HOOD RIVER

WESTSIDE AREA

Concept Plan

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3. Summary of Public Comments

COMMITTEE MEMBERSHIP

Technical Advisory Committee

Kevin Liburdy, City Planning Dept. (PMT)

John Roberts, Director, Hood River County Community Development Dept. (PMT)

Gail Curtis, Oregon Department of Transportation, Transportation and Growth Management Program (PMT)

Joel Madsen, Executive Director, Mid-Columbia Housing Authority and Columbia Cascade Housing Corporation

Saundra Buchanan (CFO) and **Don Benefield** (Operations Director), Hood River County School District

Julie Stephens, Interim Director, Columbia Area Transit

Mark Hickok, Director, Hood River Valley Parks District

Scott Edelman, Central Oregon Regional Representative, Oregon Department of Land Conservation and Development

Kim Travis, North Central Regional Solutions Team, Oregon Department of Housing and Community Services

Avi Tayar, P.E., ODOT Region 1

Mark Lago, Director, City Public Works and Engineering Dept.

Mikel Diwan, Director, County Public Works and Engineering Dept., or Don Wiley, County Engineer

Cindy Walbridge and **Jennifer Kaden**, City Planning Dept.

Steve Wheeler, City Manager

Kip Miller, City Fire Dept.

Neal Holste, City Police Dept.

** PMT = Project Management Team*

Project Advisory Committee

Ross Brown, property owner in study area

Denise McCravey, property owner in study area, real estate broker

Mike Caldwell, property and business owner in study area

Mark Fuentes, Modern Pacific Properties, property owner in study area

Bob Schuppe, property owner in study area; Chair, County Planning Commission

Belinda Ballah, property owner in study area; Director, Hood River County Prevention Dept.

Heather Staten, Executive Director, Hood River Valley Residents Committee

Susan Garrett Crowley, interested citizen on behalf of Livable Hood River

Maria Castro, interested citizen

Dan Hoyt, Mobility Manager, Mid-Columbia Economic Development District

Teresa Ocampo, interested citizen; business owner

Claudia von Flotow, interested citizen

Michael Broncheau, Manager of Fishing Site Maintenance Dept. for Columbia River InterTribal Fish Commission

Les Perkins, Manager, Farmers Irrigation District; County Board of Commissioners; and Mid-Columbia Housing Authority board member

Brian Becker, property owner in study area

Mark Zanmiller, City Council representative

Bill Irving, City Planning Commission representative

Bonnie New, interested citizen, representative of Aging in the Gorge Alliance, property owner in area

ACKNOWLEDGMENTS

Project Management Team

Kevin Liburdy, City of Hood River

John Roberts, Hood River County

Gail Curtis, ODOT

Report Contributors

Angelo Planning Group

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The contents of this document do not necessarily reflect views or policies of the State of Oregon.

Memorandum

12/18/2017

To: City of Hood River

Cc: Project Management Team

From: Joe Dills, Andrew Parish, and Kyra Schneider, Angelo Planning Group

Re: Summary of Public Comments

INTRODUCTION

This memorandum is a summary of public comments received by the Hood River Westside Area Concept Plan project team, as requested by the Project Advisory Committee. Included in this summary are descriptions of:

- Stakeholder interviews (September 28th and 29th, 2016)
- Comments received during Technical Advisory Committee meetings (informally)
- Comments received during Project Advisory Committee meetings as part of specific Public Comment periods.
- Input received during the two project open houses (November 17, 2016 and March 9, 2017)
- Input received as part of online surveys for this process.
- Correspondence received by planning staff
- Articles and letters submitted to local newspapers regarding the plan

Stakeholder Interviews

Angelo Planning Group conducted a series of interviews with property owners and stakeholders on August 30, 2016 at Hood River City Hall, plus 2 telephone interviews on September 28 and 29. Key themes are summarized below, and detailed comments can be found in Attachment A: Task 1.4 Stakeholder Interview Summary memorandum.

- Interviewees were generally very interested in **transportation connections** and looking at **alternatives**, both in terms of overall connections and the **Mt. Adams extension and the Mt. Adams / Cascade intersection** specifically. There was general support for the Mt Adams connection, but concern regarding its alignment and impact on properties and existing streets.
- There was strong support for a **high level of connectivity** overall, and for **safe and convenient bicycle and pedestrian connections**.
- Stakeholders expressed an interest in **safe and livable neighborhoods**, in terms of traffic safety and having a tight-knit community of neighbors. **Diversity of people and diversity of housing** were mentioned multiple times as a means to achieve a vibrant neighborhood.
- Maintaining and building upon the **existing, unique character of Hood River** was mentioned several times.
- The portion of the study area near Cascade was suggested by stakeholders as being more appropriate for mixed use/multifamily development and attached housing, primarily because of proximity to transportation facilities and other services.

- The **need for more housing** within the city was clear to stakeholders.
- **Communication by email and through existing groups** such as the Hood River Valley Residents Committee were suggested as good approaches for public involvement.
- Stakeholders had mixed opinions about whether a locally-serving commercial node was appropriate for the area.

Technical Advisory Committee and Public Advisory Committee Meetings

- Community perception of affordable housing is important - Commenter was on a low income housing board. Applied for a project with 40 houses, neighbors did not want it. Reduced to 30, killed affordability of the project.
- How can we assure affordability? Workforce housing/caregiver housing models that can be incentivized.
- There is a desire for cohousing. One of the incentives could be requiring only one parking space per household.
- Want to move into town as I age. Easier to address need for denser housing now, rather than trying to infill in 20 years.
- Guiding principles won't be part of someone's development application.
- When developers come in to develop a high-density area, they're not going to building government-subsidized affordable housing, they're going to build market value housing, which will appeal more to second home buyers, etc. Concern that this aggressive stance on density will shape the children's futures in this town and change it to different community.
- Concern about the way that rezoning will affect the future of her property, and the rural character and natural feel of the area. Does not support commercial uses in neighborhoods.
- Concern about changes to the livability and rural feel of the community, feeling that this project has been moving too quickly and paved the way for too much housing in the Westside Area.
- Doesn't feel that it is necessary to make lots smaller because you can still accomplish affordable housing on large lots. The biggest concern is 30th street becoming an arterial right and impacting those existing homes.
- People who live in this community moved here to have more green space.
- Desire to explore ADUs as a solution to affordability.
- Regarding the comments that density shouldn't be focused in one place, these are issues that you should bring to your City Councilors because they ultimately make those decisions.
- 30th St has many driveways, it is an existing neighborhood that would not support the type of traffic that is projected.
- Concern about the worsening flooding of Henderson Creek.
- Parking is an issue of concern, because for most residents of Hood River garages are full of outdoor gear so you have to park your car somewhere else.
- Has already experienced what this process does to communities in previous home in a nice suburb of Seattle that was developed, the neighborhood changed, and people moved out. Doesn't want to see the same thing happen in the Westside Area.
- Existing zoning is sufficient for the Westside area.
- It is unfair to homeowners to change the zoning.
- Infrastructure is already too taxed to support growth.
- Utilize commercial lands for more mixed use projects, and consider multifamily housing on the waterfront.
- Consider natural corridors and natural habitat in the plan.

- On “Looking Countywide” for opportunities for affordable housing - There is no sewer in these other places, we have to answer the question of why no new multifamily housing has been built. It doesn’t pencil.
- Access and egress for wildfire is my concern. Wine country/Mt. Adams/cascade avenue is a bad intersection.
- Can we use the Light Industrial land in the Westside in a better way?
- Will we need a new Fire Station in the westside? Fire danger analysis is needed. Fire department is underfunded.
- What does affordability mean? Are these really for low income folks – how can we help low income people stay in hood river?
- Thank you to the committee.
- Population projections are important and need to be looked at.
- Concern with hearing requirement changes in the draft zoning code.
- Concern about reducing parking requirements.
- Take care of infrastructure first.
- Do more community involvement.
- Think about sewer capacity.
- Focus on infrastructure and natural greenspaces.
- New sewage treatment plant? Public safety costs?
- Tell the truth to the taxpayers.
- I do not trust the city's agenda. "Oregon kitchen table." Let's really talk about the issue.
- Hood River policies generally comply with Goal 10 already.
- Only the seller of the land and developer benefit from rezoning.
- We are concerned about creating two separate towns, westside and eastside.
- Linear greenways are the future. Look at Minnesota.
- Bike lanes need to be better.
- ADU's are affordable housing.
- I think a lot of good work has been done. There are people who are not here today. Change and growth is happening everywhere in the City. Adaptions of the zoning code that allow flexibility are good.
- This is a good chance to move the needle on long-term priorities . Local revenue sources (like Construction Excise Taxes) help acquire housing types. Single family homeownership is becoming less popular. Need to be culturally competent . The westside plan is a good approach.

Open House #1

Project staff had discussions with community members in individual and small group settings at the event. The following is a partial list of topics and interests discussed:

- Employers having difficulty finding housing for even well-paid employees in Hood River
- A group who are actively looking for land to site a co-housing project in the Westside Area. Staff recommended remaining engaged throughout any legislative process to amend or adopt standards that may be useful in development of co-housing projects such as an update of the Planned Development ordinance.
- Interest in a local neighborhood commercial node within walking distance of the cohousing project.
- Need for “missing middle” housing
- Comment on the west end of Sherman Avenue: the area experiences flooding during peak rain events. A design for the road will need to provide proper drainage.

- Advocacy for Morrison Park to remain a park, and the potential for a trail network from Morrison Park to The Hook and other parts of the City, including the Westside Area. Concern that the scope of the Westside Area Concept Plan is focused too narrowly on the study area rather than connecting to the broader city.
- When will development happen in the Westside?
- The need for a community park in the Westside Area. There was advocacy for the 20-acre site that was the subject of study by the PSU students working with the community.
- Interest in the size, location and number of neighborhood parks
- How many existing residents are there in the Westside Area? (follow-up item)
- Extensive transit planning has been happening in the Gorge – the Westside Area Concept Plan should tap into and build on this work
- Interest in capping growth in Hood River, and discussion of how the Statewide land use program seeks to coordinate and accommodate growth in each community
- Can agriculture continue within the UGB? Yes. Can it be a mandated part of the Plan? No, urban land is designated for urban uses, even if that may not happen for many years.
- Question asked about the feasibility of installing roundabouts at key street intersections.
- Question asked about the adequacy of public infrastructure such as sewer and water lines to serve a larger number of homes on the Westside under Scenarios B or C. Also, who will pay for needed infrastructure to serve new neighborhoods?
- Concern regarding extension of 30th Street north and south, and impacts on existing neighborhoods due to increased vehicle traffic. However, appreciation for a potentially more direct route to I-84 via Exit 62.
- Concern regarding this effort to plan for new neighborhoods with parks, trails, sidewalks and bike lanes when taxpayers in many existing neighborhoods don't have these amenities.
- Question asked if new homes will need to be designed in a manner that reflects existing homes on neighboring properties.
- Question asked about the extent of wetlands and other environmental features in the study area.

Online Open House #1

The survey was available through the Hood River Westside Area Concept Plan project website (www.hrwestsideplan.com) from November 17th through December 9th. The survey addressed respondents' priorities with regards to transportation, components of the draft vision statement, housing strategies, and proposed land use programs. A detailed summary of the online survey is attached to this memorandum.

Open House #2

Project staff had discussions with community members in individual and small group settings at the event. The following is a partial list of topics and interests discussed:

- Safety concerns with various intersections in and near the study area
- Compatibility of smaller lots with existing residences in the area
- A desire for the City to better communicate the process
- Background of the planning process (Housing needs analysis, economic opportunities analysis)
- Membership and interests that makeup the advisory committees
- Pros and cons of the land use alternatives

Online Open House #2

The survey was available through the Hood River Westside Area Concept Plan project website (www.hrwestsideplan.com) from March 14, 2017 through April 5th, 2017.[1] The survey gathered input on draft frameworks including the pedestrian and bicycle network, parks and open space, the location of a locally-serving commercial area, the Wests Cascade gateway area, and land use strategies. A detailed summary is attached to this memorandum.

Public Comment and News Articles

- **"Westside Plan", Hood River News, November 3rd, 2016.**
    - About 60 people attended an open house at the Hood River Fire Station on November 17th, 2017 for the Westside Area Concept Plan. The goal of the Plan is to develop an integrated land use and transportation plan for the 450-acre project area, addressing land use, affordable housing, streets, bike ways, pedestrian paths, parks, schools, utilities, and infra-structure funding.
- **"City presents Westside plan", Hood River News, February 11th, 2017.**
    - The Westside Area Concept Plan is attempting to assess the long-term choices, issues, and opportunities for the Westside Area" of Hood River. The plan envisions that the Westside Area will grow to become an interconnected community of great neighborhoods, an attractive gateway of commercial and mixed-use activity; and an affordable and diverse area of the City.
- **"Westside Area Plan", Hood River News, March 4th, 2017.**
    - The City of Hood River is engaged in a year-long planning process for the area of town where the most growth will occur in coming years (west of Rand Road and south of Country Club Road). The plan will address transportation and utilities, parks, housing, and other issues.
- **"Our Readers Write: Losing small-town feel", Hood River News, April 19th, 2017**
    - Th City has proposed the building of 2,300-plus new units (apartments, single family homes, townhouses, etc.) as part of their Westside Area Concept Plan on the 'undeveloped' west side of Hood River, which will bring roughly 6,000 new residents and add 5,000 additional cars to our roadways.
    - With current funding levels, none of the proposed parks and paths as part of the plan are likely to be built as advertised without a new funding ballot measure.
- **"Our Readers Write: Mixed use housing", Hood River News, May 2nd, 2017.**
    - The City of Hood River is looking at rezoning the westside area from 7,000 square foot lots to smaller 4,000 square foot lots with multifamily housing densities.
    - The City should consider looking at mixed use housing in existing commercial/retail neighborhoods as an alternative. The city council should postpone their decision on the Westside Area Plan until a further study on mixed use housing development has been completed.
- **"Westside Plan Meeting, Forum to happen two nights this week", Hood River News, August 17, 2017.**

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[1] The original close date was March 28th, however several requests to keep the survey open were received from residents who were traveling for Spring Break during late March. The City opted to keep the survey open to allow additional opportunity for public input.

- Notice of a Hood River Valley Residents Committee forum on August 15th followed by the concept plan meeting on August 16th.

- **"Another Voice: Hood River Planning – don't leave folks on the other side of the gate," Hood River News, July 15, 2017.**
  - Opinion column calling for a focus on housing affordability and consideration of future residents.
- **Email correspondence**
  - Questions and concerns about the intersection of Belmont and Fairview and the possibility of improvements.
  - The City has put considerable resources into defining the housing needs, yet there is not much detail about housing in the Westside Area Concept Plan documents online. The city of Hood River has an immense need for affordable housing both for people who meet HUD federal poverty levels, and for those who are lower income but not low enough for HUD assistance.
  - Zoning concepts that had been focused on the Westside are now suggested as being applicable to the rest of the city, which goes beyond the funded scope and published intent of this project. City residents who live outside the Westside have had no notice that this project could have direct effect on their neighborhoods. References to citywide application should be removed.
  - Parts of the draft appear to deliberately limit or preclude public participation in important aspects of proposed neighborhood development, which violates comprehensive plan principles supporting meaningful public participation in important decision-making.
  - Concern about challenges for transportation facilities and stormwater runoff due to topography and increased impermeable surface coverage, and evacuation bottlenecks in the event of fire or other natural disasters.
  - The Housing Needs Analysis of 2015, which assumed an annual projected population increase of 2%, found that adequate land exists under current zoning to accommodate growth if appropriate multifamily development in C-2 zones is maximized.
  - These proposal for significant density increases comes before proper evaluation of these risks and before needed roads, schools, parks, and other critical infrastructure are properly funded, planned, or in place.
  - The 2011 Transportation System Plan (TSP) envisions a north/south connector in the Westside area to carry through-traffic and trucks.
  - The City should review the TSP north/south road assumptions to verify both the need, and desire for more road capacity, as well as consider new assumptions, which might lead to alternative scenarios more consistent with the goals of the Concept Plan.
  - A compromise might be to create an improved north/south connection by stemming-off Frankton south of the Covenant Church (before the steep grade) traversing east across the hillside over to either 30th or May in a design that mitigates the slope.
  - The proposed zoning is not sufficient to ensure diverse housing types and sufficient housing supply at all income levels to meet the current and future needs identified in Hood River's Housing Needs Analysis.
  - Some people have said that the HNA shows that Hood River could accommodate all of its growth for the next twenty years without changing zoning at all. If so, why is this rezone necessary?
  - The quality of life in Hood River has been deteriorating since about 1982.

- This concept like this will only put money in developers' pockets and leave the residents with overcrowded streets and schools, overloaded utilities and water facilities, and poor parks and recreation facilities.
- The 2015 Housing Strategy Report identified the need for more multifamily units and affordable options, and the Westside Concept Plan addresses that need creatively, mixing it intentionally with planning for transportation, parks, natural resources, infrastructure, and financing.
- Newcomers and new wealth displacing long-time residents has been happening for some time, but has been accelerating recently. Young college-educated people with emerging leadership and so much value to offer are moving away because they can't afford to live here.
- We must make Hood River an inclusive and more welcoming, affordable place for everyone already here, and plan realistically for the fact that population growth is inevitable.
- How can we assure that we end up with diverse housing types at all income levels?
- Undergrounding power lines is desired.
- Off-street parking is important.
- The plan should include more background information to educate readers about Oregon planning, the grant process, etc.
- The plan should be more flexible by recommending an overall number of park acres, rather than the number of parks.
- If the plan includes typical (suburban-sized) roads, then the cars will prevail and we will not have supported the guiding principles of the plan.
- I think the document needs a Parking Section to address a broad philosophy and a few specific details. Examples of topics include, street parking (or not) on all streets, parking lots (or not) by parks, allowing apartment builders to use street parking to meet their parking requirements.
- At the end of the day, below-market priced housing will require a funding source. That said, there are many who argue that zoning changes to increase the supply of a variety of housing types is extremely beneficial.
- Raising height limits in commercial zones would make mixed-use development in these areas easier.
- Concern that the responses to the survey were 90% white, while the county as a whole is 1/3 Hispanic.
- Support for the location of a neighborhood-serving commercial node.
- How can the zoning require multifamily buildings, rather than just allowing them?
- Concern that the plan will adversely affect schools by increasing class sizes.
- Concern about updated PSU population projections, and whether changes to zoning are needed with a lower projected growth rate.

Appendix B: Infrastructure and Funding

1. Roadway Cross Sections
2. Transportation Analysis
3. Roundabout Coordination
4. July 6, 2017 letter from ODOT regarding Exit 62
5. 2010 Exit 62 Concept Plan and Gateway Illustrations
6. Water, Sewer, Stormwater
7. Technical Memorandum 6.1: Funding Review and Funding Toolkit
8. Park Lands Acquisition: Code Research and Case Studies

Memorandum

12/28/2017

To: Project Management Team

Cc: Project Team

From: Joe Dills and Andrew Parish, Angelo Planning Group, and Walker Macy

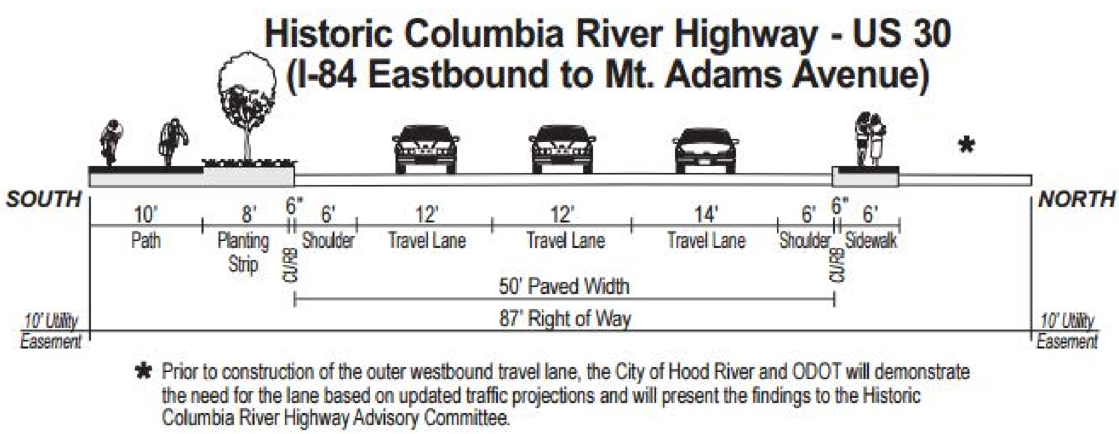
Re: Draft Street Cross-Sections

INTRODUCTION

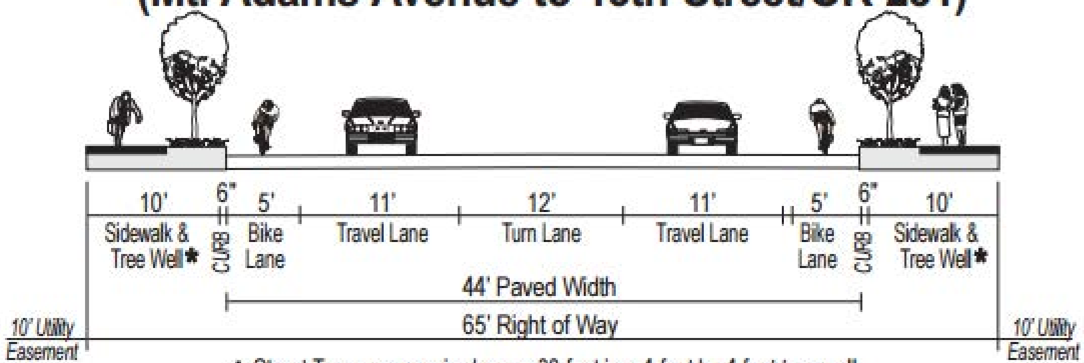
This memorandum describes the existing street cross-sections in the City of Hood River Transportation System Plan (TSP) and introduces new cross sections for roads in the Westside Area. The project team is asked to review the existing cross-sections in the context of the vision and goals of the Westside Area and evaluate whether additional cross sections are needed to implement the Westside Area Concept Plan. The draft Streets Framework Diagram is included at the end of this memorandum for reference.

CROSS-SECTIONS IN THE CURRENT TSP

The following cross sections are in the current TSP.

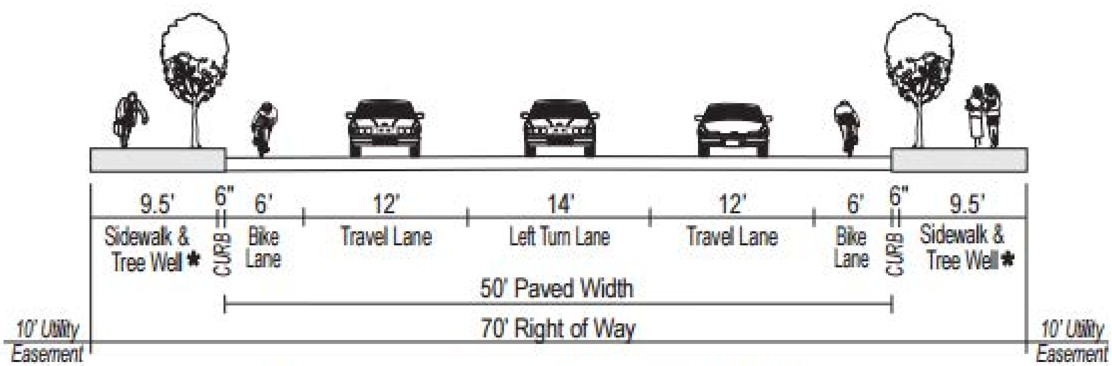


Historic Columbia River Highway - US 30
(Mt. Adams Avenue to 13th Street/OR 281)

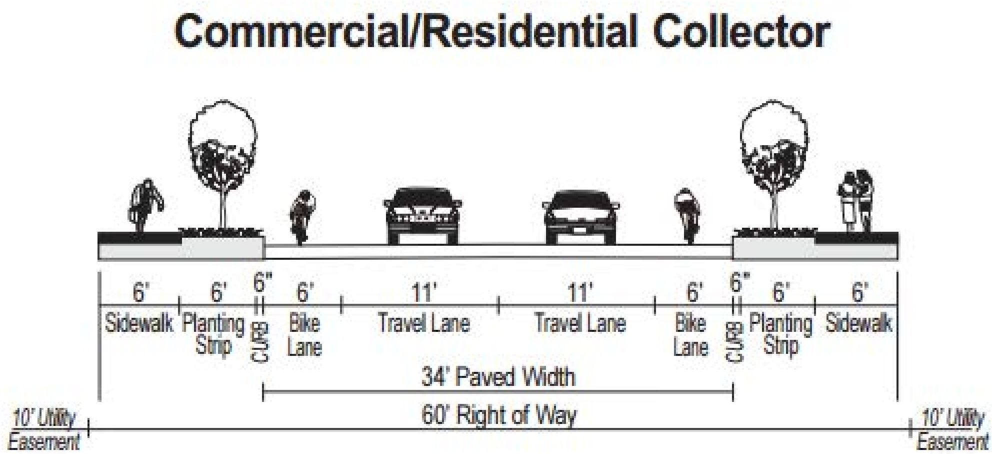


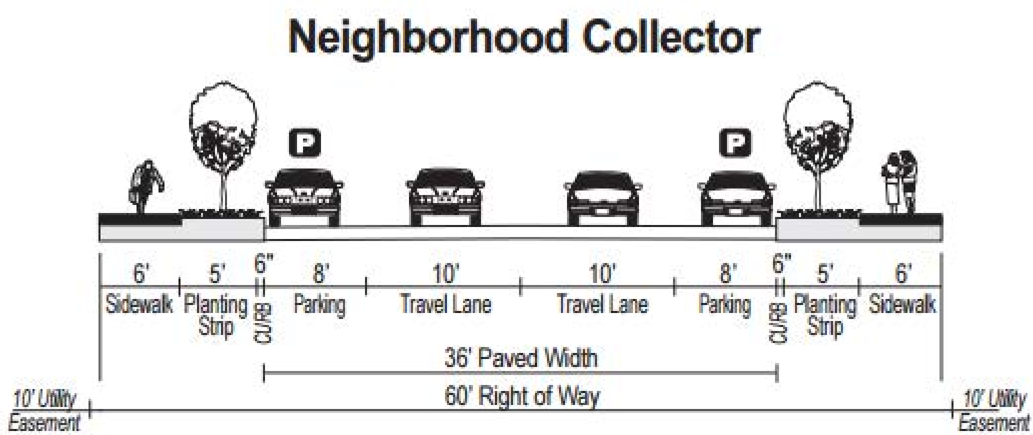
* Street Trees are required every 30 feet in a 4 foot by 4 foot tree well.

Minor Arterial

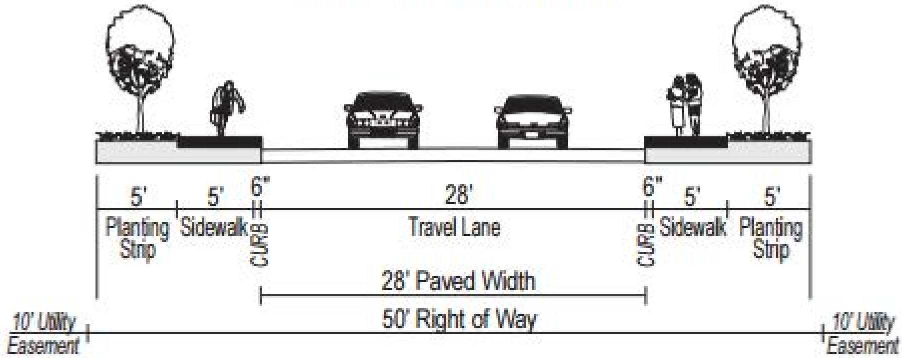


* Street Trees are required every 30 feet in a 4 foot by 4 foot tree well.

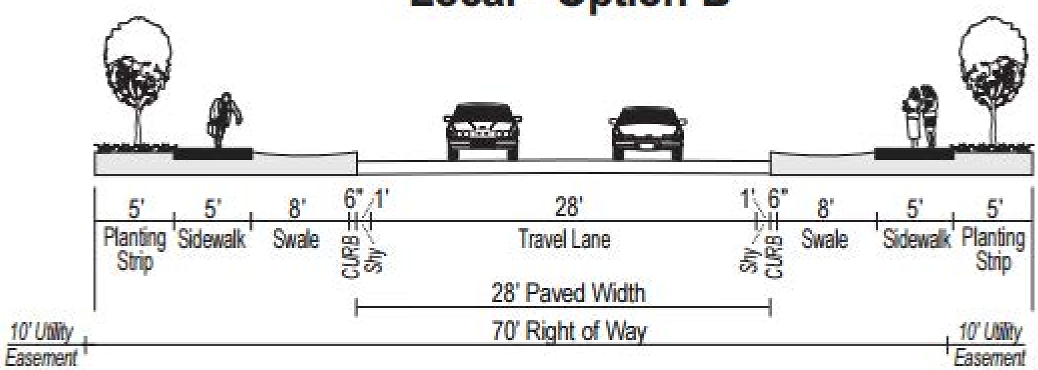

Commercial/Residential Collector
6'
Sidewalk
6'
Planting Strip
6"
CURB
6'
Bike Lane
11'
Travel Lane
11'
Travel Lane
6'
Bike Lane
6"
CURB
6'
Planting Strip
6'
Sidewalk
34' Paved Width
60' Right of Way
10' Utility Easement
10' Utility Easement


Neighborhood Collector
P
P
6'
Sidewalk
5'
Planting Strip
6"
CURB
8'
Parking
10'
Travel Lane
10'
Travel Lane
8'
Parking
6"
CURB
5'
Planting Strip
6'
Sidewalk
36' Paved Width
60' Right of Way
10' Utility Easement
10' Utility Easement

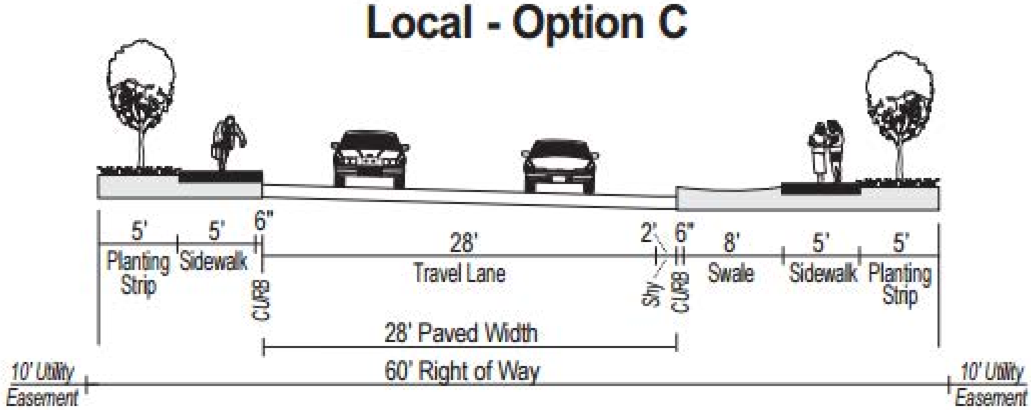
Local - Option A



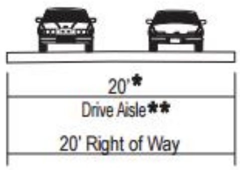
Local - Option B



Local - Option C



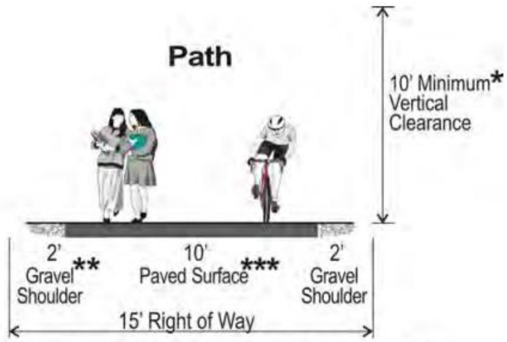
Alley



* Recommend 16-feet of paving with 2-foot-wide gravel shoulder on each side, except where alley abuts existing or proposed hard surfacing (e.g. driveway or other parking area). Where alley abuts existing or proposed hard surfacing, alley pavement should tie into abutting hard surfacing (eliminating gravel shoulder).

* On-Street Parking prohibited.

Path

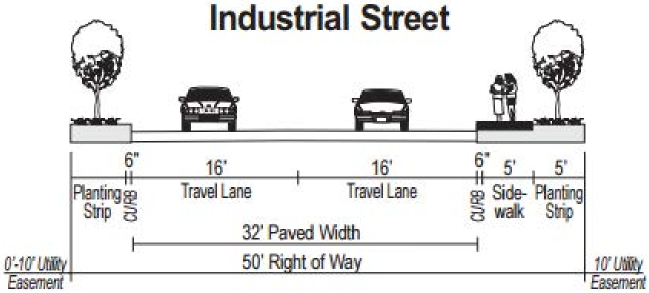


* In constrained areas, vertical clearance may be reduced to a minimum of 8 feet.

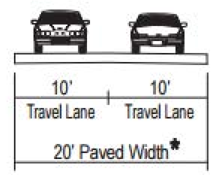
** Where path abuts existing or proposed hard surface, shoulders shall be paved to tie into the hard surface.

*** Where not required by City code, can be hard-packed gravel surface.

Industrial Street

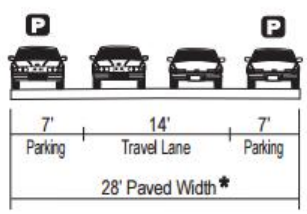


Six Home Private Street [1.]



1. 20 foot private street may be used for up to 6 homes.

Private Street [2., 3.]



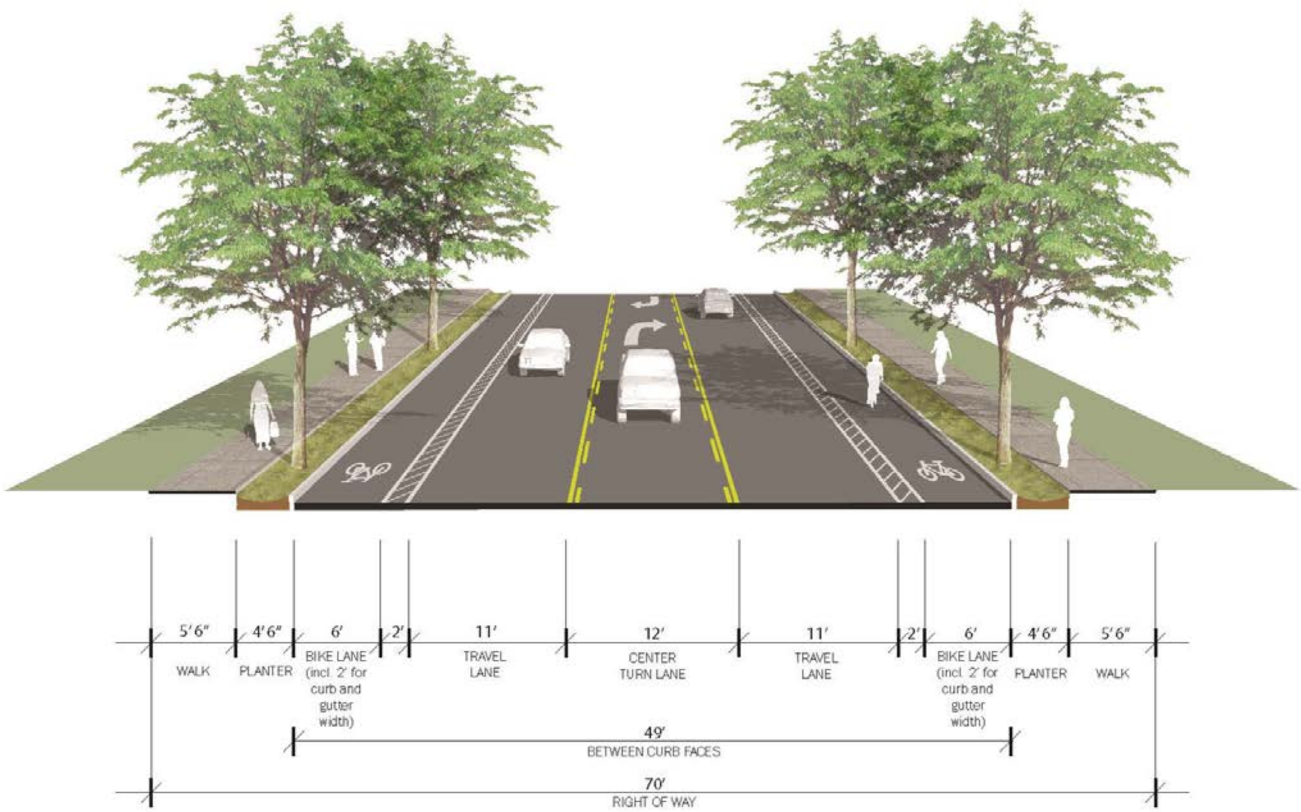
2. Cross-Section applies to PUD streets that serve more than 6 homes. An additional 0.50 parking spaces shall be added for each additional unit beyond 6 homes.

