Lane Group Flow (vph)	0	256	2179	0	0	0
Heavy Vehicles (%)	0%	3%	2%	0%	0%	0%
Turn Type		Prot	NA			
Protected Phases		4	2			
Permitted Phases						
Actuated Green, G (s)		13.4	87.3			
Effective Green, g (s)		13.4	87.3			
Actuated g/C Ratio		0.12	0.79			
Clearance Time (s)		4.0	5.3			
Vehicle Extension (s)		0.5	2.0			
Lane Grp Cap (vph)		327	2808			
v/s Ratio Prot		c0.10	c0.62			
v/s Ratio Perm						
v/c Ratio		0.78	0.78			
Uniform Delay, d1		46.9	6.1			
Progression Factor		1.00	1.86			
Incremental Delay, d2		10.7	1.9			
Delay (s)		57.6	13.2			
Level of Service		E	B			
Approach Delay (s)	57.6		13.2			0.0
Approach LOS	E		B			A

Intersection Summary			
HCM 2000 Control Delay	18.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	2.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	115	1955	190	0	0
Conflicting Peds, #/hr	0	0	0	3	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	5	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	0	6	2	8	0	0
Mvmt Flow	0	121	2058	200	0	0

Major/Minor	Minor1		Major1	
Conflicting Flow All	2158	1128	0	0
Stage 1	2158	-	-	-
Stage 2	0	-	-	-
Critical Hdwy	7.5	6.9	-	-
Critical Hdwy Stg 1	7.5	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-
Pot Cap-1 Maneuver	27	201	-	-
Stage 1	27	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	27	201	-	-
Mov Cap-2 Maneuver	27	-	-	-
Stage 1	27	-	-	-
Stage 2	-	-	-	-

Approach	WB	NB
HCM Control Delay, s	46.8	0
HCM LOS	E	

Minor Lane/Major Mvmt	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	201
HCM Lane V/C Ratio	-	-	0.602
HCM Control Delay (s)	-	-	46.8
HCM Lane LOS	-	-	E
HCM 95th %tile Q(veh)	-	-	3.4

Intersection	
Int Delay, s/veh	0.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	15	2130	50	0	0
Conflicting Peds, #/hr	0	0	0	3	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	5	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	2	2	0	0
Mvmt Flow	0	16	2315	54	0	0

Major/Minor	Minor1		Major1	
Conflicting Flow All	2342	1184	0	0
Stage 1	2342	-	-	-
Stage 2	0	-	-	-
Critical Hdwy	8.5	6.9	-	-
Critical Hdwy Stg 1	7.5	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-
Pot Cap-1 Maneuver	10	185	-	-
Stage 1	20	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	10	185	-	-
Mov Cap-2 Maneuver	10	-	-	-
Stage 1	20	-	-	-
Stage 2	-	-	-	-

Approach	WB	NB
HCM Control Delay, s	26.3	0
HCM LOS	D	

Minor Lane/Major Mvmt	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	185
HCM Lane V/C Ratio	-	-	0.088
HCM Control Delay (s)	-	-	26.3
HCM Lane LOS	-	-	D
HCM 95th %tile Q(veh)	-	-	0.3

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Bancroft St

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	0	150	2030	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	5%		0%			0%
Total Lost time (s)		4.2	5.3			
Lane Util. Factor		0.88	0.91			
Frpb, ped/bikes		1.00	1.00			
Flpb, ped/bikes		1.00	1.00			
Frt		0.85	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		2353	4577			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		2353	4577			
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	160	2160	0	0	0
RTOR Reduction (vph)	0	39	0	0	0	0
Lane Group Flow (vph)	0	121	2160	0	0	0
Confl. Peds. (#/hr)				2		
Heavy Vehicles (%)	6%	6%	2%	3%	0%	0%
Turn Type		Prot	NA			
Protected Phases		4	2			
Permitted Phases						
Actuated Green, G (s)		8.6	91.9			
Effective Green, g (s)		8.6	91.9			
Actuated g/C Ratio		0.08	0.84			
Clearance Time (s)		4.2	5.3			
Vehicle Extension (s)		0.5	2.0			
Lane Grp Cap (vph)		183	3823			
v/s Ratio Prot		c0.05	c0.47			
v/s Ratio Perm						
v/c Ratio		0.66	0.57			
Uniform Delay, d1		49.3	2.8			
Progression Factor		0.98	0.85			
Incremental Delay, d2		6.8	0.1			
Delay (s)		55.1	2.5			
Level of Service		E	A			
Approach Delay (s)	55.1		2.5		0.0	
Approach LOS	E		A		A	

Intersection Summary			
HCM 2000 Control Delay	6.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
6: SW Macadam Ave & SW Hamilton Ct

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	95	110	1900	195	0	875
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.3			5.3
Lane Util. Factor	1.00	1.00	0.95			0.95
Frpb, ped/bikes	1.00	1.00	0.99			1.00
Flpb, ped/bikes	1.00	1.00	1.00			1.00
Frt	1.00	0.85	0.99			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	1719	1538	3469			3505
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	1719	1538	3469			3505
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	100	116	2000	205	0	921
RTOR Reduction (vph)	0	24	5	0	0	0
Lane Group Flow (vph)	100	92	2200	0	0	921
Confl. Peds. (#/hr)	14			18	18	
Confl. Bikes (#/hr)				1		
Heavy Vehicles (%)	5%	5%	2%	0%	2%	3%
Turn Type	Prot	Perm	NA			NA
Protected Phases	4		6			2
Permitted Phases		4				
Actuated Green, G (s)	11.0	11.0	89.7			89.7
Effective Green, g (s)	11.0	11.0	89.7			89.7
Actuated g/C Ratio	0.10	0.10	0.82			0.82
Clearance Time (s)	4.0	4.0	5.3			5.3
Vehicle Extension (s)	1.2	1.2	1.2			1.2
Lane Grp Cap (vph)	171	153	2828			2858
v/s Ratio Prot	0.06		c0.63			0.26
v/s Ratio Perm		c0.06				
v/c Ratio	0.58	0.60	0.78			0.32
Uniform Delay, d1	47.3	47.4	5.1			2.5
Progression Factor	1.00	1.00	1.00			1.43
Incremental Delay, d2	3.3	4.2	2.2			0.3
Delay (s)	50.6	51.6	7.3			3.9
Level of Service	D	D	A			A
Approach Delay (s)	51.1		7.3			3.9
Approach LOS	D		A			A

Intersection Summary			
HCM 2000 Control Delay	9.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM 2010 AWSC
7: SW Moody Ave & SW Curry St

Intersection	
Intersection Delay, s/veh	13.1
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	0	210	50	0	40	0	0	0	0	0	0
Peak Hour Factor	0.92	0.91	0.91	0.91	0.92	0.91	0.91	0.91	0.92	0.91	0.91	0.91
Heavy Vehicles, %	2	1	3	4	2	2	0	4	2	0	0	0
Mvmt Flow	0	0	231	55	0	44	0	0	0	0	0	0
Number of Lanes	0	0	1	1	0	1	0	0	0	0	0	0

Approach	EB	WB
Opposing Approach	WB	EB
Opposing Lanes	1	2
Conflicting Approach Left	SB	
Conflicting Lanes Left	2	0
Conflicting Approach Right		SB
Conflicting Lanes Right	0	2
HCM Control Delay	12.3	10.3
HCM LOS	B	B

Lane	EBLn1	EBLn2	WBLn1	SBLn1	SBLn2
Vol Left, %	0%	0%	100%	45%	0%
Vol Thru, %	98%	0%	0%	55%	100%
Vol Right, %	2%	100%	0%	0%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	215	45	40	265	290
LT Vol	0	0	40	120	0
Through Vol	210	0	0	145	290
RT Vol	5	45	0	0	0
Lane Flow Rate	236	49	44	291	319
Geometry Grp	7	7	6	7	7
Degree of Util (X)	0.401	0.075	0.082	0.457	0.497
Departure Headway (Hd)	6.116	5.541	6.692	5.653	5.614
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	584	650	538	632	634
Service Time	3.916	3.241	4.692	3.448	3.409
HCM Lane V/C Ratio	0.404	0.075	0.082	0.46	0.503
HCM Control Delay	13	8.7	10.3	13.2	13.9
HCM Lane LOS	B	A	B	B	B
HCM 95th-tile Q	1.9	0.2	0.3	2.4	2.8

HCM Unsignalized Intersection Capacity Analysis
8: SW Moody Ave & SW Gaines St

ALT 3_2035 AM (Adopted Option)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	45	105	0	0	0	0	110	250	165
Sign Control		Stop			Stop			Free			Free	
Grade		5%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	0	47	111	0	0	0	0	116	263	174
Pedestrians		34			27			16				
Lane Width (ft)		0.0			11.0			0.0				
Walking Speed (ft/s)		4.0			4.0			4.0				
Percent Blockage		0			2			0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	671	643	268	406	729	27	471			27		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	671	643	268	406	729	27	471			27		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	90	65	100	100			93		
cM capacity (veh/h)	236	357	735	486	319	1027	1101			1552		

Direction, Lane #	WB 1	SB 1	SB 2
Volume Total	158	247	305
Volume Left	47	116	0
Volume Right	0	0	174
cSH	356	1552	1700
Volume to Capacity	0.44	0.07	0.18
Queue Length 95th (ft)	55	6	0
Control Delay (s)	23.0	3.8	0.0
Lane LOS	C	A	
Approach Delay (s)	23.0	1.7	
Approach LOS	C		

Intersection Summary				
Average Delay	6.4			
Intersection Capacity Utilization	31.0%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Signalized Intersection Capacity Analysis
9: Moody Ave/SW Moody Ave & SW Bancroft St

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	70	65	0	0	0	0	70	295	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	11	12	12	12	11	12	11
Total Lost time (s)				4.0	4.0						4.0	
Lane Util. Factor				1.00	1.00						0.95	
Frpb, ped/bikes				1.00	1.00						0.97	
Flpb, ped/bikes				1.00	1.00						0.96	
Frt				1.00	1.00						0.97	
Flt Protected				0.95	1.00						0.99	
Satd. Flow (prot)				1770	1459						3157	
Flt Permitted				0.95	1.00						0.99	
Satd. Flow (perm)				1770	1459						3157	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	0	0	0	82	76	0	0	0	0	82	347	100
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	8	0
Lane Group Flow (vph)	0	0	0	82	76	0	0	0	0	0	521	0
Confl. Peds. (#/hr)										66		61
Confl. Bikes (#/hr)												43
Heavy Vehicles (%)	0%	3%	2%	2%	12%	0%	2%	2%	2%	9%	2%	4%
Parking (#/hr)					2					2		2
Turn Type				Split	NA					Perm	NA	
Protected Phases				4	4						6	
Permitted Phases										6		
Actuated Green, G (s)				11.7	11.7						90.3	
Effective Green, g (s)				11.7	11.7						90.3	
Actuated g/C Ratio				0.11	0.11						0.82	
Clearance Time (s)				4.0	4.0						4.0	
Vehicle Extension (s)				3.0	3.0						3.0	
Lane Grp Cap (vph)				188	155						2591	
v/s Ratio Prot				0.05	c0.05							
v/s Ratio Perm											0.16	
v/c Ratio				0.44	0.49						0.20	
Uniform Delay, d1				46.1	46.3						2.1	
Progression Factor				1.22	1.22						1.00	
Incremental Delay, d2				1.6	2.4						0.2	
Delay (s)				57.8	59.1						2.3	
Level of Service				E	E						A	
Approach Delay (s)		0.0			58.4			0.0			2.3	
Approach LOS		A			E			A			A	

Intersection Summary			
HCM 2000 Control Delay	15.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.23		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	9.3
Intersection LOS	A

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Vol, veh/h	0	145	20	30	0	5	25	10	0	80	30	10	0	20	75	100
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	158	22	33	0	5	27	11	0	87	33	11	0	22	82	109
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	9.8	8.2	9	9.1
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	67%	74%	12%	10%
Vol Thru, %	25%	10%	62%	38%
Vol Right, %	8%	15%	25%	51%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	120	195	40	195
LT Vol	80	145	5	20
Through Vol	30	20	25	75
RT Vol	10	30	10	100
Lane Flow Rate	130	212	43	212
Geometry Grp	1	1	1	1
Degree of Util (X)	0.177	0.285	0.059	0.261
Departure Headway (Hd)	4.891	4.834	4.878	4.44
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	730	740	730	805
Service Time	2.942	2.881	2.939	2.484
HCM Lane V/C Ratio	0.178	0.286	0.059	0.263
HCM Control Delay	9	9.8	8.2	9.1
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.6	1.2	0.2	1

HCM Signalized Intersection Capacity Analysis
25: SW Macadam Ave & SW Hamilton St & SW Hood Ave

ALT 3_2035 AM (Adopted Option)

Movement	WBL	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SBR	SEL2	SEL	SER
Lane Configurations												
Volume (vph)	275	0	100	0	1655	355	0	0	0	275	600	600
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0	4.0					4.0	4.0
Lane Util. Factor	1.00	1.00			0.91	1.00					0.97	*0.95
Frt	1.00	0.85			1.00	0.85					1.00	1.00
Flt Protected	0.95	1.00			1.00	1.00					0.95	1.00
Satd. Flow (prot)	1770	1583			5085	1583					3090	3539
Flt Permitted	0.95	1.00			1.00	1.00					0.95	1.00
Satd. Flow (perm)	1770	1583			5085	1583					3090	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	289	0	105	0	1742	374	0	0	0	289	632	632
RTOR Reduction (vph)	0	83	0	0	0	151	0	0	0	0	0	168
Lane Group Flow (vph)	289	22	0	0	1742	223	0	0	0	0	921	464
Parking (#/hr)										0		
Turn Type	Prot	Prot			NA	Perm				Prot	Prot	custom
Protected Phases	8	8			2					6	6	6 2
Permitted Phases						2						
Actuated Green, G (s)	23.2	23.2			40.1	40.1					34.7	78.8
Effective Green, g (s)	23.2	23.2			40.1	40.1					34.7	78.8
Actuated g/C Ratio	0.21	0.21			0.36	0.36					0.32	0.72
Clearance Time (s)	4.0	4.0			4.0	4.0					4.0	
Vehicle Extension (s)	3.0	3.0			3.0	3.0					3.0	
Lane Grp Cap (vph)	373	333			1853	577					974	2535
v/s Ratio Prot	c0.16	0.01			c0.34						c0.30	0.13
v/s Ratio Perm						0.14						
v/c Ratio	0.77	0.07			0.94	0.39					0.95	0.18
Uniform Delay, d1	40.9	34.7			33.8	25.9					36.7	5.1
Progression Factor	0.81	1.00			0.99	1.20					1.00	1.00
Incremental Delay, d2	9.1	0.1			7.5	1.2					17.1	0.0
Delay (s)	42.4	34.8			40.8	32.3					53.8	5.1
Level of Service	D	C			D	C					D	A
Approach Delay (s)	40.4				39.3			0.0			34.0	
Approach LOS	D				D			A			C	

Intersection Summary			
HCM 2000 Control Delay	37.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
29: Moody Ave & SW Hamilton St