3. Parking shall be staged to allow room for passing vehicles.

* Recommend 2-foot-wide gravel shoulder on each side, except where private road abuts existing or proposed hard surfacing (e.g. driveway or other parking area).

NEW CROSS-SECTIONS FOR THE WESTSIDE AREA

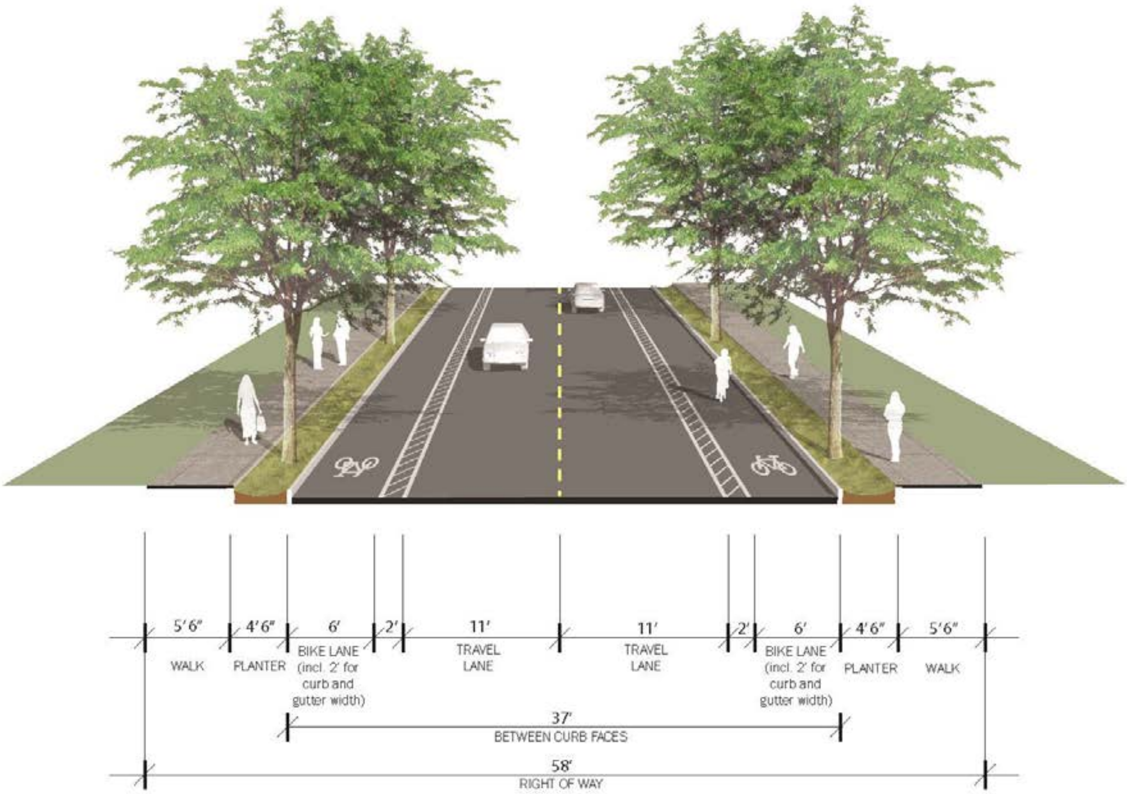
Included below are three cross sections specifically for the Westside Area. These supersede standard adopted cross-sections. These are considered typical and subject to modification as determined by the City Engineer. For any cross-sections not shown below, the adopted TSP cross sections apply.



MINOR ARTERIAL ALIGNMENT D - WITH TURN LANE

CROSS-SECTION

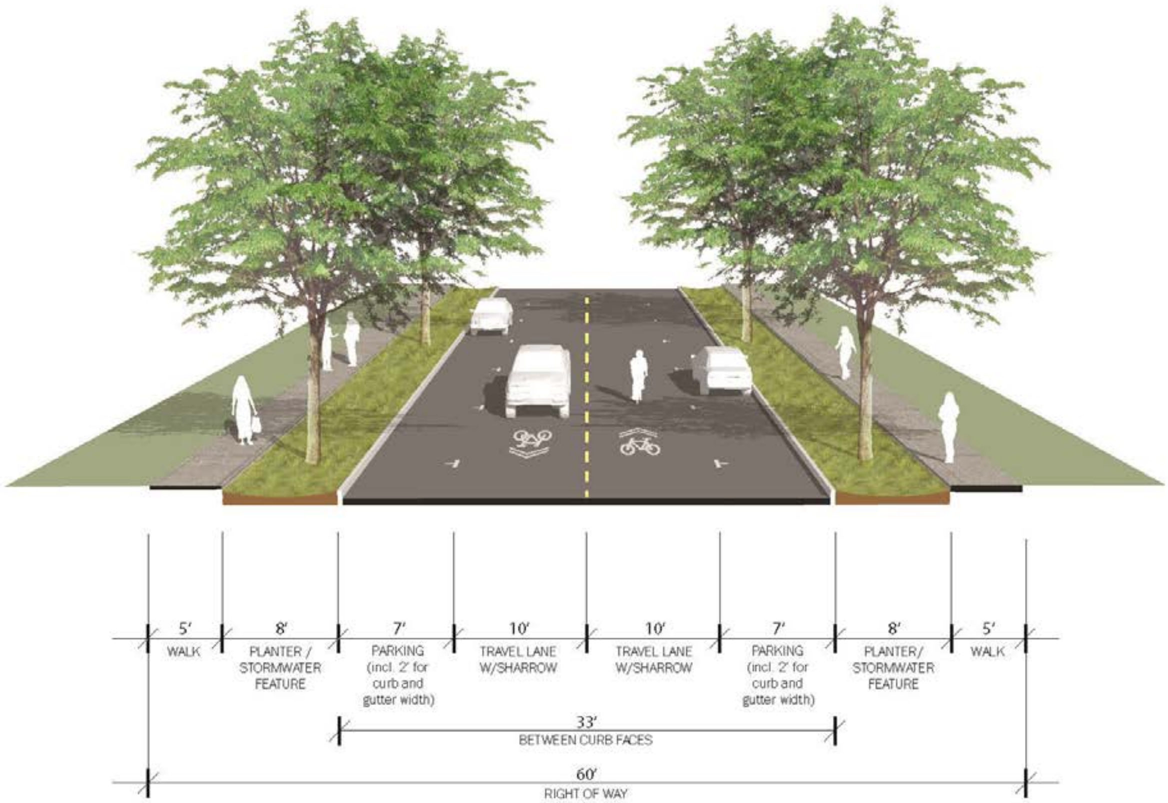
- This diagram shows the layout of the north-south connector ("Alignment D") in areas where a center left-turn lane is required.



MINOR ARTERIAL ALIGNMENT D - WITHOUT TURN LANE

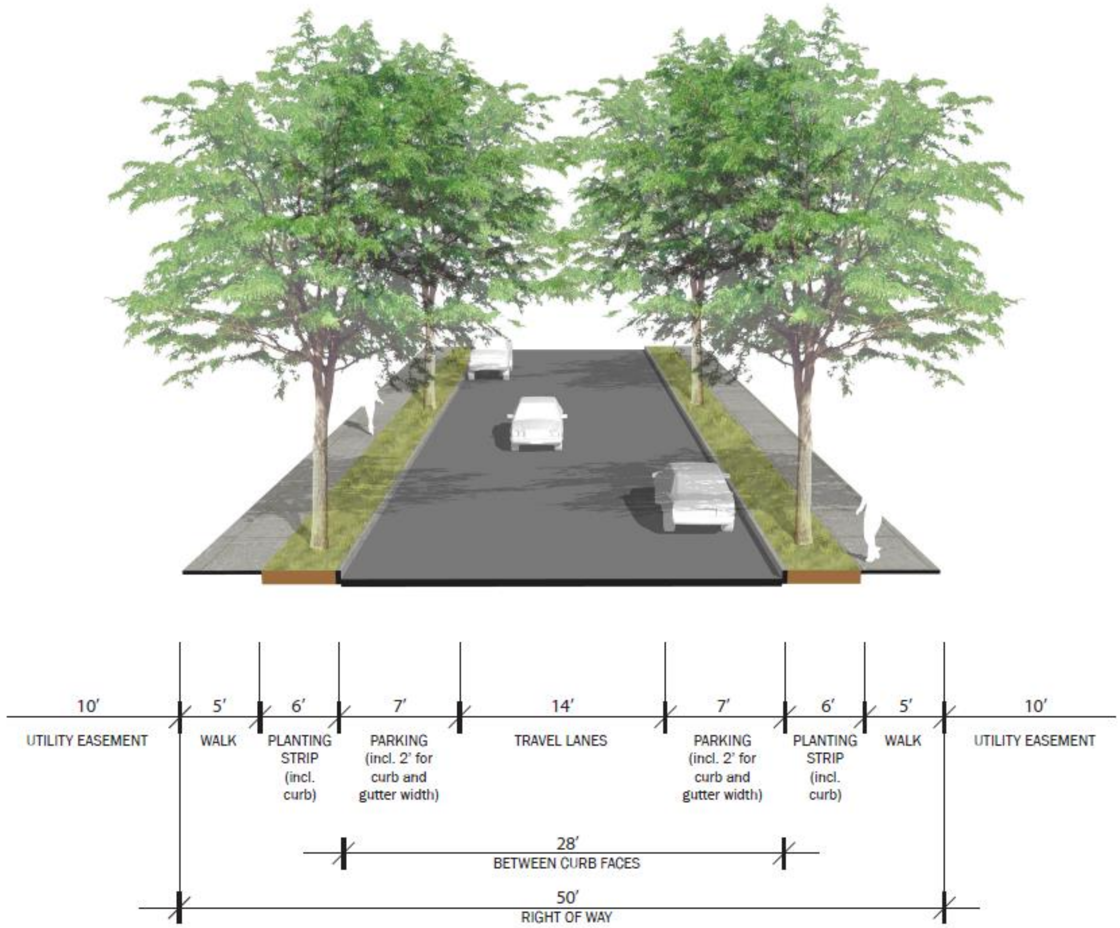
CROSS-SECTION

- This diagram shows the alignment of the north-south connector ("Alignment D") during segments where a left-turn lane is not requred, allowing for a smaller overall right-of-way.



NEIGHBORHOOD CONNECTOR STREET
CROSS-SECTION

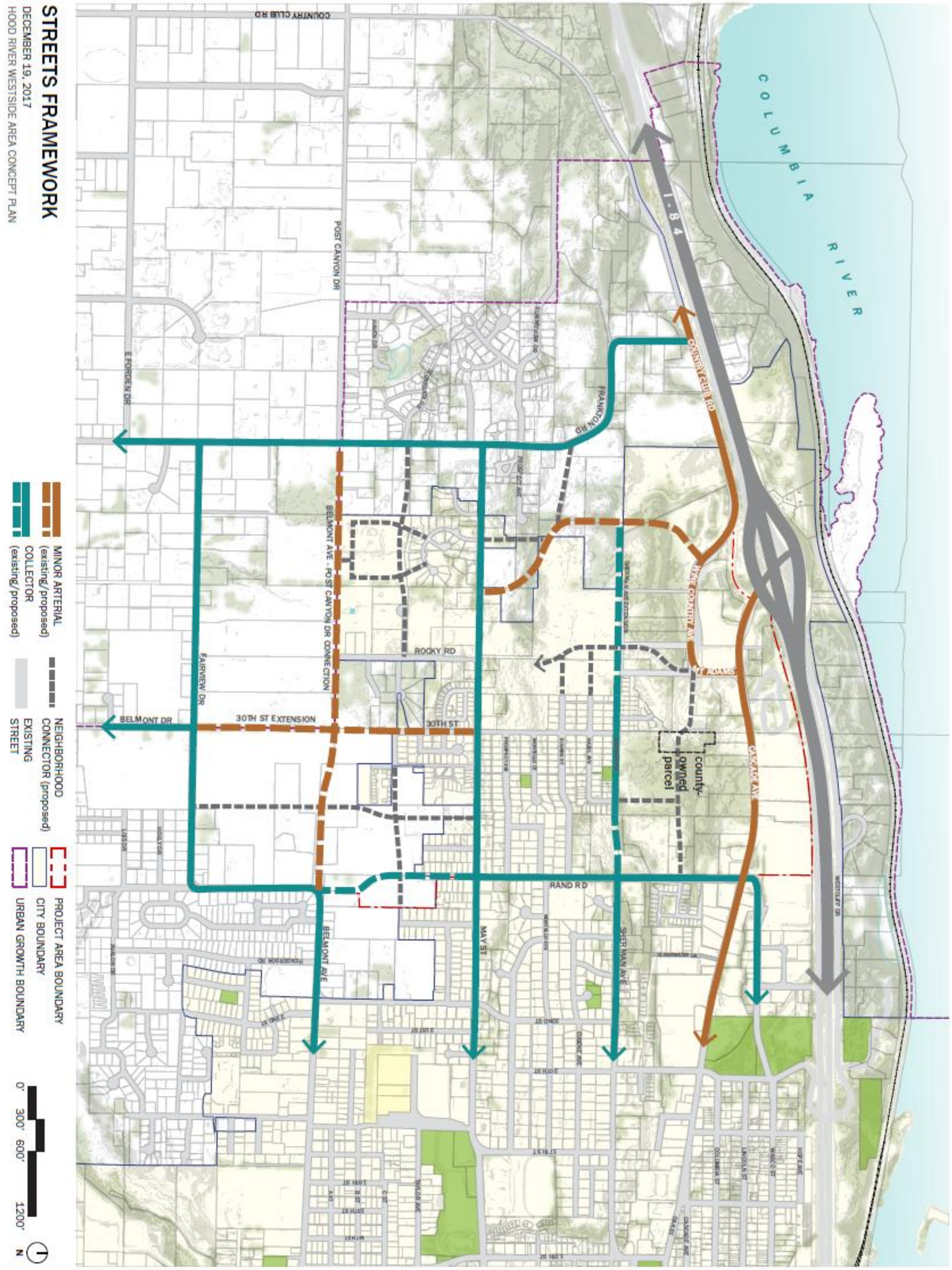
- This diagram shows a cross section for the "Neighborhood Connector" shown on the street framework plan. Sidewalks are buffered from the street by a planter/stormwater feature, and bicycle travel is accommodated in 10' travel lanes with sharrows. The City Engineer would have authority to modify this cross-section for inclusion of bioswales.



HOOD RIVER TSP LOCAL STREET

CROSS-SECTION

- This cross section is consistent with the existing local streed diagram “Option A” in the TSP, but it shows on-street parking in the image rather than as a footnote. On-street parking provides a buffer between pedestrians and moving traffic. . The City Engineer would have authority to modify this cross-section for inclusion of bioswales.


STREETS FRAMEWORK
DECEMBER 19, 2017
HOOD RIVER WESTSIDE AREA CONCEPT PLAN
MINOR ARTERIAL (existing/proposed)
COLLECTOR (existing/proposed)
NEIGHBORHOOD CONNECTOR (proposed)
EXISTING STREET
PROJECT AREA BOUNDARY
CITY BOUNDARY
URBAN GROWTH BOUNDARY
0' 300' 600' 1200'
N
COLUMBIA RIVER
I-84
COUNTRY CLUB RD
POST CANYON DR
E FORDEN DR
FRANKTON RD
BELMONT AVE - POST CANYON DR CONNECTION
ROCKY RD
FAIRVIEW DR
30TH ST EXTENSION
30TH ST
BELMONT DR
RAND RD
MAY ST
SHERMAN AVE
BELMONT AVE
CASCADE AVE
MT ADAMS
WINE COUNTRY AVE
county-owned parcel

DKS

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TECHNICAL MEMORANDUM 8

DATE: September 29, 2017

TO: Joe Dills and Andrew Parish, Angelo Planning Group

FROM: John Bosket and Jasmine Pahukula

SUBJECT: Hood River Westside Area Concept Plan – Task 6.4 Second Transportation Analysis with Updated Assumptions

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The goal of the Westside Area Concept Plan is to develop an integrated land use and transportation plan for a site of approximately 450 acres located within the City of Hood River and Hood River County. A key outcome will be efficient and orderly land use comprised primarily of residential development. The purpose of this memorandum is to address OAR 660-012-0060 Transportation Planning Rule (TPR) requirements by evaluating the transportation impacts of the proposed plan and identifying any mitigation needed to ensure adequate transportation facilities will be in place to support planned growth.

INTRODUCTION

Updated Transportation Analysis and Assumptions

Following the completion of the initial transportation analysis for this project[1], subsequent meetings with stakeholders led to refinements in the Revised Land Use Framework – July, 2017 for the Westside Area. This created a need to update the transportation analysis, but also provided an opportunity to incorporate new information that became available after the original work plan had been established. This updated transportation analysis includes the following modifications:

- Decreased 2040 population growth estimates. This change was made to align with new population forecasts from Portland State University, which assume an annual population growth rate of 1.4 percent to the year 2035, and 0.9 percent thereafter. The previous assumption was that the population would grow at an average rate of 2.0 percent per

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[1] Hood River Westside Area Concept Plan – Transportation Analysis Memorandum, DKS Associates, May 5, 2017.

year.

- The assumed number of people per household was changed from 2.25 to 2.39 to better align with assumptions made in the City's 2015 Housing Needs Analysis.
- Reduced trips within the city limits to account for a mode shift from auto to transit. This reduction was based on the assumption that by 2040, the City of Hood River would have established a transit system comparable to what the City of Sandy has today. According to census data, as much as three percent of Sandy area commute trips are currently made by transit.
- A revised land use plan within the Westside study area (i.e., decreased household growth). In this memo, the revised plan is called the Revised Land Use Framework – July, 2017.
- Two additional study intersections were added (2nd Street/I-84 Westbound Ramps and 2nd Street/I-84 Eastbound Ramps) to assess potential impacts at the I-84 Exit 63 Interchange.

The combined impact of these changes reduced citywide population and household growth assumptions (note: employment growth assumptions were not changed) as shown in Table 1.

Table 1: Changes in Population and Household Growth Resulting from Updated Analysis Assumptions

Category	Scenario - Strong increase in Workforce and Affordable Housing[2]	Revised Land Use Framework – July, 2017	Difference (Revised - 'Scenario – Strong')
City of Hood River Total Population Estimate	15,583	13,352	-2,231
City of Hood River Total Household Estimate	6,520	5,586	-934
Number of New Households within the Westside Area (2017 to 2040)	2,271	1,703	-568

[2] Hood River Westside Area Concept Plan – Transportation Analysis Memorandum, DKS Associates, May 5, 2017.

Study Area

The study area is bound by I-84 to the north, Rand Road/27th Street to the east, Belmont Drive and the urban growth boundary (UGB) to the south, and Frankton Road to the west. The following intersections were selected for traffic operations analysis and an evaluation of potential impacts from the proposed land use action.

1. Cascade Avenue/Westcliff Drive.
2. Cascade Avenue/I-84 Westbound Ramps
3. Cascade Avenue//I-84 Eastbound Ramps
4. Cascade Avenue/Mt. Adams Avenue
5. Cascade Avenue//Rand Road
6. Country Club Road/Frankton Road
7. Frankton Road/May Street
8. May Street/30th Street
9. Rand Road/27th Street/May Street
10. Frankton Road/Post Canyon Road/Belmont Avenue
11. Belmont Avenue/30th Street
12. Belmont Avenue/27th Street
13. 2nd Street/I-84 Westbound Ramps
14. 2nd Street/I-84 Eastbound Ramps

The study area and selected study intersections are shown in Figure 1.

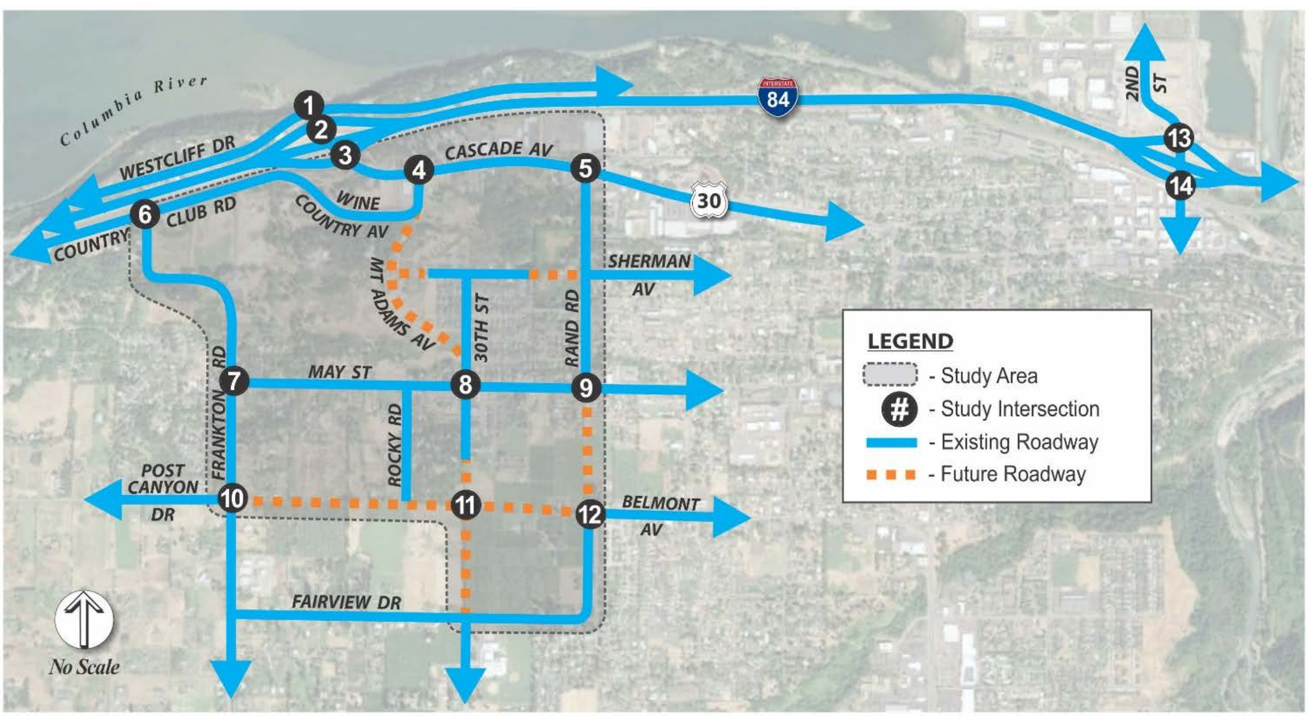

Figure 1: Study Area

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Scenarios

This analysis evaluates the following two alternatives during the weekday p.m. peak hour in the year 2040:

- Transportation Base Case – includes land use consistent with the current Comprehensive Plan/Zoning and transportation improvements identified in the adopted City of Hood River Transportation System Plan (TSP) Motor Vehicle Financially Constrained Plan.[3]
- Revised Land Use Framework – July, 2017 – includes land use within the Westside Area Plan boundary which are based on the Draft Preferred Land Use Framework[4] as revised to incorporate many of the transect ideas presented to the Project Advisory Committee on June 28, 2017, and the same transportation improvements assumed for the Transportation Base Case, with some minor changes as described in the Transportation Network Assumptions section.

Land use and transportation network assumptions for each alternative are described in more detail in the following sections.

Land Use Assumptions

The Transportation Base Case represents the existing Comprehensive Plan/Zoning that applies in the Westside Area. In other words, it does not change existing zoning to provide a baseline for use in comparing the alternatives.

The Transportation Base Case was developed by modifying population and housing growth assumptions previously used for the City's TSP update. This included using Portland State University's recent annual population growth rates of 1.4 percent through 2035, and 0.9 percent from 2035 to 2040, as well as changing the assumed number of people per household from 2.25 to 2.39 to better align with assumptions made in the City's 2015 Housing Needs Analysis[5]. Employment growth assumptions were taken from the City's 2011 Economic Opportunities Analysis[6].

The Revised Land Use Framework – July, 2017 represents changes to the Comprehensive Plan/Zoning to accommodate an increased amount of workforce and affordable housing choices by increasing housing density and providing a greater mix of housing types within the Westside Area. This scenario changes selected undeveloped residential land within the study area to "R-2A" and R-3 type land uses, which increases the opportunities for small lot, duplex/triplex, townhome, cluster developments, and apartment housing. It retains developed R-2 lands in their current zoning and R-1 lands in the south and western parts of the study area. The current R-2 lands are also retained in the southern part of the study area near Westside Elementary School. Overall, these changes increase opportunities for workforce and affordable housing and create

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[3] City of Hood River Transportation System Plan, 2011.
[4] As reviewed by the Project Advisory Committee on April 26, 2017 and the joint Planning Commission/City Council meeting on May 22, 2017
[5] City of Hood River Housing Needs Analysis, September 2015, ECONorthwest.
[6] Hood River Economic Opportunities Analysis, June 2011, FSC Group.

a transect of land use densities across the study area and within neighborhoods.

The City's transportation model uses a control total for land use that is coordinated with Hood River County and ODOT. The overall housing and employment assumptions within the City of Hood River UGB were held constant between the two alternatives. The only difference was where the growth was assumed to occur. This is a technical modeling assumption and not a land use policy change.

Transportation Network Assumptions

According to the TPR, in determining whether a proposed land use regulation amendment has a "significant effect" on the existing or planned transportation system, the evaluation must rely only on existing transportation facilities and planned facilities that are either funded or for which the state/local agency provides a written statement that the facility is reasonably likely to be funded by the end of the planning period.[7] The projects identified in the Motor Vehicle Financially Constrained Plan of the City's TSP were used to represent assumed transportation network conditions for the Transportation Base Case. The Financially Constrained Plan is a subset of all TSP projects that aligns with anticipated funding. Therefore, it is assumed that these projects are reasonably likely to be funded by 2040. The Motor Vehicle Financially Constrained Plan improvements within the Westside Area Plan boundary are listed below and shown in Figure 2.

Elements of each project that have already been constructed are not mentioned. The project ID numbers (e.g., MV3) are consistent with those used in the City's TSP.

- MV3 – Cascade Avenue/Mt. Adams Avenue:
  - Cascade Avenue at Mt. Adams Avenue: Construct a second northbound left turn lane and install yield control for eastbound right turn lane.
  - Mt. Adams Avenue at Wine Country Avenue: Construct northbound left turn lane, northbound shared through/right turn lane, channelized southbound right turn lane under yield control, southbound through lane, southbound left turn lane, eastbound left turn lane, eastbound shared through/right turn lane, east approach for property access including a westbound left turn lane, and a shared westbound through/right turn lane.
- MV4 – Mt. Adams Avenue (Wine Country Avenue to Fairview Drive): Construct Mt. Adams Avenue as a 3-lane minor arterial and construct a traffic signal at May Street/Mt. Adams Avenue/30th Street (30th Street north of May Street would be disconnected and cul-de-saced).
- MV11 – Mt. Adams Avenue/Cascade Avenue – Construct a traffic signal.
- MV12 – Mt. Adams Avenue/Wine Country Avenue - Construct a traffic signal.
- MV13 – Rand Road/Cascade Avenue - Construct a traffic signal, eastbound right turn lane and modify the northbound and southbound approach to include a left turn lane and a shared through/right turn lane.

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[7] OAR 660-012-0060(4)

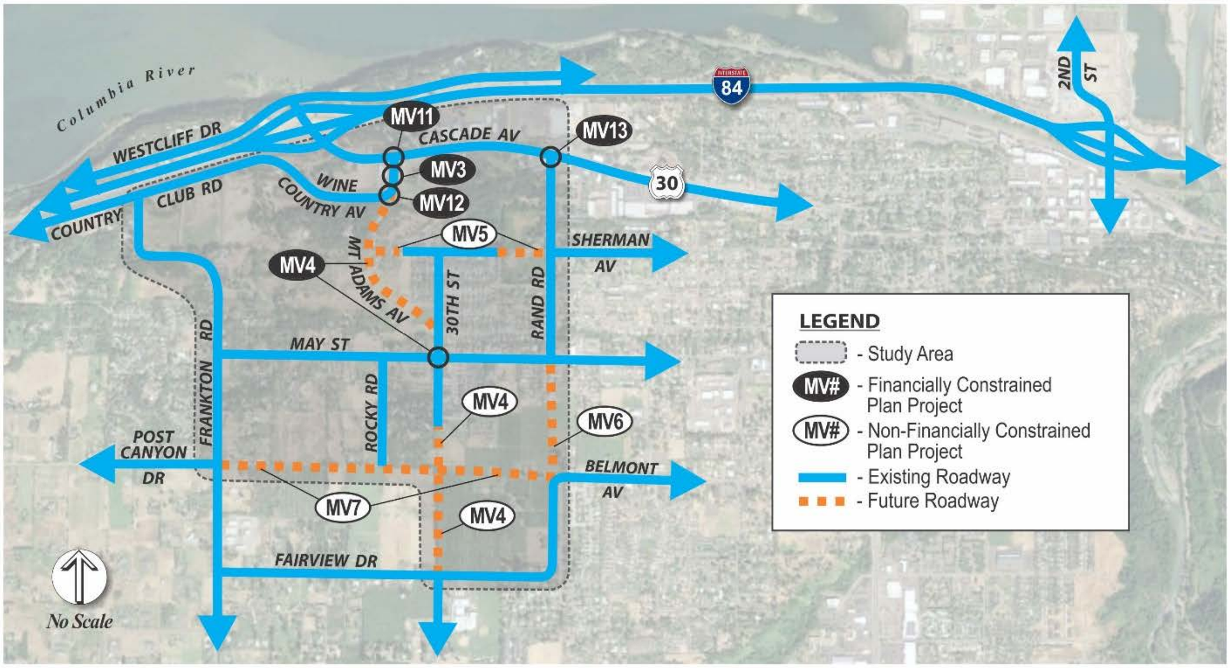

Figure 2: Transportation Base Case Transportation Network Assumptions

A select group of street extension projects from the City TSP that are not on the Financially Constrained Plan were included as well. While projects for which no reasonable funding source has been identified would not typically be assumed to be in place for TPR analysis, these streets were included because they would be necessary to access new development as it occurs within the Westside Area Plan boundary. A portion of the cost for each of these new streets would be the responsibility of developers. However, means for funding the remainder of these new streets as the area develops must be identified to satisfy TPR requirements. These projects are also shown in Figure 2 and listed below.

- MV4 – Mt. Adams Avenue (May Street to Fairview Drive): includes improvements south of May Street.[8]
- MV5 – Sherman Avenue (Rand Road to Mt. Adams Avenue) – Extend Sherman Avenue from Rand Road to Mt. Adams Avenue.
- MV6 – Rand Road (May Street to Belmont Avenue) – Extend Rand Road/27th Street from the current stub south of May Street to Belmont Avenue.
- MV7 – Belmont Avenue (Rand Road to Frankton Road) – Extend Belmont Avenue to Frankton Road.

[8] Note: The portion of project MV4 from May Street to the north was included in TSP Financially Constrained Plan. Project MV4 is split into two “phases” for budgeting purposes.

The Revised Land Use Framework – July, 2017 has the same network assumptions as the Transportation Base Case with the following exceptions, which are shown in Figure 3:

- A shift in location for Project MV4, the portion of the Mt. Adams Avenue extension between Wine Country Avenue (formally referred to as Country Club Road in the TSP) and May Street is shifted to the west. This western alignment is hereafter referred to as "Alignment D" (project MV4.2 in Figure 3).
- A shift in location for Project MV12, the traffic signal on Mt. Adams Avenue at Wine Country Avenue is moved west to the new intersection of Wine Country Avenue at Alignment D (now project MV12.1)[9]. The Wine Country Avenue/Alignment D intersection includes a westbound through lane, a westbound left turn lane, an eastbound shared through-right lane, a northbound right turn lane, and a northbound left turn lane.
- Sherman Avenue is extended further to the west, all the way to Alignment D. A neighborhood collector street further to the south would provide a connection between Alignment D and Frankton Road.
- A shift in the location for the traffic signal on May Street at 30th Street. The signal is moved west to the new intersection with Alignment D (now project MV4.3).

Alignment D and the associated intersection improvements on Wine Country Avenue and May Street are not on the TSP Financially Constrained Plan. However, since they would replace the portion of project MV4 that is on the Financially Constrained Plan, the future funds allocated for those improvements would be transferred to the new Alignment D project.

Two alternative alignments of the Mt. Adams Avenue extension, including Alignment D, were proposed (refer to the Alternatives Analysis Report[10]) instead of the alignment identified in the City's TSP. Under the Revised Land Use Framework – July, 2017, the two alignments would be functionally equivalent from a transportation standpoint if appropriate intersection improvements are included at key locations where the alignments differ.

To move forward with the transportation analysis, the alignment shown in Figure 3 (Alignment D) was assumed to be in place as part of the Revised Land Use Framework – July, 2017. To be clear, this is not a final decision between the two proposed alignments. There are other factors including construction costs, grades, and other utilities that will be used to evaluate the two alignments before a decision is made. At the time of this writing, the project committees have supported the inclusion of Alignment D in the Draft Concept Plan. However, this will not be a final decision until the City adopts the plan.

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[9] The Streets Framework plan identifies two north-south connections between Wine Country Avenue and Sherman Avenue via the Mt. Adams Avenue extension and the 30th Street extension. Assuming these two roadway extensions are intended to provide local/neighborhood access only, it is recommended that both access points are limited to right-in, right-out only at the Wine Country Avenue/Mt. Adams Avenue intersection.

[10] Hood River Westside Area Concept Plan Alternatives Analysis Report DRAFT, January 2017.

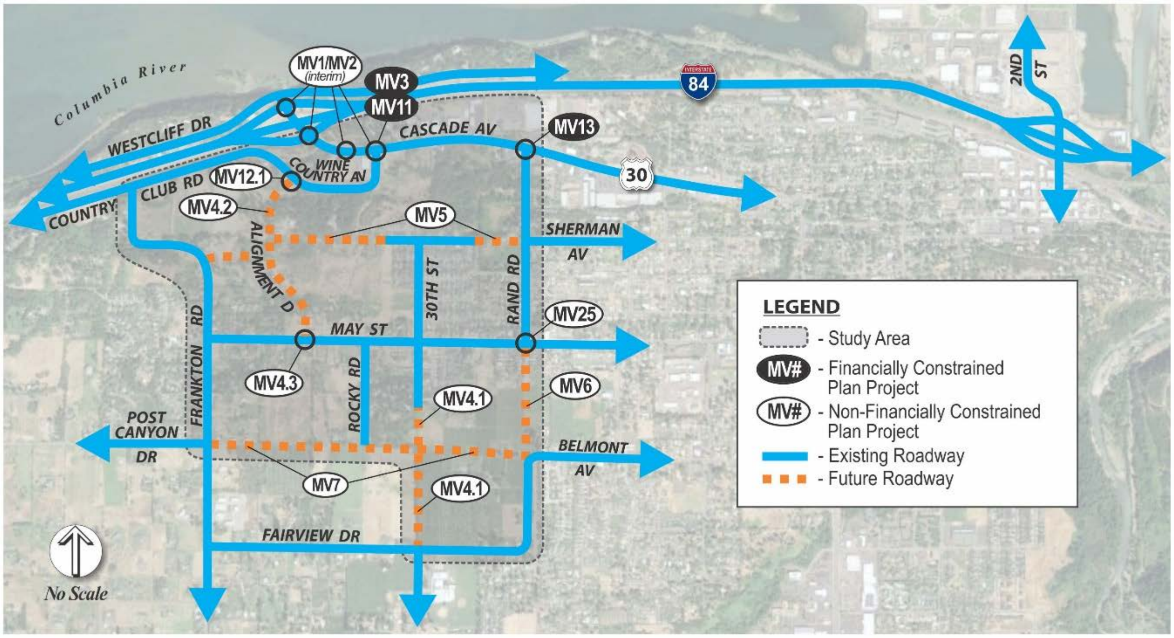

Figure 3: Revised Land Use Framework – July, 2017 Transportation Network Assumptions

Transportation Analysis

Future Traffic Volume Development

To determine future year intersection traffic operations, year 2040 motor vehicle traffic volumes were forecasted at the study intersections. These volumes were forecasted by applying each alternative's land use and transportation network assumptions to the Hood River Travel Forecast Tool created for network analysis when the 2011 TSP was developed. In addition, all citywide internal trips (i.e., those beginning and ending within the city) were reduced by three percent to account for a mode shift of some trips from auto to transit. Future volumes at the study intersections are provided in Appendix A.

Future Traffic Operations

Future intersection operations analysis was performed for the 14 study area intersections to identify potential transportation impacts from the proposed rezones associated with the Revised Land Use Framework – July, 2017. Intersections are the focus of the analysis because they are typically the controlling bottlenecks of traffic flow and the ability of a roadway system to carry traffic efficiently is nearly always diminished in their vicinity. Included are descriptions of the intersection performance measures, jurisdictional operational standards, and future traffic operational analysis.

Intersection Performance Measures

Level of service (LOS) ratings and volume-to-capacity (v/c) ratios are two commonly used performance measures that provide a good picture of intersection operations. In addition, they are often incorporated into agency mobility standards.

- Level of service (LOS): A "report card" rating (A through F) based on the average delay 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 has exceeded capacity. This condition is typically evident in long queues and delays.
- Volume-to-capacity (v/c) ratio: A decimal representation (typically between 0.00 and 1.00) of the proportion of capacity that is being used at a turn movement, approach leg, or intersection. It is determined by dividing the peak hour traffic volume by the hourly capacity of a given intersection or movement. A lower ratio indicates smooth operations and minimal delays. As the ratio approaches 0.95, congestion increases and performance is reduced. If the ratio is greater than 1.00, the turn movement, approach leg, or intersection is oversaturated and usually results in excessive queues and long delays.

Jurisdictional Operating Standards

All study intersections are subject to the adopted operating standards of either the City of Hood River or ODOT. Having all intersections meet those standards is desired, but for TPR compliance they can fail to meet operating standards if the proposed land use action does not make conditions worse than they were otherwise, except for intersections within and adopted Interchange Area Management Plan (IAMP). The Transportation Base Case serves as the baseline benchmark for operational performance for non-IAMP intersections. However, IAMP intersections must meet the operating standards under the proposed land use action. The IAMP intersections are identified in Table 2.

Intersection performance measures used for operating standards vary by roadway jurisdiction. The study intersections under ODOT jurisdiction must comply with the v/c ratio targets in the Oregon Highway Plan (OHP), which specifies a v/c ratio target of 0.95 or less for the study intersections along Cascade Avenue.[11] The OHP specifies a more restrictive v/c target of 0.85 or less for ramp terminals.[12]

The study intersections under City of Hood River jurisdiction must comply with the LOS targets in the City's TSP, which requires a LOS D or better for city-owned streets.[13]

Intersection Operations

The future traffic operations at the study intersections were determined for the weekday p.m. peak hour based on the Synchro[9] software analysis using 2000 Highway Capacity Manual methodology[14] for signalized intersections and 2010 Highway Capacity Manual methodology[15] for unsignalized intersections. The level of service (LOS) and volume to capacity (v/c) ratio of each study intersection are listed in Table 2. Detailed intersection analysis worksheets are included in Appendix B.

As shown, four study intersections fail to comply with operating standards by 2040 under the Transportation Base Case. These include:

- Cascade Avenue/I-84 Westbound Ramps (unsignalized)
- Cascade Avenue/I-84 Eastbound Ramps (unsignalized)
- Cascade Avenue/Mt. Adams Avenue (signalized)
- Rand Road/27th Street/May Street (unsignalized)

Under the Revised Land Use Framework – July, 2017, conditions worsen at the Cascade Avenue/Mt. Adams Avenue and Rand Road/27th Street/May Street intersections. Although conditions improve at the Exit 62 (Cascade Avenue/I-84) interchange under the Revised Land Use Framework – July, 2017, the Exit 62 interchange is part of an adopted IAMP. Therefore, those intersections must meet operating standards or mitigation will be required at all four of these intersections to achieve TPR compliance.

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[11] Table 7, Oregon Highway Plan, Oregon Department of Transportation, December 2011. Based on a District Highway, Non-MPO Outside of STAs where non-freeway posted speed <= 35 mph.
[12] Oregon Highway Plan, Oregon Department of Transportation, December 2011, page 76.
[13] City of Hood River Transportation System Plan, October 2011.
[14] *2000 Highway Capacity Manual*, Transportation Research Board, Washington DC, 2000.
[15] *2010 Highway Capacity Manual*, Transportation Research Board, Washington DC, 2010.

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Table 2: Future Study Intersection Operations 2040 Weekday P.M. Peak Hour

	Intersection	Operating Standard	Transportation Base Case			Revised Land Use Framework – July, 2017		
			LOS	Delay (sec)	v/c	LOS	Delay (sec)	v/c
1	Cascade Avenue/Westcliff Drive	0.95 v/c (IAMP)	A/B[1]	12.6[1]	0.12[1]	A/B[1]	12.3[1]	0.10[1]
2	Cascade Avenue/ I-84 Westbound Ramps	0.85 v/c (IAMP)	A/F	>1000	**3.40**	A/F	759.2	**2.59**
3	Cascade Avenue/ I-84 Eastbound Ramps	0.85 v/c (IAMP)	A/F	99.0	**1.07**	A/F	56.0	**0.92**
4	Cascade Avenue/Mt. Adams Avenue	0.95 v/c (IAMP)	F	168.7	**1.74**	F	196.4	**1.88**
5	Cascade Avenue/Rand Road	0.95 v/c (IAMP)	C	25.2	0.65	C	30.9	0.79
`6	Country Club Road/Frankton Road	D	A/B	12.2	0.27	A/B	11.8	0.27
7	Frankton Road/May Street	D	A/C	15.3	0.38	A/C	17.4	0.42
8	May Street/30th Street	D	C	26.5	0.57	A/C	17.5	0.29
9	Rand Road/27th Street/May Street	D	A/**F**	162.7	1.22	A/**F**	387.8	1.71
10	Frankton Road/Post Canyon Road/Belmont Avenue	D	A/C	15.6	0.20	A/C	18.9	0.24
11	Belmont Avenue/30th Street	D	A/D	29.1	0.20	A/C	23.4	0.32
12	Belmont Avenue/27th Street	D	A/B	13.9	0.13	A/B	12.3	0.10
13	2nd Street/I-84 Westbound Ramps	0.85 v/c (IAMP)	C	22.3	0.77	C	23.3	0.79
14	2nd Street/I-84 Eastbound Ramps	0.85 v/c (IAMP)	B	18.7	0.82	B	18.9	0.81
-	Alignment D/May Street	D	-	-	-	D	52.5	0.44

Bolded Red and Shaded values do not meet operating standards.
Two-Way Stop Controlled intersections:
LOS = Level of Service of Major Street/Minor Street (i.e., A/F)
V/C = Volume-to-Capacity Ratio of Worst Movement

	Delay = Seconds of Delay of Worst Movement [1] Due to the atypical traffic control at this intersection, the future operations were determined using 2000 Highway Capacity Manual methodology for unsignalized intersections.

Why do conditions at the I-84 Exit 62 ramp intersections improve under the Revised Land Use Framework – July, 2017?

Future traffic volume forecasts for each alternative use a shortest path analysis, where "short" is defined by how much time it takes to arrive at a destination. Therefore, excessive congestion can result in routing changes across the city. In this case, the unimproved Exit 62 interchange operates very poorly under the Transportation Base Case and drivers will experience very long delays. The increased housing density in the Westside Area associated with the Revised Land Use Framework – July, 2017 creates more vehicle trip demand for the Exit 62 interchange area. However, the shift of the Mt. Adams Avenue extension to Alignment D, approximately 900 feet to the west, makes Alignment D less attractive for some trips (because the trips take more time). About half of the diverted trips will choose to enter Hood River from Exit 63 and travel westbound down Cascade Avenue instead of using the Exit 62 interchange. The remaining diverted trips enter the city from the south via OR35 and from the east via State Street and will also choose to travel westbound down Cascade Avenue instead of using the Exit 62 interchange. The net result is fewer trips in the Exit 62 interchange and less delay under the Revised Land Use Framework – July, 2017, though congestion may be increased elsewhere.

Mitigation for the Exit 62 interchange is assumed to include the improvements recommended at this location in the City's TSP. The Exit 62 improvements in the City's adopted TSP (MV1) include:

Cascade Avenue/ I-84 Westbound Ramps:

- Construct traffic signal
- Construct northbound left turn lane (full length of the bridge)
- Construct second southbound through lane
- Construct westbound left turn lane
- Construct shared westbound through/left turn lane
- Construct westbound right turn lane

Cascade Avenue/ I-84 Eastbound Ramps:

- Construct traffic signal
- Construct northbound right turn lane (drop lane from Cascade Avenue to I-84 eastbound)
- Construct second southbound through lane
- Construct southbound left turn lane
- Construct eastbound right turn lane

Mitigation for the Cascade Avenue/Mt. Adams Avenue intersection is assumed to include the remainder of the improvements recommended at this location in the City's TSP. These include:

- Widen Cascade Avenue between Mt. Adams Avenue and Rand Road to include one travel lane in each direction and a center turn lane (MV2b)

To accommodate the construction of new turn lanes at the Exit 62 interchange and Cascade Avenue/Mt. Adams Avenue intersection, the additional improvements, also included in the City's adopted TSP (MV2a), will be required on Cascade Avenue between the interchange and Mt. Adams Avenue:

- Construct second eastbound lane from I-84 eastbound ramp terminal to Mt. Adams Avenue
- Construct a second westbound lane from Mt. Adams Avenue to I-84 eastbound ramp terminal (ends as right turn lane)

To summarize, the above-listed improvements at and near Exit 62 are included in the City's currently adopted TSP and are necessary to accommodate Hood River's growth under either the Transportation Base Case or Revised Land Use Framework – July, 2017.

The City's TSP does not identify any improvements for the intersection of Rand Road/27th Street/May Street. If a traffic signal were constructed, operating conditions could be improved to a LOS B, which would meet adopted standards (see Table 3). Alternatively, the City could consider constructing a mini-roundabout at this location to fit within available right-of-way at a significantly lower cost. Refer to Appendix C for an example of a mini-roundabout. This project (MV25) is the only new improvement that would be added to City's TSP to accommodate growth under the proposed Revised Land Use Framework – July, 2017.

With these mitigations in place, conditions at the four identified intersections will comply with operational standards under the Transportation Base Case and Revised Land Use Framework – July, 2017 and would meet TPR requirements.

Note: Under the Mitigated Transportation Base Case, conditions worsen at Belmont Avenue/30th Street. However, under the Mitigated Revised Land Use Framework – July, 2017, conditions at Belmont Avenue/30th Street will comply with operations standards and would meet TPR requirements.

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Table 3: Future Study Intersection Operations 2040 Weekday P.M. Peak Hour - Mitigated

	Intersection	Operating Standard	Transportation Base Case			Revised Land Use Framework – July, 2017		
			LOS	Delay (sec)	v/c	LOS	Delay (sec)	v/c
1	Cascade Avenue/Westcliff Drive	0.95 v/c	B	14.8	0.11	B	18.2	0.11
2	Cascade Avenue/ I-84 Westbound Ramps	0.85 v/c	C	27.6	0.73	C	27.0	0.67
3	Cascade Avenue/ I-84 Eastbound Ramps	0.85 v/c	C	26.0	0.65	C	22.9	0.66
4	Cascade Avenue/Mt. Adams Avenue	0.95 v/c	B	16.7	0.87	B	19.1	0.83
5	Cascade Avenue/Rand Road	0.95 v/c	C	23.1	0.72	C	28.1	0.85
6	Country Club Road/Frankton Road	D	A/B	12.7	0.31	A/B	11.8	0.26
7	Frankton Road/May Street	D	A/B	14.7	0.31	A/C	16.3	0.39
8	May Street/30th Street	D	C	20.6	0.51	A/B	14.1	0.22
9	Rand Road/27th Street/May Street	D	B	10.9	0.59	B	19.1	0.77
10	Frankton Road/Post Canyon Road/Belmont Avenue	D	A/C	17.4	0.23	A/C	18.2	0.23
11	Belmont Avenue/30th Street	D	A/**E**	43.9	0.35	A/C	23.6	0.32
12	Belmont Avenue/27th Street	D	A/B	15.5	0.14	A/B	15.8	0.21
13	2nd Street & I-84 Westbound Ramps	0.85 v/c	C	20.3	0.73	C	22.2	0.77
14	2nd Street & I-84 Eastbound Ramps	0.85 v/c	B	18.5	0.80	B	19.1	0.81
-	Alignment D/May Street	D	-	-	-	D	48.1	0.42

Bolded Red and Shaded values do not meet operating standards.
Two-Way Stop Controlled intersections:

	LOS = Level of Service of Major Street/Minor Street (i.e., A/F) V/C = Volume-to-Capacity Ratio of Worst Movement Delay = Seconds of Delay of Worst Movement

Interchange Ramp Queues

In addition to intersection operations, projected vehicle queues on the I-84 Exit 62 and Exit 63 off-ramps were also compared between alternatives to identify potential safety issues. Safety concerns arise if ramp queues exceed the provided storage area and spill back into the portion of the ramp needed to slow to a stop from exiting freeway speeds. The result is an increased risk for high-speed rear-end collisions. This is not a new issue. In 2011, the Exit 62 Interchange Area Management Plan previously analyzed ramp queues and identified the need for ramp capacity improvements.

SimTraffic modeling software was used to estimate the 95th percentile vehicle queues for the I-84 Exit 62 and Exit 63 westbound and eastbound off-ramps, without mitigating improvements, so as to assess the level of mitigations required. This analysis estimates the queue length that would not be exceeded in 95 percent of the queues formed during the peak hour.

Vehicle queues at the Cascade Avenue/I-84 Westbound Ramps are very long and would extend back into the freeway mainline under the Transportation Base Case. Conditions improve under the Revised Land Use Framework – July, 2017; however, the queues still would extend back into the freeway mainline. This change is due to the diversion of trips to the Exit 63 interchange and westbound Cascade Avenue to avoid excessive delays at the Exit 62 interchange. Detailed queuing results for the westbound and eastbound ramps at the I-84 Exit 62 and Exit 63 interchanges in their current unimproved states are included in Appendix D.

Table 4 identifies the 95th percentile queue lengths for the westbound and eastbound ramps at the I-84 Exit 62 and Exit 63 interchanges with the proposed mitigations. Operating standards at the intersections would be met under both alternatives. Queue lengths can be accommodated during the design to ensure the vehicle queues don’t extend into the deceleration area.

Table 4: 2040 Weekday P.M. Peak Hour Motor Vehicle 95th Percentile Queuing - Mitigated

Intersection		Movement	95th Percentile Vehicle Queue Length (ft.)	
			Transportation Base Case	Revised Land Use Framework – July, 2017
2	Cascade Avenue/ I-84 Westbound Ramps	Left	275	250
		Left/Through	325	275
		Right	125	75
3	Cascade Avenue/ I-84 Eastbound Ramps	Left/Through	100	100
		Right	250	225
13	2nd Street & I-84 Westbound Ramps	Left/Through	425	375
		Right	200	175
14	2nd Street & I-84 Eastbound Ramps	Left/Through	250	300
		Right	150	200

Alternative Interim Improvements for TPR Compliance

The proposed mitigation at the Exit 62 interchange, which includes significant interchange reconstruction, is not reasonably likely to be funded by 2040. As an alternative to full interchange reconstruction, which was estimated to cost approximately $35 million, a set of interim improvements are offered for consideration that would cost approximately $5 million. Congestion would still be present, but ramp queues would be mainatined at a safe length so stopped vehicles would not queue back onto the freeway mainline or within the portion of the off-ramps needed to decelerate to a stop from freeway speeds. These improvements (MV1/MV2 Interim) include:

Cascade Avenue/ I-84 Westbound Ramps

- Construct a traffic signal
- Install queue detection devices on the off-ramp and ability to pre-empt signal timing to allow the off-ramp queues to be cleared during times when queue lengths become excessive

Cascade Avenue/ I-84 Eastbound Ramps

- Construct an eastbound shared through/left turn lane to create an exclusive lane for the heavier right turn movement

Cascade Avenue

- Construct second eastbound lane from the I-84 eastbound ramp terminal to Mt. Adams Avenue (would tie into the existing eastbound right turn lane at Mt. Adams Avenue)

Westcliff Drive/Cascade Avenue

- Install a stop sign on the eastbound approach
- Remove the stop sign for the northbound right turn lane

Tables 5 and 6 show the intersection operations and Exit 62 queuing with the above improvements in place (also includes all other improvements previously discussed). As noted, the interim improvements do not meet the operating standards (v/c ratio targets), but they do prevent ramp queues from backing onto the mainline or obstructing vehicles exiting from the freeway. Although the Exit 62 interchange ramp intersections do not meet the operating standards under the Revised Land Use Framework – July 2017, the v/c ratios are less than 1.0, which is a significant improvement. While this analysis was completed for the year 2040, ODOT is advised to implement the identified safety improvements (MV1/MV2 Interim) in the near term rather than waiting until 2040.

Table 5: Future Study Intersection Operations 2040 Weekday P.M. Peak Hour – Mitigated with Interim Improvements

Intersection		Operating Standard	Transportation Base Case			Revised Land Use Framework – July, 2017		
			LOS	Delay (sec)	v/c	LOS	Delay (sec)	v/c
1	Cascade Avenue/Westcliff Drive	0.95 v/c (IAMP)	A/B[1]	12.0[1]	0.09[1]	A/B[1]	12.2[1]	0.12[1]
2	Cascade Avenue/ I-84 Westbound Ramps	0.85 v/c (IAMP)	D	49.9	**1.05**	D	35.7	0.93
3	Cascade Avenue/ I-84 Eastbound Ramps	0.85 v/c (IAMP)	A/F	115.6	**1.11**	A/E	46.4	0.87
4	Cascade Avenue/Mt. Adams Avenue	0.95 v/c (IAMP)	B	17.7	0.88	B	19.1	0.83
5	Cascade Avenue/Rand Road	0.95 v/c (IAMP)	C	23.1	0.72	C	28.1	0.85
6	Country Club Road/Frankton Road	D	A/B	12.7	0.31	A/B	11.8	0.26
7	Frankton Road/May Street	D	A/B	14.7	0.31	A/C	16.3	0.39
8	May Street/30th Street	D	C	20.6	0.51	A/B	14.1	0.22
9	Rand Road/27th Street/May Street	D	B	10.9	0.59	B	19.1	0.77
10	Frankton Road/Post Canyon Road/Belmont Avenue	D	A/C	17.4	0.23	A/C	18.2	0.23
11	Belmont Avenue/30th Street	D	A/**E**	43.9	0.35	A/C	23.6	0.32
12	Belmont Avenue/27th Street	D	A/B	15.5	0.14	A/B	15.8	0.21
13	2nd Street/I-84 Westbound Ramps	0.85 v/c (IAMP)	C	20.3	0.73	C	22.2	0.77
14	2nd Street/I-84 Eastbound Ramps	0.85 v/c (IAMP)	B	18.5	0.80	B	19.1	0.81
-	Alignment D/May Street	D	-	-	-	D	48.1	0.42
	Bolded Red and Shaded values do not meet operating standards.							

Two-Way Stop Controlled intersections:
LOS = Level of Service of Major Street/Minor Street (i.e., A/F)
V/C = Volume-to-Capacity Ratio of Worst Movement
Delay = Seconds of Delay of Worst Movement
[1] Due to the atypical traffic control at this intersection, the future operations were determined using 2000 Highway Capacity Manual methodology for unsignalized intersections.

Table 6: 2040 Weekday P.M. Peak Hour Motor Vehicle 95th Percentile Queuing – Mitigated with Interim Improvements

Intersection		Movement	95th Percentile Vehicle Queue Length (ft.)	
			Transportation Base Case	Revised Land Use Framework – July, 2017
2	Cascade Avenue/ I-84 Westbound Ramps	Left /Through/Right	1,300	400
3	Cascade Avenue/ I-84 Eastbound Ramps	Left /Through	225	150
		Right	300	250

SUMMARY OF KEY FINDINGS & RECOMMENDATIONS

Both the proposed land uses and minor transportation network changes associated with the Revised Land Use Framework – July, 2017 will have a “significant effect”, as defined by the Transportation Planning Rule, on the operational performance of the intersections at the Exit 62 interchange, Cascade Avenue/Mt. Adams Avenue, and Rand Road/27th Street/May Street. All four identified intersections will fail to meet adopted operational standards by 2040 under the Transportation Base Case and Revised Land Use Framework – July, 2017.

The following set of improvements are recommended to supplement the Financially Constrained Plan improvements and mitigate the impacts of the proposed land use action, allowing for TPR compliance. This includes the interim Exit 62 interchange improvements in lieu of the full set of interchange improvements included in the City’s TSP. However, to comply with the TPR, ODOT must be willing to provide a letter stating that these improvements are sufficient and reasonably likely to be funded by 2040.

Note: There is an identifier for each improvement highlighting the project source. Most required projects are already identified in the City’s adopted TSP. There is one new project recommended for the TSP that is necessary to accommodate growth under the proposed land use plan. There are four new interim projects recommended to satisfy TPR requirements.

Cascade Avenue/ I-84 Westbound Ramps (MV1/MV2 Interim)

- Construct a traffic signal (currently in the adopted TSP)
- Install queue detection devices on the off-ramp and ability to pre-empt signal timing to allow the off-ramp queues to be cleared during times when queue lengths become excessive (new interim project recommended for the TSP)

Cascade Avenue/ I-84 Eastbound Ramps (MV1/MV2 Interim)

- Construct an eastbound shared through/left turn lane to create an exclusive lane for the heavier right turn movement (currently in the adopted TSP)

Cascade Avenue (MV1/MV2 Interim)

- Construct second eastbound lane from the I-84 eastbound ramp terminal to Mt. Adams Avenue that would tie into the existing eastbound right turn lane at Mt. Adams Avenue (currently in the adopted TSP)

Westcliff Drive/Cascade Avenue (MV1/MV2 Interim)

- Install a stop sign on the eastbound approach (new interim project recommended for the TSP)
- Remove the stop sign for the northbound right turn lane (new interim project recommended for the TSP)

Rand Road/27th Street/May Street: (MV25)

- Construct a traffic signal; or (new project recommended for the TSP)
- Construct a mini-roundabout (new project recommended for the TSP, pending further design review)

Funding must also be identified for the following improvements currently in the City's TSP to ensure adequate facilities will be in place to support development in the Westside Area:

- MV2a – Cascade Avenue widening – Construct a second westbound lane from Mt. Adams Avenue to I-84 eastbound ramp terminal that ends as right turn lane
- MV2b – Cascade Avenue widening - Widen Cascade Avenue between Mt. Adams Avenue and Rand Road to include one travel lane in each direction and a center turn lane
- MV4.1 – 30th Street (May Street to Fairview Drive) – Extend 30th Street from May Street to Fairview Drive
- MV5 – Sherman Avenue (Rand Road to Alignment D) – Extend Sherman Avenue from Rand Road to Alignment D
- MV6 – Rand Road (May Street to Belmont Avenue) – Extend Rand Road/27th Street from the current stub south of May Street to Belmont Avenue
- MV7 – Belmont Avenue (Rand Road to Frankton Road) – Extend Belmont Avenue to Frankton Road

If the Mt. Adams Avenue alignment further to the west (Alignment D) is selected, additional refinements to the current TSP include:

- May Street/30th Street Intersection – remove project to construct a traffic signal at this intersection
- May Street/Alignment D – construct a traffic signal or roundabout (MV4.3 - this is essentially the above-listed project shifted to the west)
- Mt. Adams Avenue/Country Club Road – remove project (MV12) to construct a traffic signal at this location
- Wine County Avenue/Alignment D – construct a traffic signal, a westbound left turn lane and a northbound left turn lane (MV12.1 - this is essentially the above-listed project shifted to the west)
- New Neighborhood Collector – Construct a Neighborhood Collector street between Alignment D and Frankton Road to the south of the Sherman Avenue alignment

Funding must also be identified for these improvements; however, some would come from funding assumed for the Financially Constrained Plan project to construct the Mt. Adams Avenue extension from Cascade Avenue to May Street.

Table 7 summarizes the transportation improvements listed above. It makes a distinction between transportation improvements already identified in the City's TSP and new transportation improvements needed to support the Revised Land Use Framework – July 2017.

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Table 7: Summary of the Transportation Improvements

ID	Project	Total Cost Estimate	Project Description	On the 2011 TSP Financially Constrained Project List?	On the 2011 TSP Non-Financially Constrained Project List?	Interim Improvement	New project to add to the TSP	Only Needed if Revised Land Use Framework - July 2017 is approved	Pedestrian/Bicycle Only Improvement[a]
MV1/MV2 Interim	I-84 Exit 62 Interchange	$ 5,000,000	I-84 Westbound Ramp/Terminal - Construct traffic signal		x	x			
			I-84 Westbound Ramp/Terminal - Install queue detection devices on the off-ramp and ability to pre-empt signal timing to allow the off-ramp queues to be cleared during times when queue lengths become excessive			x	x		
			I-84 Eastbound Ramp/Terminal Construct an eastbound shared through/left turn lane to create an exclusive lane for the heavier right turn movement		x	x			
			Cascade Avenue - Construct second eastbound lane from the I-84 eastbound ramp terminal to Mt. Adams Avenue (would tie into the existing eastbound right turn lane at Mt. Adams Avenue)		x	x			
			Westcliff Drive/Cascade Avenue - Install a stop sign on the eastbound approach - Remove the stop sign for the northbound right turn lane			x	x		
MV2a	Cascade Avenue	$1,306,000	- Construct a second westbound lane from Mt. Adams Avenue to I-84 eastbound ramp terminal that ends as right turn lane (currently in the adopted TSP)		x				
MV2b	Cascade Avenue	$906,000	- Widen Cascade Avenue between Mt. Adams Avenue and Rand Road to include one travel lane in each direction and a center turn lane		x				

ID	Project	Total Cost Estimate	Project Description	On the 2011 TSP Financially Constrained Project List?	On the 2011 TSP Non-Financially Constrained Project List?	Interim Improvement	New project to add to the TSP	Only Needed if Revised Land Use Framework - July 2017 is approved	Pedestrian/Bicycle Only Improvement[a]
MV3	Cascade Ave at Mt. Adams Ave	$844,000	-Construct a northbound left turn lane -Install yield control for eastbound right turn lane	x					
MV4.1	30th Street (May Street to Fairview Drive)	$7,120,000	Construct 30th Street as a 3-lane minor arterial from the current stub south of May Street to Fairview Dr. the south/west edge of the urban growth boundary (UGB). The alignment of this roadway should remain within the urban growth boundary and should avoid the National Scenic Area. Improvements within the National Scenic Area may be subject to review for consistency with National Scenic Area provisions. New roadways constructed adjacent to the urban growth boundary may be modified by the City Engineer to include only 3/4-street improvements (e.g., no curb and sidewalk adjacent to the urban growth boundary).		x				
MV4.2	Alignment D (Wine Country Avenue to May Street)	$13,602,000	Construct Alignment D as a 3-lane minor arterial from Country Club Road to May Street.	x*					
MV4.3	May Street/Alignment D	$350,000	Construct a traffic signal	x*					
MV5	Sherman Avenue (Rand Road to Alignment D)	$7,814,000	Extend Sherman Avenue from Rand Road to Alignment D (middle segment of this extension exists)		x*				
MV6	Rand Road (May Street to Belmont)	$2,971,463	Extend Rand Road/27th Street from the current stub south of May Street to Belmont Avenue.		x				

ID	Project	Total Cost Estimate	Project Description	On the 2011 TSP Financially Constrained Project List?	On the 2011 TSP Non-Financially Constrained Project List?	Interim Improvement	New project to add to the TSP	Only Needed if Revised Land Use Framework - July 2017 is approved	Pedestrian/Bicycle Only Improvement[a]
MV7	Belmont Avenue (Rand Road to Frankton Road)	$9,807,992	Extend Belmont Avenue to Frankton Road, opposite Post Canyon Drive. The alignment of Belmont Avenue would fall within the southern UGB and avoid the National Scenic Area. Improvements within the National Scenic Area may be subject to review for consistency with National Scenic Area provisions. New roadways constructed adjacent to the urban growth boundary may be modified by the City Engineer to include only 3/4 -street improvements (e.g. no curb and sidewalk adjacent to the urban growth boundary)		x				
MV11	Mt Adams Avenue/Cascade Avenue	$398,931	Construct a traffic signal	x					
MV13	Rand Road/Cascade Avenue	$1,750,000	Construct a traffic signal, modify northbound approach to include a left turn lane and a shared through/right turn lane, modify southbound approach to include a left turn lane and a shared through/right turn lane, and construct an eastbound right turn lane	x					
MV12.1	Wine Country Avenue/Alignment D	$498,000	Construct a traffic signal	x					
			Construct a westbound left-turn lane		x*				
MV25	Rand Road/27th Street/May Street	$350,000	Construct a traffic signal				x	x	
P1.1	Historic Columbia River Highway Trail	$6,933,000	Construct an asphalt path along Westcliff Drive east to Westside Community Trail (via Wasco Street)		x*				x
P13	Historic Columbia River Highway Trail, south side of Cascade Avenue	$1,185,000	Construct an asphalt or concrete path on the south side of Cascade Avenue.				x		x
P14	30th Street North Extension	$359,000	Construct 6-foot bike lanes and 5- foot sidewalks between 30th Street to Mt. Adams Avenue/Wine Country Avenue				x		x

ID	Project	Total Cost Estimate	Project Description	On the 2011 TSP Financially Constrained Project List?	On the 2011 TSP Non-Financially Constrained Project List?	Interim Improvement	New project to add to the TSP	Only Needed if Revised Land Use Framework - July 2017 is approved	Pedestrian/Bicycle Only Improvement[a]
P15	Westside Community Trail extension to Cascade Avenue	$67,000	Extend the Westside Community Trail north between Sherman Avenue and Cascade Avenue				x		x
P4	Westside Community Trail	-	Extend Westside Community Trail east to connect with the existing trail at 20th Street.	x					x
BL7	Rand Road	$239,358	Construct bike lanes (portion within the Westside Area only)		x				x
BL6	May Street	$515,921	Construct bike lanes (portion within the Westside Area only)	x					x
P16	Upper Terrace Neighborhood Trail	$793,000	Construct Upper Terrace Neighborhood Trail between May Street and Fairview Drive				x		x
P17	Post Canyon Drive Bike Lanes and Sidewalks	$778,000	Construct 6-foot bike lanes and 5- foot sidewalks between Frankton Road and West UGB Boundary				x		x
P18	West Community Trail extension west to Frankton Road	$103,000	Extend the Westside Community Trail west between Rocky Road and Frankton Road				x		x
P19	Trail from Sherman Avenue to Frankton Road	$112,000	Construct a trail from Alignment D to Frankton Road				x		x
BL2	Frankton Bike Lanes	$387,533	Construct bike lanes		x				x
BL1	Country Club Bike Lanes	$416,028	Construct bike lanes		x				x
	Total Cost	$64,607,225							

[a] The pedestrian and bicycle improvements are not discussed in this memo. Refer to the Bicycle/Pedestrian Framework and Technical Memo 6.1:Funding Review and Funding Toolkit for more information.
* This project is a modified version of another project that is already included in the TSP.