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	800	155	0	0	0	105	0	80	55	40	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0						4.0			4.0	4.0
Lane Util. Factor		0.95						1.00			1.00	0.88
Frt		0.98						0.94			1.00	0.85
Flt Protected		1.00						0.97			0.97	1.00
Satd. Flow (prot)		3453						1706			1810	2787
Flt Permitted		1.00						0.97			0.97	1.00
Satd. Flow (perm)		3453						1706			1810	2787
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)	0	870	168	0	0	0	114	0	87	60	43	293
RTOR Reduction (vph)	0	10	0	0	0	0	0	43	0	0	0	260
Lane Group Flow (vph)	0	1028	0	0	0	0	0	158	0	0	103	33
Turn Type		NA					Split	NA		Split	NA	Prot
Protected Phases		8					2	2		6	6	6
Permitted Phases												
Actuated Green, G (s)		70.2						15.3			12.5	12.5
Effective Green, g (s)		70.2						15.3			12.5	12.5
Actuated g/C Ratio		0.64						0.14			0.11	0.11
Clearance Time (s)		4.0						4.0			4.0	4.0
Vehicle Extension (s)		3.0						3.0			3.0	3.0
Lane Grp Cap (vph)		2203						237			205	316
v/s Ratio Prot		c0.30						c0.09			c0.06	0.01
v/s Ratio Perm												
v/c Ratio		0.47						0.67			0.50	0.11
Uniform Delay, d1		10.3						44.9			45.8	43.7
Progression Factor		0.87						1.00			1.00	1.65
Incremental Delay, d2		0.1						6.9			1.9	0.1
Delay (s)		9.0						51.8			47.5	72.3
Level of Service		A						D			D	E
Approach Delay (s)		9.0			0.0			51.8			65.9	
Approach LOS		A			A			D			E	

Intersection Summary			
HCM 2000 Control Delay	28.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Appendix D:

Recommended Alternative – AM Peak Hour Year 2035

Highway Capacity Manual Reports

HCM Signalized Intersection Capacity Analysis
1: SW Macadam Ave & I-5 NB Off Ramp/SW Curry St

Preferred Alt 2_2035 AM with Lowell Extension

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	295	0	0	0	0	0	0	2095	260	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	5.3							6.3				
Lane Util. Factor	0.97							0.95				
Frpb, ped/bikes	1.00							1.00				
Flpb, ped/bikes	1.00							1.00				
Frt	1.00							0.98				
Flt Protected	1.00							1.00				
Satd. Flow (prot)	3540							3470				
Flt Permitted	1.00							1.00				
Satd. Flow (perm)	3382							3470				
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	304	0	0	0	0	0	0	2160	268	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	8	0	0	0	0
Lane Group Flow (vph)	304	0	0	0	0	0	0	2420	0	0	0	0
Confl. Peds. (#/hr)									2			
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	9%	0%	0%	0%	0%	0%	0%	2%	3%	0%	0%	0%
Turn Type	Prot							NA				
Protected Phases	4							2				
Permitted Phases												
Actuated Green, G (s)	12.3							86.1				
Effective Green, g (s)	12.3							86.1				
Actuated g/C Ratio	0.11							0.78				
Clearance Time (s)	5.3							6.3				
Vehicle Extension (s)	2.0							2.0				
Lane Grp Cap (vph)	395							2716				
v/s Ratio Prot	c0.09							c0.70				
v/s Ratio Perm												
v/c Ratio	0.77							0.89				
Uniform Delay, d1	47.5							8.6				
Progression Factor	1.00							0.71				
Incremental Delay, d2	7.9							3.2				
Delay (s)	55.4							9.3				
Level of Service	E							A				
Approach Delay (s)		55.4			0.0			9.3			0.0	
Approach LOS		E			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	14.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	83.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: SW Macadam Ave & SW Gaines St

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	0	275	2080	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	5%		0%			0%
Total Lost time (s)		4.0	5.3			
Lane Util. Factor		0.88	0.95			
Frt		0.85	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		2691	3539			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		2691	3539			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	289	2189	0	0	0
RTOR Reduction (vph)	0	27	0	0	0	0
Lane Group Flow (vph)	0	262	2189	0	0	0
Heavy Vehicles (%)	0%	3%	2%	0%	0%	0%
Turn Type		Prot	NA			
Protected Phases		4	2			
Permitted Phases						
Actuated Green, G (s)		13.7	87.0			
Effective Green, g (s)		13.7	87.0			
Actuated g/C Ratio		0.12	0.79			
Clearance Time (s)		4.0	5.3			
Vehicle Extension (s)		0.5	2.0			
Lane Grp Cap (vph)		335	2799			
v/s Ratio Prot		c0.10	c0.62			
v/s Ratio Perm						
v/c Ratio		0.78	0.78			
Uniform Delay, d1		46.7	6.3			
Progression Factor		1.00	1.16			
Incremental Delay, d2		10.4	0.8			
Delay (s)		57.1	8.2			
Level of Service		E	A			
Approach Delay (s)	57.1		8.2			0.0
Approach LOS	E		A			A

Intersection Summary			
HCM 2000 Control Delay	13.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	125	1955	235	0	0
Conflicting Peds, #/hr	0	0	0	3	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	5	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	0	6	2	8	0	0
Mvmt Flow	0	132	2058	247	0	0

Major/Minor	Minor1		Major1	
Conflicting Flow All	2182	1152	0	0
Stage 1	2182	-	-	-
Stage 2	0	-	-	-
Critical Hdwy	7.5	6.9	-	-
Critical Hdwy Stg 1	7.5	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-
Pot Cap-1 Maneuver	26	194	-	-
Stage 1	26	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	26	194	-	-
Mov Cap-2 Maneuver	26	-	-	-
Stage 1	26	-	-	-
Stage 2	-	-	-	-

Approach	WB	NB
HCM Control Delay, s	55.6	0
HCM LOS	F	

Minor Lane/Major Mvmt	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	194
HCM Lane V/C Ratio	-	-	0.678
HCM Control Delay (s)	-	-	55.6
HCM Lane LOS	-	-	F
HCM 95th %tile Q(veh)	-	-	4.1

Intersection	
Int Delay, s/veh	0.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	15	2175	435	0	0
Conflicting Peds, #/hr	0	0	0	3	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	5	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	2	2	0	0
Mvmt Flow	0	16	2364	473	0	0

Major/Minor	Minor1		Major1	
Conflicting Flow All	2601	1417	0	0
Stage 1	2601	-	-	-
Stage 2	0	-	-	-
Critical Hdwy	8.5	6.9	-	-
Critical Hdwy Stg 1	7.5	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-
Pot Cap-1 Maneuver	6	129	-	-
Stage 1	13	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	6	129	-	-
Mov Cap-2 Maneuver	6	-	-	-
Stage 1	13	-	-	-
Stage 2	-	-	-	-

Approach	WB	NB
HCM Control Delay, s	36.9	0
HCM LOS	E	

Minor Lane/Major Mvmt	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	129
HCM Lane V/C Ratio	-	-	0.126
HCM Control Delay (s)	-	-	36.9
HCM Lane LOS	-	-	E
HCM 95th %tile Q(veh)	-	-	0.4

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Preferred Alt 2_2035 AM with Lowell Extension

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	655	0	0	140	0	150	0	1805	235	0	0	0
Ideal Flow (vphpl)	1235	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	0.97			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	2189			1660		1449		3463				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	2189			1660		1449		3463				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	697	0	0	149	0	160	0	1920	250	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	7	0	0	0	0
Lane Group Flow (vph)	697	0	0	149	0	160	0	2163	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	31.8			37.0		110.0		63.5				
Effective Green, g (s)	31.8			37.0		104.7		63.5				
Actuated g/C Ratio	0.29			0.34		0.95		0.58				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	632			558		1379		1999				
v/s Ratio Prot	c0.32			c0.09				c0.62				
v/s Ratio Perm						0.11						
v/c Ratio	1.10			0.27		0.12		1.08				
Uniform Delay, d1	39.1			26.6		0.1		23.2				
Progression Factor	1.00			1.00		1.00		0.52				
Incremental Delay, d2	67.3			0.3		0.0		42.3				
Delay (s)	106.4			26.9		0.2		54.3				
Level of Service	F			C		A		D				
Approach Delay (s)		106.4			13.1			54.3			0.0	
Approach LOS		F			B			D			A	

Intersection Summary			
HCM 2000 Control Delay	61.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	110.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
6: SW Macadam Ave & SW Hamilton Ct

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	230	210	1830	300	185	740
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.3	5.3	3.5	5.3
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.91	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1719	1538	3539	1470	1770	3505
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1719	1538	3539	1470	1770	3505
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	242	221	1926	316	195	779
RTOR Reduction (vph)	0	176	0	88	0	0
Lane Group Flow (vph)	242	45	1926	228	195	779
Confl. Peds. (#/hr)	14			18	18	
Confl. Bikes (#/hr)				1		
Heavy Vehicles (%)	5%	5%	2%	0%	2%	3%
Turn Type	Prot	Prot	NA	Perm	Prot	NA
Protected Phases	3	3	6		5	2
Permitted Phases				6		
Actuated Green, G (s)	18.1	18.1	65.7	65.7	13.4	82.6
Effective Green, g (s)	18.1	18.1	65.7	65.7	13.4	82.6
Actuated g/C Ratio	0.16	0.16	0.60	0.60	0.12	0.75
Clearance Time (s)	4.0	4.0	5.3	5.3	3.5	5.3
Vehicle Extension (s)	3.0	3.0	1.2	1.2	0.2	1.2
Lane Grp Cap (vph)	282	253	2113	877	215	2631
v/s Ratio Prot	c0.14	0.03	c0.54		c0.11	0.22
v/s Ratio Perm				0.16		
v/c Ratio	0.86	0.18	0.91	0.26	0.91	0.30
Uniform Delay, d1	44.7	39.5	19.6	10.6	47.7	4.4
Progression Factor	1.00	1.00	1.00	1.00	1.08	0.81
Incremental Delay, d2	21.9	0.3	7.4	0.7	36.0	0.3
Delay (s)	66.6	39.9	27.0	11.3	87.6	3.9
Level of Service	E	D	C	B	F	A
Approach Delay (s)	53.8		24.8			20.6
Approach LOS	D		C			C

Intersection Summary			
HCM 2000 Control Delay	27.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.8
Intersection Capacity Utilization	84.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	12.4
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	0	180	80	0	40	0	0	0	0	0	0
Peak Hour Factor	0.92	0.91	0.91	0.91	0.92	0.91	0.91	0.91	0.92	0.91	0.91	0.91
Heavy Vehicles, %	2	1	3	4	2	2	0	4	2	0	0	0
Mvmt Flow	0	0	198	88	0	44	0	0	0	0	0	0
Number of Lanes	0	0	1	1	0	1	0	0	0	0	0	0

Approach	EB	WB
Opposing Approach	WB	EB
Opposing Lanes	1	2
Conflicting Approach Left	SB	
Conflicting Lanes Left	2	0
Conflicting Approach Right		SB
Conflicting Lanes Right	0	2
HCM Control Delay	11.2	10.2
HCM LOS	B	B

Lane	EBLn1	EBLn2	WBLn1	SBLn1	SBLn2
Vol Left, %	0%	0%	100%	40%	0%
Vol Thru, %	96%	0%	0%	60%	100%
Vol Right, %	4%	100%	0%	0%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	188	72	40	240	290
LT Vol	0	0	40	95	0
Through Vol	180	0	0	145	290
RT Vol	8	72	0	0	0
Lane Flow Rate	207	79	44	264	319
Geometry Grp	7	7	6	7	7
Degree of Util (X)	0.347	0.118	0.081	0.41	0.494
Departure Headway (Hd)	6.039	5.379	6.611	5.596	5.585
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	591	659	545	638	641
Service Time	3.831	3.17	4.611	3.385	3.374
HCM Lane V/C Ratio	0.35	0.12	0.081	0.414	0.498
HCM Control Delay	12.1	8.9	10.2	12.3	13.8
HCM Lane LOS	B	A	B	B	B
HCM 95th-tile Q	1.5	0.4	0.3	2	2.7

HCM Unsignalized Intersection Capacity Analysis
8: SW Moody Ave & SW Gaines St

Preferred Alt 2_2035 AM with Lowell Extension

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	45	105	0	0	0	0	130	255	170
Sign Control		Stop			Stop			Free			Free	
Grade		5%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	0	47	111	0	0	0	0	137	268	179
Pedestrians		34			27			16				
Lane Width (ft)		0.0			11.0			0.0				
Walking Speed (ft/s)		4.0			4.0			4.0				
Percent Blockage		0			2			0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								906				
pX, platoon unblocked												
vC, conflicting volume	721	693	274	451	782	27	481			27		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	721	693	274	451	782	27	481			27		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	89	62	100	100			91		
cM capacity (veh/h)	208	329	730	447	293	1027	1092			1552		

Direction, Lane #	WB 1	SB 1	SB 2
Volume Total	158	271	313
Volume Left	47	137	0
Volume Right	0	0	179
cSH	327	1552	1700
Volume to Capacity	0.48	0.09	0.18
Queue Length 95th (ft)	63	7	0
Control Delay (s)	25.9	4.2	0.0
Lane LOS	D	A	
Approach Delay (s)	25.9	1.9	
Approach LOS	D		

Intersection Summary				
Average Delay	7.0			
Intersection Capacity Utilization	31.9%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM 2010 AWSC
9: SW Bancroft St & SW Moody Ave

12/10/2015

Intersection	
Intersection Delay, s/veh	14.3
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	0	225	10	0	45	75	0	0	0	0	210
Peak Hour Factor	0.92	0.85	0.85	0.85	0.92	0.85	0.85	0.85	0.92	0.85	0.85	0.85
Heavy Vehicles, %	2	0	3	2	2	2	12	0	2	2	2	2
Mvmt Flow	0	0	265	12	0	53	88	0	0	0	0	247
Number of Lanes	0	0	1	0	0	0	1	0	0	0	0	1

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	2
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	2	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	2	1
HCM Control Delay	15.1	12.2	12.4
HCM LOS	C	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1	SBLn2
Vol Left, %	0%	0%	38%	26%	0%
Vol Thru, %	0%	96%	62%	74%	0%
Vol Right, %	100%	4%	0%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	210	235	120	270	215
LT Vol	0	0	45	70	0
Through Vol	0	225	75	200	0
RT Vol	210	10	0	0	215
Lane Flow Rate	247	276	141	318	253
Geometry Grp	5	2	2	7	7
Degree of Util (X)	0.388	0.481	0.266	0.574	0.39
Departure Headway (Hd)	5.754	6.258	6.788	6.51	5.545
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	630	570	532	550	642
Service Time	3.754	4.354	4.788	4.302	3.336
HCM Lane V/C Ratio	0.392	0.484	0.265	0.578	0.394
HCM Control Delay	12.4	15.1	12.2	17.8	11.9
HCM Lane LOS	B	C	B	C	B
HCM 95th-tile Q	1.8	2.6	1.1	3.6	1.8

Intersection	
Int Delay, s/veh	4.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	205	30	30	35	0	0	0	0	0	210	90
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	5	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	223	33	33	38	0	0	0	0	0	228	98

Major/Minor	Minor2			Minor1						Major2		
Conflicting Flow All	296	277	162	226	326	0				0	0	0
Stage 1	277	277	-	0	0	-				-	-	-
Stage 2	19	0	-	226	326	-				-	-	-
Critical Hdwy	7.84	7.54	7.44	6.84	6.54	-				-	-	-
Critical Hdwy Stg 1	6.84	6.54	-	-	-	-				-	-	-
Critical Hdwy Stg 2	-	-	-	5.84	5.54	-				-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	-				-	-	-
Pot Cap-1 Maneuver	618	583	835	742	591	-				-	-	-
Stage 1	690	629	-	-	-	-				-	-	-
Stage 2	-	-	-	790	647	-				-	-	-
Platoon blocked, %											-	-
Mov Cap-1 Maneuver	618	0	835	742	0	-				-	-	-
Mov Cap-2 Maneuver	618	0	-	742	0	-				-	-	-
Stage 1	690	0	-	-	0	-				-	-	-
Stage 2	-	0	-	790	0	-				-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	11.2		0
HCM LOS	B	-	