APPENDIX

A – 2040 Traffic Volumes

B – 2040 HCM Reports

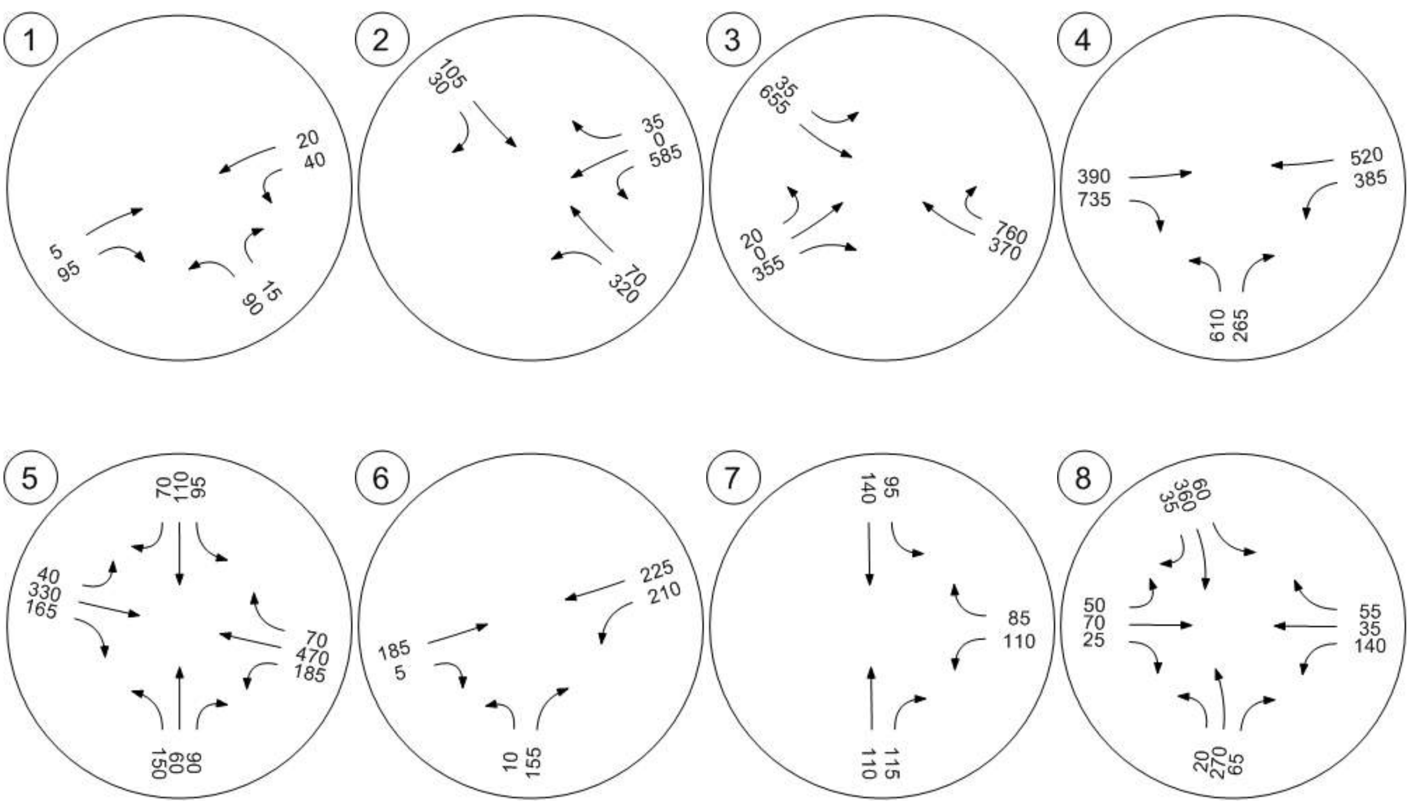
C – Mini Roundabout Example

D – 2040 Queuing Reports

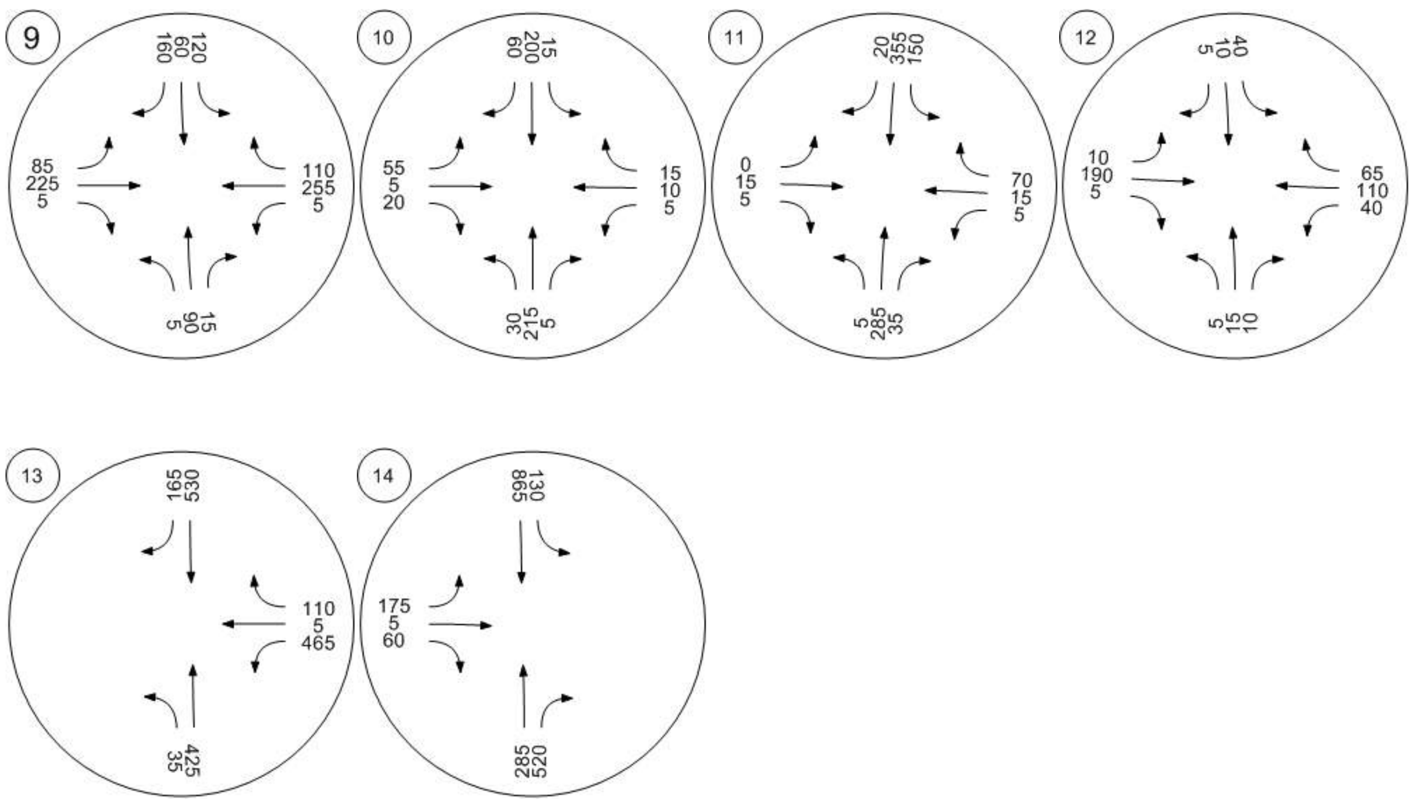
Appendix A – 2040 Traffic Volumes

Transportation Base Case Financially Constrained Volumes

Traffic Volume - Base Volume

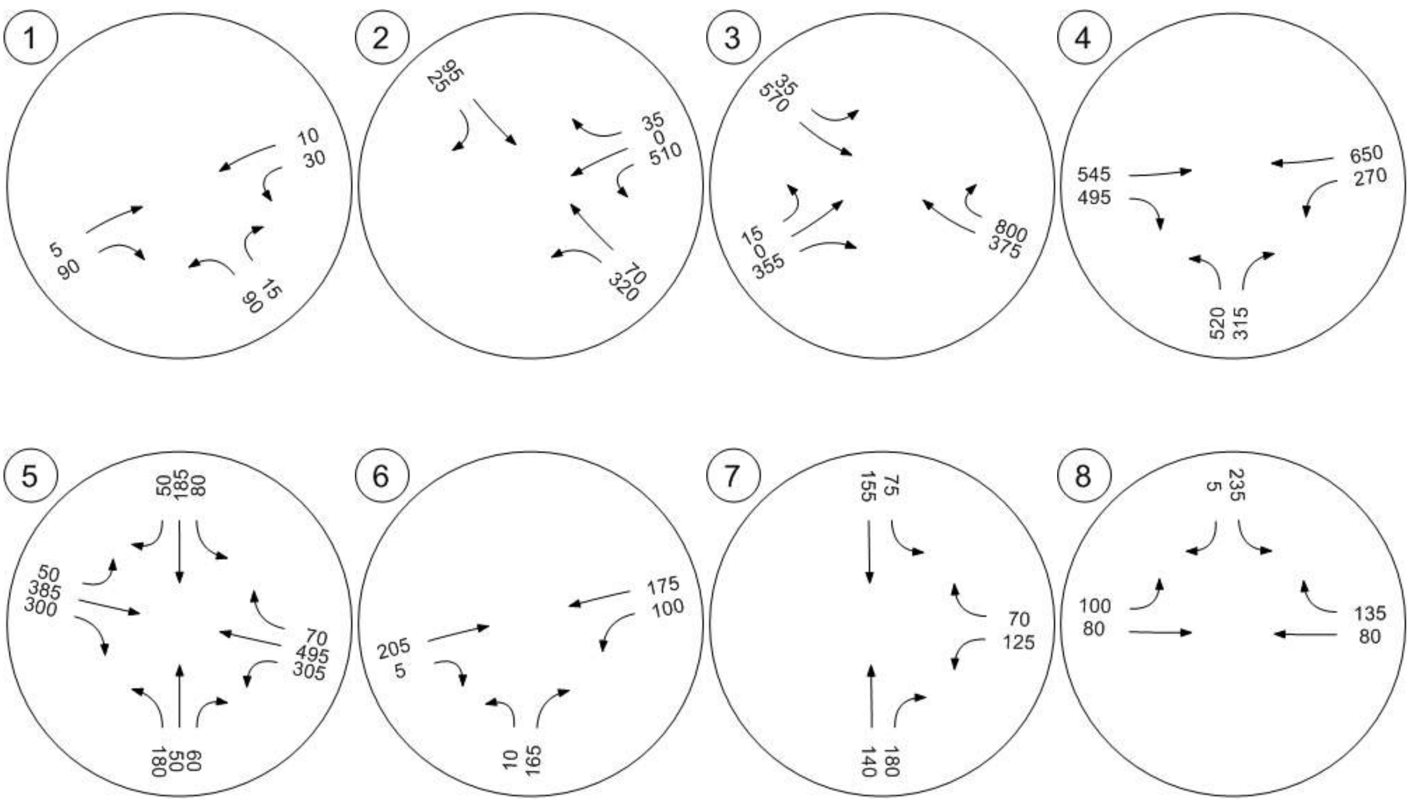


Traffic Volume - Base Volume



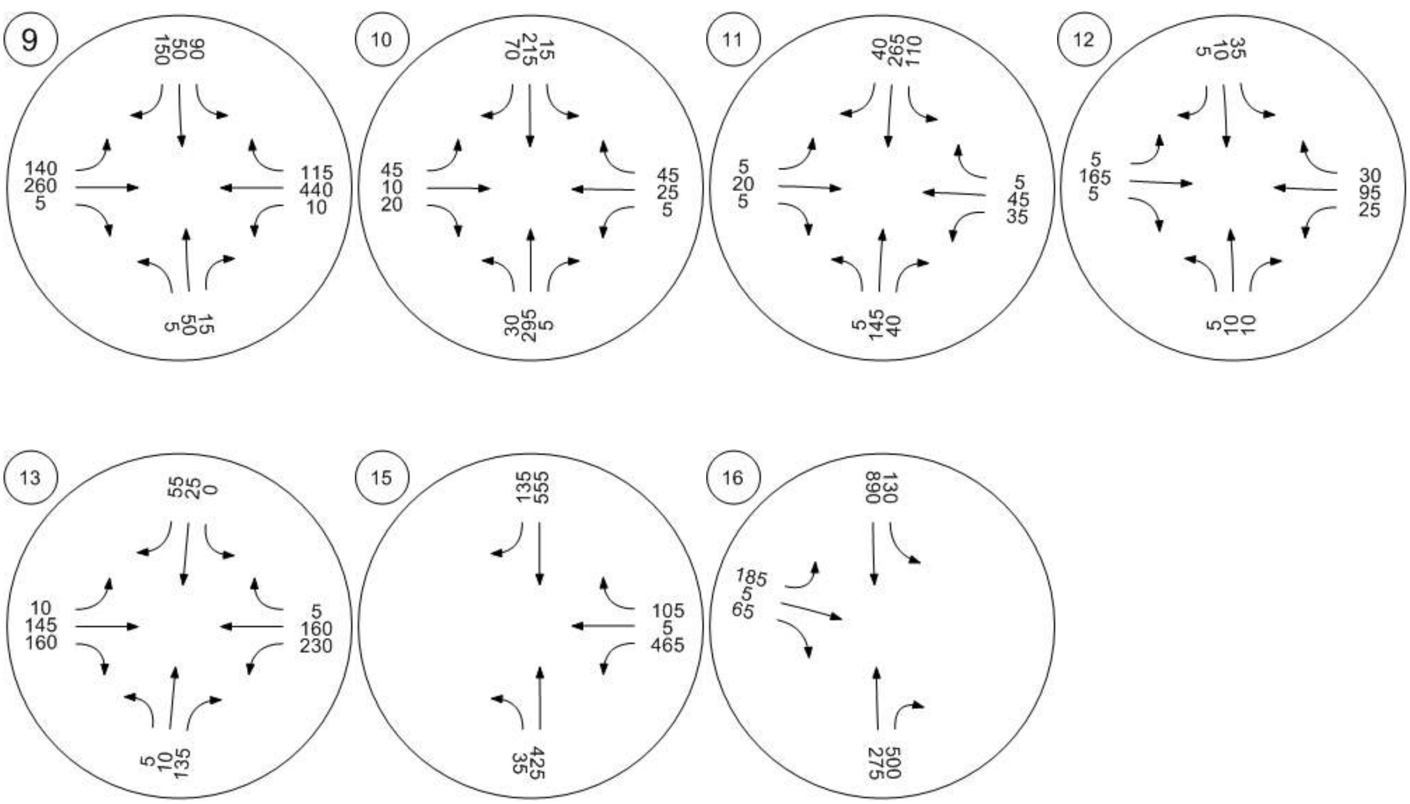
Revised Land Use Framework – July 2017 Financially Constrained Volumes

Traffic Volume - Base Volume



Revised Land Use Framework July 2017 - FC

Traffic Volume - Base Volume



Transportation Base Case Mitigated Volumes

Transportation Base Case - Mitigated

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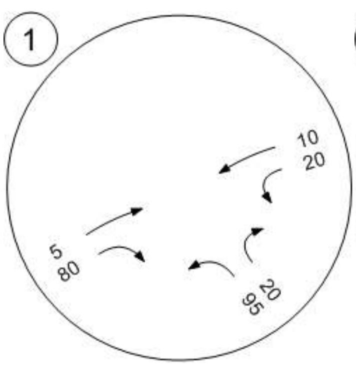
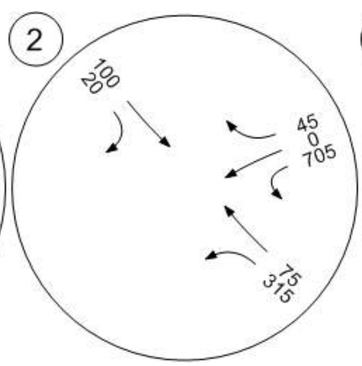
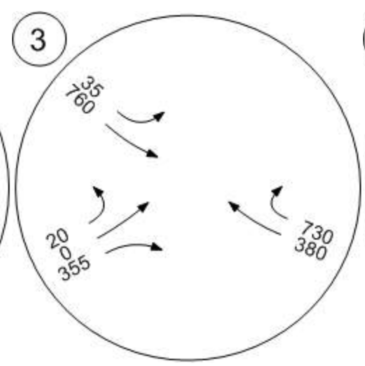
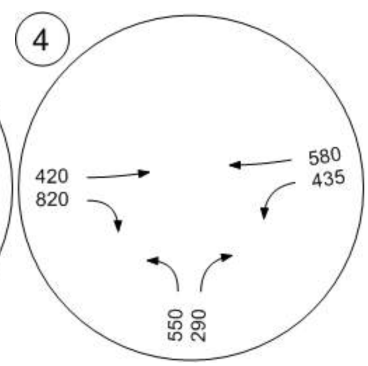
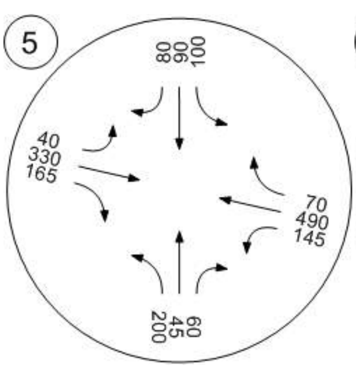
Traffic Volume - Base Volume

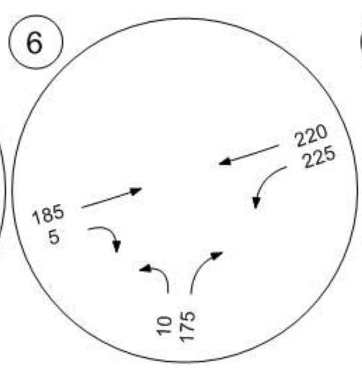


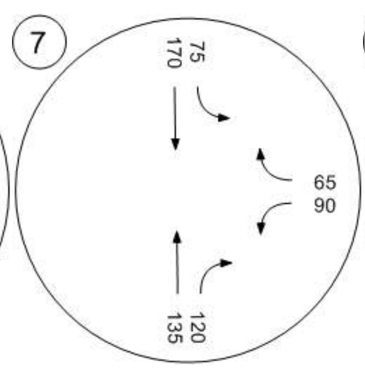


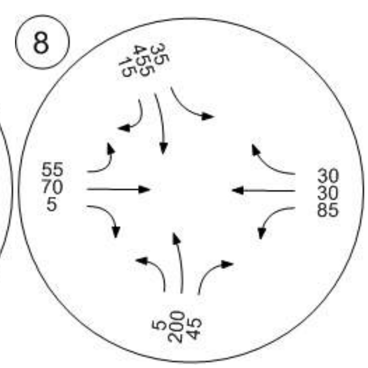












Transportation Base Case - Mitigated

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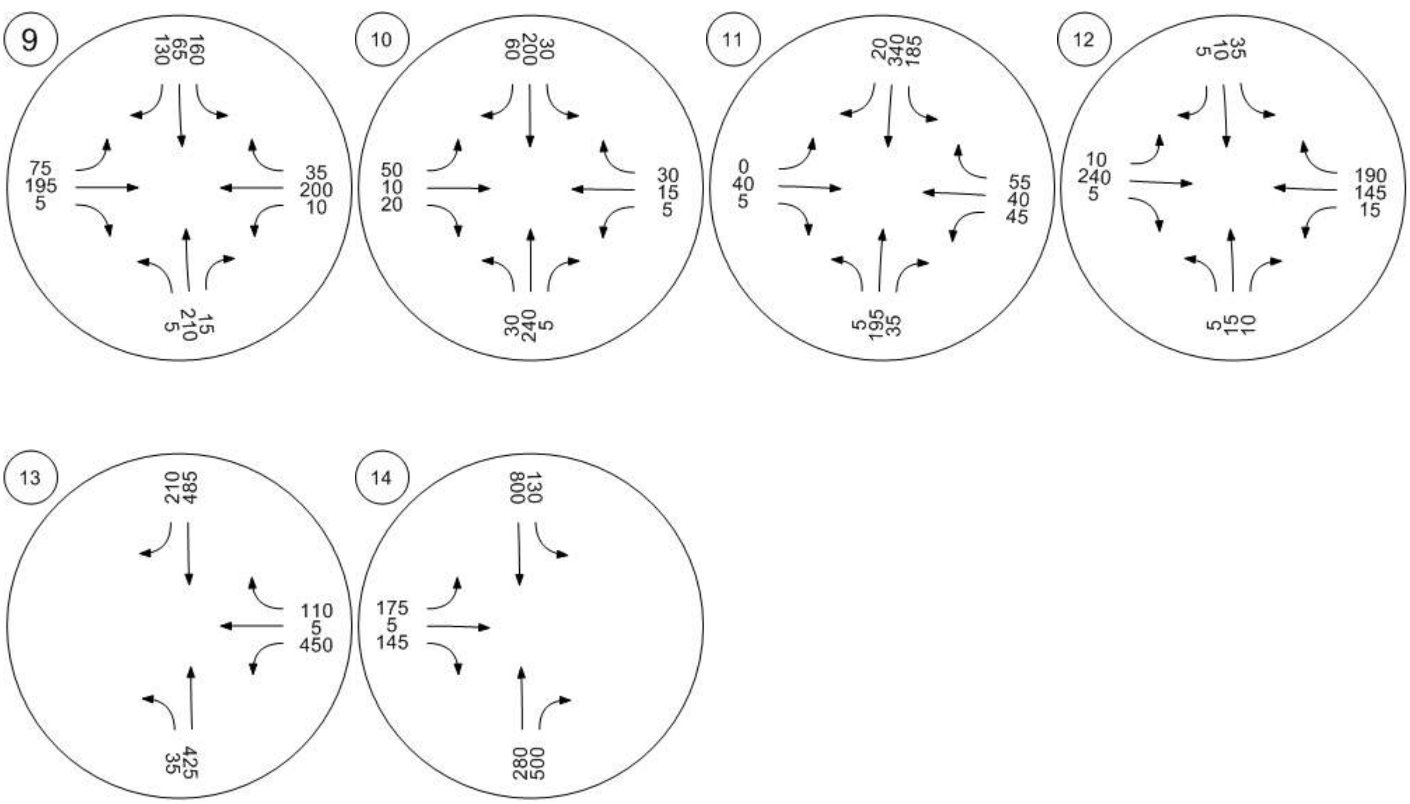
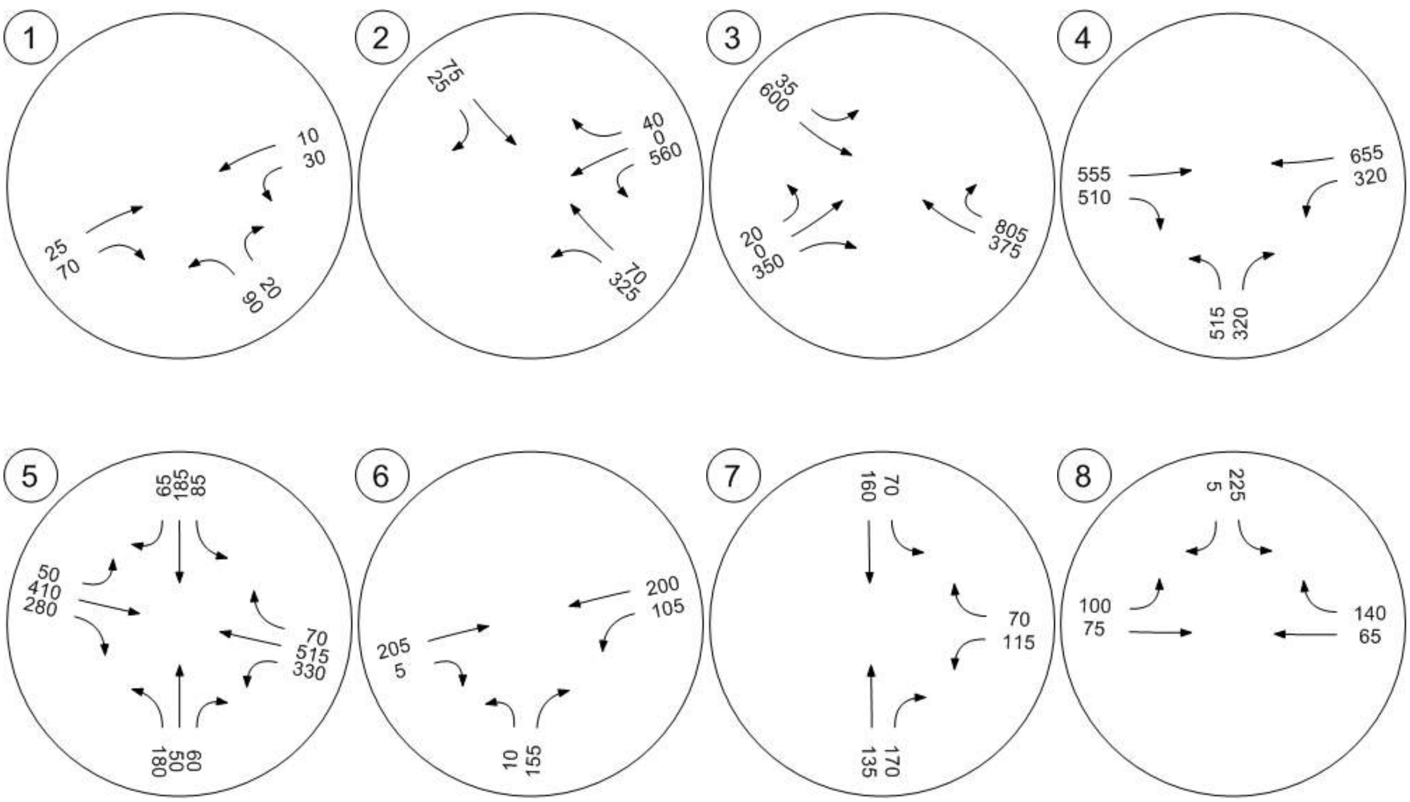
Traffic Volume - Base Volume



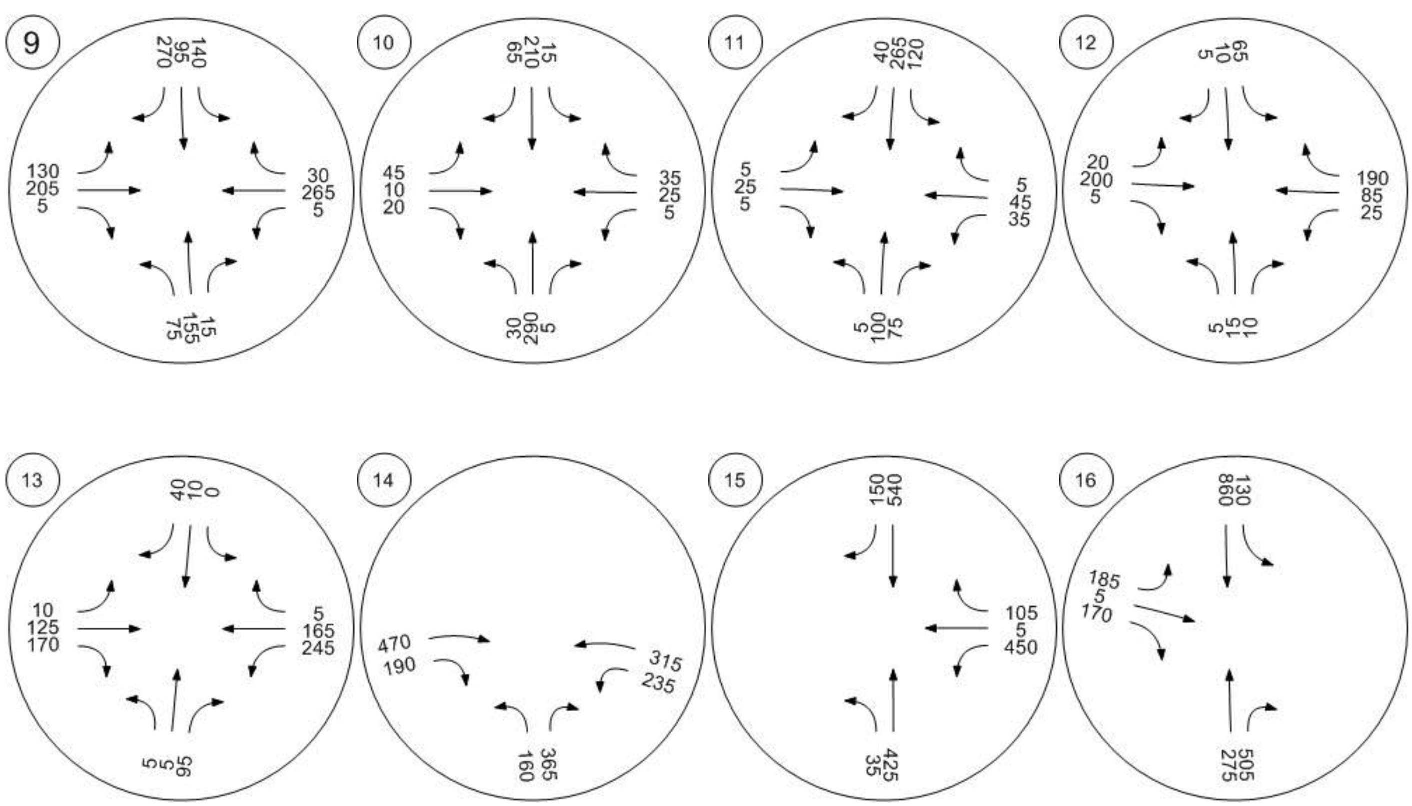
Revised Land Use Framework – July 2017 Mitigated Volumes

Traffic Volume - Base Volume



Revised Land Use Framework July 2017 - Mitigated

Traffic Volume - Base Volume



Appendix B – 2040 HCM Reports

- Transportation Base Case Financially Constrained HCM Reports
- Revised Land Use Framework – July 2017 Financially Constrained HCM Reports
- Transportation Base Case Mitigated HCM Reports
- Revised Land Use Framework – July 2017 Mitigated HCM Reports
- Transportation Base Case Interim Solution HCM Reports
- Revised Land Use Framework – July 2017 Interim Solution HCM Reports

Transportation Base Case Financially Constrained HCM Reports

Movement	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	5	95	40	20	90	15
Future Volume (Veh/h)	5	95	40	20	90	15
Sign Control	Yield			Stop	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	6	106	44	22	100	17
Pedestrians	10			10		
Lane Width (ft)	12.0			12.0		
Walking Speed (ft/s)	4.0			4.0		
Percent Blockage	1			1		
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	220	10	319	220	10	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	220	10	319	220	10	
tC, single (s)	6.5	6.2	7.2	6.6	4.1	
tC, 2 stage (s)						
tF (s)	4.0	3.3	3.6	4.1	2.2	
p0 queue free %	99	90	91	96	94	
cM capacity (veh/h)	625	1062	512	610	1596	

Direction, Lane #	EB 1	WB 1	NW 1	NW 2
Volume Total	112	66	100	17
Volume Left	0	44	100	0
Volume Right	106	0	0	17
cSH	1024	541	1596	1700
Volume to Capacity	0.11	0.12	0.06	0.01
Queue Length 95th (ft)	9	10	5	0
Control Delay (s)	8.9	12.6	7.4	0.0
Lane LOS	A	B	A	
Approach Delay (s)	8.9	12.6	6.3	
Approach LOS	A	B		

Intersection Summary			
Average Delay	8.7		
Intersection Capacity Utilization	24.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	390	735	385	520	610	265
Future Volume (vph)	390	735	385	520	610	265
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		0.98	0.95	1.00
Satd. Flow (prot)	1699	1421		1662	1630	1395
Flt Permitted	1.00	1.00		0.49	0.95	1.00
Satd. Flow (perm)	1699	1421		827	1630	1395
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	433	817	428	578	678	294
RTOR Reduction (vph)	0	0	0	0	0	182
Lane Group Flow (vph)	433	817	0	1006	678	112
Confl. Peds. (#/hr)		10	10			10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Turn Type	NA	Free	pm+pt	NA	Prot	pm+ov
Protected Phases	6		5	2	4	5
Permitted Phases		Free	2			4
Actuated Green, G (s)	46.4	90.0		56.0	26.0	31.6
Effective Green, g (s)	46.4	90.0		56.0	26.0	31.6
Actuated g/C Ratio	0.52	1.00		0.62	0.29	0.35
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)	875	1421		566	470	551
v/s Ratio Prot	0.25			c0.11	c0.42	0.01
v/s Ratio Perm		0.57		c0.99		0.07
v/c Ratio	0.49	0.57		1.78	1.44	0.20
Uniform Delay, d1	14.2	0.0		17.0	32.0	20.4
Progression Factor	1.00	1.00		0.94	0.73	1.05
Incremental Delay, d2	0.4	1.7		356.2	206.9	0.1
Delay (s)	14.6	1.7		372.1	230.2	21.5
Level of Service	B	A		F	F	C
Approach Delay (s)	6.2			372.1	167.1	
Approach LOS	A			F	F	

Intersection Summary			
HCM 2000 Control Delay	168.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.74		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	121.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	3.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	55	5	20	5	10	15	30	215	5	15	200	60
Future Vol, veh/h	55	5	20	5	10	15	30	215	5	15	200	60
Conflicting Peds, #/hr	10	0	10	0	0	0	10	0	0	0	0	10
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, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	92	93	92	92	92	93	93	92	92	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	59	5	22	5	11	16	32	231	5	16	215	65

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	612	591	267	601	620	244	290	0	0	237	0	0
Stage 1	290	290	-	298	298	-	-	-	-	-	-	-
Stage 2	322	301	-	303	322	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	405	420	772	412	404	795	1272	-	-	1330	-	-
Stage 1	718	672	-	711	667	-	-	-	-	-	-	-
Stage 2	690	665	-	706	651	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	369	399	759	380	384	788	1261	-	-	1319	-	-
Mov Cap-2 Maneuver	369	399	-	380	384	-	-	-	-	-	-	-
Stage 1	691	657	-	690	648	-	-	-	-	-	-	-
Stage 2	640	646	-	665	637	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	15.6	12.5	1	0.4
HCM LOS	C	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1261	-	-	426	515	1319	-	-
HCM Lane V/C Ratio	0.026	-	-	0.202	0.063	0.012	-	-
HCM Control Delay (s)	7.9	0	-	15.6	12.5	7.8	0	-
HCM Lane LOS	A	A	-	C	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.7	0.2	0	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	70	25	140	35	55	20	270	65	60	360	35
Future Volume (vph)	50	70	25	140	35	55	20	270	65	60	360	35
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.99			0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			0.99		1.00	1.00		1.00	1.00	
Frt		0.98			0.97		1.00	0.97		1.00	0.99	
Flt Protected		0.98			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1625			1572		1630	1649		1630	1685	
Flt Permitted		0.84			0.69		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1387			1117		1630	1649		1630	1685	
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)	54	76	27	152	38	60	22	293	71	65	391	38
RTOR Reduction (vph)	0	10	0	0	15	0	0	8	0	0	3	0
Lane Group Flow (vph)	0	147	0	0	235	0	22	356	0	65	426	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)		23.1			23.1		2.5	47.7		7.2	52.4	
Effective Green, g (s)		23.1			23.1		2.5	47.7		7.2	52.4	
Actuated g/C Ratio		0.26			0.26		0.03	0.53		0.08	0.58	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		355			286		45	873		130	981	
v/s Ratio Prot							0.01	0.22		c0.04	c0.25	
v/s Ratio Perm		0.11			c0.21							
v/c Ratio		0.42			0.82		0.49	0.41		0.50	0.43	
Uniform Delay, d1		27.8			31.5		43.1	12.7		39.7	10.5	
Progression Factor		1.01			1.00		1.00	1.00		0.62	1.98	
Incremental Delay, d2		0.8			17.1		8.1	1.4		2.6	1.2	
Delay (s)		28.8			48.6		51.3	14.1		27.2	22.0	
Level of Service		C			D		D	B		C	C	
Approach Delay (s)		28.8			48.6			16.2			22.7	
Approach LOS		C			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	26.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	4.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	185	5	210	225	10	155
Future Vol, veh/h	185	5	210	225	10	155
Conflicting Peds, #/hr	0	10	10	0	10	10
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	4	5	5	5	5
Mvmt Flow	206	6	233	250	11	172

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	221	0	945	228
Stage 1	-	-	-	-	218	-
Stage 2	-	-	-	-	727	-
Critical Hdwy	-	-	4.15	-	6.45	6.25
Critical Hdwy Stg 1	-	-	-	-	5.45	-
Critical Hdwy Stg 2	-	-	-	-	5.45	-
Follow-up Hdwy	-	-	2.245	-	3.545	3.345
Pot Cap-1 Maneuver	-	-	1331	-	287	804
Stage 1	-	-	-	-	811	-
Stage 2	-	-	-	-	473	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1320	-	224	791
Mov Cap-2 Maneuver	-	-	-	-	224	-
Stage 1	-	-	-	-	804	-
Stage 2	-	-	-	-	373	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4	12.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	686	-	-	1320	-
HCM Lane V/C Ratio	0.267	-	-	0.177	-
HCM Control Delay (s)	12.2	-	-	8.3	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	1.1	-	-	0.6	-

Intersection	
Int Delay, s/veh	3.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	15	5	5	15	70	5	285	35	150	355	20
Future Vol, veh/h	0	15	5	5	15	70	5	285	35	150	355	20
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	200	-	-	200	-	-	200	-	-	200	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	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	16	5	5	16	76	5	310	38	163	386	22

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1129	1102	417	1094	1094	349	418	0	0	358	0	0
Stage 1	733	733	-	350	350	-	-	-	-	-	-	-
Stage 2	396	369	-	744	744	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	181	212	636	191	214	694	1141	-	-	1201	-	-
Stage 1	412	426	-	666	633	-	-	-	-	-	-	-
Stage 2	629	621	-	407	421	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	132	179	625	155	181	682	1131	-	-	1191	-	-
Mov Cap-2 Maneuver	132	179	-	155	181	-	-	-	-	-	-	-
Stage 1	407	365	-	658	625	-	-	-	-	-	-	-
Stage 2	537	613	-	330	360	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	23.3	15.6	0.1	2.4
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1131	-	-	-	218	155	458	1191	-	-
HCM Lane V/C Ratio	0.005	-	-	-	0.1	0.035	0.202	0.137	-	-
HCM Control Delay (s)	8.2	-	-	0	23.3	29.1	14.8	8.5	-	-
HCM Lane LOS	A	-	-	A	C	D	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	0.3	0.1	0.7	0.5	-	-

Intersection	
Int Delay, s/veh	3.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	190	5	40	100	65	5	15	10	40	10	5
Future Vol, veh/h	10	190	5	40	100	65	5	15	10	40	10	5
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	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	11	207	5	43	109	71	5	16	11	43	11	5

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	189	0	0	222	0	0	490	517	229	496	485	164
Stage 1	-	-	-	-	-	-	241	241	-	241	241	-
Stage 2	-	-	-	-	-	-	249	276	-	255	244	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1385	-	-	1347	-	-	489	462	810	484	482	881
Stage 1	-	-	-	-	-	-	762	706	-	762	706	-
Stage 2	-	-	-	-	-	-	755	682	-	749	704	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1373	-	-	1336	-	-	453	434	797	441	453	866
Mov Cap-2 Maneuver	-	-	-	-	-	-	453	434	-	441	453	-
Stage 1	-	-	-	-	-	-	749	694	-	749	675	-
Stage 2	-	-	-	-	-	-	706	652	-	709	692	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.4	1.5	12.4	13.9
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	516	1373	-	-	1336	-	-	464
HCM Lane V/C Ratio	0.063	0.008	-	-	0.033	-	-	0.129
HCM Control Delay (s)	12.4	7.6	0	-	7.8	0	-	13.9
HCM Lane LOS	B	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.2	0	-	-	0.1	-	-	0.4