Minor Lane/Major Mvmt	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	835	-	-	-	-
HCM Lane V/C Ratio	0.306	-	-	-	-
HCM Control Delay (s)	11.2	-	0	-	-
HCM Lane LOS	B	-	A	-	-
HCM 95th %tile Q(veh)	1.3	-	-	-	-

Intersection	
Intersection Delay, s/veh	17.6
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	195	60	230	0	10	50	5	0	165	10	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	212	65	250	0	11	54	5	0	179	11	5
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	23.2	10.2	12.5
HCM LOS	C	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	92%	40%	15%	4%
Vol Thru, %	6%	12%	77%	8%
Vol Right, %	3%	47%	8%	88%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	180	485	65	255
LT Vol	165	195	10	10
Through Vol	10	60	50	20
RT Vol	5	230	5	225
Lane Flow Rate	196	527	71	277
Geometry Grp	1	1	1	1
Degree of Util (X)	0.339	0.764	0.122	0.419
Departure Headway (Hd)	6.243	5.216	6.204	5.443
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	571	691	572	657
Service Time	4.326	3.274	4.3	3.519
HCM Lane V/C Ratio	0.343	0.763	0.124	0.422
HCM Control Delay	12.5	23.2	10.2	12.4
HCM Lane LOS	B	C	B	B
HCM 95th-tile Q	1.5	7.2	0.4	2.1

HCM Signalized Intersection Capacity Analysis
28: SW Moody Ave & SW Lowell St

Preferred Alt 2_2035 AM with Lowell Extension

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	265	170	70	5	0	0	0	0	15	245	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0						4.0	
Lane Util. Factor		1.00			1.00						0.95	
Frt		0.95			1.00						0.99	
Flt Protected		1.00			0.96						1.00	
Satd. Flow (prot)		1764			1779						3510	
Flt Permitted		1.00			0.58						1.00	
Satd. Flow (perm)		1764			1079						3510	
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)	0	288	185	76	5	0	0	0	0	16	266	11
RTOR Reduction (vph)	0	40	0	0	0	0	0	0	0	0	5	0
Lane Group Flow (vph)	0	433	0	0	81	0	0	0	0	0	288	0
Turn Type		NA		pm+pt	NA					Perm	NA	
Protected Phases		4		3	8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		12.7			12.7						8.3	
Effective Green, g (s)		12.7			12.7						8.3	
Actuated g/C Ratio		0.44			0.44						0.29	
Clearance Time (s)		4.0			4.0						4.0	
Vehicle Extension (s)		3.0			3.0						3.0	
Lane Grp Cap (vph)		772			472						1004	
v/s Ratio Prot		c0.25										
v/s Ratio Perm					0.08						0.08	
v/c Ratio		0.56			0.17						0.29	
Uniform Delay, d1		6.1			5.0						8.0	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.9			0.2						0.2	
Delay (s)		7.0			5.1						8.2	
Level of Service		A			A						A	
Approach Delay (s)		7.0			5.1			0.0			8.2	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	29.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	46.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	655	0	0	140	0	150	0	1805	235	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	1.00			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1736			1660		1449		3463				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1736			1660		1449		3463				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	697	0	0	149	0	160	0	1920	250	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	7	0	0	0	0
Lane Group Flow (vph)	697	0	0	149	0	160	0	2163	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	34.8			40.0		110.0		60.5				
Effective Green, g (s)	34.8			40.0		104.7		60.5				
Actuated g/C Ratio	0.32			0.36		0.95		0.55				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	549			603		1379		1904				
v/s Ratio Prot	c0.40			c0.09				c0.62				
v/s Ratio Perm						0.11						
v/c Ratio	1.27			0.25		0.12		1.14				
Uniform Delay, d1	37.6			24.5		0.1		24.8				
Progression Factor	1.00			1.00		1.00		0.50				
Incremental Delay, d2	135.2			0.2		0.0		65.1				
Delay (s)	172.8			24.7		0.2		77.4				
Level of Service	F			C		A		E				
Approach Delay (s)		172.8			12.0			77.4			0.0	
Approach LOS		F			B			E			A	

Intersection Summary			
HCM 2000 Control Delay	91.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	117.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Appendix E:

Recommended Alternative – PM Peak Hour Year 2035

Highway Capacity Manual Reports

HCM Signalized Intersection Capacity Analysis
1: SW Macadam Ave & I-5 NB Off Ramp/SW Curry St

Preferred Alt 2_2035 PM with Lowell Extension

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	355	0	0	0	0	0	0	1850	180	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	5.3							6.3				
Lane Util. Factor	0.97							0.95				
Frpb, ped/bikes	1.00							1.00				
Flpb, ped/bikes	1.00							1.00				
Frt	1.00							0.99				
Flt Protected	1.00							1.00				
Satd. Flow (prot)	3540							3484				
Flt Permitted	1.00							1.00				
Satd. Flow (perm)	3382							3484				
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	370	0	0	0	0	0	0	1927	188	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	9	0	0	0	0
Lane Group Flow (vph)	370	0	0	0	0	0	0	2106	0	0	0	0
Confl. Peds. (#/hr)									2			
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	9%	0%	0%	0%	0%	0%	0%	2%	3%	0%	0%	0%
Turn Type	Prot							NA				
Protected Phases	4							2				
Permitted Phases												
Actuated Green, G (s)	11.3							57.1				
Effective Green, g (s)	11.3							57.1				
Actuated g/C Ratio	0.14							0.71				
Clearance Time (s)	5.3							6.3				
Vehicle Extension (s)	2.0							2.0				
Lane Grp Cap (vph)	500							2486				
v/s Ratio Prot	c0.10							c0.60				
v/s Ratio Perm												
v/c Ratio	0.74							0.85				
Uniform Delay, d1	32.9							8.3				
Progression Factor	1.00							0.81				
Incremental Delay, d2	4.9							2.7				
Delay (s)	37.9							9.5				
Level of Service	D							A				
Approach Delay (s)		37.9			0.0			9.5			0.0	
Approach LOS		D			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	13.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	75.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: SW Macadam Ave & SW Gaines St

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	0	390	1640	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	5%		0%			0%
Total Lost time (s)		4.0	5.3			
Lane Util. Factor		0.88	0.95			
Frt		0.85	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		2691	3539			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		2691	3539			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	424	1783	0	0	0
RTOR Reduction (vph)	0	40	0	0	0	0
Lane Group Flow (vph)	0	384	1783	0	0	0
Heavy Vehicles (%)	0%	3%	2%	0%	0%	0%
Turn Type		Prot	NA			
Protected Phases		4	2			
Permitted Phases						
Actuated Green, G (s)		14.0	56.7			
Effective Green, g (s)		14.0	56.7			
Actuated g/C Ratio		0.18	0.71			
Clearance Time (s)		4.0	5.3			
Vehicle Extension (s)		0.5	2.0			
Lane Grp Cap (vph)		470	2508			
v/s Ratio Prot		c0.14	c0.50			
v/s Ratio Perm						
v/c Ratio		0.82	0.71			
Uniform Delay, d1		31.8	6.8			
Progression Factor		1.00	1.00			
Incremental Delay, d2		10.0	1.7			
Delay (s)		41.7	8.6			
Level of Service		D	A			
Approach Delay (s)	41.7		8.6			0.0
Approach LOS	D		A			A

Intersection Summary			
HCM 2000 Control Delay	15.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	66.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	3.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	150	1490	90	0	0
Conflicting Peds, #/hr	0	0	0	3	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	5	-	0	-	-	0
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	0	6	2	8	0	0
Mvmt Flow	0	172	1713	103	0	0

Major/Minor	Minor1		Major1	
Conflicting Flow All	1764	907	0	0
Stage 1	1764	-	-	-
Stage 2	0	-	-	-
Critical Hdwy	7.5	6.9	-	-
Critical Hdwy Stg 1	7.5	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-
Pot Cap-1 Maneuver	55	282	-	-
Stage 1	55	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	55	282	-	-
Mov Cap-2 Maneuver	55	-	-	-
Stage 1	55	-	-	-
Stage 2	-	-	-	-

Approach	WB	NB
HCM Control Delay, s	36	0
HCM LOS	E	

Minor Lane/Major Mvmt	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	282
HCM Lane V/C Ratio	-	-	0.611
HCM Control Delay (s)	-	-	36
HCM Lane LOS	-	-	E
HCM 95th %tile Q(veh)	-	-	3.7

Intersection	
Int Delay, s/veh	0.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	40	1540	350	0	0
Conflicting Peds, #/hr	0	0	0	3	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	5	-	0	-	-	0
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	0	0	2	2	0	0
Mvmt Flow	0	46	1770	402	0	0

Major/Minor	Minor1		Major1	
Conflicting Flow All	1971	1085	0	0
Stage 1	1971	-	-	-
Stage 2	0	-	-	-
Critical Hdwy	8.5	6.9	-	-
Critical Hdwy Stg 1	7.5	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-
Pot Cap-1 Maneuver	22	215	-	-
Stage 1	38	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	22	215	-	-
Mov Cap-2 Maneuver	22	-	-	-
Stage 1	38	-	-	-
Stage 2	-	-	-	-

Approach	WB	NB
HCM Control Delay, s	26.2	0
HCM LOS	D	

Minor Lane/Major Mvmt	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	215
HCM Lane V/C Ratio	-	-	0.214
HCM Control Delay (s)	-	-	26.2
HCM Lane LOS	-	-	D
HCM 95th %tile Q(veh)	-	-	0.8

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	455	0	0	210	0	120	0	1315	180	0	0	0
Ideal Flow (vphpl)	1235	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	0.97			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	2189			1660		1449		3460				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	2189			1660		1449		3460				
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)	495	0	0	228	0	130	0	1429	196	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	6	0	0	0	0
Lane Group Flow (vph)	495	0	0	228	0	130	0	1619	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	30.1			35.3		110.0		65.2				
Effective Green, g (s)	30.1			35.3		104.7		65.2				
Actuated g/C Ratio	0.27			0.32		0.95		0.59				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	598			532		1379		2050				
v/s Ratio Prot	c0.23			c0.14				c0.47				
v/s Ratio Perm						0.09						
v/c Ratio	0.83			0.43		0.09		0.79				
Uniform Delay, d1	37.5			29.4		0.1		17.2				
Progression Factor	1.00			1.00		1.00		0.42				
Incremental Delay, d2	8.8			0.6		0.0		2.2				
Delay (s)	46.3			30.0		0.2		9.4				
Level of Service	D			C		A		A				
Approach Delay (s)		46.3			19.1			9.4			0.0	
Approach LOS		D			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	18.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	84.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
6: SW Macadam Ave & SW Hamilton Ct

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	325	200	1295	270	150	1040
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.3	5.3	3.5	5.3
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.91	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1719	1538	3539	1470	1770	3505
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1719	1538	3539	1470	1770	3505
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	357	220	1423	297	165	1143
RTOR Reduction (vph)	0	167	0	109	0	0
Lane Group Flow (vph)	357	53	1423	188	165	1143
Confl. Peds. (#/hr)	14			18	18	
Confl. Bikes (#/hr)				1		
Heavy Vehicles (%)	5%	5%	2%	0%	2%	3%
Turn Type	Prot	Prot	NA	Perm	Prot	NA
Protected Phases	3	3	6		5	2
Permitted Phases				6		
Actuated Green, G (s)	26.3	26.3	58.2	58.2	12.7	74.4
Effective Green, g (s)	26.3	26.3	58.2	58.2	12.7	74.4
Actuated g/C Ratio	0.24	0.24	0.53	0.53	0.12	0.68
Clearance Time (s)	4.0	4.0	5.3	5.3	3.5	5.3
Vehicle Extension (s)	3.0	3.0	1.2	1.2	0.2	1.2
Lane Grp Cap (vph)	410	367	1872	777	204	2370
v/s Ratio Prot	c0.21	0.03	c0.40		c0.09	0.33
v/s Ratio Perm				0.13		
v/c Ratio	0.87	0.14	0.76	0.24	0.81	0.48
Uniform Delay, d1	40.2	33.0	20.4	14.0	47.5	8.5
Progression Factor	1.00	1.00	1.00	1.00	1.03	0.82
Incremental Delay, d2	17.9	0.2	3.0	0.7	19.5	0.7
Delay (s)	58.1	33.2	23.4	14.7	68.2	7.7
Level of Service	E	C	C	B	E	A
Approach Delay (s)	48.6		21.9			15.3
Approach LOS	D		C			B

Intersection Summary			
HCM 2000 Control Delay	23.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.8
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	21.5
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	0	125	55	0	95	0	0	0	0	0	0
Peak Hour Factor	0.92	0.93	0.93	0.93	0.92	0.93	0.93	0.93	0.92	0.93	0.93	0.93
Heavy Vehicles, %	2	1	3	4	2	2	0	4	2	0	0	0
Mvmt Flow	0	0	134	59	0	102	0	0	0	0	0	0
Number of Lanes	0	0	1	1	0	1	0	0	0	0	0	0

Approach	EB	WB
Opposing Approach	WB	EB
Opposing Lanes	1	2
Conflicting Approach Left	SB	
Conflicting Lanes Left	2	0
Conflicting Approach Right		SB
Conflicting Lanes Right	0	2
HCM Control Delay	11.4	11.7
HCM LOS	B	B

Lane	EBLn1	EBLn2	WBLn1	SBLn1	SBLn2
Vol Left, %	0%	0%	100%	19%	0%
Vol Thru, %	96%	0%	0%	81%	100%
Vol Right, %	4%	100%	0%	0%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	131	50	95	313	507
LT Vol	0	0	95	60	0
Through Vol	125	0	0	253	507
RT Vol	6	50	0	0	0
Lane Flow Rate	140	53	102	337	545
Geometry Grp	7	7	6	7	7
Degree of Util (X)	0.268	0.092	0.198	0.513	0.844
Departure Headway (Hd)	6.865	6.2	6.974	5.603	5.695
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	526	581	517	647	643
Service Time	4.569	3.904	4.983	3.303	3.395
HCM Lane V/C Ratio	0.266	0.091	0.197	0.521	0.848
HCM Control Delay	12.1	9.5	11.7	14.1	31.6
HCM Lane LOS	B	A	B	B	D
HCM 95th-tile Q	1.1	0.3	0.7	2.9	9.3

HCM Unsignalized Intersection Capacity Analysis
8: SW Moody Ave & SW Gaines St

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	70	65	0	0	0	0	155	430	325
Sign Control		Stop			Stop			Free			Free	
Grade		5%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	0	76	71	0	0	0	0	168	467	353
Pedestrians		34			27			16				
Lane Width (ft)		0.0			11.0			0.0				
Walking Speed (ft/s)		4.0			4.0			4.0				
Percent Blockage		0			2			0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								906				
pX, platoon unblocked												
vC, conflicting volume	1050	1042	460	614	1219	27	855			27		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1050	1042	460	614	1219	27	855			27		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	77	56	100	100			89		
cM capacity (veh/h)	109	202	553	336	159	1027	794			1552		

Direction, Lane #	WB 1	SB 1	SB 2
Volume Total	147	402	587
Volume Left	76	168	0
Volume Right	0	0	353
cSH	219	1552	1700
Volume to Capacity	0.67	0.11	0.35
Queue Length 95th (ft)	104	9	0
Control Delay (s)	49.7	3.7	0.0
Lane LOS	E	A	
Approach Delay (s)	49.7	1.5	
Approach LOS	E		

Intersection Summary				
Average Delay	7.7			
Intersection Capacity Utilization	41.8%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM 2010 AWSC
9: SW Bancroft St & SW Moody Ave

12/10/2015

Intersection	
Intersection Delay, s/veh	12.2
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	0	155	25	0	35	90	0	0	0	0	205
Peak Hour Factor	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	0	3	2	2	2	12	0	2	2	2	2
Mvmt Flow	0	0	172	28	0	39	100	0	0	0	0	228
Number of Lanes	0	0	1	0	0	0	1	0	0	0	0	1

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	2
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	2	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	2	1
HCM Control Delay	12.1	11.3	10.9
HCM LOS	B	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1	SBLn2
Vol Left, %	0%	0%	28%	29%	0%
Vol Thru, %	0%	86%	72%	71%	0%
Vol Right, %	100%	14%	0%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	205	180	125	260	240
LT Vol	0	0	35	75	0
Through Vol	0	155	90	185	0
RT Vol	205	25	0	0	240
Lane Flow Rate	228	200	139	289	267
Geometry Grp	5	2	2	7	7
Degree of Util (X)	0.332	0.333	0.241	0.494	0.383
Departure Headway (Hd)	5.24	5.999	6.258	6.152	5.176
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	683	598	571	584	693
Service Time	3.297	4.058	4.322	3.9	2.924
HCM Lane V/C Ratio	0.334	0.334	0.243	0.495	0.385
HCM Control Delay	10.9	12.1	11.3	14.8	11.1
HCM Lane LOS	B	B	B	B	B
HCM 95th-tile Q	1.5	1.5	0.9	2.7	1.8

Intersection	
Int Delay, s/veh	1.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	60	30	10	25	0	0	0	0	0	375	125
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	5	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	65	33	11	27	0	0	0	0	0	408	136

Major/Minor	Minor2			Minor1						Major2		
Conflicting Flow All	490	476	271	236	543	0				0	0	0
Stage 1	476	476	-	0	0	-				-	-	-
Stage 2	14	0	-	236	543	-				-	-	-
Critical Hdwy	7.84	7.54	7.44	6.84	6.54	-				-	-	-
Critical Hdwy Stg 1	6.84	6.54	-	-	-	-				-	-	-
Critical Hdwy Stg 2	-	-	-	5.84	5.54	-				-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	-				-	-	-
Pot Cap-1 Maneuver	443	426	700	731	445	-				-	-	-
Stage 1	518	486	-	-	-	-				-	-	-
Stage 2	-	-	-	781	518	-				-	-	-
Platoon blocked, %											-	-
Mov Cap-1 Maneuver	443	0	700	731	0	-				-	-	-
Mov Cap-2 Maneuver	443	0	-	731	0	-				-	-	-
Stage 1	518	0	-	-	0	-				-	-	-
Stage 2	-	0	-	781	0	-				-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	11		0
HCM LOS	B	-	

Minor Lane/Major Mvmt	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	700	-	-	-	-
HCM Lane V/C Ratio	0.14	-	-	-	-
HCM Control Delay (s)	11	-	0	-	-
HCM Lane LOS	B	-	A	-	-
HCM 95th %tile Q(veh)	0.5	-	-	-	-

Intersection	
Intersection Delay, s/veh	16.5
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	185	55	180	0	10	50	10	0	255	10	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	201	60	196	0	11	54	11	0	277	11	5
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	20.6	10.5	15.3
HCM LOS	C	B	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	94%	44%	14%	4%
Vol Thru, %	4%	13%	71%	6%
Vol Right, %	2%	43%	14%	90%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	270	420	70	245
LT Vol	255	185	10	10
Through Vol	10	55	50	15
RT Vol	5	180	10	220
Lane Flow Rate	293	457	76	266
Geometry Grp	1	1	1	1
Degree of Util (X)	0.499	0.7	0.138	0.408
Departure Headway (Hd)	6.122	5.517	6.51	5.613
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	584	648	554	644
Service Time	4.219	3.596	4.51	3.613
HCM Lane V/C Ratio	0.502	0.705	0.137	0.413
HCM Control Delay	15.3	20.6	10.5	12.4
HCM Lane LOS	C	C	B	B
HCM 95th-tile Q	2.8	5.7	0.5	2

HCM Signalized Intersection Capacity Analysis
28: SW Moody Ave & SW Lowell St

Preferred Alt 2_2035 PM with Lowell Extension

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	245	105	20	15	0	0	0	0	15	375	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0						4.0	
Lane Util. Factor		1.00			1.00						0.95	
Frt		0.96			1.00						0.99	
Flt Protected		1.00			0.97						1.00	
Satd. Flow (prot)		1787			1810						3501	
Flt Permitted		1.00			0.77						1.00	
Satd. Flow (perm)		1787			1441						3501	
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)	0	266	114	22	16	0	0	0	0	16	408	27
RTOR Reduction (vph)	0	28	0	0	0	0	0	0	0	0	9	0
Lane Group Flow (vph)	0	352	0	0	38	0	0	0	0	0	442	0
Turn Type		NA		pm+pt	NA					Perm	NA	
Protected Phases		4		3	8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		11.5			11.5						10.1	
Effective Green, g (s)		11.5			11.5						10.1	
Actuated g/C Ratio		0.39			0.39						0.34	
Clearance Time (s)		4.0			4.0						4.0	
Vehicle Extension (s)		3.0			3.0						3.0	
Lane Grp Cap (vph)		694			559						1194	
v/s Ratio Prot		c0.20										
v/s Ratio Perm					0.03						0.13	
v/c Ratio		0.51			0.07						0.37	
Uniform Delay, d1		6.9			5.7						7.4	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.6			0.1						0.2	
Delay (s)		7.5			5.7						7.5	
Level of Service		A			A						A	
Approach Delay (s)		7.5			5.7			0.0			7.5	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	29.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	37.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Preferred Alt 2_2035 PM with Lowell Extension

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	455	0	0	210	0	120	0	1315	180	0	0	0
Ideal Flow (vphpl)	1235	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	1.00			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1670			1660		1449		3460				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1670			1660		1449		3460				
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)	495	0	0	228	0	130	0	1429	196	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	7	0	0	0	0
Lane Group Flow (vph)	495	0	0	228	0	130	0	1618	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	33.9			39.1		110.0		61.4				
Effective Green, g (s)	33.9			39.1		104.7		61.4				
Actuated g/C Ratio	0.31			0.36		0.95		0.56				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	514			590		1379		1931				
v/s Ratio Prot	c0.30			c0.14				c0.47				
v/s Ratio Perm						0.09						
v/c Ratio	0.96			0.39		0.09		0.84				
Uniform Delay, d1	37.4			26.5		0.1		20.2				
Progression Factor	1.00			1.00		1.00		0.44				
Incremental Delay, d2	30.1			0.4		0.0		3.2				
Delay (s)	67.6			26.9		0.2		12.1				
Level of Service	E			C		A		B				
Approach Delay (s)		67.6			17.2			12.1			0.0	
Approach LOS		E			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	23.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	103.0%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Appendix F:

Vehicle Queuing Analysis –

Recommended Alternative

AM Peak Hour Year 2035

Queuing and Blocking Report
Preferred Alt 2_2035 AM with Lowell Extension

3/18/2015

Intersection: 1: SW Macadam Ave & I-5 NB Off Ramp/SW Curry St

Movement	EB	EB	NB	NB
Directions Served	L	L	T	TR
Maximum Queue (ft)	227	204	384	397
Average Queue (ft)	123	76	206	234
95th Queue (ft)	193	168	348	373
Link Distance (ft)	1051	1051	429	429
Upstream Blk Time (%)			0	0
Queuing Penalty (veh)			0	1
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: SW Macadam Ave & SW Gaines St

Movement	WB	WB	NB	NB
Directions Served	R	R	T	T
Maximum Queue (ft)	138	154	270	305
Average Queue (ft)	66	78	127	155
95th Queue (ft)	114	128	218	250
Link Distance (ft)	187	187	477	477
Upstream Blk Time (%)	0	0		
Queuing Penalty (veh)	0	0		
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: SW Macadam Ave & SW Abernethy St

Movement	WB	NB	NB
Directions Served	R	T	TR
Maximum Queue (ft)	121	55	48
Average Queue (ft)	55	6	7
95th Queue (ft)	98	76	83
Link Distance (ft)	149	335	335
Upstream Blk Time (%)	0	2	2
Queuing Penalty (veh)	0	17	18
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Queuing and Blocking Report
Preferred Alt 2_2035 AM with Lowell Extension

3/18/2015

Intersection: 4: SW Macadam Ave & SW Lowell St

Movement	WB	NB	NB
Directions Served	R	T	TR
Maximum Queue (ft)	52	275	363
Average Queue (ft)	14	30	73
95th Queue (ft)	44	180	293
Link Distance (ft)	135	342	342
Upstream Blk Time (%)		2	3
Queuing Penalty (veh)		27	36
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Movement	EB	EB	WB	WB	NB	NB
Directions Served	L	L	L	R	T	TR
Maximum Queue (ft)	100	450	214	125	355	361
Average Queue (ft)	96	416	143	106	332	335
95th Queue (ft)	110	432	243	155	343	349
Link Distance (ft)		340	152		268	268
Upstream Blk Time (%)		67	31		56	62
Queuing Penalty (veh)		437	91		566	630
Storage Bay Dist (ft)	75			100		
Storage Blk Time (%)	42	63	10	45		
Queuing Penalty (veh)	137	206	15	64		

Since EB queues are greater than link length, go to link 26 for complete results:
50th = 340+2450=2790
95th = 340+4350=4690
Since NB queues are greater than link length, go to link 25 and link 6 for complete results:
50th = 268 + 777+2200= 3250
95th = 268 + 777+2550= 3600

Intersection: 6: SW Macadam Ave & SW Hamilton Ct

Movement	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	R	T	T	R	L	T	T
Maximum Queue (ft)	239	214	2286	2281	225	225	653	594
Average Queue (ft)	208	186	2206	2207	185	209	444	336
95th Queue (ft)	275	247	2532	2523	323	273	880	814
Link Distance (ft)	214		2224	2224			777	777
Upstream Blk Time (%)	33	8	72	86			8	9
Queuing Penalty (veh)	145	0	0	0			34	41
Storage Bay Dist (ft)		200			200	200		
Storage Blk Time (%)	35	17		63	1	74	1	
Queuing Penalty (veh)	73	38		189	6	271	2	

Queuing and Blocking Report
Recommended Alt_2035 AM

10/27/2015

Intersection: 9: SW Bancroft St & SW Moody Ave

Movement	EB	WB	NB	SB	SB
Directions Served	TR	LT	R	LT	R
Maximum Queue (ft)	151	104	109	154	161
Average Queue (ft)	63	49	45	69	59
95th Queue (ft)	115	86	80	124	117
Link Distance (ft)	152	2656	1114	338	338
Upstream Blk Time (%)	0				
Queuing Penalty (veh)	1				
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 17: SW Abernethy St & SW Moody Ave

Movement	EB	WB	SB	SB
Directions Served	TR	LT	T	TR
Maximum Queue (ft)	112	110	56	93
Average Queue (ft)	51	39	8	10
95th Queue (ft)	91	105	96	110
Link Distance (ft)	149	373	457	457
Upstream Blk Time (%)	2	0	1	1
Queuing Penalty (veh)	5	0	1	1
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 21: SW Hamilton Ct

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	175	127	265	580
Average Queue (ft)	101	45	101	260
95th Queue (ft)	152	96	231	693
Link Distance (ft)	214	441	358	1112
Upstream Blk Time (%)	0		1	
Queuing Penalty (veh)	0		0	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 25: SW Macadam Ave

Movement	NB	NB	SB	SE
Directions Served	T	T	T	R
Maximum Queue (ft)	820	814	53	157
Average Queue (ft)	780	786	6	55
95th Queue (ft)	828	810	43	272
Link Distance (ft)	777	777	268	382
Upstream Blk Time (%)	12	16		5
Queuing Penalty (veh)	117	159		40
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 26: SW Hood Ave

Movement	EB	EB
Directions Served	T	R
Maximum Queue (ft)	4115	4079
Average Queue (ft)	2453	2146
95th Queue (ft)	4333	4390
Link Distance (ft)	5693	5693
Upstream Blk Time (%)	0	0
Queuing Penalty (veh)	0	0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 28: SW Moody Ave & SW Lowell St

Movement	EB	WB	SB	SB
Directions Served	TR	LT	LT	TR
Maximum Queue (ft)	150	176	224	234
Average Queue (ft)	85	64	56	91
95th Queue (ft)	147	164	177	207
Link Distance (ft)	135	428	332	332
Upstream Blk Time (%)	6	1	2	3
Queuing Penalty (veh)	24	0	3	4
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 3438

Appendix G:

Vehicle Queuing Analysis –

Recommended Alternative

PM Peak Hour Year 2035

Queuing and Blocking Report
Preferred Alt 2_2035 PM with Lowell Extension

3/18/2015

Intersection: 1: SW Macadam Ave & I-5 NB Off Ramp/SW Curry St

Movement	EB	EB	NB	NB
Directions Served	L	L	T	TR
Maximum Queue (ft)	253	220	429	435
Average Queue (ft)	148	110	200	236
95th Queue (ft)	216	193	362	391
Link Distance (ft)	1051	1051	429	429
Upstream Blk Time (%)			0	0
Queuing Penalty (veh)			2	2
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: SW Macadam Ave & SW Gaines St

Movement	WB	WB	NB	NB
Directions Served	R	R	T	T
Maximum Queue (ft)	176	195	353	369
Average Queue (ft)	95	112	167	191
95th Queue (ft)	157	175	285	308
Link Distance (ft)	187	187	477	477
Upstream Blk Time (%)	0	1		
Queuing Penalty (veh)	0	1		
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: SW Macadam Ave & SW Abernethy St

Movement	WB	NB	NB
Directions Served	R	T	TR
Maximum Queue (ft)	155	14	14
Average Queue (ft)	74	0	0
95th Queue (ft)	128	9	8
Link Distance (ft)	149	335	335
Upstream Blk Time (%)	1		
Queuing Penalty (veh)	1		
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Queuing and Blocking Report
Preferred Alt 2_2035 PM with Lowell Extension

3/18/2015

Intersection: 4: SW Macadam Ave & SW Lowell St

Movement	WB	NB	NB
Directions Served	R	T	TR
Maximum Queue (ft)	64	114	242
Average Queue (ft)	29	7	23
95th Queue (ft)	59	68	125
Link Distance (ft)	135	342	342
Upstream Blk Time (%)			0
Queuing Penalty (veh)			1
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Movement	EB	EB	WB	WB	NB	NB
Directions Served	L	L	L	R	T	TR
Maximum Queue (ft)	100	417	199	125	362	353
Average Queue (ft)	92	273	129	83	328	329
95th Queue (ft)	118	435	220	153	381	371
Link Distance (ft)		340	152		268	268
Upstream Blk Time (%)		7	12		48	54
Queuing Penalty (veh)		31	41		360	404
Storage Bay Dist (ft)	75			100		
Storage Blk Time (%)	17	44	16	15		
Queuing Penalty (veh)	38	100	19	33		

Since EB queues are greater than link length, go to link 26 for complete results:
50th = 275
95th = 340+83=425
Since NB queues are greater than link length, go to link 25 and link 6 for complete results:
50th = 268 + 630 = 900
95th = 268 + 777+2294= 3350