Intersection						
Int Delay, s/veh	5.8					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	110	85	100	115	95	140
Future Vol, veh/h	110	85	100	115	95	140
Conflicting Peds, #/hr	10	10	0	10	10	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, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	120	92	109	125	103	152

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	550	191	0	0	244	0
Stage 1	181	-	-	-	-	-
Stage 2	369	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	496	851	-	-	1322	-
Stage 1	850	-	-	-	-	-
Stage 2	699	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	446	837	-	-	1311	-
Mov Cap-2 Maneuver	446	-	-	-	-	-
Stage 1	843	-	-	-	-	-
Stage 2	634	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15.3	0	3.2
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	560	1311	-
HCM Lane V/C Ratio	-	-	0.378	0.079	-
HCM Control Delay (s)	-	-	15.3	8	0
HCM Lane LOS	-	-	C	A	A
HCM 95th %tile Q(veh)	-	-	1.8	0.3	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	330	165	185	470	70	150	60	90	95	110	70
Future Volume (vph)	40	330	165	185	470	70	150	60	90	95	110	70
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	0.97		1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		0.98	1.00		0.98	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.91		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1626	1716	1383	1608	1655		1599	1511		1596	1582	
Flt Permitted	0.33	1.00	1.00	0.40	1.00		0.54	1.00		0.59	1.00	
Satd. Flow (perm)	557	1716	1383	670	1655		912	1511		996	1582	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	44	367	183	206	522	78	167	67	100	106	122	78
RTOR Reduction (vph)	0	0	98	0	6	0	0	60	0	0	26	0
Lane Group Flow (vph)	44	367	85	206	594	0	167	108	0	106	174	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			4			8	
Permitted Phases	6		6	2			4			8		
Actuated Green, G (s)	44.7	41.7	41.7	55.0	48.0		27.0	27.0		27.0	27.0	
Effective Green, g (s)	44.7	41.7	41.7	55.0	48.0		27.0	27.0		27.0	27.0	
Actuated g/C Ratio	0.50	0.46	0.46	0.61	0.53		0.30	0.30		0.30	0.30	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	312	795	640	506	882		273	453		298	474	
v/s Ratio Prot	0.00	0.21		c0.04	c0.36			0.07			0.11	
v/s Ratio Perm	0.07		0.06	0.21			c0.18			0.11		
v/c Ratio	0.14	0.46	0.13	0.41	0.67		0.61	0.24		0.36	0.37	
Uniform Delay, d1	12.4	16.5	13.8	8.9	15.3		27.0	23.7		24.7	24.8	
Progression Factor	1.39	1.44	3.70	1.00	1.00		1.01	1.03		1.00	1.00	
Incremental Delay, d2	0.2	1.8	0.4	0.5	4.1		9.8	1.2		0.7	0.5	
Delay (s)	17.4	25.4	51.5	9.4	19.4		37.2	25.7		25.4	25.3	
Level of Service	B	C	D	A	B		D	C		C	C	
Approach Delay (s)		32.9			16.9			31.4			25.3	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	17

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	35	655	0	0	370	760	20	0	355	0	0	0
Future Vol, veh/h	35	655	0	0	370	760	20	0	355	0	0	0
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Free	Free	Free
RT Channelized	-	-	None	-	-	Yield	-	-	None	-	-	None
Storage Length	-	-	-	-	-	50	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	-	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	3	3	3	2	2	2	3	3	3
Mvmt Flow	39	728	0	0	411	844	22	0	394	0	0	0

Major/Minor	Major1			Major2			Minor1		
Conflicting Flow All	421	0	-	-	-	0	1227	1227	738
Stage 1	-	-	-	-	-	-	806	806	-
Stage 2	-	-	-	-	-	-	421	421	-
Critical Hdwy	4.12	-	-	-	-	-	6.42	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	5.42	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.42	5.52	-
Follow-up Hdwy	2.218	-	-	-	-	-	3.518	4.018	3.318
Pot Cap-1 Maneuver	1138	-	0	0	-	-	197	178	418
Stage 1	-	-	0	0	-	-	439	395	-
Stage 2	-	-	0	0	-	-	662	589	-
Platoon blocked, %		-			-	-			
Mov Cap-1 Maneuver	1129	-	-	-	-	-	184	0	415
Mov Cap-2 Maneuver	-	-	-	-	-	-	184	0	-
Stage 1	-	-	-	-	-	-	414	0	-
Stage 2	-	-	-	-	-	-	656	0	-

Approach	SE	NW	NE
HCM Control Delay, s	0.4	0	98.9
HCM LOS			F

Minor Lane/Major Mvmt	NELn1	NWT	NWR	SEL	SET
Capacity (veh/h)	389	-	-	1129	-
HCM Lane V/C Ratio	1.071	-	-	0.034	-
HCM Control Delay (s)	98.9	-	-	8.3	0
HCM Lane LOS	F	-	-	A	A
HCM 95th %tile Q(veh)	14.3	-	-	0.1	-

Intersection	
Int Delay, s/veh	52.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	85	225	5	5	255	110	5	90	15	120	60	160
Future Vol, veh/h	85	225	5	5	255	110	5	90	15	120	60	160
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	20	20	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	3	3	3	2	2	2	8	8	8	2	2	2
Mvmt Flow	91	242	5	5	274	118	5	97	16	129	65	172

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	402	0	0	257	0	0	909	850	275	858	794	353
Stage 1	-	-	-	-	-	-	437	437	-	354	354	-
Stage 2	-	-	-	-	-	-	472	413	-	504	440	-
Critical Hdwy	4.13	-	-	4.12	-	-	7.18	6.58	6.28	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.18	5.58	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.18	5.58	-	6.12	5.52	-
Follow-up Hdwy	2.227	-	-	2.218	-	-	3.572	4.072	3.372	3.518	4.018	3.318
Pot Cap-1 Maneuver	1151	-	-	1308	-	-	250	291	750	277	321	691
Stage 1	-	-	-	-	-	-	587	569	-	663	630	-
Stage 2	-	-	-	-	-	-	561	583	-	550	578	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1141	-	-	1286	-	-	141	258	731	174	285	680
Mov Cap-2 Maneuver	-	-	-	-	-	-	141	258	-	174	285	-
Stage 1	-	-	-	-	-	-	528	512	-	596	622	-
Stage 2	-	-	-	-	-	-	371	575	-	389	520	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	2.3	0.1	28	162.7
HCM LOS			D	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	272	1141	-	-	1286	-	-	299
HCM Lane V/C Ratio	0.435	0.08	-	-	0.004	-	-	1.223
HCM Control Delay (s)	28	8.4	0	-	7.8	0	-	162.7
HCM Lane LOS	D	A	A	-	A	A	-	F
HCM 95th %tile Q(veh)	2.1	0.3	-	-	0	-	-	16.6

Intersection	
Int Delay, s/veh	611.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	585	0	35	0	105	30	320	70	0
Future Vol, veh/h	0	0	0	585	0	35	0	105	30	320	70	0
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	-	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	5	5	5
Mvmt Flow	0	0	0	650	0	39	0	117	33	356	78	0

Major/Minor	Minor2			Major1			Major2		
Conflicting Flow All	932	949	88	-	0	0	160	0	0
Stage 1	789	789	-	-	-	-	-	-	-
Stage 2	143	160	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	-	-	-	4.15	-	-
Critical Hdwy Stg 1	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	-	-	-	2.245	-	-
Pot Cap-1 Maneuver	~ 247	260	970	0	-	-	1401	-	0
Stage 1	~ 384	402	-	0	-	-	-	-	0
Stage 2	860	766	-	0	-	-	-	-	0
Platoon blocked, %					-	-		-	
Mov Cap-1 Maneuver	~ 194	190	962	-	-	-	1389	-	-
Mov Cap-2 Maneuver	~ 194	190	-	-	-	-	-	-	-
Stage 1	~ 384	294	-	-	-	-	-	-	-
Stage 2	853	766	-	-	-	-	-	-	-

Approach	WB	SE	NW
HCM Control Delay, s	$ 1124.4	0	7
HCM LOS	F		

Minor Lane/Major Mvmt	NWL	NWT	WBLn1	SET	SER
Capacity (veh/h)	1389	-	203	-	-
HCM Lane V/C Ratio	0.256	-	3.394	-	-
HCM Control Delay (s)	8.5	0	$ 1124.4	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th %tile Q(veh)	1	-	64.7	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	465	5	110	35	425	0	0	530	165
Future Volume (vph)	0	0	0	465	5	110	35	425	0	0	530	165
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0	4.0	4.0	4.0			4.0	3.5
Lane Util. Factor					1.00	1.00	1.00	1.00			1.00	1.00
Frpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	0.99
Flpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	1.00
Frt					1.00	0.85	1.00	1.00			1.00	0.85
Flt Protected					0.95	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)					1651	1473	1599	1683			1683	1411
Flt Permitted					0.95	1.00	0.21	1.00			1.00	1.00
Satd. Flow (perm)					1651	1473	348	1683			1683	1411
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)	0	0	0	495	5	117	37	452	0	0	564	176
RTOR Reduction (vph)	0	0	0	0	0	71	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	500	46	37	452	0	0	564	176
Confl. Peds. (#/hr)							5		12	12		5
Confl. Bikes (#/hr)									3			
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	4%	4%	4%	4%	4%	4%
Turn Type				Split	NA	Perm	pm+pt	NA			NA	Free
Protected Phases				4	4		1	6			2	
Permitted Phases						4	6					Free
Actuated Green, G (s)					34.6	34.6	46.4	46.4			38.7	90.0
Effective Green, g (s)					35.1	35.1	46.4	46.9			39.2	90.0
Actuated g/C Ratio					0.39	0.39	0.52	0.52			0.44	1.00
Clearance Time (s)					4.5	4.5	4.0	4.5			4.5	
Vehicle Extension (s)					3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)					643	574	230	877			733	1411
v/s Ratio Prot					c0.30		0.01	c0.27			c0.34	
v/s Ratio Perm						0.03	0.08					0.12
v/c Ratio					0.78	0.08	0.16	0.52			0.77	0.12
Uniform Delay, d1					24.0	17.3	13.9	14.1			21.6	0.0
Progression Factor					1.00	1.00	1.01	1.02			1.00	1.00
Incremental Delay, d2					5.9	0.1	0.2	1.3			7.6	0.2
Delay (s)					29.9	17.3	14.3	15.7			29.2	0.2
Level of Service					C	B	B	B			C	A
Approach Delay (s)		0.0			27.5			15.6			22.3	
Approach LOS		A			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	22.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	120.4%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	175	5	60	0	0	0	0	285	520	130	865	0
Future Volume (vph)	175	5	60	0	0	0	0	285	520	130	865	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0	4.0					4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00					1.00		1.00	1.00	
Frpb, ped/bikes		1.00	1.00					0.96		1.00	1.00	
Flpb, ped/bikes		1.00	1.00					1.00		1.00	1.00	
Frt		1.00	0.85					0.91		1.00	1.00	
Flt Protected		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (prot)		1531	1365					1502		1630	1716	
Flt Permitted		0.95	1.00					1.00		0.17	1.00	
Satd. Flow (perm)		1531	1365					1502		296	1716	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	188	5	65	0	0	0	0	306	559	140	930	0
RTOR Reduction (vph)	0	0	54	0	0	0	0	71	0	0	0	0
Lane Group Flow (vph)	0	193	11	0	0	0	0	794	0	140	930	0
Confl. Peds. (#/hr)							4		15	15		4
Confl. Bikes (#/hr)									4			4
Heavy Vehicles (%)	9%	9%	9%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Split	NA	Perm					NA		pm+pt	NA	
Protected Phases	8	8						6		5	2	
Permitted Phases			8							2		
Actuated Green, G (s)		14.6	14.6					56.9		66.4	66.4	
Effective Green, g (s)		15.1	15.1					57.4		66.4	66.9	
Actuated g/C Ratio		0.17	0.17					0.64		0.74	0.74	
Clearance Time (s)		4.5	4.5					4.5		4.0	4.5	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		256	229					957		299	1275	
v/s Ratio Prot		c0.13						c0.53		0.03	c0.54	
v/s Ratio Perm			0.01							0.32		
v/c Ratio		0.75	0.05					0.83		0.47	0.73	
Uniform Delay, d1		35.7	31.4					12.5		10.0	6.5	
Progression Factor		1.00	1.00					1.00		1.79	1.08	
Incremental Delay, d2		11.9	0.1					8.3		0.9	2.8	
Delay (s)		47.5	31.5					20.8		18.9	9.8	
Level of Service		D	C					C		B	A	
Approach Delay (s)		43.5			0.0			20.8			10.9	
Approach LOS		D			A			C			B	

Intersection Summary			
HCM 2000 Control Delay	18.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	120.4%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

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Movement	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	5	90	30	10	90	15
Future Volume (Veh/h)	5	90	30	10	90	15
Sign Control	Yield			Stop	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	6	100	33	11	100	17
Pedestrians	10			10		
Lane Width (ft)	12.0			12.0		
Walking Speed (ft/s)	4.0			4.0		
Percent Blockage	1			1		
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	220	10	313	220	10	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	220	10	313	220	10	
tC, single (s)	6.5	6.2	7.2	6.6	4.1	
tC, 2 stage (s)						
tF (s)	4.0	3.3	3.6	4.1	2.2	
p0 queue free %	99	91	94	98	94	
cM capacity (veh/h)	625	1062	520	610	1596	

Direction, Lane #	EB 1	WB 1	NW 1	NW 2
Volume Total	106	44	100	17
Volume Left	0	33	100	0
Volume Right	100	0	0	17
cSH	1022	540	1596	1700
Volume to Capacity	0.10	0.08	0.06	0.01
Queue Length 95th (ft)	9	7	5	0
Control Delay (s)	8.9	12.3	7.4	0.0
Lane LOS	A	B	A	
Approach Delay (s)	8.9	12.3	6.3	
Approach LOS	A	B		

Intersection Summary			
Average Delay	8.3		
Intersection Capacity Utilization	23.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	545	495	270	650	520	315
Future Volume (vph)	545	495	270	650	520	315
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		0.99	0.95	1.00
Satd. Flow (prot)	1699	1425		1674	1630	1397
Flt Permitted	1.00	1.00		0.41	0.95	1.00
Satd. Flow (perm)	1699	1425		689	1630	1397
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	606	550	300	722	578	350
RTOR Reduction (vph)	0	0	0	0	0	144
Lane Group Flow (vph)	606	550	0	1022	578	206
Confl. Peds. (#/hr)			10			10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Turn Type	NA	Free	pm+pt	NA	Prot	pm+ov
Protected Phases	6		5	2	4	5
Permitted Phases		Free	2			4
Actuated Green, G (s)	48.0	90.0		58.0	24.0	30.0
Effective Green, g (s)	48.0	90.0		58.0	24.0	30.0
Actuated g/C Ratio	0.53	1.00		0.64	0.27	0.33
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)	906	1425		509	434	527
v/s Ratio Prot	0.36			c0.13	c0.35	0.03
v/s Ratio Perm		0.39		c1.16		0.12
v/c Ratio	0.67	0.39		2.01	1.33	0.39
Uniform Delay, d1	15.2	0.0		16.0	33.0	23.0
Progression Factor	1.00	1.00		1.01	0.77	0.59
Incremental Delay, d2	1.9	0.8		459.2	162.2	0.4
Delay (s)	17.1	0.8		475.4	187.8	14.0
Level of Service	B	A		F	F	B
Approach Delay (s)	9.4			475.4	122.3	
Approach LOS	A			F	F	

Intersection Summary			
HCM 2000 Control Delay	196.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.88		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	125.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	45	10	20	5	25	45	30	295	5	15	215	70
Future Vol, veh/h	45	10	20	5	25	45	30	295	5	15	215	70
Conflicting Peds, #/hr	10	0	10	0	0	0	10	0	0	0	0	10
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, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	92	93	92	92	92	93	93	92	92	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	48	11	22	5	27	49	32	317	5	16	231	75

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	743	698	289	712	733	330	316	0	0	323	0	0
Stage 1	311	311	-	384	384	-	-	-	-	-	-	-
Stage 2	432	387	-	328	349	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	331	364	750	347	348	712	1244	-	-	1237	-	-
Stage 1	699	658	-	639	611	-	-	-	-	-	-	-
Stage 2	602	610	-	685	633	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	274	344	738	314	329	706	1234	-	-	1227	-	-
Mov Cap-2 Maneuver	274	344	-	314	329	-	-	-	-	-	-	-
Stage 1	671	642	-	619	591	-	-	-	-	-	-	-
Stage 2	513	590	-	638	618	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18.9	14	0.7	0.4
HCM LOS	C	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1234	-	-	340	482	1227	-	-
HCM Lane V/C Ratio	0.026	-	-	0.238	0.169	0.013	-	-
HCM Control Delay (s)	8	0	-	18.9	14	8	0	-
HCM Lane LOS	A	A	-	C	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.9	0.6	0	-	-

Intersection	
Int Delay, s/veh	4.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	205	5	100	175	10	165
Future Vol, veh/h	205	5	100	175	10	165
Conflicting Peds, #/hr	0	10	10	0	10	10
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	4	5	5	5	5
Mvmt Flow	228	6	111	194	11	183

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	243	0	668	251
Stage 1	-	-	-	-	241	-
Stage 2	-	-	-	-	427	-
Critical Hdwy	-	-	4.15	-	6.45	6.25
Critical Hdwy Stg 1	-	-	-	-	5.45	-
Critical Hdwy Stg 2	-	-	-	-	5.45	-
Follow-up Hdwy	-	-	2.245	-	3.545	3.345
Pot Cap-1 Maneuver	-	-	1306	-	419	780
Stage 1	-	-	-	-	792	-
Stage 2	-	-	-	-	652	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1295	-	372	767
Mov Cap-2 Maneuver	-	-	-	-	372	-
Stage 1	-	-	-	-	785	-
Stage 2	-	-	-	-	584	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.9	11.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	723	-	-	1295	-
HCM Lane V/C Ratio	0.269	-	-	0.086	-
HCM Control Delay (s)	11.8	-	-	8	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	1.1	-	-	0.3	-

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	100	80	80	135	235	5
Future Volume (vph)	100	80	80	135	235	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00
Frpb, ped/bikes		1.00	0.97		1.00	0.95
Flpb, ped/bikes		0.99	1.00		1.00	1.00
Frt		1.00	0.92		1.00	0.85
Flt Protected		0.97	1.00		0.95	1.00
Satd. Flow (prot)		1654	1515		1630	1385
Flt Permitted		0.47	1.00		0.95	1.00
Satd. Flow (perm)		807	1515		1630	1385
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	109	87	87	147	255	5
RTOR Reduction (vph)	0	0	97	0	0	2
Lane Group Flow (vph)	0	196	137	0	255	3
Confl. Peds. (#/hr)	10			10	10	10
Confl. Bikes (#/hr)				5		5
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)		19.9	19.9		62.1	62.1
Effective Green, g (s)		19.9	19.9		62.1	62.1
Actuated g/C Ratio		0.22	0.22		0.69	0.69
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)		178	334		1124	955
v/s Ratio Prot			0.09		c0.16	
v/s Ratio Perm		c0.24				0.00
v/c Ratio		1.10	0.41		0.23	0.00
Uniform Delay, d1		35.0	30.0		5.1	4.3
Progression Factor		1.01	1.00		2.17	2.39
Incremental Delay, d2		97.1	0.8		0.4	0.0
Delay (s)		132.6	30.9		11.6	10.4
Level of Service		F	C		B	B
Approach Delay (s)		132.6	30.9		11.6	
Approach LOS		F	C		B	

Intersection Summary			
HCM 2000 Control Delay	52.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	48.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	5	20	5	35	45	5	5	145	40	110	265	40
Future Vol, veh/h	5	20	5	35	45	5	5	145	40	110	265	40
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
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, %	-	0	-	-	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	5	22	5	38	49	5	5	158	43	120	288	43

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	786	781	330	773	781	199	342	0	0	211	0	0
Stage 1	559	559	-	200	200	-	-	-	-	-	-	-
Stage 2	227	222	-	573	581	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	310	326	712	316	326	842	1217	-	-	1360	-	-
Stage 1	513	511	-	802	736	-	-	-	-	-	-	-
Stage 2	776	720	-	505	500	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	240	284	700	265	284	828	1207	-	-	1349	-	-
Mov Cap-2 Maneuver	240	284	-	265	284	-	-	-	-	-	-	-
Stage 1	506	451	-	791	726	-	-	-	-	-	-	-
Stage 2	709	710	-	421	441	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18.2	23.4	0.2	2.1
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1207	-	-	305	287	1349	-	-
HCM Lane V/C Ratio	0.005	-	-	0.107	0.322	0.089	-	-
HCM Control Delay (s)	8	0	-	18.2	23.4	7.9	0	-
HCM Lane LOS	A	A	-	C	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.4	1.3	0.3	-	-

Intersection												
Int Delay, s/veh	2.8											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	5	165	5	25	95	30	5	10	10	35	10	5
Future Vol, veh/h	5	165	5	25	95	30	5	10	10	35	10	5
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	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	5	179	5	27	103	33	5	11	11	38	11	5

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	146	0	0	195	0	0	395	403	202	398	390	140
Stage 1	-	-	-	-	-	-	203	203	-	184	184	-
Stage 2	-	-	-	-	-	-	192	200	-	214	206	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1436	-	-	1378	-	-	565	536	839	562	545	908
Stage 1	-	-	-	-	-	-	799	733	-	818	747	-
Stage 2	-	-	-	-	-	-	810	736	-	788	731	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1424	-	-	1367	-	-	533	514	825	526	523	893
Mov Cap-2 Maneuver	-	-	-	-	-	-	533	514	-	526	523	-
Stage 1	-	-	-	-	-	-	789	724	-	808	725	-
Stage 2	-	-	-	-	-	-	770	715	-	757	722	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.2	1.3	11.2	12.3
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	610	1424	-	-	1367	-	-	548
HCM Lane V/C Ratio	0.045	0.004	-	-	0.02	-	-	0.099
HCM Control Delay (s)	11.2	7.5	0	-	7.7	0	-	12.3
HCM Lane LOS	B	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0.1	-	-	0.3

Intersection	
Int Delay, s/veh	5.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	125	70	140	180	75	155
Future Vol, veh/h	125	70	140	180	75	155
Conflicting Peds, #/hr	10	10	0	10	10	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, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	136	76	152	196	82	168

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	602	270	0	0	358	0
Stage 1	260	-	-	-	-	-
Stage 2	342	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	463	769	-	-	1201	-
Stage 1	783	-	-	-	-	-
Stage 2	719	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	421	756	-	-	1191	-
Mov Cap-2 Maneuver	421	-	-	-	-	-
Stage 1	776	-	-	-	-	-
Stage 2	659	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	17.4	0	2.7
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	501	1191	-
HCM Lane V/C Ratio	-	-	0.423	0.068	-
HCM Control Delay (s)	-	-	17.4	8.2	0
HCM Lane LOS	-	-	C	A	A
HCM 95th %tile Q(veh)	-	-	2.1	0.2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	385	300	305	495	70	180	50	60	80	185	50
Future Volume (vph)	50	385	300	305	495	70	180	50	60	80	185	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	0.97		1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		0.98	1.00		0.98	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.92		1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1627	1716	1382	1614	1657		1604	1530		1592	1642	
Flt Permitted	0.29	1.00	1.00	0.28	1.00		0.47	1.00		0.67	1.00	
Satd. Flow (perm)	493	1716	1382	481	1657		800	1530		1121	1642	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	56	428	333	339	550	78	200	56	67	89	206	56
RTOR Reduction (vph)	0	0	205	0	6	0	0	45	0	0	11	0
Lane Group Flow (vph)	56	428	128	339	622	0	200	78	0	89	251	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			4			8	
Permitted Phases	6		6	2			4			8		
Actuated Green, G (s)	38.6	34.6	34.6	52.0	44.0		30.0	30.0		30.0	30.0	
Effective Green, g (s)	38.6	34.6	34.6	52.0	44.0		30.0	30.0		30.0	30.0	
Actuated g/C Ratio	0.43	0.38	0.38	0.58	0.49		0.33	0.33		0.33	0.33	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	261	659	531	446	810		266	510		373	547	
v/s Ratio Prot	0.01	0.25		c0.11	c0.38			0.05			0.15	
v/s Ratio Perm	0.08		0.09	0.33			c0.25			0.08		
v/c Ratio	0.21	0.65	0.24	0.76	0.77		0.75	0.15		0.24	0.46	
Uniform Delay, d1	16.0	22.7	18.8	12.9	18.8		26.7	21.1		21.7	23.6	
Progression Factor	0.92	1.12	3.19	1.00	1.00		0.96	0.86		1.00	1.00	
Incremental Delay, d2	0.3	3.9	0.8	7.5	6.9		17.7	0.6		0.3	0.6	
Delay (s)	15.0	29.2	60.9	20.3	25.7		43.3	18.7		22.1	24.2	
Level of Service	B	C	E	C	C		D	B		C	C	
Approach Delay (s)		41.2			23.8			34.0			23.7	
Approach LOS		D			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	30.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	9.8

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	35	570	0	0	375	800	15	0	355	0	0	0
Future Vol, veh/h	35	570	0	0	375	800	15	0	355	0	0	0
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Free	Free	Free
RT Channelized	-	-	None	-	-	Yield	-	-	None	-	-	None
Storage Length	-	-	-	-	-	50	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	-	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	3	3	3	2	2	2	3	3	3
Mvmt Flow	39	633	0	0	417	889	17	0	394	0	0	0

Major/Minor	Major1			Major2			Minor1		
Conflicting Flow All	427	0	-	-	-	0	1138	1138	643
Stage 1	-	-	-	-	-	-	711	711	-
Stage 2	-	-	-	-	-	-	427	427	-
Critical Hdwy	4.12	-	-	-	-	-	6.42	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	5.42	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.42	5.52	-
Follow-up Hdwy	2.218	-	-	-	-	-	3.518	4.018	3.318
Pot Cap-1 Maneuver	1132	-	0	0	-	-	223	201	473
Stage 1	-	-	0	0	-	-	487	436	-
Stage 2	-	-	0	0	-	-	658	585	-
Platoon blocked, %		-			-	-			
Mov Cap-1 Maneuver	1123	-	-	-	-	-	209	0	469
Mov Cap-2 Maneuver	-	-	-	-	-	-	209	0	-
Stage 1	-	-	-	-	-	-	461	0	-
Stage 2	-	-	-	-	-	-	653	0	-

Approach	SE	NW	NE
HCM Control Delay, s	0.5	0	56
HCM LOS			F

Minor Lane/Major Mvmt	NELn1	NWT	NWR	SEL	SET
Capacity (veh/h)	446	-	-	1123	-
HCM Lane V/C Ratio	0.922	-	-	0.035	-
HCM Control Delay (s)	56	-	-	8.3	0
HCM Lane LOS	F	-	-	A	A
HCM 95th %tile Q(veh)	10.4	-	-	0.1	-

Intersection	
Int Delay, s/veh	88.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	140	260	5	10	440	115	5	50	15	90	50	150
Future Vol, veh/h	140	260	5	10	440	115	5	50	15	90	50	150
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	20	20	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	3	3	3	2	2	2	8	8	8	2	2	2
Mvmt Flow	151	280	5	11	473	124	5	54	16	97	54	161

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	607	0	0	295	0	0	1267	1221	312	1204	1162	555
Stage 1	-	-	-	-	-	-	593	593	-	566	566	-
Stage 2	-	-	-	-	-	-	674	628	-	638	596	-
Critical Hdwy	4.13	-	-	4.12	-	-	7.18	6.58	6.28	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.18	5.58	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.18	5.58	-	6.12	5.52	-
Follow-up Hdwy	2.227	-	-	2.218	-	-	3.572	4.072	3.372	3.518	4.018	3.318
Pot Cap-1 Maneuver	966	-	-	1266	-	-	141	175	714	161	195	531
Stage 1	-	-	-	-	-	-	482	484	-	509	507	-
Stage 2	-	-	-	-	-	-	435	467	-	465	492	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	958	-	-	1245	-	-	60	138	696	~ 92	154	522
Mov Cap-2 Maneuver	-	-	-	-	-	-	60	138	-	~ 92	154	-
Stage 1	-	-	-	-	-	-	389	390	-	410	496	-
Stage 2	-	-	-	-	-	-	262	457	-	313	397	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	3.3	0.1	51	$ 387.8
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	150	958	-	-	1245	-	-	182
HCM Lane V/C Ratio	0.502	0.157	-	-	0.009	-	-	1.713
HCM Control Delay (s)	51	9.5	0	-	7.9	0	-	$ 387.8
HCM Lane LOS	F	A	A	-	A	A	-	F
HCM 95th %tile Q(veh)	2.4	0.6	-	-	0	-	-	21.6

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	394.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	510	0	35	0	95	25	320	70	0
Future Vol, veh/h	0	0	0	510	0	35	0	95	25	320	70	0
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	-	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	5	5	5
Mvmt Flow	0	0	0	567	0	39	0	106	28	356	78	0

Major/Minor				Minor2			Major1			Major2		
Conflicting Flow All				918	932	88	-	0	0	143	0	0
Stage 1				789	789	-	-	-	-	-	-	-
Stage 2				129	143	-	-	-	-	-	-	-
Critical Hdwy				6.42	6.52	6.22	-	-	-	4.15	-	-
Critical Hdwy Stg 1				5.42	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2				5.42	5.52	-	-	-	-	-	-	-
Follow-up Hdwy				3.518	4.018	3.318	-	-	-	2.245	-	-
Pot Cap-1 Maneuver				~ 302	266	970	0	-	-	1421	-	0
Stage 1				~ 448	402	-	0	-	-	-	-	0
Stage 2				897	779	-	0	-	-	-	-	0
Platoon blocked, %								-	-		-	
Mov Cap-1 Maneuver				~ 222	0	962	-	-	-	1409	-	-
Mov Cap-2 Maneuver				~ 222	0	-	-	-	-	-	-	-
Stage 1				~ 330	0	-	-	-	-	-	-	-
Stage 2				897	0	-	-	-	-	-	-	-

Approach	WB	SE	NW
HCM Control Delay, s	$ 759.2	0	6.9
HCM LOS	F		

Minor Lane/Major Mvmt	NWL	NWT	WBLn1	SET	SER
Capacity (veh/h)	1409	-	234	-	-
HCM Lane V/C Ratio	0.252	-	2.588	-	-
HCM Control Delay (s)	8.4	0	$ 759.2	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th %tile Q(veh)	1	-	50.9	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	5.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	145	160	230	160	5	5	10	135	0	25	55
Future Vol, veh/h	10	145	160	230	160	5	5	10	135	0	25	55
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	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	11	158	174	250	174	5	5	11	147	0	27	60

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	189	0	0	342	0	0	1006	965	265	1042	1050	197
Stage 1	-	-	-	-	-	-	276	276	-	687	687	-
Stage 2	-	-	-	-	-	-	730	689	-	355	363	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1385	-	-	1217	-	-	220	255	774	208	227	844
Stage 1	-	-	-	-	-	-	730	682	-	437	447	-
Stage 2	-	-	-	-	-	-	414	446	-	662	625	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1373	-	-	1207	-	-	145	191	761	129	170	830
Mov Cap-2 Maneuver	-	-	-	-	-	-	145	191	-	129	170	-
Stage 1	-	-	-	-	-	-	717	670	-	429	341	-
Stage 2	-	-	-	-	-	-	270	341	-	516	614	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.2	5.1	13.9	17.5
HCM LOS			B	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	568	1373	-	-	1207	-	-	375
HCM Lane V/C Ratio	0.287	0.008	-	-	0.207	-	-	0.232
HCM Control Delay (s)	13.9	7.6	0	-	8.8	0	-	17.5
HCM Lane LOS	B	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	1.2	0	-	-	0.8	-	-	0.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	465	5	105	35	425	0	0	555	135
Future Volume (vph)	0	0	0	465	5	105	35	425	0	0	555	135
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0	4.0	4.0	4.0			4.0	3.5
Lane Util. Factor					1.00	1.00	1.00	1.00			1.00	1.00
Frpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	0.99
Flpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	1.00
Frt					1.00	0.85	1.00	1.00			1.00	0.85
Flt Protected					0.95	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)					1651	1473	1599	1683			1683	1411
Flt Permitted					0.95	1.00	0.19	1.00			1.00	1.00
Satd. Flow (perm)					1651	1473	312	1683			1683	1411
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)	0	0	0	495	5	112	37	452	0	0	590	144
RTOR Reduction (vph)	0	0	0	0	0	68	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	500	44	37	452	0	0	590	144
Confl. Peds. (#/hr)							5		12	12		5
Confl. Bikes (#/hr)									3			
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	4%	4%	4%	4%	4%	4%
Turn Type				Split	NA	Perm	pm+pt	NA			NA	Free
Protected Phases				4	4		1	6			2	
Permitted Phases						4	6					Free
Actuated Green, G (s)					34.6	34.6	46.4	46.4			38.7	90.0
Effective Green, g (s)					35.1	35.1	46.4	46.9			39.2	90.0
Actuated g/C Ratio					0.39	0.39	0.52	0.52			0.44	1.00
Clearance Time (s)					4.5	4.5	4.0	4.5			4.5	
Vehicle Extension (s)					3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)					643	574	213	877			733	1411
v/s Ratio Prot					c0.30		0.01	c0.27			c0.35	
v/s Ratio Perm						0.03	0.08					0.10
v/c Ratio					0.78	0.08	0.17	0.52			0.80	0.10
Uniform Delay, d1					24.0	17.3	14.4	14.1			22.1	0.0
Progression Factor					1.00	1.00	0.98	1.00			1.00	1.00
Incremental Delay, d2					5.9	0.1	0.2	1.3			9.2	0.1
Delay (s)					29.9	17.3	14.3	15.4			31.2	0.1
Level of Service					C	B	B	B			C	A
Approach Delay (s)		0.0			27.6			15.3			25.1	
Approach LOS		A			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	23.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	120.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	185	5	165	0	0	0	0	275	500	130	890	0
Future Volume (vph)	185	5	165	0	0	0	0	275	500	130	890	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0	4.0					4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00					1.00		1.00	1.00	
Frpb, ped/bikes		1.00	1.00					0.96		1.00	1.00	
Flpb, ped/bikes		1.00	1.00					1.00		1.00	1.00	
Frt		1.00	0.85					0.91		1.00	1.00	
Flt Protected		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (prot)		1531	1365					1502		1630	1716	
Flt Permitted		0.95	1.00					1.00		0.19	1.00	
Satd. Flow (perm)		1531	1365					1502		324	1716	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	199	5	177	0	0	0	0	296	538	140	957	0
RTOR Reduction (vph)	0	0	147	0	0	0	0	71	0	0	0	0
Lane Group Flow (vph)	0	204	30	0	0	0	0	763	0	140	957	0
Confl. Peds. (#/hr)							4		15	15		4
Confl. Bikes (#/hr)									4			4
Heavy Vehicles (%)	9%	9%	9%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Split	NA	Perm					NA		pm+pt	NA	
Protected Phases	8	8						6		5	2	
Permitted Phases			8							2		
Actuated Green, G (s)		14.8	14.8					56.8		66.2	66.2	
Effective Green, g (s)		15.3	15.3					57.3		66.2	66.7	
Actuated g/C Ratio		0.17	0.17					0.64		0.74	0.74	
Clearance Time (s)		4.5	4.5					4.5		4.0	4.5	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		260	232					956		316	1271	
v/s Ratio Prot		c0.13						c0.51		0.03	c0.56	
v/s Ratio Perm			0.02							0.30		
v/c Ratio		0.78	0.13					0.80		0.44	0.75	
Uniform Delay, d1		35.8	31.7					12.1		9.2	6.8	
Progression Factor		1.00	1.00					1.00		1.58	1.06	
Incremental Delay, d2		14.3	0.3					6.9		0.7	3.0	
Delay (s)		50.1	32.0					19.0		15.2	10.3	
Level of Service		D	C					B		B	B	
Approach Delay (s)		41.7			0.0			19.0			10.9	
Approach LOS		D			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	18.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	120.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Transportation Base Case Mitigated HCM Reports

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	420	820	435	580	550	290
Future Volume (vph)	420	820	435	580	550	290
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frpb, ped/bikes	1.00	0.98	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1699	1421	1614	1699	3162	1420
Flt Permitted	1.00	1.00	0.28	1.00	0.95	1.00
Satd. Flow (perm)	1699	1421	475	1699	3162	1420
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	467	911	483	644	611	322
RTOR Reduction (vph)	0	0	0	0	0	112
Lane Group Flow (vph)	467	911	483	644	611	210
Confl. Peds. (#/hr)		10	10			10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Turn Type	NA	Free	pm+pt	NA	Prot	pm+ov
Protected Phases	6		5	2	4	5
Permitted Phases		Free	2			4
Actuated Green, G (s)	37.9	90.0	61.8	61.8	20.2	40.1
Effective Green, g (s)	37.9	90.0	61.8	61.8	20.2	40.1
Actuated g/C Ratio	0.42	1.00	0.69	0.69	0.22	0.45
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)	715	1421	578	1166	709	695
v/s Ratio Prot	0.27		c0.18	0.38	c0.19	0.07
v/s Ratio Perm		0.64	c0.39			0.08
v/c Ratio	0.65	0.64	0.84	0.55	0.86	0.30
Uniform Delay, d1	20.8	0.0	11.0	7.1	33.6	16.0
Progression Factor	1.00	1.00	1.54	1.03	0.73	1.44
Incremental Delay, d2	2.0	2.0	9.0	1.6	7.1	0.2
Delay (s)	22.7	2.0	25.9	9.0	31.7	23.2
Level of Service	C	A	C	A	C	C
Approach Delay (s)	9.0			16.2	28.8	
Approach LOS	A			B	C	

Intersection Summary			
HCM 2000 Control Delay	16.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	50	10	20	5	15	30	30	240	5	30	200	60
Future Vol, veh/h	50	10	20	5	15	30	30	240	5	30	200	60
Conflicting Peds, #/hr	10	0	10	0	0	0	10	0	0	0	0	10
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, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	92	93	92	92	92	93	93	92	92	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	54	11	22	5	16	33	32	258	5	33	215	65

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	683	651	267	664	680	271	290	0	0	263	0	0
Stage 1	323	323	-	325	325	-	-	-	-	-	-	-
Stage 2	360	328	-	339	355	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	363	388	772	374	373	768	1272	-	-	1301	-	-
Stage 1	689	650	-	687	649	-	-	-	-	-	-	-
Stage 2	658	647	-	676	630	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	314	362	759	336	348	762	1261	-	-	1290	-	-
Mov Cap-2 Maneuver	314	362	-	336	348	-	-	-	-	-	-	-
Stage 1	663	625	-	666	630	-	-	-	-	-	-	-
Stage 2	590	628	-	620	605	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	17.4	12.8	0.9	0.8
HCM LOS	C	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1261	-	-	375	514	1290	-	-
HCM Lane V/C Ratio	0.026	-	-	0.23	0.106	0.025	-	-
HCM Control Delay (s)	7.9	0	-	17.4	12.8	7.9	0	-
HCM Lane LOS	A	A	-	C	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.9	0.4	0.1	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	70	5	85	30	30	5	200	45	35	455	15
Future Volume (vph)	55	70	5	85	30	30	5	200	45	35	455	15
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00			0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		0.99			0.99		1.00	1.00		1.00	1.00	
Frt		1.00			0.97		1.00	0.97		1.00	1.00	
Flt Protected		0.98			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1656			1583		1630	1653		1630	1705	
Flt Permitted		0.81			0.70		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1365			1139		1630	1653		1630	1705	
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)	60	76	5	92	33	33	5	217	49	38	495	16
RTOR Reduction (vph)	0	2	0	0	12	0	0	7	0	0	1	0
Lane Group Flow (vph)	0	139	0	0	146	0	5	259	0	38	510	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)		15.6			15.6		1.2	57.6		4.8	61.2	
Effective Green, g (s)		15.6			15.6		1.2	57.6		4.8	61.2	
Actuated g/C Ratio		0.17			0.17		0.01	0.64		0.05	0.68	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		236			197		21	1057		86	1159	
v/s Ratio Prot							0.00	0.16		c0.02	c0.30	
v/s Ratio Perm		0.10			c0.13							
v/c Ratio		0.59			0.74		0.24	0.25		0.44	0.44	
Uniform Delay, d1		34.3			35.3		43.9	6.9		41.3	6.6	
Progression Factor		0.99			1.00		1.00	1.00		0.58	1.87	
Incremental Delay, d2		3.9			13.5		5.8	0.6		3.1	1.0	
Delay (s)		37.8			48.8		49.7	7.5		26.9	13.3	
Level of Service		D			D		D	A		C	B	
Approach Delay (s)		37.8			48.8			8.2			14.2	
Approach LOS		D			D			A			B	

Intersection Summary			
HCM 2000 Control Delay	20.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	5.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	185	5	225	220	10	175
Future Vol, veh/h	185	5	225	220	10	175
Conflicting Peds, #/hr	0	10	10	0	10	10
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	4	5	5	5	5
Mvmt Flow	206	6	250	244	11	194

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	221	0	972	228
Stage 1	-	-	-	-	218	-
Stage 2	-	-	-	-	754	-
Critical Hdwy	-	-	4.15	-	7.15	6.25
Critical Hdwy Stg 1	-	-	-	-	6.15	-
Critical Hdwy Stg 2	-	-	-	-	6.15	-
Follow-up Hdwy	-	-	2.245	-	3.545	3.345
Pot Cap-1 Maneuver	-	-	1331	-	229	804
Stage 1	-	-	-	-	778	-
Stage 2	-	-	-	-	397	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1320	-	187	791
Mov Cap-2 Maneuver	-	-	-	-	187	-
Stage 1	-	-	-	-	778	-
Stage 2	-	-	-	-	307	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4.2	12.7
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	673	-	-	1320	-
HCM Lane V/C Ratio	0.305	-	-	0.189	-
HCM Control Delay (s)	12.7	-	-	8.4	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	1.3	-	-	0.7	-

Intersection	
Int Delay, s/veh	7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	40	5	45	40	55	5	195	35	185	340	20
Future Vol, veh/h	0	40	5	45	40	55	5	195	35	185	340	20
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	200	-	-	200	-	-	200	-	-	200	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	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	43	5	49	43	60	5	212	38	201	370	22

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1096	1064	400	1069	1055	251	401	0	0	260	0	0
Stage 1	793	793	-	252	252	-	-	-	-	-	-	-
Stage 2	303	271	-	817	803	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	191	223	650	199	226	788	1158	-	-	1304	-	-
Stage 1	382	400	-	752	698	-	-	-	-	-	-	-
Stage 2	706	685	-	370	396	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	126	184	639	140	187	775	1148	-	-	1293	-	-
Mov Cap-2 Maneuver	126	184	-	140	187	-	-	-	-	-	-	-
Stage 1	377	335	-	742	689	-	-	-	-	-	-	-
Stage 2	603	676	-	267	332	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	28.7	28.1	0.2	2.8
HCM LOS	D	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1148	-	-	-	200	140	333	1293	-	-
HCM Lane V/C Ratio	0.005	-	-	-	0.245	0.349	0.31	0.156	-	-
HCM Control Delay (s)	8.2	-	-	0	28.7	43.9	20.6	8.3	-	-
HCM Lane LOS	A	-	-	A	D	E	C	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	0.9	1.4	1.3	0.6	-	-

Intersection	
Int Delay, s/veh	2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	240	5	15	145	190	5	15	10	35	10	5
Future Vol, veh/h	10	240	5	15	145	190	5	15	10	35	10	5
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	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	11	261	5	16	158	207	5	16	11	38	11	5

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	374	0	0	276	0	0	607	702	284	612	601	281
Stage 1	-	-	-	-	-	-	295	295	-	303	303	-
Stage 2	-	-	-	-	-	-	312	407	-	309	298	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1184	-	-	1287	-	-	408	362	755	405	414	758
Stage 1	-	-	-	-	-	-	713	669	-	706	664	-
Stage 2	-	-	-	-	-	-	699	597	-	701	667	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1174	-	-	1276	-	-	382	346	742	371	396	745
Mov Cap-2 Maneuver	-	-	-	-	-	-	382	346	-	371	396	-
Stage 1	-	-	-	-	-	-	699	656	-	692	648	-
Stage 2	-	-	-	-	-	-	666	583	-	661	654	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.3	14.1	15.5
HCM LOS			B	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	429	1174	-	-	1276	-	-	396
HCM Lane V/C Ratio	0.076	0.009	-	-	0.013	-	-	0.137
HCM Control Delay (s)	14.1	8.1	0	-	7.9	0	-	15.5
HCM Lane LOS	B	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	0.2	0	-	-	0	-	-	0.5

Intersection	
Int Delay, s/veh	4.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	90	65	135	120	75	170
Future Vol, veh/h	90	65	135	120	75	170
Conflicting Peds, #/hr	10	10	0	10	10	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, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	98	71	147	130	82	185

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	580	232	0	0	287	0
Stage 1	222	-	-	-	-	-
Stage 2	358	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	477	807	-	-	1275	-
Stage 1	815	-	-	-	-	-
Stage 2	707	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	435	794	-	-	1264	-
Mov Cap-2 Maneuver	435	-	-	-	-	-
Stage 1	808	-	-	-	-	-
Stage 2	651	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	14.7	0	2.5
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	537	1264	-
HCM Lane V/C Ratio	-	-	0.314	0.064	-
HCM Control Delay (s)	-	-	14.7	8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1.3	0.2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	330	165	145	490	70	200	45	60	100	90	80
Future Volume (vph)	40	330	165	145	490	70	200	45	60	100	90	80
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	0.97		1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		0.98	1.00		0.98	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.91		1.00	0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1628	1716	1383	1608	1656		1598	1521		1591	1555	
Flt Permitted	0.27	1.00	1.00	0.39	1.00		0.57	1.00		0.68	1.00	
Satd. Flow (perm)	461	1716	1383	654	1656		965	1521		1135	1555	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	44	367	183	161	544	78	222	50	67	111	100	89
RTOR Reduction (vph)	0	0	101	0	6	0	0	45	0	0	35	0
Lane Group Flow (vph)	44	367	82	161	617	0	222	72	0	111	154	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			4			8	
Permitted Phases	6		6	2			4			8		
Actuated Green, G (s)	43.2	40.2	40.2	52.0	45.0		30.0	30.0		30.0	30.0	
Effective Green, g (s)	43.2	40.2	40.2	52.0	45.0		30.0	30.0		30.0	30.0	
Actuated g/C Ratio	0.48	0.45	0.45	0.58	0.50		0.33	0.33		0.33	0.33	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	260	766	617	460	828		321	507		378	518	
v/s Ratio Prot	0.01	0.21		c0.03	c0.37			0.05			0.10	
v/s Ratio Perm	0.08		0.06	0.17			c0.23			0.10		
v/c Ratio	0.17	0.48	0.13	0.35	0.74		0.69	0.14		0.29	0.30	
Uniform Delay, d1	13.8	17.5	14.6	10.0	17.9		26.0	21.0		22.2	22.2	
Progression Factor	0.52	0.89	2.08	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	1.8	0.4	0.5	6.0		11.6	0.6		0.4	0.3	
Delay (s)	7.4	17.5	30.9	10.5	23.9		37.6	21.6		22.6	22.5	
Level of Service	A	B	C	B	C		D	C		C	C	
Approach Delay (s)		20.9			21.2			32.1			22.5	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	23.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	35	760	0	0	380	730	20	0	355	0	0	0
Future Volume (vph)	35	760	0	0	380	730	20	0	355	0	0	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Lane Util. Factor	1.00	0.95			1.00	1.00		1.00	1.00			
Frpb, ped/bikes	1.00	1.00			1.00	0.95		1.00	0.97			
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.98	1.00			
Frt	1.00	1.00			1.00	0.85		1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (prot)	1630	3260			1699	1371		1602	1410			
Flt Permitted	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (perm)	1630	3260			1699	1371		1602	1410			
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	39	844	0	0	422	811	22	0	394	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	317	0	0	137	0	0	0
Lane Group Flow (vph)	39	844	0	0	422	494	0	22	257	0	0	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	3%	3%	3%
Turn Type	Prot	NA			NA	Perm	Perm	NA	Perm			
Protected Phases	1	6			2			4				
Permitted Phases						2	4		4			
Actuated Green, G (s)	3.2	62.0			54.8	54.8		20.0	20.0			
Effective Green, g (s)	3.2	62.0			54.8	54.8		20.0	20.0			
Actuated g/C Ratio	0.04	0.69			0.61	0.61		0.22	0.22			
Clearance Time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0	3.0		3.0	3.0			
Lane Grp Cap (vph)	57	2245			1034	834		356	313			
v/s Ratio Prot	c0.02	0.26			0.25							
v/s Ratio Perm						c0.36		0.01	c0.18			
v/c Ratio	0.68	0.38			0.41	0.59		0.06	0.82			
Uniform Delay, d1	42.9	5.9			9.2	10.8		27.6	33.3			
Progression Factor	1.00	1.00			0.83	3.71		1.00	1.00			
Incremental Delay, d2	28.9	0.5			0.9	2.2		0.1	15.7			
Delay (s)	71.8	6.4			8.5	42.2		27.7	49.1			
Level of Service	E	A			A	D		C	D			
Approach Delay (s)		9.2			30.7			47.9			0.0	
Approach LOS		A			C			D			A	

Intersection Summary			
HCM 2000 Control Delay	26.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	101.9%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	75	195	5	10	200	35	5	210	15	160	65	130
Future Volume (vph)	75	195	5	10	200	35	5	210	15	160	65	130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			0.99			1.00			0.99	
Flpb, ped/bikes		1.00			1.00			1.00			0.99	
Frt		1.00			0.98			0.99			0.95	
Flt Protected		0.99			1.00			1.00			0.98	
Satd. Flow (prot)		1667			1669			1599			1560	
Flt Permitted		0.87			0.98			0.99			0.78	
Satd. Flow (perm)		1467			1645			1590			1244	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	81	210	5	11	215	38	5	226	16	172	70	140
RTOR Reduction (vph)	0	1	0	0	7	0	0	3	0	0	27	0
Lane Group Flow (vph)	0	295	0	0	257	0	0	244	0	0	355	0
Confl. Peds. (#/hr)	10		10	10		10	10		20	20		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	8%	8%	8%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		15.9			15.9			20.3			20.3	
Effective Green, g (s)		15.9			15.9			20.3			20.3	
Actuated g/C Ratio		0.36			0.36			0.46			0.46	
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)		527			591			730			571	
v/s Ratio Prot												
v/s Ratio Perm		c0.20			0.16			0.15			c0.29	
v/c Ratio		0.56			0.43			0.33			0.62	
Uniform Delay, d1		11.3			10.7			7.6			9.0	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.4			0.5			0.3			2.1	
Delay (s)		12.7			11.3			7.9			11.2	
Level of Service		B			B			A			B	
Approach Delay (s)		12.7			11.3			7.9			11.2	
Approach LOS		B			B			A			B	

Intersection Summary			
HCM 2000 Control Delay	10.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	44.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	0	0	0	705	0	45	0	100	20	315	75	0
Future Volume (vph)	0	0	0	705	0	45	0	100	20	315	75	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)				4.0	4.0	4.0		4.0		4.0	4.0	
Lane Util. Factor				0.95	0.95	1.00		0.95		1.00	1.00	
Frpb, ped/bikes				1.00	1.00	0.97		1.00		1.00	1.00	
Flpb, ped/bikes				0.99	0.99	1.00		1.00		0.99	1.00	
Frt				1.00	1.00	0.85		0.98		1.00	1.00	
Flt Protected				0.95	0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)				1527	1527	1416		3167		1575	1667	
Flt Permitted				0.95	0.95	1.00		1.00		0.56	1.00	
Satd. Flow (perm)				1527	1527	1416		3167		932	1667	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	783	0	50	0	111	22	350	83	0
RTOR Reduction (vph)	0	0	0	0	0	35	0	14	0	0	0	0
Lane Group Flow (vph)	0	0	0	391	392	15	0	119	0	350	83	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	5%	5%	5%
Turn Type				Perm	NA	Perm		NA		pm+pt	NA	
Protected Phases					8			7 6		5	2	
Permitted Phases				8		8				2		
Actuated Green, G (s)				22.0	22.0	22.0		27.7		36.6	36.6	
Effective Green, g (s)				22.0	22.0	22.0		27.7		36.6	36.6	
Actuated g/C Ratio				0.30	0.30	0.30		0.38		0.50	0.50	
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)				460	460	426		1201		566	835	
v/s Ratio Prot								c0.04		c0.10	0.05	
v/s Ratio Perm				0.26	0.26	0.01				c0.21		
v/c Ratio				0.85	0.85	0.04		0.10		0.62	0.10	
Uniform Delay, d1				24.0	24.0	18.0		14.6		11.8	9.6	
Progression Factor				1.00	1.00	1.00		1.20		1.00	1.00	
Incremental Delay, d2				13.7	14.1	0.0		0.0		2.0	0.2	
Delay (s)				37.7	38.1	18.0		17.6		13.8	9.8	
Level of Service				D	D	B		B		B	A	
Approach Delay (s)		0.0			36.7			17.6			13.1	
Approach LOS		A			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	27.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	73.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	60.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations						
Traffic Volume (vph)	5	80	20	10	95	20
Future Volume (vph)	5	80	20	10	95	20
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.95
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		0.97	0.95	1.00
Satd. Flow (prot)	1716	1456		1512	1630	1391
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	1716	1456		1562	1630	1391
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	6	89	22	11	106	22
RTOR Reduction (vph)	0	60	0	0	0	11
Lane Group Flow (vph)	6	29	0	33	106	11
Confl. Peds. (#/hr)					10	10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	2%	2%	12%	12%	2%	2%
Turn Type	NA	custom	Perm	NA	Prot	Perm
Protected Phases	7	6		7	2 8	
Permitted Phases		7	7			2
Actuated Green, G (s)	2.4	23.7		2.4	62.6	36.6
Effective Green, g (s)	2.4	23.7		2.4	62.6	36.6
Actuated g/C Ratio	0.03	0.32		0.03	0.86	0.50
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)	56	552		51	1397	697
v/s Ratio Prot	0.00	0.02			c0.07	
v/s Ratio Perm		0.00		c0.02		0.01
v/c Ratio	0.11	0.05		0.65	0.08	0.02
Uniform Delay, d1	34.3	16.9		34.9	0.8	9.1
Progression Factor	1.00	1.00		1.00	0.70	0.18
Incremental Delay, d2	0.8	0.0		24.8	0.0	0.0
Delay (s)	35.1	17.0		59.7	0.6	1.7
Level of Service	D	B		E	A	A
Approach Delay (s)	18.1			59.7	0.8	
Approach LOS	B			E	A	

Intersection Summary			
HCM 2000 Control Delay	14.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.11		
Actuated Cycle Length (s)	73.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	28.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	450	5	110	35	425	0	0	485	210
Future Volume (vph)	0	0	0	450	5	110	35	425	0	0	485	210
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0	4.0	4.0	4.0			4.0	3.5
Lane Util. Factor					1.00	1.00	1.00	1.00			1.00	1.00
Frpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	0.99
Flpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	1.00
Frt					1.00	0.85	1.00	1.00			1.00	0.85
Flt Protected					0.95	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)					1651	1473	1599	1683			1683	1411
Flt Permitted					0.95	1.00	0.25	1.00			1.00	1.00
Satd. Flow (perm)					1651	1473	425	1683			1683	1411
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)	0	0	0	479	5	117	37	452	0	0	516	223
RTOR Reduction (vph)	0	0	0	0	0	72	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	484	45	37	452	0	0	516	223
Confl. Peds. (#/hr)							5		12	12		5
Confl. Bikes (#/hr)									3			
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	4%	4%	4%	4%	4%	4%
Turn Type				Split	NA	Perm	pm+pt	NA			NA	Free
Protected Phases				4	4		1	6			2	
Permitted Phases						4	6					Free
Actuated Green, G (s)					33.8	33.8	47.2	47.2			39.3	90.0
Effective Green, g (s)					34.3	34.3	47.2	47.7			39.8	90.0
Actuated g/C Ratio					0.38	0.38	0.52	0.53			0.44	1.00
Clearance Time (s)					4.5	4.5	4.0	4.5			4.5	
Vehicle Extension (s)					3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)					629	561	273	891			744	1411
v/s Ratio Prot					c0.29		0.01	c0.27			c0.31	
v/s Ratio Perm						0.03	0.06					0.16
v/c Ratio					0.77	0.08	0.14	0.51			0.69	0.16
Uniform Delay, d1					24.4	17.8	12.8	13.6			20.2	0.0
Progression Factor					1.00	1.00	1.00	1.00			1.00	1.00
Incremental Delay, d2					5.7	0.1	0.1	1.3			5.3	0.2
Delay (s)					30.0	17.8	12.9	14.9			25.5	0.2
Level of Service					C	B	B	B			C	A
Approach Delay (s)		0.0			27.7			14.8			17.9	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	20.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	115.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	175	5	145	0	0	0	0	280	500	130	800	0
Future Volume (vph)	175	5	145	0	0	0	0	280	500	130	800	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0	4.0					4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00					1.00		1.00	1.00	
Frpb, ped/bikes		1.00	1.00					0.96		1.00	1.00	
Flpb, ped/bikes		1.00	1.00					1.00		1.00	1.00	
Frt		1.00	0.85					0.91		1.00	1.00	
Flt Protected		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (prot)		1531	1365					1503		1630	1716	
Flt Permitted		0.95	1.00					1.00		0.19	1.00	
Satd. Flow (perm)		1531	1365					1503		320	1716	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	188	5	156	0	0	0	0	301	538	140	860	0
RTOR Reduction (vph)	0	0	130	0	0	0	0	70	0	0	0	0
Lane Group Flow (vph)	0	193	26	0	0	0	0	769	0	140	860	0
Confl. Peds. (#/hr)							4		15	15		4
Confl. Bikes (#/hr)									4			4
Heavy Vehicles (%)	9%	9%	9%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Split	NA	Perm					NA		pm+pt	NA	
Protected Phases	8	8						6		5	2	
Permitted Phases			8							2		
Actuated Green, G (s)		14.6	14.6					56.9		66.4	66.4	
Effective Green, g (s)		15.1	15.1					57.4		66.4	66.9	
Actuated g/C Ratio		0.17	0.17					0.64		0.74	0.74	
Clearance Time (s)		4.5	4.5					4.5		4.0	4.5	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		256	229					958		316	1275	
v/s Ratio Prot		c0.13						c0.51		0.03	c0.50	
v/s Ratio Perm			0.02							0.30		
v/c Ratio		0.75	0.11					0.80		0.44	0.67	
Uniform Delay, d1		35.7	31.8					12.1		9.3	5.9	
Progression Factor		1.00	1.00					1.00		1.60	1.17	
Incremental Delay, d2		11.9	0.2					7.1		0.8	2.3	
Delay (s)		47.5	32.0					19.2		15.6	9.2	
Level of Service		D	C					B		B	A	
Approach Delay (s)		40.6			0.0			19.2			10.1	
Approach LOS		D			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	18.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	115.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Revised Land Use Framework – July 2017 Mitigated HCM Reports

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	555	510	320	655	515	320
Future Volume (vph)	555	510	320	655	515	320
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frpb, ped/bikes	1.00	0.98	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1699	1421	1614	1699	3162	1413
Flt Permitted	1.00	1.00	0.24	1.00	0.95	1.00
Satd. Flow (perm)	1699	1421	403	1699	3162	1413
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	617	567	356	728	572	356
RTOR Reduction (vph)	0	0	0	0	0	124
Lane Group Flow (vph)	617	567	356	728	572	233
Confl. Peds. (#/hr)		10	10			10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Turn Type	NA	Free	pm+pt	NA	Prot	pm+ov
Protected Phases	6		5	2	4	5
Permitted Phases		Free	2			4
Actuated Green, G (s)	46.5	90.0	63.5	63.5	18.5	31.5
Effective Green, g (s)	46.5	90.0	63.5	63.5	18.5	31.5
Actuated g/C Ratio	0.52	1.00	0.71	0.71	0.21	0.35
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)	877	1421	459	1198	649	557
v/s Ratio Prot	0.36		c0.11	0.43	c0.18	0.06
v/s Ratio Perm		0.40	c0.43			0.10
v/c Ratio	0.70	0.40	0.78	0.61	0.88	0.42
Uniform Delay, d1	16.5	0.0	10.6	6.8	34.7	22.3
Progression Factor	1.01	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.4	0.8	8.0	2.3	13.3	0.5
Delay (s)	19.2	0.8	18.6	9.1	48.0	22.8
Level of Service	B	A	B	A	D	C
Approach Delay (s)	10.4			12.2	38.3	
Approach LOS	B			B	D	

Intersection Summary			
HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	35	600	0	0	375	805	20	0	350	0	0	0
Future Volume (vph)	35	600	0	0	375	805	20	0	350	0	0	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Lane Util. Factor	1.00	0.95			1.00	1.00		1.00	1.00			
Frpb, ped/bikes	1.00	1.00			1.00	0.95		1.00	0.96			
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.98	1.00			
Frt	1.00	1.00			1.00	0.85		1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (prot)	1630	3260			1699	1372		1602	1406			
Flt Permitted	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (perm)	1630	3260			1699	1372		1602	1406			
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	39	667	0	0	417	894	22	0	389	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	286	0	0	242	0	0	0
Lane Group Flow (vph)	39	667	0	0	417	608	0	22	147	0	0	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	3%	3%	3%
Turn Type	Prot	NA			NA	Perm	Perm	NA	Perm			
Protected Phases	1	6			2			4				
Permitted Phases						2	4		4			
Actuated Green, G (s)	3.3	68.2			60.9	60.9		13.8	13.8			
Effective Green, g (s)	3.3	68.2			60.9	60.9		13.8	13.8			
Actuated g/C Ratio	0.04	0.76			0.68	0.68		0.15	0.15			
Clearance Time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0	3.0		3.0	3.0			
Lane Grp Cap (vph)	59	2470			1149	928		245	215			
v/s Ratio Prot	c0.02	0.20			0.25							
v/s Ratio Perm						c0.44		0.01	c0.10			
v/c Ratio	0.66	0.27			0.36	0.65		0.09	0.68			
Uniform Delay, d1	42.8	3.3			6.2	8.4		32.7	36.0			
Progression Factor	1.00	1.00			0.67	3.73		1.00	1.00			
Incremental Delay, d2	24.4	0.3			0.6	2.5		0.2	8.6			
Delay (s)	67.2	3.6			4.8	34.0		32.9	44.7			
Level of Service	E	A			A	C		C	D			
Approach Delay (s)		7.1			24.7			44.0			0.0	
Approach LOS		A			C			D			A	

Intersection Summary			
HCM 2000 Control Delay	22.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	101.8%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	0	0	0	560	0	40	0	75	25	325	70	0
Future Volume (vph)	0	0	0	560	0	40	0	75	25	325	70	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)				4.0	4.0	4.0		4.0		4.0	4.0	
Lane Util. Factor				0.95	0.95	1.00		0.95		1.00	1.00	
Frpb, ped/bikes				1.00	1.00	0.97		0.99		1.00	1.00	
Flpb, ped/bikes				0.99	0.99	1.00		1.00		0.99	1.00	
Frt				1.00	1.00	0.85		0.96		1.00	1.00	
Flt Protected				0.95	0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)				1527	1527	1415		3120		1574	1667	
Flt Permitted				0.95	0.95	1.00		1.00		0.59	1.00	
Satd. Flow (perm)				1527	1527	1415		3120		974	1667	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	622	0	44	0	83	28	361	78	0
RTOR Reduction (vph)	0	0	0	0	0	33	0	16	0	0	0	0
Lane Group Flow (vph)	0	0	0	311	311	11	0	95	0	361	78	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	5%	5%	5%
Turn Type				Perm	NA	Perm		NA		pm+pt	NA	
Protected Phases					8			7 6		5	2	
Permitted Phases				8		8				2		
Actuated Green, G (s)				17.8	17.8	17.8		32.0		40.2	40.2	
Effective Green, g (s)				17.8	17.8	17.8		32.0		40.2	40.2	
Actuated g/C Ratio				0.24	0.24	0.24		0.44		0.55	0.55	
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)				372	372	345		1367		628	917	
v/s Ratio Prot								c0.03		c0.09	0.05	
v/s Ratio Perm				c0.20	0.20	0.01				c0.23		
v/c Ratio				0.84	0.84	0.03		0.07		0.57	0.09	
Uniform Delay, d1				26.2	26.2	21.0		11.9		9.7	7.7	
Progression Factor				1.00	1.00	1.00		1.26		1.00	1.00	
Incremental Delay, d2				14.9	14.9	0.0		0.0		1.3	0.2	
Delay (s)				41.2	41.2	21.1		15.0		11.0	7.9	
Level of Service				D	D	C		B		B	A	
Approach Delay (s)		0.0			39.8			15.0			10.5	
Approach LOS		A			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	27.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	73.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations						
Traffic Volume (vph)	25	70	30	10	90	20
Future Volume (vph)	25	70	30	10	90	20
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.95
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		0.96	0.95	1.00
Satd. Flow (prot)	1716	1456		1506	1630	1392
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	1716	1456		1562	1630	1392
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	28	78	33	11	100	22
RTOR Reduction (vph)	0	48	0	0	0	10
Lane Group Flow (vph)	28	30	0	44	100	12
Confl. Peds. (#/hr)					10	10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	2%	2%	12%	12%	2%	2%
Turn Type	NA	custom	Perm	NA	Prot	Perm
Protected Phases	7	6		7	2 8	
Permitted Phases		7	7			2
Actuated Green, G (s)	3.0	28.0		3.0	62.0	40.2
Effective Green, g (s)	3.0	28.0		3.0	62.0	40.2
Actuated g/C Ratio	0.04	0.38		0.04	0.85	0.55
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)	70	638		64	1384	766
v/s Ratio Prot	0.02	0.02			c0.06	
v/s Ratio Perm		0.00		c0.03		0.01
v/c Ratio	0.40	0.05		0.69	0.07	0.02
Uniform Delay, d1	34.1	14.1		34.5	0.9	7.4
Progression Factor	1.00	1.00		1.00	0.67	0.17
Incremental Delay, d2	3.7	0.0		26.5	0.0	0.0
Delay (s)	37.8	14.2		61.0	0.6	1.3
Level of Service	D	B		E	A	A
Approach Delay (s)	20.4			61.0	0.7	
Approach LOS	C			E	A	

Intersection Summary			
HCM 2000 Control Delay	18.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.11		
Actuated Cycle Length (s)	73.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	29.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	3.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	45	10	20	5	25	35	30	290	5	15	210	65
Future Vol, veh/h	45	10	20	5	25	35	30	290	5	15	210	65
Conflicting Peds, #/hr	10	0	10	0	0	0	10	0	0	0	0	10
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, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	92	93	92	92	92	93	93	92	92	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	48	11	22	5	27	38	32	312	5	16	226	70

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	725	685	281	699	717	325	306	0	0	317	0	0
Stage 1	303	303	-	379	379	-	-	-	-	-	-	-
Stage 2	422	382	-	320	338	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	340	371	758	354	355	716	1255	-	-	1243	-	-
Stage 1	706	664	-	643	615	-	-	-	-	-	-	-
Stage 2	609	613	-	692	641	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	286	351	745	321	336	710	1245	-	-	1233	-	-
Mov Cap-2 Maneuver	286	351	-	321	336	-	-	-	-	-	-	-
Stage 1	678	648	-	623	596	-	-	-	-	-	-	-
Stage 2	529	594	-	645	625	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18.2	14.1	0.7	0.4
HCM LOS	C	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1245	-	-	353	467	1233	-	-
HCM Lane V/C Ratio	0.026	-	-	0.229	0.151	0.013	-	-
HCM Control Delay (s)	8	0	-	18.2	14.1	8	0	-
HCM Lane LOS	A	A	-	C	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.9	0.5	0	-	-

Intersection	
Int Delay, s/veh	4.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	205	5	105	200	10	155
Future Vol, veh/h	205	5	105	200	10	155
Conflicting Peds, #/hr	0	10	10	0	10	10
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	4	5	5	5	5
Mvmt Flow	228	6	117	222	11	172

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	243	0	707	251
Stage 1	-	-	-	-	241	-
Stage 2	-	-	-	-	466	-
Critical Hdwy	-	-	4.15	-	6.45	6.25
Critical Hdwy Stg 1	-	-	-	-	5.45	-
Critical Hdwy Stg 2	-	-	-	-	5.45	-
Follow-up Hdwy	-	-	2.245	-	3.545	3.345
Pot Cap-1 Maneuver	-	-	1306	-	397	780
Stage 1	-	-	-	-	792	-
Stage 2	-	-	-	-	625	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1295	-	350	767
Mov Cap-2 Maneuver	-	-	-	-	350	-
Stage 1	-	-	-	-	785	-
Stage 2	-	-	-	-	556	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.8	11.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	715	-	-	1295	-
HCM Lane V/C Ratio	0.256	-	-	0.09	-
HCM Control Delay (s)	11.8	-	-	8.1	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	1	-	-	0.3	-

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	100	75	65	140	225	5
Future Volume (vph)	100	75	65	140	225	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00
Frpb, ped/bikes		1.00	0.96		1.00	0.95
Flpb, ped/bikes		0.99	1.00		1.00	1.00
Frt		1.00	0.91		1.00	0.85
Flt Protected		0.97	1.00		0.95	1.00
Satd. Flow (prot)		1652	1499		1630	1385
Flt Permitted		0.49	1.00		0.95	1.00
Satd. Flow (perm)		832	1499		1630	1385
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	109	82	71	152	245	5
RTOR Reduction (vph)	0	0	119	0	0	2
Lane Group Flow (vph)	0	191	104	0	245	3
Confl. Peds. (#/hr)	10			10	10	10
Confl. Bikes (#/hr)				5		5
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)		19.6	19.6		62.4	62.4
Effective Green, g (s)		19.6	19.6		62.4	62.4
Actuated g/C Ratio		0.22	0.22		0.69	0.69
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)		181	326		1130	960
v/s Ratio Prot			0.07		c0.15	
v/s Ratio Perm		c0.23				0.00
v/c Ratio		1.06	0.32		0.22	0.00
Uniform Delay, d1		35.2	29.6		5.0	4.2
Progression Factor		1.00	1.00		2.12	2.36
Incremental Delay, d2		82.3	0.6		0.4	0.0
Delay (s)		117.5	30.2		11.0	10.0
Level of Service		F	C		B	B
Approach Delay (s)		117.5	30.2		11.0	
Approach LOS		F	C		B	

Intersection Summary			
HCM 2000 Control Delay	48.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	47.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	25	5	35	45	5	5	100	75	120	265	40
Future Vol, veh/h	5	25	5	35	45	5	5	100	75	120	265	40
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
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, %	-	0	-	-	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	5	27	5	38	49	5	5	109	82	130	288	43

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	779	792	330	767	772	169	342	0	0	200	0	0
Stage 1	581	581	-	170	170	-	-	-	-	-	-	-
Stage 2	198	211	-	597	602	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	313	322	712	319	330	875	1217	-	-	1372	-	-
Stage 1	499	500	-	832	758	-	-	-	-	-	-	-
Stage 2	804	728	-	490	489	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	241	278	700	261	285	860	1207	-	-	1361	-	-
Mov Cap-2 Maneuver	241	278	-	261	285	-	-	-	-	-	-	-
Stage 1	492	437	-	821	748	-	-	-	-	-	-	-
Stage 2	737	718	-	399	428	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18.9	23.6	0.2	2.2
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1207	-	-	297	285	1361	-	-
HCM Lane V/C Ratio	0.005	-	-	0.128	0.324	0.096	-	-
HCM Control Delay (s)	8	0	-	18.9	23.6	7.9	0	-
HCM Lane LOS	A	A	-	C	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.4	1.4	0.3	-	-

Intersection	
Int Delay, s/veh	3.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	20	200	5	25	85	190	5	15	10	65	10	5
Future Vol, veh/h	20	200	5	25	85	190	5	15	10	65	10	5
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	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	22	217	5	27	92	207	5	16	11	71	11	5