Intersection: 6: SW Macadam Ave & SW Hamilton Ct

Movement	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	R	T	T	R	L	T	T
Maximum Queue (ft)	239	214	1608	1602	225	224	651	674
Average Queue (ft)	215	165	1078	1096	181	200	405	358
95th Queue (ft)	264	254	2294	2293	312	275	796	757
Link Distance (ft)	214		2224	2224			777	777
Upstream Blk Time (%)	29	2	10	13			2	2
Queuing Penalty (veh)	150	0	0	0			12	13
Storage Bay Dist (ft)		200			200	200		
Storage Blk Time (%)	32	5		45	1	65	1	
Queuing Penalty (veh)	63	17		120	4	335	2	

Queuing and Blocking Report
Recommended Alt_2035 PM

10/27/2015

Intersection: 9: SW Bancroft St & SW Moody Ave

Movement	EB	WB	NB	SB	SB
Directions Served	TR	LT	R	LT	R
Maximum Queue (ft)	146	145	99	180	181
Average Queue (ft)	65	55	48	75	74
95th Queue (ft)	120	118	80	140	161
Link Distance (ft)	152	2656	1114	338	338
Upstream Blk Time (%)	0				0
Queuing Penalty (veh)	1				1
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 17: SW Abernethy St & SW Moody Ave

Movement	EB	WB	SB	SB
Directions Served	TR	LT	T	TR
Maximum Queue (ft)	79	61	41	90
Average Queue (ft)	39	24	2	6
95th Queue (ft)	62	54	33	62
Link Distance (ft)	149	373	457	457
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 21: SW Hamilton Ct

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	201	110	313	402
Average Queue (ft)	112	42	178	155
95th Queue (ft)	170	81	390	353
Link Distance (ft)	214	441	358	1112
Upstream Blk Time (%)	0		19	
Queuing Penalty (veh)	1		0	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 25: SW Macadam Ave

Movement	NB	NB	SB	SE
Directions Served	T	T	T	R
Maximum Queue (ft)	802	800	45	143
Average Queue (ft)	611	631	3	18
95th Queue (ft)	1030	1041	36	131
Link Distance (ft)	777	777	268	382
Upstream Blk Time (%)	5	6		1
Queuing Penalty (veh)	34	48		5
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 26: SW Hood Ave

Movement	EB	EB
Directions Served	T	R
Maximum Queue (ft)	166	378
Average Queue (ft)	16	46
95th Queue (ft)	83	241
Link Distance (ft)	2662	2662
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 28: SW Moody Ave & SW Lowell St

Movement	EB	WB	SB	SB
Directions Served	TR	LT	LT	TR
Maximum Queue (ft)	150	72	149	203
Average Queue (ft)	96	30	48	92
95th Queue (ft)	149	66	130	177
Link Distance (ft)	135	428	332	332
Upstream Blk Time (%)	2		0	1
Queuing Penalty (veh)	7		0	2
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 1852

Appendix H:

Interim Year Capacity Analysis – AM Peak Hour

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Year 2020 AM Peak - 2 EBLs

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	480	0	0	110	0	95	0	1575	190	0	0	0
Ideal Flow (vphpl)	1235	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	0.97			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	2189			1660		1449		3468				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	2189			1660		1449		3468				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	511	0	0	117	0	101	0	1676	202	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	6	0	0	0	0
Lane Group Flow (vph)	511	0	0	117	0	101	0	1872	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	29.2			34.4		110.0		66.1				
Effective Green, g (s)	29.2			34.4		104.7		66.1				
Actuated g/C Ratio	0.27			0.31		0.95		0.60				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	581			519		1379		2083				
v/s Ratio Prot	c0.23			c0.07				c0.54				
v/s Ratio Perm						0.07						
v/c Ratio	0.88			0.23		0.07		0.90				
Uniform Delay, d1	38.7			27.9		0.1		19.1				
Progression Factor	1.00			1.00		1.00		0.46				
Incremental Delay, d2	13.8			0.2		0.0		4.5				
Delay (s)	52.5			28.2		0.2		13.2				
Level of Service	D			C		A		B				
Approach Delay (s)		52.5			15.2			13.2			0.0	
Approach LOS		D			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	21.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Year 2020 AM Peak Hour - Single EBL

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	480	0	0	110	0	95	0	1575	190	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	1.00			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1736			1660		1449		3468				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1736			1660		1449		3468				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	511	0	0	117	0	101	0	1676	202	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	6	0	0	0	0
Lane Group Flow (vph)	511	0	0	117	0	101	0	1872	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	33.8			39.0		110.0		61.5				
Effective Green, g (s)	33.8			39.0		104.7		61.5				
Actuated g/C Ratio	0.31			0.35		0.95		0.56				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	533			588		1379		1938				
v/s Ratio Prot	c0.29			c0.07				c0.54				
v/s Ratio Perm						0.07						
v/c Ratio	0.96			0.20		0.07		0.97				
Uniform Delay, d1	37.4			24.7		0.1		23.2				
Progression Factor	1.00			1.00		1.00		0.52				
Incremental Delay, d2	28.3			0.2		0.0		10.2				
Delay (s)	65.7			24.8		0.2		22.4				
Level of Service	E			C		A		C				
Approach Delay (s)		65.7			13.4			22.4			0.0	
Approach LOS		E			B			C			A	

Intersection Summary			
HCM 2000 Control Delay	30.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	96.7%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Year 2025 AM Peak - 2 EBLs

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	540	0	0	120	0	110	0	1650	205	0	0	0
Ideal Flow (vphpl)	1235	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	0.97			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	2189			1660		1449		3467				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	2189			1660		1449		3467				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	574	0	0	128	0	117	0	1755	218	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	6	0	0	0	0
Lane Group Flow (vph)	574	0	0	128	0	117	0	1967	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	30.2			35.4		110.0		65.1				
Effective Green, g (s)	30.2			35.4		104.7		65.1				
Actuated g/C Ratio	0.27			0.32		0.95		0.59				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	600			534		1379		2051				
v/s Ratio Prot	c0.26			c0.08				c0.57				
v/s Ratio Perm						0.08						
v/c Ratio	0.96			0.24		0.08		0.96				
Uniform Delay, d1	39.3			27.4		0.1		21.2				
Progression Factor	1.00			1.00		1.00		0.52				
Incremental Delay, d2	25.9			0.2		0.0		8.4				
Delay (s)	65.1			27.6		0.2		19.4				
Level of Service	E			C		A		B				
Approach Delay (s)		65.1			14.5			19.4			0.0	
Approach LOS		E			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	28.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	97.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Year 2025 AM Peak - single EBL

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	540	0	0	120	0	110	0	1650	205	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	1.00			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1736			1660		1449		3467				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1736			1660		1449		3467				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	574	0	0	128	0	117	0	1755	218	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	6	0	0	0	0
Lane Group Flow (vph)	574	0	0	128	0	117	0	1967	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	34.8			40.0		110.0		60.5				
Effective Green, g (s)	34.8			40.0		104.7		60.5				
Actuated g/C Ratio	0.32			0.36		0.95		0.55				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	549			603		1379		1906				
v/s Ratio Prot	c0.33			c0.08				c0.57				
v/s Ratio Perm						0.08						
v/c Ratio	1.05			0.21		0.08		1.03				
Uniform Delay, d1	37.6			24.1		0.1		24.8				
Progression Factor	1.00			1.00		1.00		0.54				
Incremental Delay, d2	50.8			0.2		0.0		24.9				
Delay (s)	88.4			24.3		0.2		38.3				
Level of Service	F			C		A		D				
Approach Delay (s)		88.4			12.8			38.3			0.0	
Approach LOS		F			B			D			A	

Intersection Summary			
HCM 2000 Control Delay	46.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	103.5%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Year 2030 AM Peak - 2 EBLs

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	595	0	0	130	0	130	0	1730	220	0	0	0
Ideal Flow (vphpl)	1235	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	0.97			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	2189			1660		1449		3465				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	2189			1660		1449		3465				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	633	0	0	138	0	138	0	1840	234	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	7	0	0	0	0
Lane Group Flow (vph)	633	0	0	138	0	138	0	2067	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	31.8			37.0		110.0		63.5				
Effective Green, g (s)	31.8			37.0		104.7		63.5				
Actuated g/C Ratio	0.29			0.34		0.95		0.58				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	632			558		1379		2000				
v/s Ratio Prot	c0.29			c0.08				c0.60				
v/s Ratio Perm						0.10						
v/c Ratio	1.00			0.25		0.10		1.03				
Uniform Delay, d1	39.1			26.4		0.1		23.2				
Progression Factor	1.00			1.00		1.00		0.52				
Incremental Delay, d2	36.2			0.2		0.0		24.6				
Delay (s)	75.3			26.7		0.2		36.8				
Level of Service	E			C		A		D				
Approach Delay (s)		75.3			13.4			36.8			0.0	
Approach LOS		E			B			D			A	

Intersection Summary			
HCM 2000 Control Delay	42.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	103.7%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Year 2030 AM Peak - Single EBL

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	595	0	0	130	0	130	0	1730	220	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	1.00			1.00		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1736			1660		1449		3465				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1736			1660		1449		3465				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	633	0	0	138	0	138	0	1840	234	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	7	0	0	0	0
Lane Group Flow (vph)	633	0	0	138	0	138	0	2067	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	35.8			41.0		110.0		59.5				
Effective Green, g (s)	35.8			41.0		104.7		59.5				
Actuated g/C Ratio	0.33			0.37		0.95		0.54				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	564			618		1379		1874				
v/s Ratio Prot	c0.36			c0.08				c0.60				
v/s Ratio Perm						0.10						
v/c Ratio	1.12			0.22		0.10		1.10				
Uniform Delay, d1	37.1			23.6		0.1		25.2				
Progression Factor	1.00			1.00		1.00		0.51				
Incremental Delay, d2	76.2			0.2		0.0		51.5				
Delay (s)	113.3			23.8		0.2		64.5				
Level of Service	F			C		A		E				
Approach Delay (s)		113.3			12.0			64.5			0.0	
Approach LOS		F			B			E			A	

Intersection Summary			
HCM 2000 Control Delay	70.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	110.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Appendix I:

Interim Year Queuing Analysis

Queuing and Blocking Report
Year 2020 AM Peak - 2 EBLs

4/12/2015

Intersection: 5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Movement	EB	EB	WB	WB	NB	NB
Directions Served	L	L	L	R	T	TR
Maximum Queue (ft)	100	434	176	125	348	370
Average Queue (ft)	94	343	74	38	332	334
95th Queue (ft)	116	490	148	105	340	349
Link Distance (ft)		340	152		268	268
Upstream Blk Time (%)		26	2		50	55
Queuing Penalty (veh)		125	3		441	482
Storage Bay Dist (ft)	75			100		
Storage Blk Time (%)	19	56	6	2		
Queuing Penalty (veh)	46	136	4	2		

Note - when the queue is longer than the link length, the EB through length from Int. 26 needs to be added for the cumulative queue distance

Intersection: 26: SW Hood Ave

Movement	EB	EB
Directions Served	T	R
Maximum Queue (ft)	483	380
Average Queue (ft)	130	61
95th Queue (ft)	498	421
Link Distance (ft)	5693	5693
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Since 343>340, average queue = 343+130=473

Zone Summary

Zone wide Queuing Penalty: 1239

Queuing and Blocking Report
Year 2020 AM Peak Hour - Single EBL

4/12/2015

Intersection: 5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Movement	EB	WB	WB	NB	NB
Directions Served	L	L	R	T	TR
Maximum Queue (ft)	420	167	120	357	378
Average Queue (ft)	373	64	33	338	340
95th Queue (ft)	481	134	98	347	355
Link Distance (ft)	347	154		273	273
Upstream Blk Time (%)	37	1		53	58
Queuing Penalty (veh)	181	2		466	514
Storage Bay Dist (ft)			100		
Storage Blk Time (%)		4	0		
Queuing Penalty (veh)		3	0		

Intersection: 26: SW Hood Ave

Movement	EB	EB
Directions Served	T	R
Maximum Queue (ft)	616	559
Average Queue (ft)	244	154
95th Queue (ft)	798	755
Link Distance (ft)	5693	5693
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 1166

Queuing and Blocking Report
Year 2025 AM Peak - 2 EBLs

4/12/2015

Intersection: 5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Movement	EB	EB	WB	WB	NB	NB
Directions Served	L	L	L	R	T	TR
Maximum Queue (ft)	100	436	198	125	364	374
Average Queue (ft)	96	403	112	86	333	336
95th Queue (ft)	112	470	208	158	347	353
Link Distance (ft)		340	152		268	268
Upstream Blk Time (%)		58	15		51	56
Queuing Penalty (veh)		311	35		473	522
Storage Bay Dist (ft)	75			100		
Storage Blk Time (%)	38	62	7	30		
Queuing Penalty (veh)	103	168	8	36		

Intersection: 26: SW Hood Ave

Movement	EB	EB
Directions Served	T	R
Maximum Queue (ft)	954	802
Average Queue (ft)	527	140
95th Queue (ft)	1215	667
Link Distance (ft)	5693	5693
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 1655

Queuing and Blocking Report
Year 2025 AM Peak - single EBL

4/12/2015

Intersection: 5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Movement	EB	WB	WB	NB	NB
Directions Served	L	L	R	T	TR
Maximum Queue (ft)	435	195	121	355	386
Average Queue (ft)	410	76	55	338	342
95th Queue (ft)	444	159	125	349	360
Link Distance (ft)	347	154		273	273
Upstream Blk Time (%)	65	2		53	59
Queuing Penalty (veh)	348	6		496	550
Storage Bay Dist (ft)			100		
Storage Blk Time (%)		6	2		
Queuing Penalty (veh)		7	3		

Intersection: 26: SW Hood Ave

Movement	EB	EB
Directions Served	T	R
Maximum Queue (ft)	1110	1010
Average Queue (ft)	696	191
95th Queue (ft)	1490	812
Link Distance (ft)	5693	5693
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 1409

Queuing and Blocking Report
Year 2030 AM Peak - 2 EBLs

4/12/2015

Intersection: 5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Movement	EB	EB	WB	WB	NB	NB
Directions Served	L	L	L	R	T	TR
Maximum Queue (ft)	100	459	204	125	357	376
Average Queue (ft)	96	414	121	94	332	335
95th Queue (ft)	107	444	219	153	342	351
Link Distance (ft)		340	152		268	268
Upstream Blk Time (%)		65	18		54	58
Queuing Penalty (veh)		385	46		522	566
Storage Bay Dist (ft)	75			100		
Storage Blk Time (%)	40	62	7	32		
Queuing Penalty (veh)	118	183	9	42		

Intersection: 26: SW Hood Ave

Movement	EB	EB
Directions Served	T	R
Maximum Queue (ft)	1750	1559
Average Queue (ft)	1107	465
95th Queue (ft)	1914	1361
Link Distance (ft)	5693	5693
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 1871

Queuing and Blocking Report
Year 2030 AM Peak - Single EBL

4/12/2015

Intersection: 5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

Movement	EB	WB	WB	NB	NB
Directions Served	L	L	R	T	TR
Maximum Queue (ft)	444	179	125	360	363
Average Queue (ft)	415	83	56	339	340
95th Queue (ft)	431	163	132	348	352
Link Distance (ft)	347	154		273	273
Upstream Blk Time (%)	70	3		54	59
Queuing Penalty (veh)	414	7		532	572
Storage Bay Dist (ft)			100		
Storage Blk Time (%)		6	3		
Queuing Penalty (veh)		7	3		

Intersection: 26: SW Hood Ave

Movement	EB	EB
Directions Served	T	R
Maximum Queue (ft)	1997	1792
Average Queue (ft)	1340	690
95th Queue (ft)	2396	1871
Link Distance (ft)	5693	5693
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 1535

Appendix J:

Moody/Bancroft Additional Analysis –

Queuing Without Moody Ave Extension (AM and PM 2035)

Queuing and Blocking Report
AM 2035 Without Moody extension

11/3/2015

Intersection: 9: SW Bancroft St & SW Moody Ave

Movement	EB	WB	SB	SB
Directions Served	T	T	L	R
Maximum Queue (ft)	166	156	296	423
Average Queue (ft)	87	73	67	148
95th Queue (ft)	149	137	151	390
Link Distance (ft)	145	2661	688	688
Upstream Blk Time (%)	3		0	0
Queuing Penalty (veh)	9		0	0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Queuing and Blocking Report
2035 PM withouth Moody extension

11/3/2015

Intersection: 9: SW Bancroft St & SW Moody Ave

Movement	EB	WB	SB	SB
Directions Served	T	T	L	R
Maximum Queue (ft)	167	142	333	380
Average Queue (ft)	87	55	104	274
95th Queue (ft)	151	103	305	441
Link Distance (ft)	159	2663	338	338
Upstream Blk Time (%)	1		2	16
Queuing Penalty (veh)	3		5	39
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Appendix K:

Moody/Bancroft Additional Analysis –

Queuing WITH Moody Ave Extension (AM and PM 2035)

Queuing and Blocking Report
Recommended Alt_2035 AM

10/27/2015

Intersection: 9: SW Bancroft St & SW Moody Ave

Movement	EB	WB	NB	SB	SB
Directions Served	TR	LT	R	LT	R
Maximum Queue (ft)	151	104	109	154	161
Average Queue (ft)	63	49	45	69	59
95th Queue (ft)	115	86	80	124	117
Link Distance (ft)	152	2656	1114	338	338
Upstream Blk Time (%)	0				
Queuing Penalty (veh)	1				
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Queuing and Blocking Report
Recommended Alt_2035 PM

10/27/2015

Intersection: 9: SW Bancroft St & SW Moody Ave

Movement	EB	WB	NB	SB	SB
Directions Served	TR	LT	R	LT	R
Maximum Queue (ft)	146	145	99	180	181
Average Queue (ft)	65	55	48	75	74
95th Queue (ft)	120	118	80	140	161
Link Distance (ft)	152	2656	1114	338	338
Upstream Blk Time (%)	0				0
Queuing Penalty (veh)	1				1
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Appendix L:

Moody/Bancroft Additional Analysis –

Eight Hour Signal Warrant Analysis

WITHOUT MOODY

8th Highest Hour Factor
0.65

	SB RT	SB LT	EB	WB	Total
2035 AM	270	175	300	125	870
65%	176	114	195	81	
Major Street Total - 2 lanes		289			
Minor Street Higher Approach		195			

	SB RT	SB LT	EB	WB	Total
2035 PM	425	75	250	90	840
65%	276	49	163	59	
Major Street Total - 2 lanes		325			
Minor Street Higher Approach		163			

WITH Moody

	SB RT	SB TH/LT	EB TH	EB RT	WB TH	WB LT	NB RT	Total
2035 AM	215	270	225	10	75	45	210	1050
65%	140	176	146	7	49	29	137	
Major Street Total - 2 lanes		452						
Minor Street Higher Approach		153						

	SB RT	SB TH/LT	EB TH	EB RT	WB TH	WB LT	NB RT	Total
2035 PM	240	260	155	25	90	35	210	1015
65%	156	169	101	16	59	23	137	
Major Street Total - 2 lanes		462						
Minor Street Higher Approach		117						

Appendix M:

Macadam/Bancroft Dual Westbound Left

Queuing Analysis

Capacity Analysis

Queuing and Blocking Report
2035 PM_WITH Moody extension_dual WBL test

10/27/2015

Intersection: 9: SW Bancroft St & SW Moody Ave

Movement	EB	WB	NB	SB	SB
Directions Served	TR	LT	R	LT	R
Maximum Queue (ft)	142	96	99	159	216
Average Queue (ft)	61	46	48	52	91
95th Queue (ft)	109	80	80	107	176
Link Distance (ft)	152	2656	1113	325	325
Upstream Blk Time (%)	0			0	0
Queuing Penalty (veh)	0			0	1
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Queuing and Blocking Report
Recommended Alt_2035 PM

10/27/2015

Intersection: 9: SW Bancroft St & SW Moody Ave

Movement	EB	WB	NB	SB	SB
Directions Served	TR	LT	R	LT	R
Maximum Queue (ft)	146	145	99	180	181
Average Queue (ft)	65	55	48	75	74
95th Queue (ft)	120	118	80	140	161
Link Distance (ft)	152	2656	1114	338	338
Upstream Blk Time (%)	0				0
Queuing Penalty (veh)	1				1
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Queuing and Blocking Report
AM 2035_WITH Moody_dual WBL test

10/27/2015

Intersection: 9: SW Bancroft St & SW Moody Ave

Movement	EB	WB	NB	SB	SB
Directions Served	TR	LT	R	LT	R
Maximum Queue (ft)	142	106	101	105	160
Average Queue (ft)	64	48	42	44	68
95th Queue (ft)	112	87	74	78	118
Link Distance (ft)	152	2656	1113	325	325
Upstream Blk Time (%)	0				
Queuing Penalty (veh)	0				
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Queuing and Blocking Report
Recommended Alt_2035 AM

10/27/2015

Intersection: 9: SW Bancroft St & SW Moody Ave

Movement	EB	WB	NB	SB	SB
Directions Served	TR	LT	R	LT	R
Maximum Queue (ft)	151	104	109	154	161
Average Queue (ft)	63	49	45	69	59
95th Queue (ft)	115	86	80	124	117
Link Distance (ft)	152	2656	1114	338	338
Upstream Blk Time (%)	0				
Queuing Penalty (veh)	1				
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

10/21/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	655	0	0	240	0	155	0	1810	300	0	0	0
Ideal Flow (vphpl)	1900	1800	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.0		4.0		5.3				
Lane Util. Factor	1.00			0.97		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1736			3221		1449		3446				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1736			3221		1449		3446				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	697	0	0	255	0	165	0	1926	319	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	8	0	9	0	0	0	0
Lane Group Flow (vph)	697	0	0	255	0	157	0	2236	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 7 2						
Actuated Green, G (s)	36.8			42.2		110.0		58.5				
Effective Green, g (s)	36.8			42.2		104.7		58.5				
Actuated g/C Ratio	0.33			0.38		0.95		0.53				
Clearance Time (s)	4.2			4.0				5.3				
Vehicle Extension (s)	0.5			3.0				2.0				
Lane Grp Cap (vph)	580			1235		1379		1832				
v/s Ratio Prot	c0.40			c0.08				c0.65				
v/s Ratio Perm						0.11						
v/c Ratio	1.20			0.21		0.11		1.22				
Uniform Delay, d1	36.6			22.7		0.1		25.8				
Progression Factor	1.00			1.00		1.00		0.76				
Incremental Delay, d2	106.5			0.1		0.0		103.2				
Delay (s)	143.1			22.8		0.2		122.7				
Level of Service	F			C		A		F				
Approach Delay (s)		143.1			13.9			122.7			0.0	
Approach LOS		F			B			F			A	

Intersection Summary			
HCM 2000 Control Delay	113.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.18		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	120.0%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

11/3/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	455	0	0	395	0	120	0	1315	250	0	0	0
Ideal Flow (vphpl)	1235	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	1.00			0.97		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1670			3221		1449		3434				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1670			3221		1449		3434				
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)	495	0	0	429	0	130	0	1429	272	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	6	0	11	0	0	0	0
Lane Group Flow (vph)	495	0	0	429	0	124	0	1690	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	33.9			39.1		110.0		61.4				
Effective Green, g (s)	33.9			39.1		104.7		61.4				
Actuated g/C Ratio	0.31			0.36		0.95		0.56				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	514			1144		1379		1916				
v/s Ratio Prot	c0.30			c0.13				c0.49				
v/s Ratio Perm						0.09						
v/c Ratio	0.96			0.38		0.09		0.88				
Uniform Delay, d1	37.4			26.4		0.1		21.2				
Progression Factor	1.00			1.00		1.00		0.57				
Incremental Delay, d2	30.1			0.2		0.0		5.7				
Delay (s)	67.6			26.6		0.2		17.6				
Level of Service	E			C		A		B				
Approach Delay (s)		67.6			20.4			17.6			0.0	
Approach LOS		E			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	27.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	105.2%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

10/21/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	655	0	0	240	0	150	0	1805	235	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	1.00			0.97		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1736			3221		1449		3463				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1736			3221		1449		3463				
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	697	0	0	255	0	160	0	1920	250	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	8	0	7	0	0	0	0
Lane Group Flow (vph)	697	0	0	255	0	152	0	2163	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	34.8			40.0		110.0		60.5				
Effective Green, g (s)	34.8			40.0		104.7		60.5				
Actuated g/C Ratio	0.32			0.36		0.95		0.55				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	549			1171		1379		1904				
v/s Ratio Prot	c0.40			c0.08				c0.62				
v/s Ratio Perm						0.11						
v/c Ratio	1.27			0.22		0.11		1.14				
Uniform Delay, d1	37.6			24.2		0.1		24.8				
Progression Factor	1.00			1.00		1.00		0.65				
Incremental Delay, d2	135.2			0.1		0.0		66.9				
Delay (s)	172.8			24.3		0.2		83.0				
Level of Service	F			C		A		F				
Approach Delay (s)		172.8			15.0			83.0			0.0	
Approach LOS		F			B			F			A	

Intersection Summary			
HCM 2000 Control Delay	93.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	117.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: SW Macadam Ave & SW Hood Ave/SW Bancroft St

10/21/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	455	0	0	310	0	120	0	1315	180	0	0	0
Ideal Flow (vphpl)	1235	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			5%			0%			0%	
Total Lost time (s)	4.2			4.2		4.2		5.3				
Lane Util. Factor	1.00			0.97		1.00		0.95				
Frpb, ped/bikes	1.00			1.00		0.98		1.00				
Flpb, ped/bikes	1.00			1.00		1.00		1.00				
Frt	1.00			1.00		0.85		0.98				
Flt Protected	0.95			0.95		1.00		1.00				
Satd. Flow (prot)	1670			3221		1449		3460				
Flt Permitted	0.95			0.95		1.00		1.00				
Satd. Flow (perm)	1670			3221		1449		3460				
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)	495	0	0	337	0	130	0	1429	196	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	6	0	7	0	0	0	0
Lane Group Flow (vph)	495	0	0	337	0	124	0	1618	0	0	0	0
Confl. Peds. (#/hr)	40					40			2			
Heavy Vehicles (%)	4%	0%	4%	6%	0%	6%	0%	2%	3%	0%	0%	0%
Turn Type	Prot			Prot		Perm		NA				
Protected Phases	7			4				2				
Permitted Phases						4 2 7						
Actuated Green, G (s)	33.9			39.1		110.0		61.4				
Effective Green, g (s)	33.9			39.1		104.7		61.4				
Actuated g/C Ratio	0.31			0.36		0.95		0.56				
Clearance Time (s)	4.2			4.2				5.3				
Vehicle Extension (s)	2.0			3.0				2.0				
Lane Grp Cap (vph)	514			1144		1379		1931				
v/s Ratio Prot	c0.30			c0.10				c0.47				
v/s Ratio Perm						0.09						
v/c Ratio	0.96			0.29		0.09		0.84				
Uniform Delay, d1	37.4			25.5		0.1		20.2				
Progression Factor	1.00			1.00		1.00		0.57				
Incremental Delay, d2	30.1			0.1		0.0		4.1				
Delay (s)	67.6			25.7		0.2		15.6				
Level of Service	E			C		A		B				
Approach Delay (s)		67.6			18.6			15.6			0.0	
Approach LOS		E			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	26.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	103.0%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Appendix N:

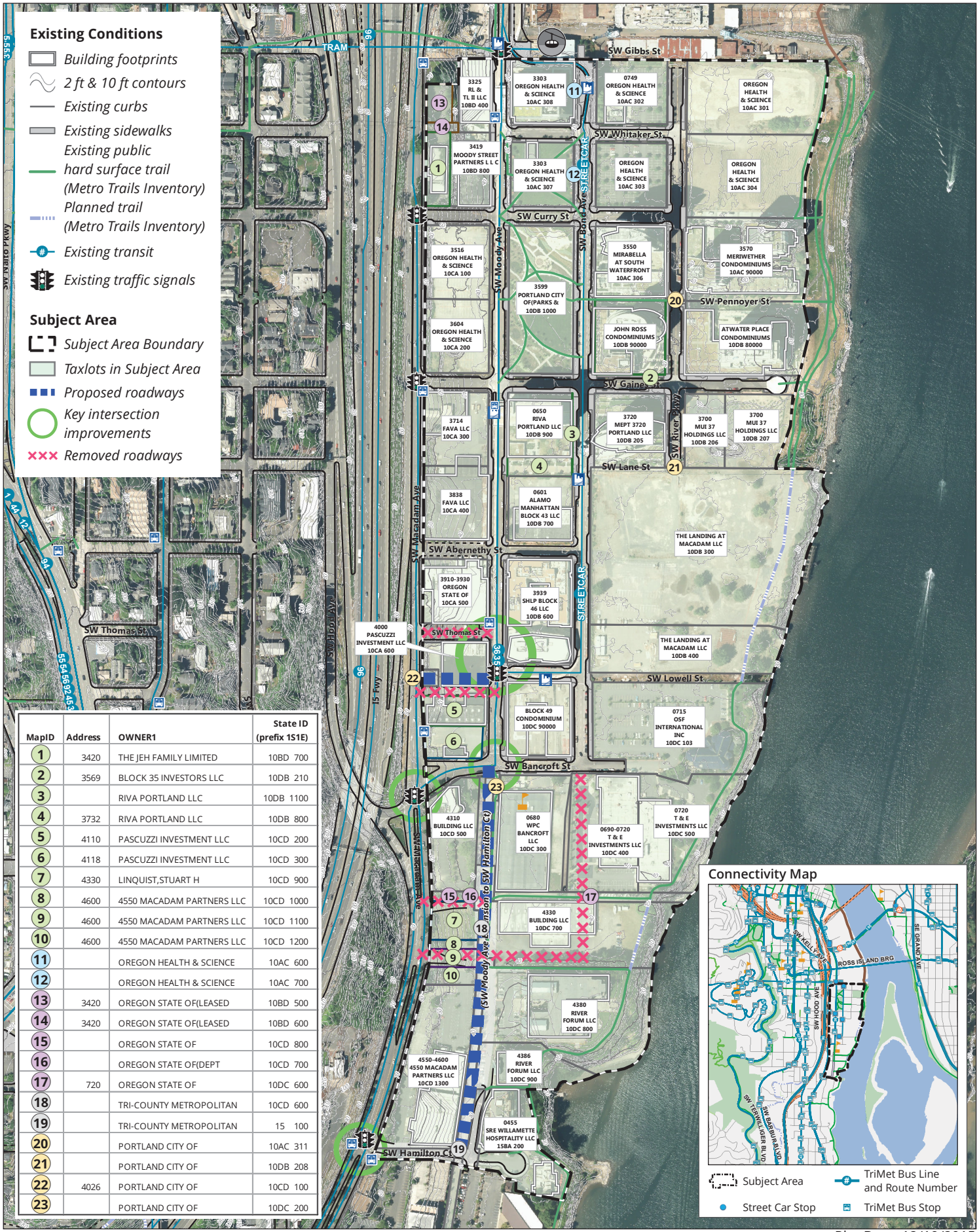
South Portal Property Owner and Improvement Overview Map

PBOT
PORTLAND BUREAU OF TRANSPORTATION

South Waterfront Street Plan Recommended Amendments

0 100 Feet

All properties 1S1E



MapID	Address	OWNER1	State ID (prefix 1S1E)
1	3420	THE JEH FAMILY LIMITED	10BD 700
2	3569	BLOCK 35 INVESTORS LLC	10DB 210
3		RIVA PORTLAND LLC	10DB 1100
4	3732	RIVA PORTLAND LLC	10DB 800
5	4110	PASCUZZI INVESTMENT LLC	10CD 200
6	4118	PASCUZZI INVESTMENT LLC	10CD 300
7	4330	LINQUIST,STUART H	10CD 900
8	4600	4550 MACADAM PARTNERS LLC	10CD 1000
9	4600	4550 MACADAM PARTNERS LLC	10CD 1100
10	4600	4550 MACADAM PARTNERS LLC	10CD 1200
11		OREGON HEALTH & SCIENCE	10AC 600
12		OREGON HEALTH & SCIENCE	10AC 700
13	3420	OREGON STATE OF(LEASED	10BD 500
14	3420	OREGON STATE OF(LEASED	10BD 600
15		OREGON STATE OF	10CD 800
16		OREGON STATE OF(DEPT	10CD 700
17	720	OREGON STATE OF	10DC 600
18		TRI-COUNTY METROPOLITAN	10CD 600
19		TRI-COUNTY METROPOLITAN	15 100
20		PORTLAND CITY OF	10AC 311
21		PORTLAND CITY OF	10DB 208
22	4026	PORTLAND CITY OF	10CD 100
23		PORTLAND CITY OF	10DC 200

Plot Date: 12/19/2015

Appendix O:

Leading Zero Addressing Issue

The Project Team received feedback during outreach about difficulty experienced with wayfinding on account of the unusual leading zero addressing scheme. Very few cities aside from Portland have this scheme, and as the table shows in following Maps A through E, the wayfinding issue extends to other neighborhoods besides South Waterfront. The tendency of GPS applications and people unfamiliar with the leading zero is to omit it, which can result in being routed to an incorrect location west of South Waterfront and similarly-addressed neighborhoods to the south. Portland Fire & Rescue has confirmed that it would be technically feasible to readdress this portion of SW Portland as South Portland. This would result in the City being divided into six (6) rather than five (5) sections. No further action on eliminating the leading zero addresses on east-west streets is proposed as part of the South Portal project.