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	309	0	0	233	0	0	542	637	240	547	536	216
Stage 1	-	-	-	-	-	-	274	274	-	260	260	-
Stage 2	-	-	-	-	-	-	268	363	-	287	276	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1252	-	-	1335	-	-	451	395	799	448	451	824
Stage 1	-	-	-	-	-	-	732	683	-	745	693	-
Stage 2	-	-	-	-	-	-	738	625	-	720	682	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1242	-	-	1324	-	-	417	371	786	406	424	810
Mov Cap-2 Maneuver	-	-	-	-	-	-	417	371	-	406	424	-
Stage 1	-	-	-	-	-	-	711	664	-	724	670	-
Stage 2	-	-	-	-	-	-	697	604	-	673	663	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.7	0.6	13.4	15.8
HCM LOS			B	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	461	1242	-	-	1324	-	-	421
HCM Lane V/C Ratio	0.071	0.018	-	-	0.021	-	-	0.207
HCM Control Delay (s)	13.4	8	0	-	7.8	0	-	15.8
HCM Lane LOS	B	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	0.2	0.1	-	-	0.1	-	-	0.8

Intersection	
Int Delay, s/veh	5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	115	70	135	170	70	160
Future Vol, veh/h	115	70	135	170	70	160
Conflicting Peds, #/hr	10	10	0	10	10	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, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	125	76	147	185	76	174

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	585	259	0	0	342	0
Stage 1	249	-	-	-	-	-
Stage 2	336	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	473	780	-	-	1217	-
Stage 1	792	-	-	-	-	-
Stage 2	724	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	433	767	-	-	1207	-
Mov Cap-2 Maneuver	433	-	-	-	-	-
Stage 1	785	-	-	-	-	-
Stage 2	668	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	16.3	0	2.5
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	518	1207	-
HCM Lane V/C Ratio	-	-	0.388	0.063	-
HCM Control Delay (s)	-	-	16.3	8.2	0
HCM Lane LOS	-	-	C	A	A
HCM 95th %tile Q(veh)	-	-	1.8	0.2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	410	280	330	515	70	180	50	60	85	185	65
Future Volume (vph)	50	410	280	330	515	70	180	50	60	85	185	65
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	0.97		1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		0.99	1.00		0.98	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.92		1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1627	1716	1382	1614	1658		1606	1530		1592	1626	
Flt Permitted	0.28	1.00	1.00	0.24	1.00		0.45	1.00		0.67	1.00	
Satd. Flow (perm)	481	1716	1382	400	1658		764	1530		1121	1626	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	56	456	311	367	572	78	200	56	67	94	206	72
RTOR Reduction (vph)	0	0	198	0	5	0	0	45	0	0	14	0
Lane Group Flow (vph)	56	456	113	367	645	0	200	78	0	94	264	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			4			8	
Permitted Phases	6		6	2			4			8		
Actuated Green, G (s)	36.7	32.7	32.7	52.0	44.0		30.0	30.0		30.0	30.0	
Effective Green, g (s)	36.7	32.7	32.7	52.0	44.0		30.0	30.0		30.0	30.0	
Actuated g/C Ratio	0.41	0.36	0.36	0.58	0.49		0.33	0.33		0.33	0.33	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	247	623	502	437	810		254	510		373	542	
v/s Ratio Prot	0.01	0.27		c0.14	0.39			0.05			0.16	
v/s Ratio Perm	0.08		0.08	c0.34			c0.26			0.08		
v/c Ratio	0.23	0.73	0.23	0.84	0.80		0.79	0.15		0.25	0.49	
Uniform Delay, d1	17.0	24.8	19.9	14.1	19.2		27.1	21.1		21.8	23.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	7.4	1.0	13.3	8.0		21.4	0.6		0.4	0.7	
Delay (s)	17.5	32.3	20.9	27.4	27.2		48.6	21.7		22.2	24.6	
Level of Service	B	C	C	C	C		D	C		C	C	
Approach Delay (s)		27.0			27.3			38.3			24.0	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	28.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	205	5	5	265	30	75	155	15	140	95	270
Future Volume (vph)	130	205	5	5	265	30	75	155	15	140	95	270
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			1.00			1.00			0.98	
Flpb, ped/bikes		1.00			1.00			1.00			0.99	
Frt		1.00			0.99			0.99			0.93	
Flt Protected		0.98			1.00			0.98			0.99	
Satd. Flow (prot)		1656			1684			1573			1522	
Flt Permitted		0.72			0.99			0.78			0.84	
Satd. Flow (perm)		1218			1676			1240			1295	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	140	220	5	5	285	32	81	167	16	151	102	290
RTOR Reduction (vph)	0	1	0	0	4	0	0	3	0	0	49	0
Lane Group Flow (vph)	0	364	0	0	318	0	0	261	0	0	494	0
Confl. Peds. (#/hr)	10		10	10		10	10		20	20		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	8%	8%	8%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		27.0			27.0			32.5			32.5	
Effective Green, g (s)		27.0			27.0			32.5			32.5	
Actuated g/C Ratio		0.40			0.40			0.48			0.48	
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)		487			670			597			623	
v/s Ratio Prot												
v/s Ratio Perm		c0.30			0.19			0.21			c0.38	
v/c Ratio		0.75			0.47			0.44			0.79	
Uniform Delay, d1		17.3			15.0			11.5			14.7	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		6.2			0.5			0.5			6.9	
Delay (s)		23.5			15.5			12.0			21.6	
Level of Service		C			B			B			C	
Approach Delay (s)		23.5			15.5			12.0			21.6	
Approach LOS		C			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	67.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	88.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	4.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	125	170	245	165	5	5	5	95	0	10	40
Future Vol, veh/h	10	125	170	245	165	5	5	5	95	0	10	40
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	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	11	136	185	266	179	5	5	5	103	0	11	43

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	195	0	0	331	0	0	1012	987	248	1039	1077	202
Stage 1	-	-	-	-	-	-	260	260	-	725	725	-
Stage 2	-	-	-	-	-	-	752	727	-	314	352	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1378	-	-	1228	-	-	218	247	791	209	219	839
Stage 1	-	-	-	-	-	-	745	693	-	416	430	-
Stage 2	-	-	-	-	-	-	402	429	-	697	632	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1367	-	-	1218	-	-	156	182	778	141	161	825
Mov Cap-2 Maneuver	-	-	-	-	-	-	156	182	-	141	161	-
Stage 1	-	-	-	-	-	-	731	680	-	408	322	-
Stage 2	-	-	-	-	-	-	276	322	-	589	620	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	5.2	12.8	14.1
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	578	1367	-	-	1218	-	-	452
HCM Lane V/C Ratio	0.197	0.008	-	-	0.219	-	-	0.12
HCM Control Delay (s)	12.8	7.7	0	-	8.8	0	-	14.1
HCM Lane LOS	B	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.7	0	-	-	0.8	-	-	0.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	450	5	105	35	425	0	0	540	150
Future Volume (vph)	0	0	0	450	5	105	35	425	0	0	540	150
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0	4.0	4.0	4.0			4.0	3.5
Lane Util. Factor					1.00	1.00	1.00	1.00			1.00	1.00
Frpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	0.99
Flpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	1.00
Frt					1.00	0.85	1.00	1.00			1.00	0.85
Flt Protected					0.95	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)					1651	1473	1599	1683			1683	1411
Flt Permitted					0.95	1.00	0.21	1.00			1.00	1.00
Satd. Flow (perm)					1651	1473	345	1683			1683	1411
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)	0	0	0	479	5	112	37	452	0	0	574	160
RTOR Reduction (vph)	0	0	0	0	0	69	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	484	43	37	452	0	0	574	160
Confl. Peds. (#/hr)							5		12	12		5
Confl. Bikes (#/hr)									3			
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	4%	4%	4%	4%	4%	4%
Turn Type				Split	NA	Perm	pm+pt	NA			NA	Free
Protected Phases				4	4		1	6			2	
Permitted Phases						4	6					Free
Actuated Green, G (s)					33.8	33.8	47.2	47.2			39.3	90.0
Effective Green, g (s)					34.3	34.3	47.2	47.7			39.8	90.0
Actuated g/C Ratio					0.38	0.38	0.52	0.53			0.44	1.00
Clearance Time (s)					4.5	4.5	4.0	4.5			4.5	
Vehicle Extension (s)					3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)					629	561	235	891			744	1411
v/s Ratio Prot					c0.29		0.01	c0.27			c0.34	
v/s Ratio Perm						0.03	0.08					0.11
v/c Ratio					0.77	0.08	0.16	0.51			0.77	0.11
Uniform Delay, d1					24.4	17.8	13.6	13.6			21.3	0.0
Progression Factor					1.00	1.00	0.97	1.00			1.00	1.00
Incremental Delay, d2					5.7	0.1	0.2	1.2			7.6	0.2
Delay (s)					30.0	17.8	13.5	14.8			28.9	0.2
Level of Service					C	B	B	B			C	A
Approach Delay (s)		0.0			27.7			14.7			22.6	
Approach LOS		A			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	22.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	118.6%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	185	5	170	0	0	0	0	275	505	130	860	0
Future Volume (vph)	185	5	170	0	0	0	0	275	505	130	860	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0	4.0					4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00					1.00		1.00	1.00	
Frpb, ped/bikes		1.00	1.00					0.96		1.00	1.00	
Flpb, ped/bikes		1.00	1.00					1.00		1.00	1.00	
Frt		1.00	0.85					0.91		1.00	1.00	
Flt Protected		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (prot)		1531	1365					1501		1630	1716	
Flt Permitted		0.95	1.00					1.00		0.19	1.00	
Satd. Flow (perm)		1531	1365					1501		318	1716	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	199	5	183	0	0	0	0	296	543	140	925	0
RTOR Reduction (vph)	0	0	152	0	0	0	0	72	0	0	0	0
Lane Group Flow (vph)	0	204	31	0	0	0	0	767	0	140	925	0
Confl. Peds. (#/hr)							4		15	15		4
Confl. Bikes (#/hr)									4			4
Heavy Vehicles (%)	9%	9%	9%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Split	NA	Perm					NA		pm+pt	NA	
Protected Phases	8	8						6		5	2	
Permitted Phases			8							2		
Actuated Green, G (s)		14.9	14.9					56.7		66.1	66.1	
Effective Green, g (s)		15.4	15.4					57.2		66.1	66.6	
Actuated g/C Ratio		0.17	0.17					0.64		0.73	0.74	
Clearance Time (s)		4.5	4.5					4.5		4.0	4.5	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		261	233					953		312	1269	
v/s Ratio Prot		c0.13						c0.51		0.03	c0.54	
v/s Ratio Perm			0.02							0.30		
v/c Ratio		0.78	0.13					0.81		0.45	0.73	
Uniform Delay, d1		35.7	31.6					12.2		9.4	6.6	
Progression Factor		1.00	1.00					1.00		1.66	1.07	
Incremental Delay, d2		14.1	0.3					7.2		0.8	2.8	
Delay (s)		49.8	31.9					19.4		16.4	9.9	
Level of Service		D	C					B		B	A	
Approach Delay (s)		41.3			0.0			19.4			10.7	
Approach LOS		D			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	118.6%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	470	190	235	315	160	365
Future Volume (vph)	470	190	235	315	160	365
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0			4.0	4.0	4.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frpb, ped/bikes	0.98			1.00	1.00	0.93
Flpb, ped/bikes	1.00			1.00	0.97	1.00
Frt	0.96			1.00	1.00	0.85
Flt Protected	1.00			0.98	0.95	1.00
Satd. Flow (prot)	1622			1674	1574	1362
Flt Permitted	1.00			0.48	0.95	1.00
Satd. Flow (perm)	1622			823	1574	1362
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	511	207	255	342	174	397
RTOR Reduction (vph)	8	0	0	0	0	322
Lane Group Flow (vph)	710	0	0	597	174	75
Confl. Peds. (#/hr)		10	10		10	10
Confl. Bikes (#/hr)		5				5
Turn Type	NA		custom	NA	Perm	pm+ov
Protected Phases	6		5			5
Permitted Phases			2	2	8	8
Actuated Green, G (s)	86.0			86.0	16.0	16.0
Effective Green, g (s)	86.0			86.0	16.0	16.0
Actuated g/C Ratio	0.78			0.78	0.15	0.15
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)	1268			643	228	198
v/s Ratio Prot	0.44					
v/s Ratio Perm				c0.73	c0.11	0.05
v/c Ratio	0.56			0.93	0.76	0.38
Uniform Delay, d1	4.7			9.6	45.2	42.5
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	0.5			21.7	21.2	1.2
Delay (s)	5.2			31.3	66.4	43.7
Level of Service	A			C	E	D
Approach Delay (s)	5.2			31.3	50.6	
Approach LOS	A			C	D	

Intersection Summary			
HCM 2000 Control Delay	27.2	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)	12.0
Intersection Capacity Utilization	95.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Transportation Base Case Interim Solution HCM Reports

Movement	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	5	80	20	10	95	20
Future Volume (Veh/h)	5	80	20	10	95	20
Sign Control	Stop			Stop	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	6	89	22	11	106	22
Pedestrians	10			10		
Lane Width (ft)	12.0			12.0		
Walking Speed (ft/s)	4.0			4.0		
Percent Blockage	1			1		
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)					185	
pX, platoon unblocked						
vC, conflicting volume	232	10	314	232	10	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	232	10	314	232	10	
tC, single (s)	6.5	6.2	7.2	6.6	4.1	
tC, 2 stage (s)						
tF (s)	4.0	3.3	3.6	4.1	2.2	
p0 queue free %	99	92	96	98	93	
cM capacity (veh/h)	613	1062	524	598	1596	

Direction, Lane #	EB 1	WB 1	NW 1	NW 2
Volume Total	95	33	106	22
Volume Left	0	22	106	0
Volume Right	89	0	0	22
cSH	1015	546	1596	1700
Volume to Capacity	0.09	0.06	0.07	0.01
Queue Length 95th (ft)	8	5	5	0
Control Delay (s)	8.9	12.0	7.4	0.0
Lane LOS	A	B	A	
Approach Delay (s)	8.9	12.0	6.1	
Approach LOS	A	B		

Intersection Summary			
Average Delay	7.9		
Intersection Capacity Utilization	23.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	420	820	435	580	550	290
Future Volume (vph)	420	820	435	580	550	290
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frpb, ped/bikes	1.00	0.98	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1699	1421	1614	1699	3162	1420
Flt Permitted	1.00	1.00	0.28	1.00	0.95	1.00
Satd. Flow (perm)	1699	1421	481	1699	3162	1420
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	467	911	483	644	611	322
RTOR Reduction (vph)	0	0	0	0	0	113
Lane Group Flow (vph)	467	911	483	644	611	209
Confl. Peds. (#/hr)		10	10			10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Turn Type	NA	Free	pm+pt	NA	Prot	pm+ov
Protected Phases	6		5	2	4	5
Permitted Phases		Free	2			4
Actuated Green, G (s)	38.3	90.0	61.8	61.8	20.2	39.7
Effective Green, g (s)	38.3	90.0	61.8	61.8	20.2	39.7
Actuated g/C Ratio	0.43	1.00	0.69	0.69	0.22	0.44
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)	723	1421	575	1166	709	689
v/s Ratio Prot	0.27		c0.18	0.38	c0.19	0.07
v/s Ratio Perm		0.64	c0.39			0.08
v/c Ratio	0.65	0.64	0.84	0.55	0.86	0.30
Uniform Delay, d1	20.5	0.0	10.7	7.1	33.6	16.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.0	2.2	10.4	1.9	10.5	0.3
Delay (s)	22.5	2.2	21.1	9.0	44.1	16.5
Level of Service	C	A	C	A	D	B
Approach Delay (s)	9.1			14.2	34.5	
Approach LOS	A			B	C	

Intersection Summary			
HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	18.4

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	35	760	0	0	380	730	20	0	355	0	0	0
Future Vol, veh/h	35	760	0	0	380	730	20	0	355	0	0	0
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Free	Free	Free
RT Channelized	-	-	None	-	-	Yield	-	-	None	-	-	None
Storage Length	-	-	-	-	-	0	-	-	300	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	-	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	3	3	3	2	2	2	3	3	3
Mvmt Flow	39	844	0	0	422	811	22	0	394	0	0	0

Major/Minor	Major1			Major2			Minor1		
Conflicting Flow All	432	0	-	-	-	0	1354	1354	854
Stage 1	-	-	-	-	-	-	922	922	-
Stage 2	-	-	-	-	-	-	432	432	-
Critical Hdwy	4.12	-	-	-	-	-	6.42	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	5.42	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.42	5.52	-
Follow-up Hdwy	2.218	-	-	-	-	-	3.518	4.018	3.318
Pot Cap-1 Maneuver	1128	-	0	0	-	-	165	150	~ 358
Stage 1	-	-	0	0	-	-	387	349	-
Stage 2	-	-	0	0	-	-	655	582	-
Platoon blocked, %		-			-	-			
Mov Cap-1 Maneuver	1119	-	-	-	-	-	153	0	~ 355
Mov Cap-2 Maneuver	-	-	-	-	-	-	153	0	-
Stage 1	-	-	-	-	-	-	361	0	-
Stage 2	-	-	-	-	-	-	650	0	-

Approach	SE	NW	NE
HCM Control Delay, s	0.4	0	111.2
HCM LOS			F

Minor Lane/Major Mvmt	NELn1	NELn2	NWT	NWR	SEL	SET
Capacity (veh/h)	153	355	-	-	1119	-
HCM Lane V/C Ratio	0.145	1.111	-	-	0.035	-
HCM Control Delay (s)	32.5	115.6	-	-	8.3	0
HCM Lane LOS	D	F	-	-	A	A
HCM 95th %tile Q(veh)	0.5	14.9	-	-	0.1	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	0	0	0	705	0	40	0	100	20	315	75	0
Future Volume (vph)	0	0	0	705	0	40	0	100	20	315	75	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					1.00			1.00			1.00	
Frpb, ped/bikes					1.00			0.99			1.00	
Flpb, ped/bikes					0.98			1.00			0.98	
Frt					0.99			0.98			1.00	
Flt Protected					0.95			1.00			0.96	
Satd. Flow (prot)					1584			1664			1575	
Flt Permitted					0.95			1.00			0.68	
Satd. Flow (perm)					1584			1664			1113	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	783	0	44	0	111	22	350	83	0
RTOR Reduction (vph)	0	0	0	0	33	0	0	7	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	794	0	0	126	0	0	433	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	5%	5%	5%
Turn Type				Perm	NA			NA		pm+pt	NA	
Protected Phases					8			6		5	2	
Permitted Phases				8						2		
Actuated Green, G (s)					41.0			31.0			31.0	
Effective Green, g (s)					41.0			31.0			31.0	
Actuated g/C Ratio					0.51			0.39			0.39	
Clearance Time (s)					4.0			4.0			4.0	
Vehicle Extension (s)					3.0			3.0			3.0	
Lane Grp Cap (vph)					811			644			431	
v/s Ratio Prot								0.08				
v/s Ratio Perm					0.50						c0.39	
v/c Ratio					0.98			0.20			1.00	
Uniform Delay, d1					19.1			16.2			24.5	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					26.1			0.7			44.5	
Delay (s)					45.2			16.9			69.0	
Level of Service					D			B			E	
Approach Delay (s)		0.0			45.2			16.9			69.0	
Approach LOS		A			D			B			E	

Intersection Summary			
HCM 2000 Control Delay	49.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	25	70	30	10	90	20
Future Volume (Veh/h)	25	70	30	10	90	20
Sign Control	Stop			Stop	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	28	78	33	11	100	22
Pedestrians	10			10		
Lane Width (ft)	12.0			12.0		
Walking Speed (ft/s)	4.0			4.0		
Percent Blockage	1			1		
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)					185	
pX, platoon unblocked						
vC, conflicting volume	220	10	302	220	10	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	220	10	302	220	10	
tC, single (s)	6.5	6.2	7.2	6.6	4.1	
tC, 2 stage (s)						
tF (s)	4.0	3.3	3.6	4.1	2.2	
p0 queue free %	96	93	94	98	94	
cM capacity (veh/h)	625	1062	527	610	1596	

Direction, Lane #	EB 1	WB 1	NW 1	NW 2
Volume Total	106	44	100	22
Volume Left	0	33	100	0
Volume Right	78	0	0	22
cSH	897	545	1596	1700
Volume to Capacity	0.12	0.08	0.06	0.01
Queue Length 95th (ft)	10	7	5	0
Control Delay (s)	9.6	12.2	7.4	0.0
Lane LOS	A	B	A	
Approach Delay (s)	9.6	12.2	6.1	
Approach LOS	A	B		

Intersection Summary			
Average Delay	8.4		
Intersection Capacity Utilization	23.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	555	510	320	655	515	320
Future Volume (vph)	555	510	320	655	515	320
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frpb, ped/bikes	1.00	0.98	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1699	1421	1614	1699	3162	1413
Flt Permitted	1.00	1.00	0.24	1.00	0.95	1.00
Satd. Flow (perm)	1699	1421	403	1699	3162	1413
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	617	567	356	728	572	356
RTOR Reduction (vph)	0	0	0	0	0	124
Lane Group Flow (vph)	617	567	356	728	572	233
Confl. Peds. (#/hr)		10	10			10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Turn Type	NA	Free	pm+pt	NA	Prot	pm+ov
Protected Phases	6		5	2	4	5
Permitted Phases		Free	2			4
Actuated Green, G (s)	46.5	90.0	63.5	63.5	18.5	31.5
Effective Green, g (s)	46.5	90.0	63.5	63.5	18.5	31.5
Actuated g/C Ratio	0.52	1.00	0.71	0.71	0.21	0.35
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)	877	1421	459	1198	649	557
v/s Ratio Prot	0.36		c0.11	0.43	c0.18	0.06
v/s Ratio Perm		0.40	c0.43			0.10
v/c Ratio	0.70	0.40	0.78	0.61	0.88	0.42
Uniform Delay, d1	16.5	0.0	10.6	6.8	34.7	22.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.6	0.8	8.0	2.3	13.3	0.5
Delay (s)	19.1	0.8	18.6	9.1	48.0	22.8
Level of Service	B	A	B	A	D	C
Approach Delay (s)	10.4			12.2	38.3	
Approach LOS	B			B	D	

Intersection Summary			
HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Int Delay, s/veh	7.8

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	35	600	0	0	375	805	20	0	350	0	0	0
Future Vol, veh/h	35	600	0	0	375	805	20	0	350	0	0	0
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Free	Free	Free
RT Channelized	-	-	None	-	-	Yield	-	-	None	-	-	None
Storage Length	-	-	-	-	-	0	-	-	300	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	-	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	3	3	3	2	2	2	3	3	3
Mvmt Flow	39	667	0	0	417	894	22	0	389	0	0	0

Major/Minor	Major1			Major2			Minor1		
Conflicting Flow All	427	0	-	-	-	0	1171	1171	677
Stage 1	-	-	-	-	-	-	744	744	-
Stage 2	-	-	-	-	-	-	427	427	-
Critical Hdwy	4.12	-	-	-	-	-	6.42	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	5.42	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.42	5.52	-
Follow-up Hdwy	2.218	-	-	-	-	-	3.518	4.018	3.318
Pot Cap-1 Maneuver	1132	-	0	0	-	-	213	193	453
Stage 1	-	-	0	0	-	-	470	421	-
Stage 2	-	-	0	0	-	-	658	585	-
Platoon blocked, %		-			-	-			
Mov Cap-1 Maneuver	1123	-	-	-	-	-	200	0	449
Mov Cap-2 Maneuver	-	-	-	-	-	-	200	0	-
Stage 1	-	-	-	-	-	-	444	0	-
Stage 2	-	-	-	-	-	-	653	0	-

Approach	SE	NW	NE
HCM Control Delay, s	0.5	0	45.3
HCM LOS			E

Minor Lane/Major Mvmt	NELn1	NELn2	NWT	NWR	SEL	SET
Capacity (veh/h)	200	449	-	-	1123	-
HCM Lane V/C Ratio	0.111	0.866	-	-	0.035	-
HCM Control Delay (s)	25.2	46.4	-	-	8.3	0
HCM Lane LOS	D	E	-	-	A	A
HCM 95th %tile Q(veh)	0.4	8.9	-	-	0.1	-

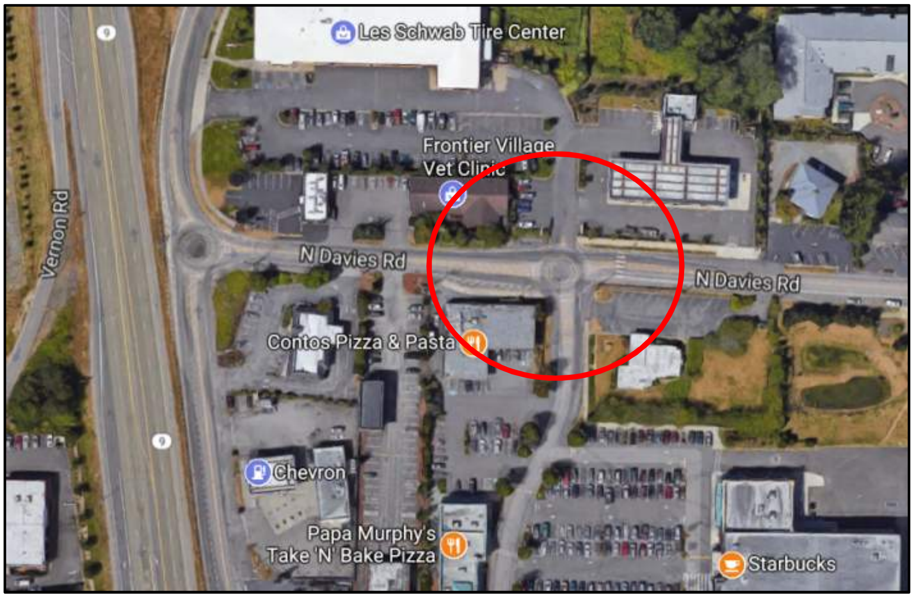
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	0	0	0	560	0	40	0	75	25	325	70	0
Future Volume (vph)	0	0	0	560	0	40	0	75	25	325	70	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					1.00			1.00			1.00	
Frpb, ped/bikes					1.00			0.99			1.00	
Flpb, ped/bikes					0.98			1.00			0.98	
Frt					0.99			0.97			1.00	
Flt Protected					0.96			1.00			0.96	
Satd. Flow (prot)					1582			1637			1573	
Flt Permitted					0.96			1.00			0.69	
Satd. Flow (perm)					1582			1637			1129	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	622	0	44	0	83	28	361	78	0
RTOR Reduction (vph)	0	0	0	0	34	0	0	11	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	632	0	0	100	0	0	439	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	5%	5%	5%
Turn Type				Perm	NA			NA		pm+pt	NA	
Protected Phases					8			6		5	2	
Permitted Phases				8						2		
Actuated Green, G (s)					40.3			31.7			31.7	
Effective Green, g (s)					40.3			31.7			31.7	
Actuated g/C Ratio					0.50			0.40			0.40	
Clearance Time (s)					4.0			4.0			4.0	
Vehicle Extension (s)					3.0			3.0			3.0	
Lane Grp Cap (vph)					796			648			447	
v/s Ratio Prot								0.06				
v/s Ratio Perm					0.40						c0.39	
v/c Ratio					0.79			0.15			0.98	
Uniform Delay, d1					16.4			15.5			23.9	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					5.5			0.5			37.7	
Delay (s)					21.9			16.0			61.5	
Level of Service					C			B			E	
Approach Delay (s)		0.0			21.9			16.0			61.5	
Approach LOS		A			C			B			E	

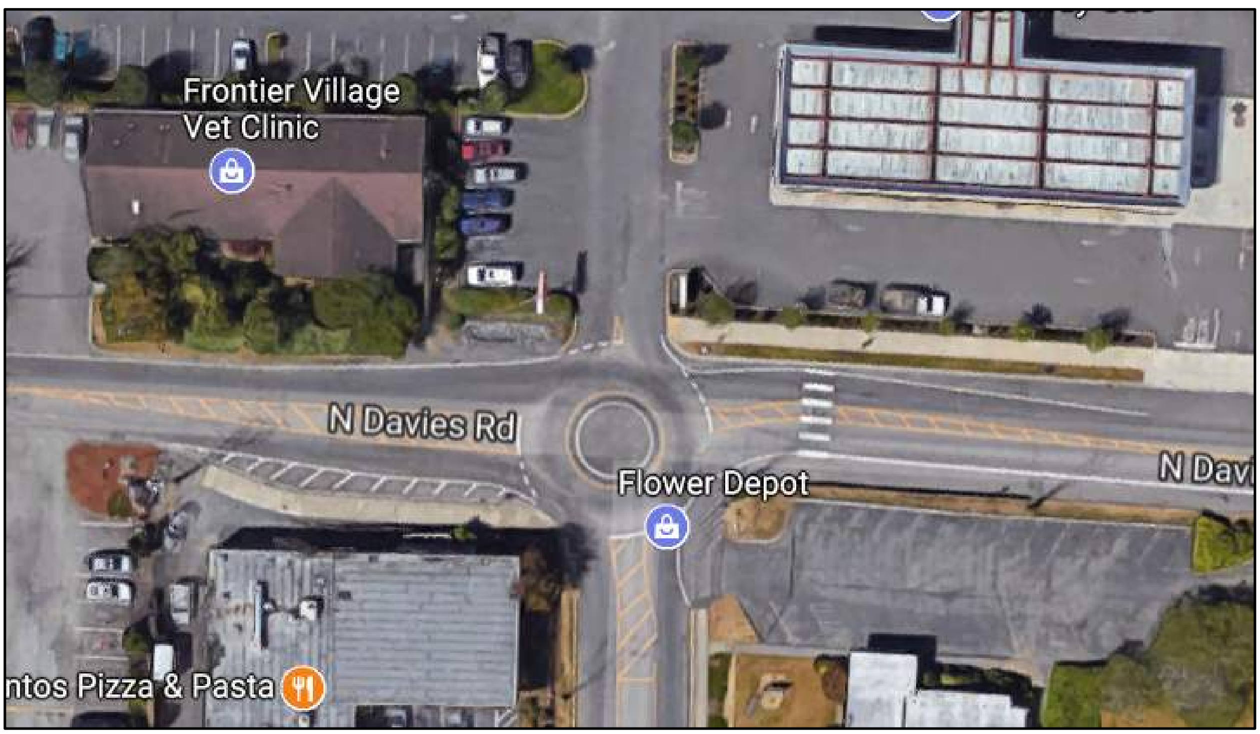
Intersection Summary			
HCM 2000 Control Delay	35.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Appendix C – Mini-Roundabout Example

Lake Stevens, Washington- Davies Road Mini Roundabout

- Diameter: ~ 70 feet
- Center Island: ~ 28 feet
- Approaches: 30 – 45 feet





Appendix D – 2040 Queuing Reports

- Transportation Base Case Financially Constrained Queuing Reports
- Revised Land Use Framework – July 2017 Financially Constrained Queuing Reports
- Transportation Base Case Mitigated Queuing Reports
- Revised Land Use Framework – July 2017 Mitigated Queuing Reports
- Transportation Base Case Interim Solution Queuing Reports
- Revised Land Use Framework – July 2017 Interim Solution Queuing Reports

Transportation Base Case Financially Constrained Queuing Reports

Intersection: 3: Mt Adams Ave & Cascade Ave

Movement	EB	EB	WB	NB	NB
Directions Served	T	R	LT	L	R
Maximum Queue (ft)	744	205	10549	225	8903
Average Queue (ft)	211	65	6441	224	5681
95th Queue (ft)	523	222	11023	225	9391
Link Distance (ft)	764		15917		10342
Upstream Blk Time (%)	0				0
Queuing Penalty (veh)	3				0
Storage Bay Dist (ft)		180		200	
Storage Blk Time (%)	7	0		65	0
Queuing Penalty (veh)	54	1		172	2

Intersection: 18: I-84 EB Ramp & Cascade Ave

Movement	SE	NW	NE
Directions Served	LT	TR	LTR
Maximum Queue (ft)	312	184	876
Average Queue (ft)	98	35	488
95th Queue (ft)	266	121	1055
Link Distance (ft)	295	764	12080
Upstream Blk Time (%)	3		
Queuing Penalty (veh)	18		
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 23: Cascade Ave & I-84 WB Ramp

Movement	WB	SE	NW
Directions Served	LTR	TR	LT
Maximum Queue (ft)	5205	79	109
Average Queue (ft)	3281	10	33
95th Queue (ft)	5616	47	80
Link Distance (ft)	11771	103	295
Upstream Blk Time (%)		0	
Queuing Penalty (veh)		0	
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 4: 2nd Street & I-84 WB Ramp

Movement	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	L	T	T	R
Maximum Queue (ft)	494	304	120	351	1280	90
Average Queue (ft)	242	65	34	201	625	48
95th Queue (ft)	422	210	89	337	1341	120
Link Distance (ft)	5318			346	3535	
Upstream Blk Time (%)				0		
Queuing Penalty (veh)				2		
Storage Bay Dist (ft)		300	100			65
Storage Blk Time (%)	6	0	0	18	44	0
Queuing Penalty (veh)	6	0	0	6	73	2

Intersection: 5: 2nd Street & I-84 EB Ramp

Movement	EB	EB	NB	SB	SB
Directions Served	LT	R	TR	L	T
Maximum Queue (ft)	276	128	911	124	358
Average Queue (ft)	151	35	386	88	269
95th Queue (ft)	255	89	790	146	406
Link Distance (ft)	1942		1985		346
Upstream Blk Time (%)					2
Queuing Penalty (veh)					18
Storage Bay Dist (ft)		325		100	
Storage Blk Time (%)	0	0		10	15
Queuing Penalty (veh)	0	0		84	20

Network Summary

Network wide Queuing Penalty: 213

Revised Land Use Framework – July 2017 Financially Constrained Queuing Reports

Intersection: 3: Mt Adams Ave & Cascade Ave

Movement	EB	EB	WB	NB	NB
Directions Served	T	R	LT	L	R
Maximum Queue (ft)	730	205	9324	225	6894
Average Queue (ft)	308	104	7725	224	4578
95th Queue (ft)	640	272	11296	224	7417
Link Distance (ft)	764		9262		8812
Upstream Blk Time (%)	1		49		0
Queuing Penalty (veh)	7		0		0
Storage Bay Dist (ft)		180		200	
Storage Blk Time (%)	13	0		63	4
Queuing Penalty (veh)	65	2		198	19

Intersection: 18: I-84 EB Ramp & Cascade Ave

Movement	SE	NW	NW	NE
Directions Served	LT	T	R	LTR
Maximum Queue (ft)	142	169	86	680
Average Queue (ft)	21	49	64	338
95th Queue (ft)	84	118	77	753
Link Distance (ft)	295	764		7862
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)			50	
Storage Blk Time (%)		1	8	
Queuing Penalty (veh)		5	29	

Intersection: 23: Cascade Ave & I-84 WB Ramp

Movement	WB	SE	NW
Directions Served	LTR	TR	LT
Maximum Queue (ft)	2131	45	103
Average Queue (ft)	1468	5	28
95th Queue (ft)	2621	25	71
Link Distance (ft)	9688	103	295
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 4: 2nd Street & I-84 WB Ramp

Movement	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	L	T	T	R
Maximum Queue (ft)	542	325	117	354	1336	90
Average Queue (ft)	253	65	39	209	752	40
95th Queue (ft)	493	211	101	343	1831	113
Link Distance (ft)	4040			346	2714	
Upstream Blk Time (%)				0	2	
Queuing Penalty (veh)				2	0	
Storage Bay Dist (ft)		300	100			65
Storage Blk Time (%)	7	0	0	17	47	0
Queuing Penalty (veh)	8	0	0	6	64	1

Intersection: 5: 2nd Street & I-84 EB Ramp

Movement	EB	EB	NB	SB	SB
Directions Served	LT	R	TR	L	T
Maximum Queue (ft)	378	224	576	125	357
Average Queue (ft)	182	49	252	88	261
95th Queue (ft)	333	148	492	147	395
Link Distance (ft)	1942		1985		346
Upstream Blk Time (%)					2
Queuing Penalty (veh)					21
Storage Bay Dist (ft)		325		100	
Storage Blk Time (%)	3	0		8	16
Queuing Penalty (veh)	2	0		69	20