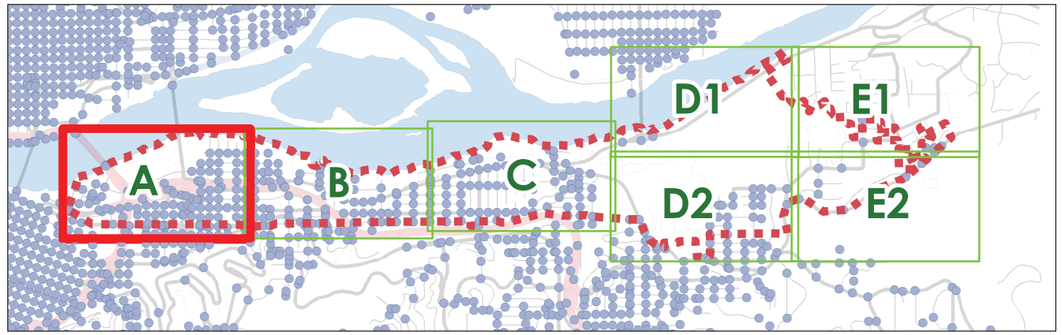
South Portland Streets: Map A

DRAFT

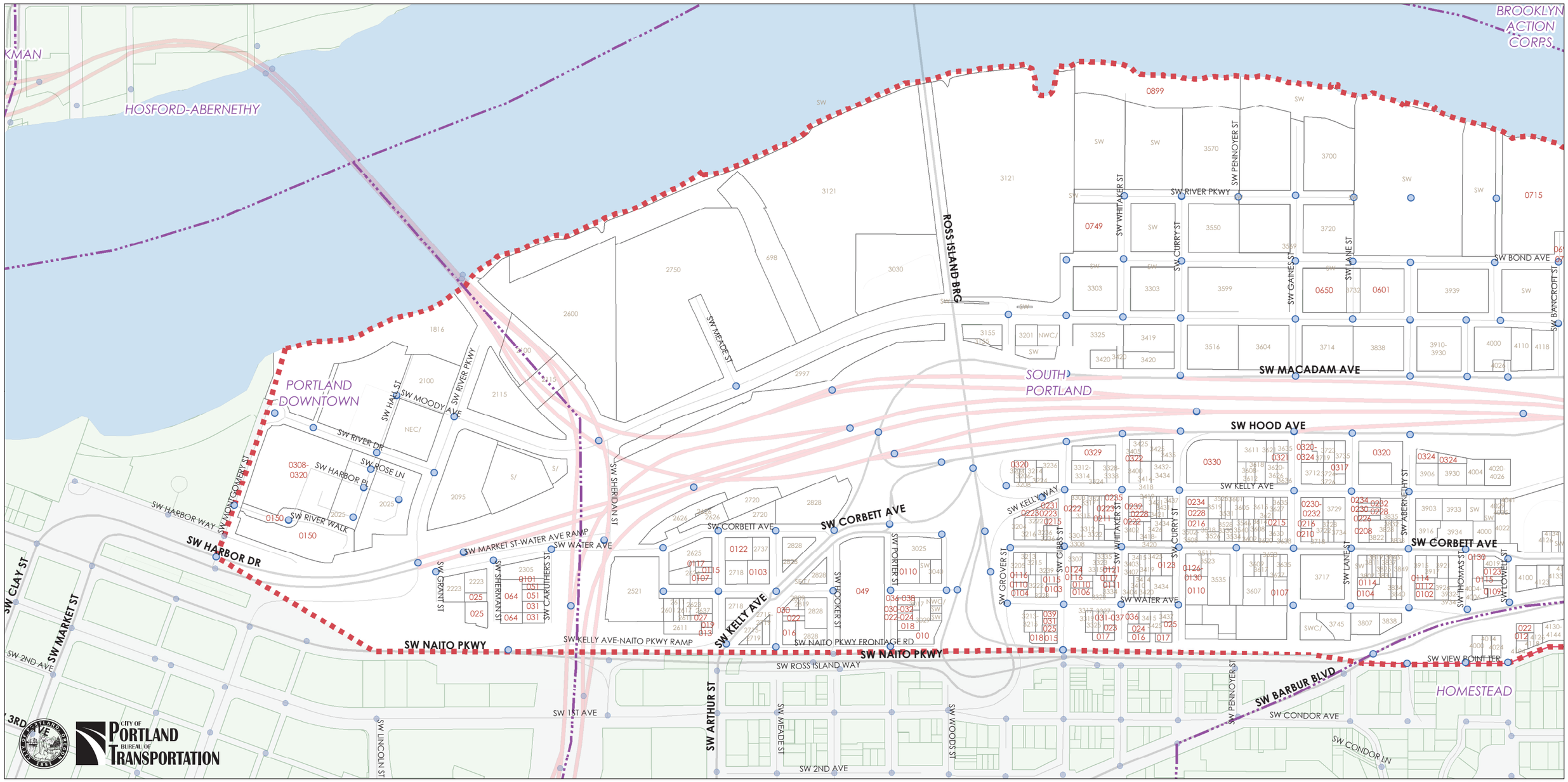
Estimated # of Intersections in Each Portland Quadrant		
Quadrant		*Intersections*
North		2,857
Northeast		5,312
Northwest		1,287
Southeast		6,703
Southwest		3,352
SW-W *	3,059	
SW-E **	293	
Total Intersections		**19,511**

*(not in area of map W of View Point Terrace)

**(in area of map E of View Point Terrace)



0 500 Feet



Plot Date: 12/12/2014

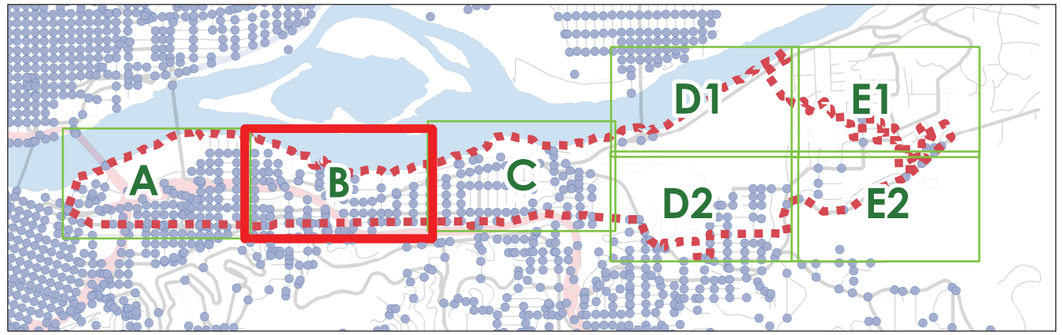
South Portland Streets: Map B

DRAFT

Estimated # of Intersections in Each Portland Quadrant		
Quadrant		*Intersections*
North		2,857
Northeast		5,312
Northwest		1,287
Southeast		6,703
Southwest		3,352
SW-W *	3,059	
SW-E **	293	
Total Intersections		**19,511**

*(not in area of map W of View Point Terrace)

**(in area of map E of View Point Terrace)



0 500 Feet

BROOKLYN ACTION CORPS

SOUTH PORTLAND

HOMESTEAD

HILLSDALE

SW RIVER PKWY
SW BOND AVE
SW MOODY AVE
SW MACADAM AVE
SW HOOD AVE-MACADAM AVE RAMP
SW HOOD AVE
SW KELLY AVE
SW CORBETT AVE
SW WATER AVE
SW BARBUR BLVD
SW NAITO PKWY
SW VIEW POINT TER
SW LANDING DR
SW RIVERPOINT LN
SW RIVERIDGE LN
SW RIVERSIDE LN
SW VIRGINIA AVE
SW 1ST AVE
SW CONDOR AVE
SW 2ND CT
SW CURRY ST
SW PENNOYER ST
SW GAINES ST
SW LANE ST
SW BANCROFT ST
SW HAMILTON ST
SW HAMILTON CT
SW CONDOR WAY
SW SAVIN RD
SW ABERNETHY ST
SW THOMAS ST
SW TOWLE ST
SW SEYMOUR CT
SW RICHARDSON CT
SW MITCHELL ST
SW BOUNDARY ST
SW BOUNDARY CT
SW SWEENEY ST
SW FLOWER ST
SW PENDLETON ST
SW WILLOWA ST

CITY OF PORTLAND BUREAU OF TRANSPORTATION

Plot Date: 12/12/2014

South Portland Streets: Map C

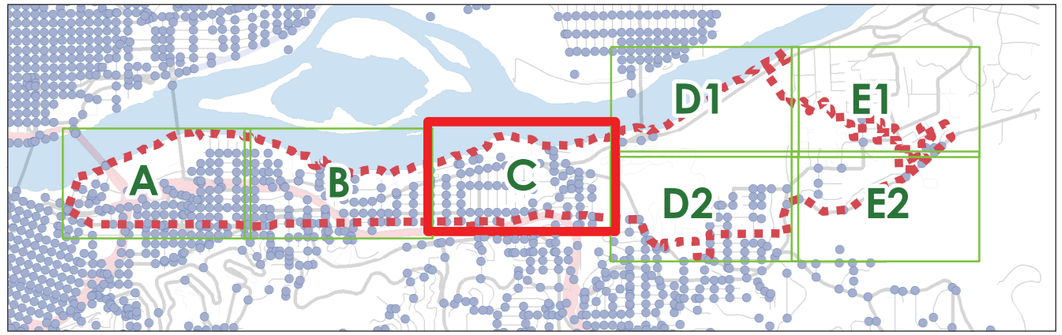
DRAFT

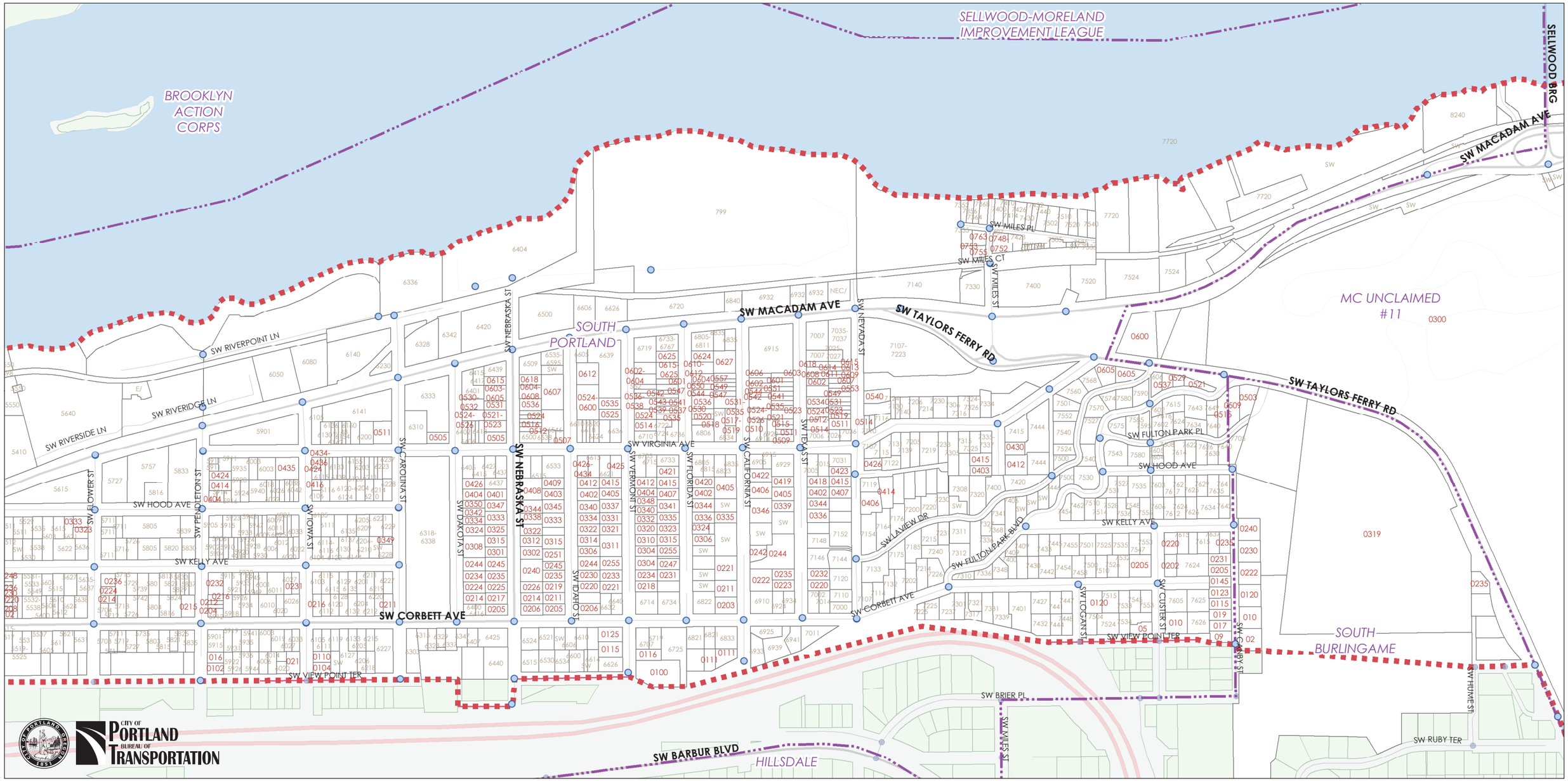
0 500 Feet

Estimated # of Intersections in Each Portland Quadrant		
Quadrant		*Intersections*
North		2,857
Northeast		5,312
Northwest		1,287
Southeast		6,703
Southwest		3,352
SW-W *	3,059	
SW-E **	293	
Total Intersections		**19,511**

*(not in area of map W of View Point Terrace)

**(in area of map E of View Point Terrace)





Plot Date: 12/12/2014

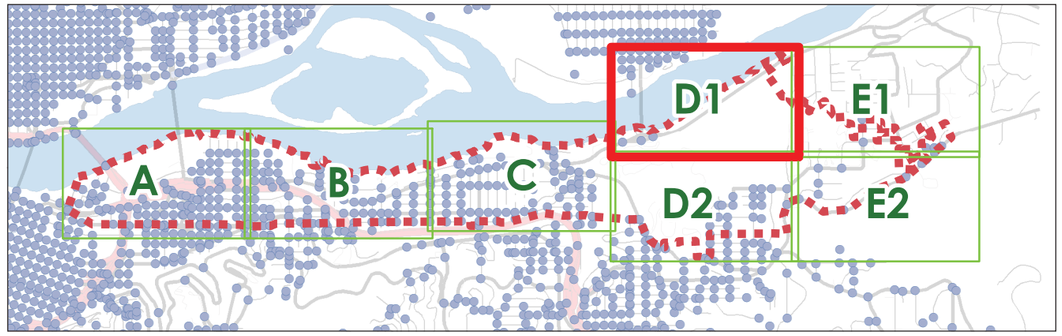
South Portland Streets: Map D1

DRAFT

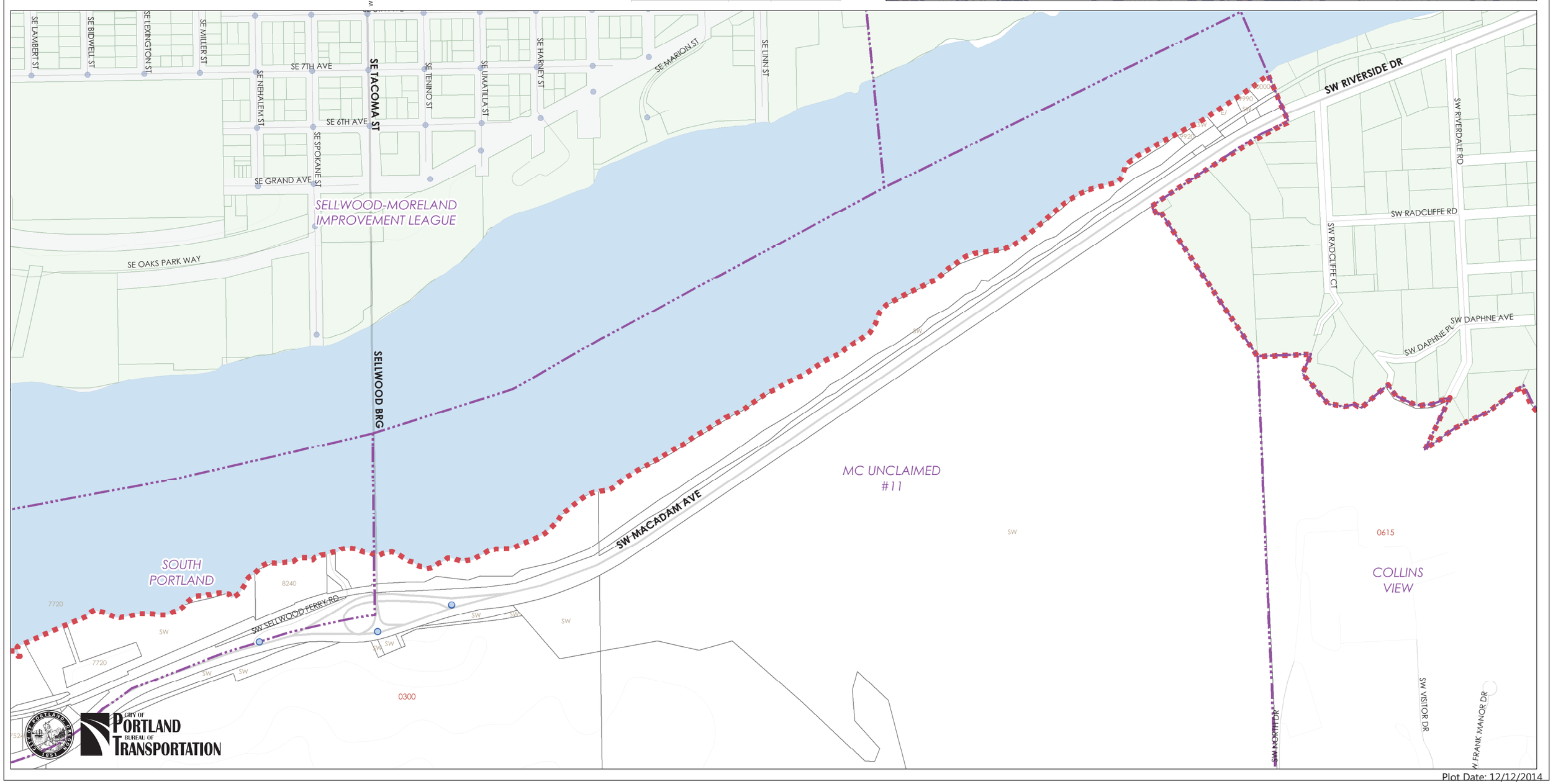
Estimated # of Intersections in Each Portland Quadrant		
Quadrant		*Intersections*
North		2,857
Northeast		5,312
Northwest		1,287
Southeast		6,703
Southwest		3,352
SW-W *	3,059	
SW-E **	293	
Total Intersections		**19,511**

*(not in area of map W of View Point Terrace)

**(in area of map E of View Point Terrace)



0 500 Feet



CITY OF PORTLAND BUREAU OF TRANSPORTATION

Plot Date: 12/12/2014

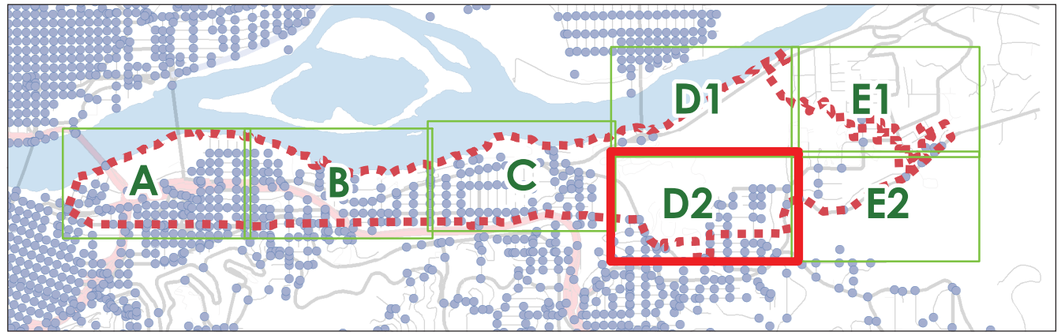
South Portland Streets: Map D2

DRAFT

0 500 Feet

Estimated # of Intersections in Each Portland Quadrant		
Quadrant		*Intersections*
North		2,857
Northeast		5,312
Northwest		1,287
Southeast		6,703
Southwest		3,352
SW-W *	3,059	
SW-E **	293	
Total Intersections		**19,511**

*(not in area of map W of View Point Terrace)
**(in area of map E of View Point Terrace)



SW MACADAM AVE
SW FULTON PARK BLVD
SW FULTON PARK PL
SW HOOD AVE
SW KELLY AVE
SW CORBETT AVE
SW CANBY ST
SW TAYLORS FERRY RD
SW HUME ST
SOUTH BURLINGAME
SW RUBY TER
SW 2ND AVE
SW 3RD AVE
SW CRESTLINE DR
SW 4TH AVE
SW 5TH AVE
SW CARSON ST
SW PRIMROSE ST
SW BOONES FERRY RD
MC UNCLAIMED #11
SW PALATINE HILL RD
SW CLARAMAE WAY
SW ORCHID CT
SW VIEW POINT TER
SW BRIER PL
SW 1ST AVE
COLLINS VIEW
SW BRUGGER ST
SW PLUM ST
SW MAPLECREST DR
SW NORTH DR
SW VISITOR DR
SW FRANK MANOR DR
SW RIVERSIDE ST
SW HOOD AVE
SW TERWILLIGER PL
SW PALATINE RD
SW TERWILLIGER BLVD
SW RIDGE DR
MC UNCLAIMED #13
SW ALFRE

City of Portland Bureau of Transportation

South Portland Streets: Map E1

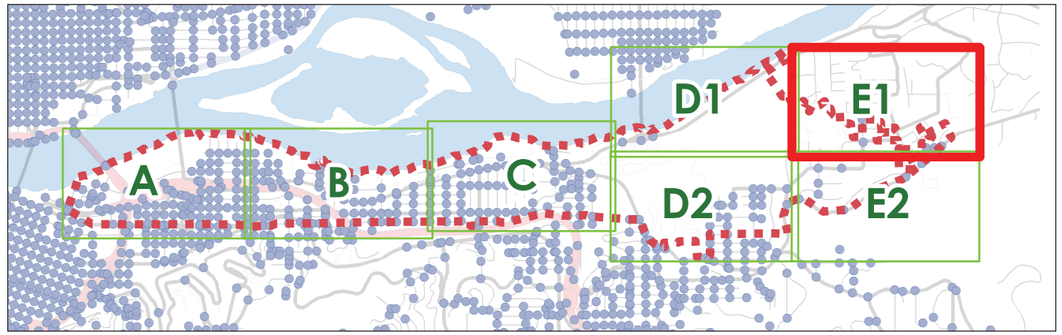
DRAFT

0 500 Feet

Estimated # of Intersections in Each Portland Quadrant		
Quadrant		*Intersections*
North		2,857
Northeast		5,312
Northwest		1,287
Southeast		6,703
Southwest		3,352
SW-W *	3,059	
SW-E **	293	
Total Intersections		**19,511**

*(not in area of map W of View Point Terrace)

**(in area of map E of View Point Terrace)



CITY OF PORTLAND BUREAU OF TRANSPORTATION

Plot Date: 12/12/2014

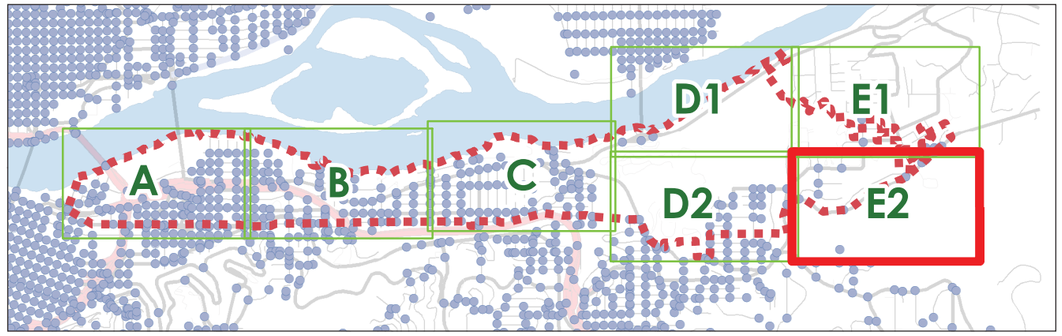
South Portland Streets: Map E2

DRAFT

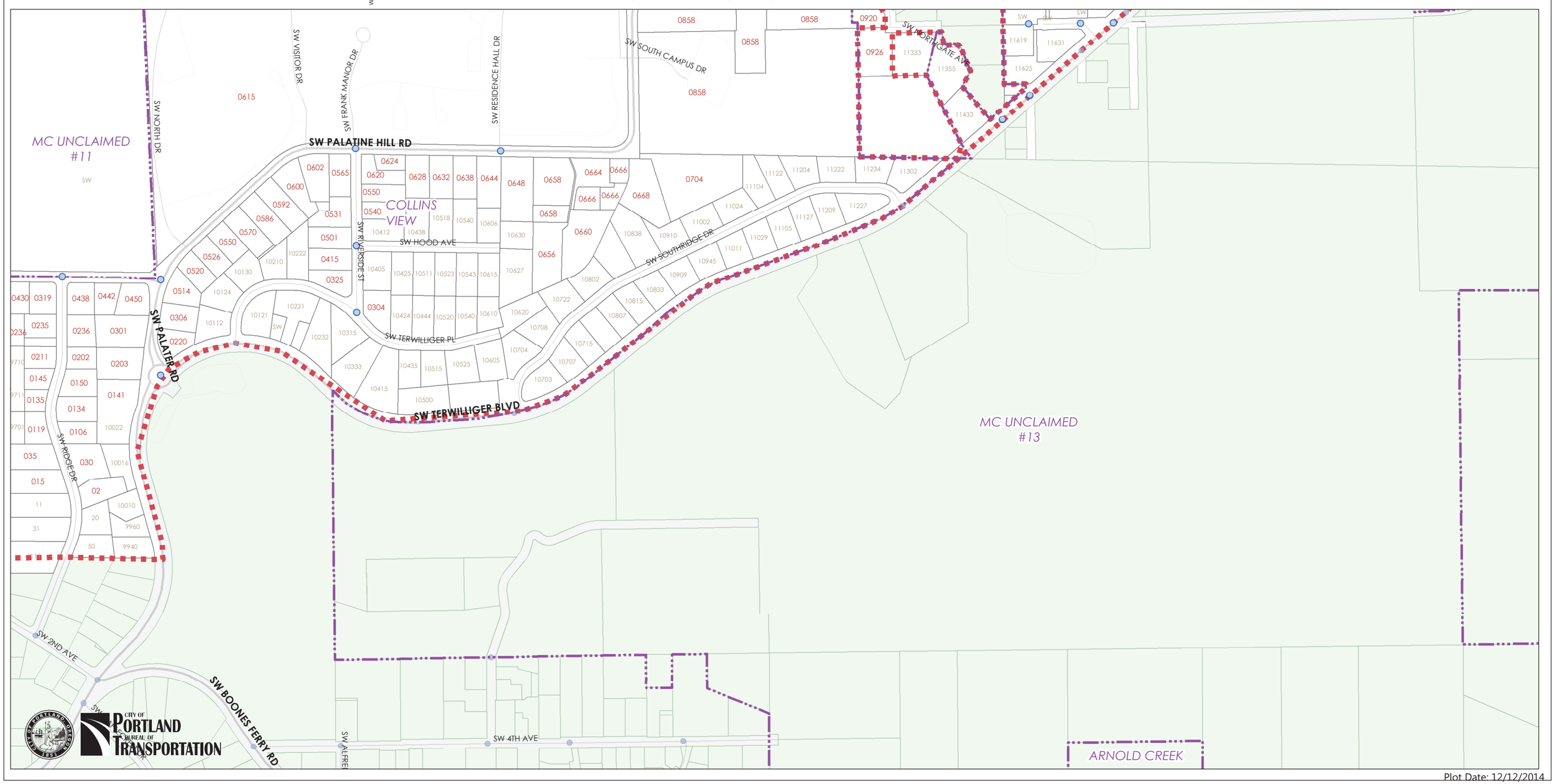
Estimated # of Intersections in Each Portland Quadrant		
Quadrant		*Intersections*
North		2,857
Northeast		5,312
Northwest		1,287
Southeast		6,703
Southwest		3,352
SW-W *	3,059	
SW-E **	293	
Total Intersections		**19,511**

*(not in area of map W of View Point Terrace)

**(in area of map E of View Point Terrace)



0 500 Feet



Plot Date: 12/12/2014