Network Summary

Network wide Queuing Penalty: 194

Transportation Base Case Mitigated Queuing Reports

Intersection: 18: I-84 EB Ramp & Cascade Ave

Movement	SE	SE	SE	NW	NW	NE	NE
Directions Served	L	T	T	T	R	LT	R
Maximum Queue (ft)	166	261	282	216	320	153	280
Average Queue (ft)	99	82	111	54	114	19	131
95th Queue (ft)	167	208	256	141	252	85	229
Link Distance (ft)		290	290	748	748	7548	
Upstream Blk Time (%)		0	0				
Queuing Penalty (veh)		0	1				
Storage Bay Dist (ft)	150						300
Storage Blk Time (%)	4	2					0
Queuing Penalty (veh)	14	1					0

Intersection: 23: Cascade Ave & I-84 WB Ramp

Movement	WB	WB	WB	SE	SE	NW	NW
Directions Served	L	LT	R	T	TR	L	T
Maximum Queue (ft)	274	432	231	86	95	279	108
Average Queue (ft)	168	200	27	26	36	139	31
95th Queue (ft)	268	326	115	62	76	246	82
Link Distance (ft)		8247		99	99	290	290
Upstream Blk Time (%)				0	0	0	
Queuing Penalty (veh)				0	0	1	
Storage Bay Dist (ft)	250		250				
Storage Blk Time (%)	1	2	0				
Queuing Penalty (veh)	3	9	0				

Zone Summary

Zone wide Queuing Penalty: 29

Intersection: 4: 2nd Street & I-84 WB Ramp

Movement	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	L	T	T	R
Maximum Queue (ft)	533	278	125	343	1151	90
Average Queue (ft)	239	62	38	194	505	56
95th Queue (ft)	414	205	98	322	1021	127
Link Distance (ft)	5318			346	3535	
Upstream Blk Time (%)				0		
Queuing Penalty (veh)				1		
Storage Bay Dist (ft)		300	100			65
Storage Blk Time (%)	6	0	0	18	43	0
Queuing Penalty (veh)	6	0	0	6	90	2

Intersection: 5: 2nd Street & I-84 EB Ramp

Movement	EB	EB	NB	SB	SB
Directions Served	LT	R	TR	L	T
Maximum Queue (ft)	277	201	694	125	357
Average Queue (ft)	144	68	298	88	258
95th Queue (ft)	244	147	604	144	395
Link Distance (ft)	1942		1985		346
Upstream Blk Time (%)					2
Queuing Penalty (veh)					18
Storage Bay Dist (ft)		325		100	
Storage Blk Time (%)	0	0		9	16
Queuing Penalty (veh)	0	0		76	20

Network Summary

Network wide Queuing Penalty: 220

Revised Land Use Framework – July 2017 Mitigated Queuing Reports

Intersection: 18: I-84 EB Ramp & Cascade Ave

Movement	SE	SE	SE	NW	NW	NE	NE
Directions Served	L	T	T	T	R	LT	R
Maximum Queue (ft)	172	248	233	218	487	138	247
Average Queue (ft)	101	68	61	47	131	23	116
95th Queue (ft)	173	195	179	151	317	103	206
Link Distance (ft)		290	290	748	748	7548	
Upstream Blk Time (%)		0	0		0		
Queuing Penalty (veh)		0	0		0		
Storage Bay Dist (ft)	150						300
Storage Blk Time (%)	6	1				0	1
Queuing Penalty (veh)	18	0				0	0

Intersection: 23: Cascade Ave & I-84 WB Ramp

Movement	WB	WB	WB	SE	SE	NW	NW
Directions Served	L	LT	R	T	TR	L	T
Maximum Queue (ft)	263	330	120	68	76	261	97
Average Queue (ft)	156	159	19	23	22	128	30
95th Queue (ft)	236	259	75	55	60	230	77
Link Distance (ft)		8247		99	99	290	290
Upstream Blk Time (%)				0	0	0	
Queuing Penalty (veh)				0	0	0	
Storage Bay Dist (ft)	250		250				
Storage Blk Time (%)	1	1	0				
Queuing Penalty (veh)	2	2	0				

Zone Summary

Zone wide Queuing Penalty: 24

Intersection: 4: 2nd Street & I-84 WB Ramp

Movement	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	L	T	T	R
Maximum Queue (ft)	444	253	124	345	1070	90
Average Queue (ft)	222	52	32	194	505	48
95th Queue (ft)	357	164	85	341	1075	121
Link Distance (ft)	5318			346	3535	
Upstream Blk Time (%)				0		
Queuing Penalty (veh)				2		
Storage Bay Dist (ft)		300	100			65
Storage Blk Time (%)	3	0	0	16	42	0
Queuing Penalty (veh)	3	0	0	6	64	2

Intersection: 5: 2nd Street & I-84 EB Ramp

Movement	EB	EB	NB	SB	SB
Directions Served	LT	R	TR	L	T
Maximum Queue (ft)	329	272	800	124	358
Average Queue (ft)	161	94	332	84	269
95th Queue (ft)	295	201	721	140	400
Link Distance (ft)	1942		1985		346
Upstream Blk Time (%)					1
Queuing Penalty (veh)					12
Storage Bay Dist (ft)		325		100	
Storage Blk Time (%)	1	0		8	17
Queuing Penalty (veh)	2	0		70	22

Network Summary

Network wide Queuing Penalty: 182

Transportation Base Case Interim Solution Queuing Reports

Intersection: 3: Mt Adams Ave & Cascade Ave

Movement	EB	EB	WB	WB	NB	NB	NB
Directions Served	T	R	L	T	L	L	R
Maximum Queue (ft)	528	276	418	535	275	573	228
Average Queue (ft)	262	7	234	170	196	260	92
95th Queue (ft)	468	117	394	378	299	494	180
Link Distance (ft)	747	747		10310		6991	6991
Upstream Blk Time (%)		0					
Queuing Penalty (veh)		0					
Storage Bay Dist (ft)			400		250		
Storage Blk Time (%)			2	0	6	11	
Queuing Penalty (veh)			14	0	17	30	

Intersection: 18: I-84 EB Ramp & Cascade Ave

Movement	SE	NW	NW	NE	NE
Directions Served	LT	T	R	LT	R
Maximum Queue (ft)	218	357	256	359	317
Average Queue (ft)	43	98	54	50	157
95th Queue (ft)	150	326	172	212	283
Link Distance (ft)	295	747	747	7559	
Upstream Blk Time (%)	0				
Queuing Penalty (veh)	1				
Storage Bay Dist (ft)					300
Storage Blk Time (%)				0	3
Queuing Penalty (veh)				0	1

Intersection: 23: Cascade Ave & I-84 WB Ramp

Movement	WB	SE	NW
Directions Served	LTR	TR	LT
Maximum Queue (ft)	1192	113	312
Average Queue (ft)	674	56	249
95th Queue (ft)	1302	106	366
Link Distance (ft)	8246	103	295
Upstream Blk Time (%)		2	19
Queuing Penalty (veh)		2	78
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Revised Land Use Framework – July 2017 Interim Solution Queuing Reports

Intersection: 3: Mt Adams Ave & Cascade Ave

Movement	EB	EB	WB	WB	NB	NB	NB
Directions Served	T	R	L	T	L	L	R
Maximum Queue (ft)	627	384	377	404	275	620	346
Average Queue (ft)	306	29	199	162	209	300	130
95th Queue (ft)	556	212	343	322	322	591	260
Link Distance (ft)	747	747		10310		6991	6991
Upstream Blk Time (%)	0	0					
Queuing Penalty (veh)	0	0					
Storage Bay Dist (ft)			400		250		
Storage Blk Time (%)			1	0	10	19	
Queuing Penalty (veh)			7	0	27	50	

Intersection: 18: I-84 EB Ramp & Cascade Ave

Movement	SE	NW	NW	NE	NE
Directions Served	LT	T	R	LT	R
Maximum Queue (ft)	178	416	285	149	283
Average Queue (ft)	30	112	63	28	127
95th Queue (ft)	109	359	200	141	232
Link Distance (ft)	295	747	747	7559	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)					300
Storage Blk Time (%)				0	2
Queuing Penalty (veh)				0	0

Intersection: 23: Cascade Ave & I-84 WB Ramp

Movement	WB	SE	NW
Directions Served	LTR	TR	LT
Maximum Queue (ft)	450	112	314
Average Queue (ft)	234	52	257
95th Queue (ft)	379	98	370
Link Distance (ft)	8246	103	295
Upstream Blk Time (%)		1	23
Queuing Penalty (veh)		1	91
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Process for Potential Road Cross-Section Modifications

of Historic Columbia River Highway within the City of Hood River

September 11, 2017

City of Hood River community members expressed interest in a roundabout at the intersection of Cascade Avenue and Mt. Adams as part of the Westside Area Concept Plan. The 2011 City of Hood Transportation System Plan includes a traditional signalized intersection at Cascade Avenue and Mt. Adams and an approved road cross-section for Cascade Avenue.[1] To understand the benefits of a roundabout versus a signalized intersection, DKS conducted an analysis of the two alternatives based on specific factors.[2] These factors included cost, operations, safety, and environmental considerations. DKS concluded that both solutions would work operationally, and the roundabout would be safer due to slower travel speeds but considerably more expensive than a signalized intersection.[3] The DKS analysis did not include an assessment of the impacts of a roundabout to the historic values of the Historic Columbia River Highway[4].

ODOT, in coordination with the State Historic Preservation Office and the Historic Columbia River Highway Advisory Committee will conduct an assessment of the impacts of a potential roundabout on the Historic Highway District if support for the roundabout continues through the Westside Area Concept Plan adoption and if Hood River anticipates using federal funds to construct a roundabout [5]. To clarify that this is a potential future City of Hood River action, the recommended TSP amendments include a future historic assessment should the roundabout be the city's selected alternative. The city will conduct an impact assessment to the Historic Highway District consistent with the "Programmatic Agreement Regarding the Historic Columbia River Highway as it Passes Through the City of Hood River, Hood River County Oregon[6]."

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1 See City of Hood River Transportation System Plan, Figure 6a http://www.oregon.gov/LCD/TGM/TGMProducts/1D-11.pdf

2 DKS Technical Memo 8, Hood River Westside Area Concept Plan – Task 6.4 Second Transportation Analysis with Updated Assumptions dated August 9, 2017

3 The City of Hood River is responsible for the cost of the intersection improvements despite the alternative chosen based the current intersection improvement agreement.

4 The "Programmatic Agreement Regarding the Historic Columbia River Highway as it Passes Through the City of Hood River, Hood River County Oregon" (Misc. Contracts and Agreements No. 19942) requires determination of impacts of actions or programs on the Historic District. Agencies party to the "Programmatic Agreement" include: City of Hood River, County of Hood River, ODOT, SHPO and FHWA.

5 The HCRC Historic District is defined in the "Programmatic Agreement" as the "curb to curb" area or "existing highway pavement" where there are no curbs.

6 ODOT is not obligated to cover the cost of the historic impact assessment.

Kate Brown., Governor

Department of Transportation
Region 1 Headquarters
123 NW Flanders Street
Portland, Oregon 97209
(503) 731.8200
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July 6, 2017

MEMORANDUM

To: Steve Wheeler, Cindy Wallbridge, Kevin Liburdy, City of Hood River

From: Gail Curtis, Senior Planner, ODOT

Subject: Westside Area Concept Plan TPR compliance at time of comprehensive plan amendment

The purpose of this memo is to identify the Transportation Planning Rule (TPR) provision that will enable compliance with the TPR at the time of adoption of the Westside Area Concept Plan.

The TPR allows that a local government may request a "reasonably likely [funding]" letter from ODOT in situations where a land use amendment will have a significant effect on the state transportation system. The letter indicates that the needed improvements will be provided by the end of the planning period, which is 2040 in this case.

To exercise this TPR provision, I recommend that the city establish an understanding with ODOT regarding the "reasonably likely" funding for Exit 62 improvements. Based on that understanding the city should submit a formal request for ODOT to provide a "reasonably likely [funding]" letter in advance of the adoption process.

Explanation of TPR Provision:

> <u>TPR test</u>: If an amendment to a functional plan, an acknowledged comprehensive plan, or a land use regulation (including a zoning map) would significantly affect an existing or planned transportation facility, then the local government must mitigate that effect as provided in the TPR 660-012-0060(1).
>
> One of the TPR mitigation options, from **660-012-0060(4)(c),** applies when there is an Interchange Area Management Plan (IAMP). In this case, it has been determined that the Westside Area Concept Plan would have a significant effect on the I-84 interchange at Exit 62 which has an adopted IAMP. In accordance with this provision, the City may rely on the improvements identified in the IAMP and the City of Hood River TSP <u>if</u> ODOT provides a "reasonably likely" letter stating that improvements needed to mitigate the effect are reasonably likely to be in place by the end of the planning period.

Further, ODOT's understanding is that the other TSP transportation needs associated with the Westside Area Concept Plan will be addressed through development, redevelopment, funds the city has or is able to obtain, or, possibly, county funds. This includes investments on Cascade Avenue.

Attachment: TPR 660-012-0060

ATTACHMENT

660-012-0060

Plan and Land Use Regulation Amendments

(1) If an amendment to a functional plan, an acknowledged comprehensive plan, or a land use regulation (including a zoning map) would significantly affect an existing or planned transportation facility, then the local government must put in place measures as provided in section (2) of this rule, unless the amendment is allowed under section (3), (9) or (10) of this rule. A plan or land use regulation amendment significantly affects a transportation facility if it would:

(a) Change the functional classification of an existing or planned transportation facility (exclusive of correction of map errors in an adopted plan);

(b) Change standards implementing a functional classification system; or

(c) Result in any of the effects listed in paragraphs (A) through (C) of this subsection based on projected conditions measured at the end of the planning period identified in the adopted TSP. As part of evaluating projected conditions, the amount of traffic projected to be generated within the area of the amendment may be reduced if the amendment includes an enforceable, ongoing requirement that would demonstrably limit traffic generation, including, but not limited to, transportation demand management. This reduction may diminish or completely eliminate the significant effect of the amendment.

(A) Types or levels of travel or access that are inconsistent with the functional classification of an existing or planned transportation facility;

(B) Degrade the performance of an existing or planned transportation facility such that it would not meet the performance standards identified in the TSP or comprehensive plan; or

(C) Degrade the performance of an existing or planned transportation facility that is otherwise projected to not meet the performance standards identified in the TSP or comprehensive plan.

(2) If a local government determines that there would be a significant effect, then the local government must ensure that allowed land uses are consistent with the identified function, capacity, and performance standards of the facility measured at the end of the planning period identified in the adopted TSP through one or a combination of the remedies listed in (a) through (e) below, unless the amendment meets the balancing test in subsection (2)(e) of this section or qualifies for partial mitigation in section (11) of this rule. A local government using subsection (2)(e), section (3), section (10) or section (11) to approve an amendment recognizes that additional motor vehicle traffic congestion may result and that other facility providers would not be expected to provide additional capacity for motor vehicles in response to this congestion.

(a) Adopting measures that demonstrate allowed land uses are consistent with the planned function, capacity, and performance standards of the transportation facility.

(b) Amending the TSP or comprehensive plan to provide transportation facilities, improvements or services adequate to support the proposed land uses consistent with the requirements of this division; such amendments shall include a funding plan or mechanism consistent with section (4) or include an amendment to the transportation finance plan so that the facility, improvement, or service will be provided by the end of the planning period.

(c) Amending the TSP to modify the planned function, capacity or performance standards of the transportation facility.

(d) Providing other measures as a condition of development or through a development agreement or similar funding method, including, but not limited to, transportation system management measures or minor transportation improvements. Local governments shall, as part of the amendment, specify when measures or improvements provided pursuant to this subsection will be provided.

(e) Providing improvements that would benefit modes other than the significantly affected mode, improvements to facilities other than the significantly affected facility, or improvements at other locations, if:

(A) The provider of the significantly affected facility provides a written statement that the system-wide benefits are sufficient to balance the significant effect, even though the improvements would not result in consistency for all performance standards;

(B) The providers of facilities being improved at other locations provide written statements of approval; and

(C) The local jurisdictions where facilities are being improved provide written statements of approval.

(3) Notwithstanding sections (1) and (2) of this rule, a local government may approve an amendment that would significantly affect an existing transportation facility without assuring that the allowed land uses are consistent with the function, capacity and performance standards of the facility where:

(a) In the absence of the amendment, planned transportation facilities, improvements and services as set forth in section (4) of this rule would not be adequate to achieve consistency with the identified function, capacity or performance standard for that facility by the end of the planning period identified in the adopted TSP;

(b) Development resulting from the amendment will, at a minimum, mitigate the impacts of the amendment in a manner that avoids further degradation to the performance of the facility by the time of the development through one or a combination of transportation improvements or measures;

(c) The amendment does not involve property located in an interchange area as defined in paragraph (4)(d)(C); and

(d) For affected state highways, ODOT provides a written statement that the proposed funding and timing for the identified mitigation improvements or measures are, at a minimum, sufficient to avoid further degradation to the performance of the affected state highway. However, if a local government provides the appropriate ODOT regional office with written notice of a proposed amendment in a manner that provides ODOT reasonable opportunity to submit a written statement into the record of the local government proceeding, and ODOT does not provide a written statement, then the local government may proceed with applying subsections (a) through (c) of this section.

(4) Determinations under sections (1)–(3) of this rule shall be coordinated with affected transportation facility and service providers and other affected local governments.

(a) In determining whether an amendment has a significant effect on an existing or planned transportation facility under subsection (1)(c) of this rule, local governments shall rely on existing transportation facilities and services and on the planned transportation facilities, improvements and services set forth in subsections (b) and (c) below.

(b) Outside of interstate interchange areas, the following are considered planned facilities, improvements and services:

(A) Transportation facilities, improvements or services that are funded for construction or implementation in the Statewide Transportation Improvement Program or a locally or regionally adopted transportation improvement program or capital improvement plan or program of a transportation service provider.

(B) Transportation facilities, improvements or services that are authorized in a local transportation system plan and for which a funding plan or mechanism is in place or approved. These include, but are not limited to, transportation facilities, improvements or services for which: transportation systems development charge revenues are being collected; a local improvement district or reimbursement district has been established or will be established prior to development; a development agreement has been adopted; or conditions of approval to fund the improvement have been adopted.

(C) Transportation facilities, improvements or services in a metropolitan planning organization (MPO) area that are part of the area's federally-approved, financially constrained regional transportation system plan.

(D) Improvements to state highways that are included as planned improvements in a regional or local transportation system plan or comprehensive plan when ODOT provides a written statement that the improvements are reasonably likely to be provided by the end of the planning period.

(E) Improvements to regional and local roads, streets or other transportation facilities or services that are included as planned improvements in a regional or local transportation system plan or comprehensive plan when the local government(s) or transportation service provider(s) responsible for the facility, improvement or service provides a written statement that the facility, improvement or service is reasonably likely to be provided by the end of the planning period.

(c) Within interstate interchange areas, the improvements included in (b)(A)–(C) are considered planned facilities, improvements and services, except where:

(A) ODOT provides a written statement that the proposed funding and timing of mitigation measures are sufficient to avoid a significant adverse impact on the Interstate Highway system, then local governments may also rely on the improvements identified in paragraphs (b)(D) and (E) of this section; or

(B) There is an adopted interchange area management plan, then local governments may also rely on the improvements identified in that plan and which are also identified in paragraphs (b)(D) and (E) of this section.

(d) As used in this section and section (3):

(A) Planned interchange means new interchanges and relocation of existing interchanges that are authorized in an adopted transportation system plan or comprehensive plan;

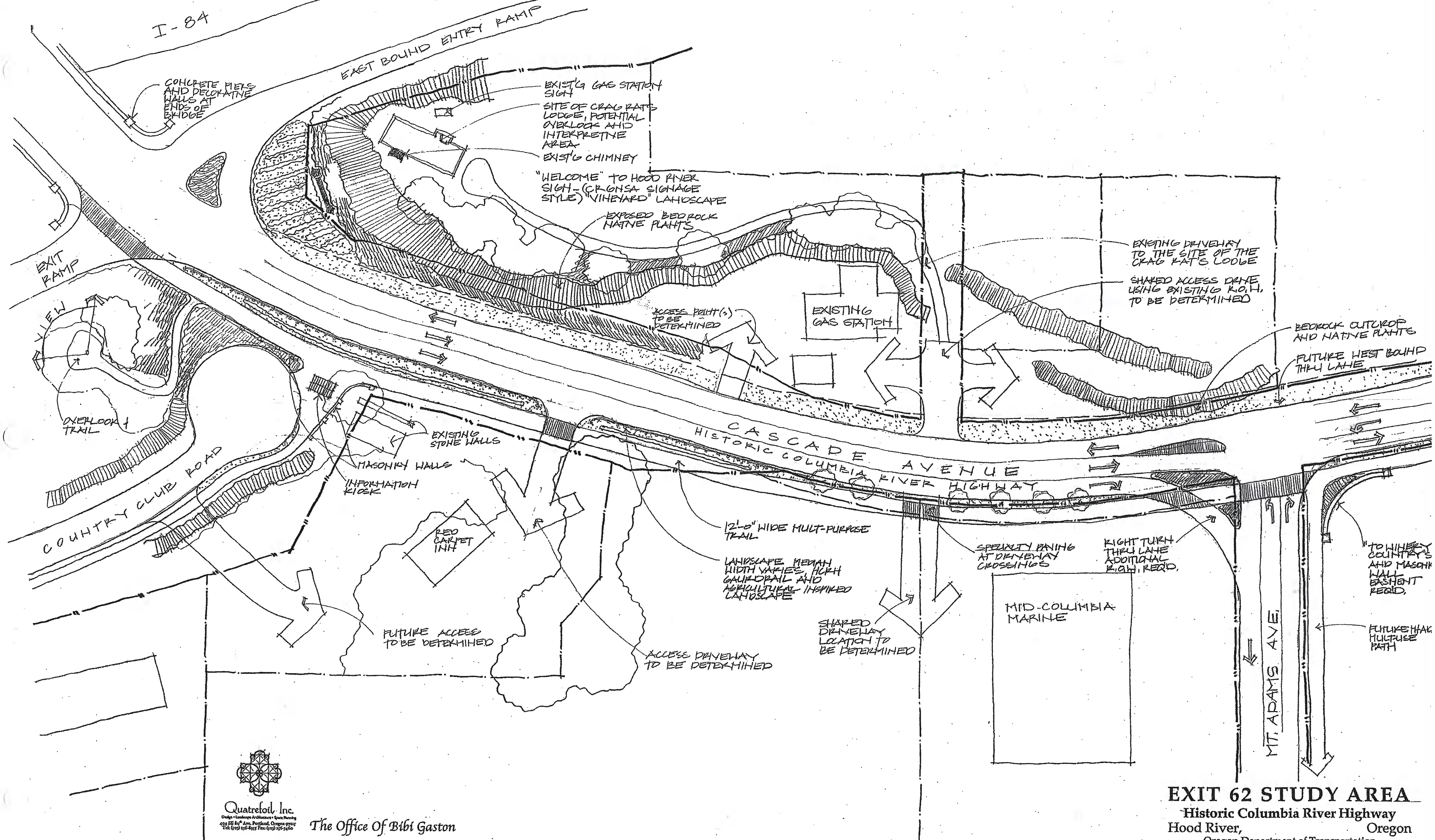
(B) Interstate highway means Interstates 5, 82, 84, 105, 205 and 405; and

(C) Interstate interchange area means:

(i) Property within one-quarter mile of the ramp terminal intersection of an existing or planned interchange on an Interstate Highway; or

(ii) The interchange area as defined in the Interchange Area Management Plan adopted as an amendment to the Oregon Highway Plan.

(e) For purposes of this section, a written statement provided pursuant to paragraphs (b)(D), (b)(E) or (c)(A) provided by ODOT, a local government or transportation facility provider, as appropriate, shall be conclusive in determining whether a transportation facility, improvement or service is a planned transportation facility, improvement or service. In the absence of a written statement, a local government can only rely upon planned transportation facilities, improvements and services identified in paragraphs (b)(A)–(C) to determine whether there is a significant effect that requires application of the remedies in section (2).



EXIT 62 STUDY AREA

Historic Columbia River Highway

Hood River, Oregon

Oregon Department of Transportation

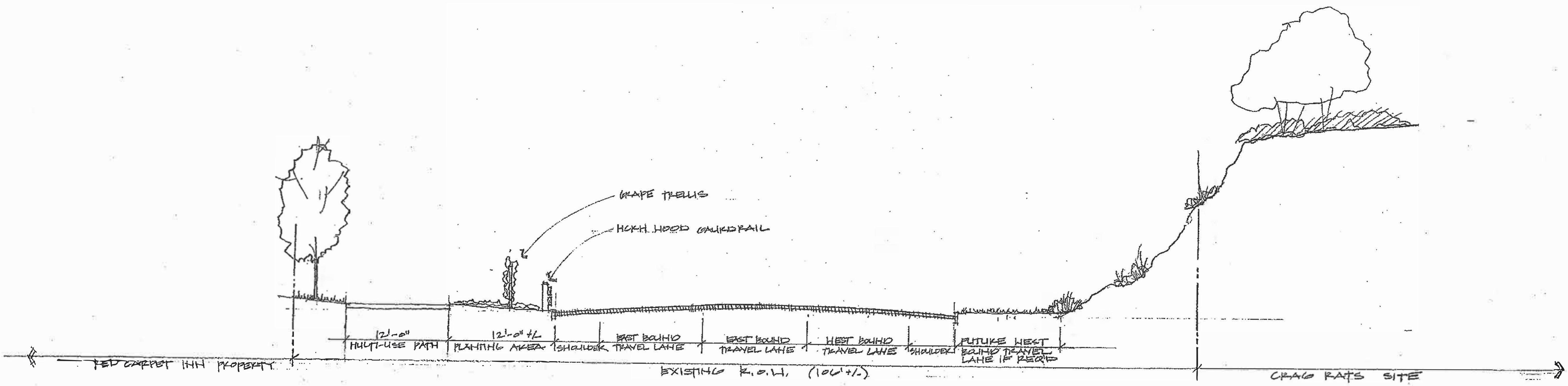
Concept Plan 'Alt A'

Scale 1" = 30' – 0"

3.22.10

SK.1

29



ROAD SECTION - DESIGN ALTERNATE 'A'
SCALE: 3/16"=1'-0"

Quatrefoil, Inc.

The Office Of Bibi Gaston

EXIT 62 STUDY AREA

Historic Columbia River Highway

Hood River, Oregon

Oregon Department of Transportation

3.22.10

Road Cross Sections

31

SK3

**NOTE: Intersection treatment alternatives will be evaluated if certain cost and minimizing impact thresholds are feasible.

HOOD RIVER
WESTSIDE AREA
Concept Plan

GATEWAY OPTION A

2010 Quatrefoil Study

APRIL 2017

**NOTE: Intersection treatment alternatives will be evaluated if certain cost and minimizing impact thresholds are feasible.

HOOD RIVER WESTSIDE AREA Concept Plan

GATEWAY OPTION B

roundabout with HCRH wall

APRIL 2017

DAVID EVANS AND ASSOCIATES INC.

PROJECT MEMORANDUM

DATE:	June 15, 2017
FROM:	Steven Harrison, PE – David Evans and Associates, Inc.
TO:	City of Hood River TAC
SUBJECT:	**Water System Evaluation – Summary Findings and Planning Level Cost Estimates**
PROJECT:	**Hood River Westside Area Concept Plan**
DEA PROJECT NO:	APGI0000-0005

This memo provides a summary to support the evaluation of the preferred alternative for the Westside Area Concept Plan including estimated water system demands and estimated waterline capacity and associated costs. This memo is related to the future water system infrastructure needs within the Concept Plan boundary. Information was gathered from the City of Hood River (City) to identify their near term plans to provide adequate water system capacity to serve the study area.

Evaluation Assumptions

The water system expansion into the Westside Area Concept Plan area will be based on the largest single point demand in the area. The largest single point water demand is fire service flow. Although providing domestic and irrigation services to the area is essential, the water system expansion will be developed to provide sufficient fire flow while maintaining a minimum water pressure.

Our evaluation did not include smaller diameter service lines (6-inches and smaller) to private land development projects, however, we did include the larger main lines (8-inches and larger) that are necessary to serve the larger area.

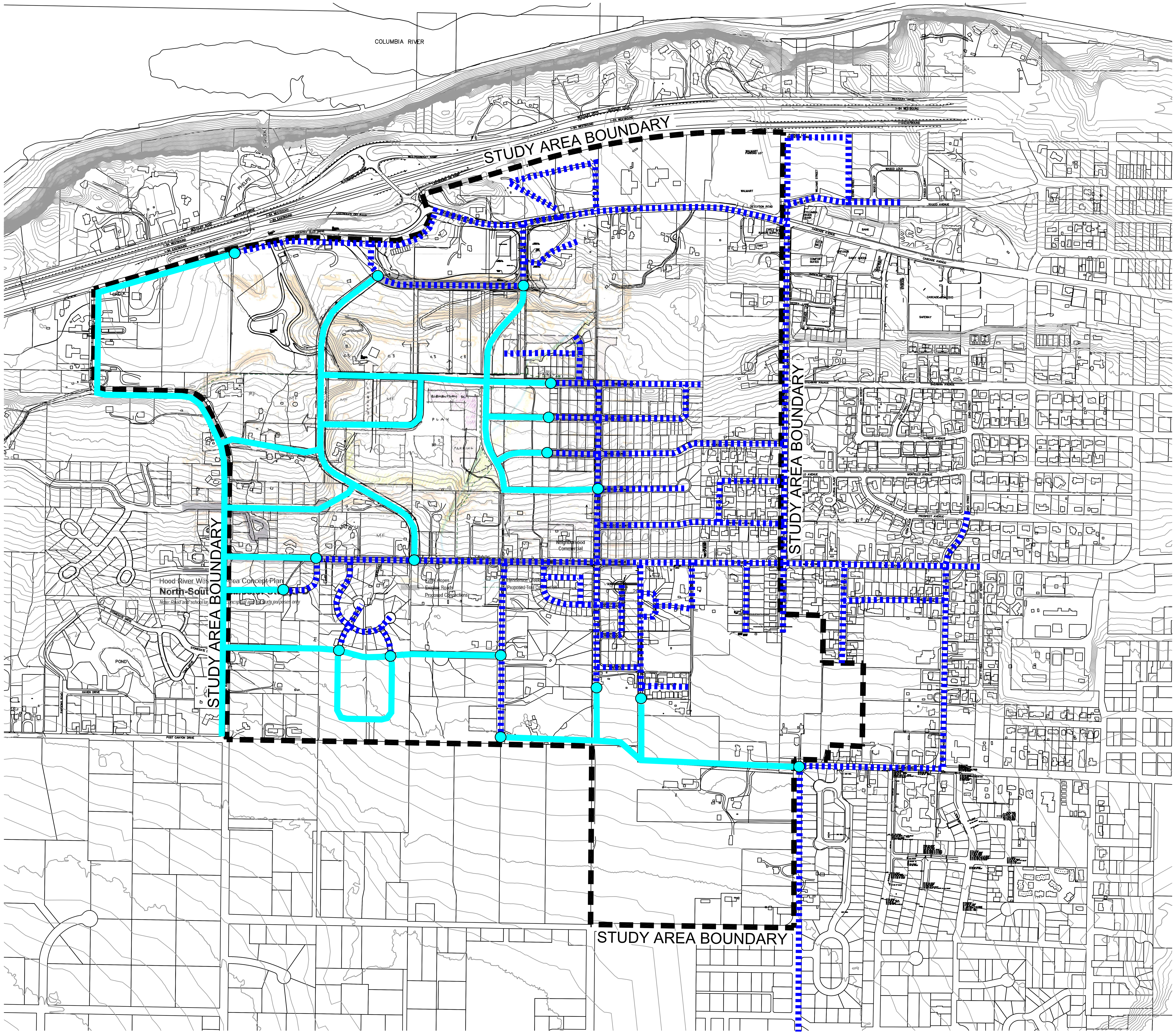
The unit cost for the water system is on a per linear foot basis and, in addition to raw pipe material, includes a 20% increase for miscellaneous items such as utility relocation, abandoning of existing facilities, etc.; 15% increase for general contractor profit and overhead; 25% increase for engineering and administration; and a 30% increase for general contingency. Based on our previous experience, we estimate the unit costs to be as follows:

Water System Unit Costs	
Ductile Iron Pipe Diameter (inches)	Unit Cost ($/LF)
8	270
10	291

Concept Plan Description

Water System Infrastructure Improvements

Westside Concept Plan				
Description	Pipe Diameter	Total Length (ft)	Unit Cost ($/LF)	SubTotal
Belmont Dr. West Ext to Rocky Rd	10	2,180	291	$634,400
29th St. Extension South	8	420	270	$113,400
30th St. Extension South	8	400	270	$108,000
Blackberry Dr. from Rocky Rd. to Frankton Rd	10	1,940	291	$564,600
Vista Loo connection to Blackberry Dr.	8	1,150	270	$310,500
May Dr. Extension to Frankton Rd	8	650	270	$175,500
Elan Dr. Extension to Frankton Rd	8	420	270	$113,400
Frankton Rd South Extension from Blackberry Dr.	8	650	270	$175,500
Frankton Rd - May St. to Blackberry Dr.	8	650	270	$175,500
Frankton Rd – May St. to Country Club	8	2,650	270	$715,500
Country Club Rd Extension to Frankton	8	1,180	270	$318,600
New North-South Arterial (Alignment D) – Wine Country Rd. to May St.	8	2,680	270	$723,600
East-West Connection from Align D to Frankton Rd	8	720	270	$194,400
Prospect Av from Align D to Frankton Rd	8	980	270	$264,600
Adams Extension North to 30th St.	8	2,230	270	$602,100
Sherman Extension West to Align D	8	1,680	270	$453,600
High School from Sherman to Align D	8	950	270	$256,500
Hazel Extension West to Adams	8	470	270	$126,900
Eugene Extension West to Adams	8	450	270	$121,500
			Total:	**$6,148,100**



LEGEND

- POINT OF CONNECTION
- STUDY AREA BOUNDARY
- EXISTING WATERLINE
- FUTURE WATERLINE

0 100 200 400

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PROJECT
HOOD RIVER WESTSIDE CONCEPT PLAN
HOOD RIVER, OREGON

SHEET TITLE
WATER SYSTEM ANALYSIS

NO.	DATE	REVISION	BY

SCALE:
DATE: 5-31-2017
DRN.
CK.

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JOB NO. APGI0000-0005

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DAVID EVANS AND ASSOCIATES INC.

PROJECT MEMORANDUM

DATE:	June 15, 2017 (revised December 7, 2017)
FROM:	Steven Harrison, PE – David Evans and Associates, Inc.
TO:	City of Hood River TAC
SUBJECT:	**Sanitary Sewer Evaluation – Summary Findings and Planning Level Cost Estimates**
PROJECT:	**Hood River Westside Area Concept Plan**
DEA PROJECT NO:	APGI0000-0005

This memo provides information to support the evaluation of the Westside Area Concept Plan. This memo is related to the sanitary sewer infrastructure needs within the study area. Information was gathered from the City of Hood River to identify their near and term plans to provide adequate sanitary sewer capacity to serve the study area and to verify our cost assumptions.

Evaluation Assumptions

The preferred plan depicts three different conceptual land use zones; R-2A, R-3 and Commercial/Industrial. The average daily sanitary sewer flows from each of these land uses are given below:

Land Use Zone	Average Daily Sanitary Sewer Flow (gallons/day/unit)	Average Daily Sanitary Sewer Flow (gallons/day/employee)
R-2A	360	
R-3	295	
Commercial/Industrial		45.8

Because sanitary sewer flows fluctuate throughout the day, the peak hourly design flow rate is obtained by multiplying the average daily rate by a peaking factor. Based on the anticipated population of the study area, the peaking factor can range from 1.8 to 5.5. A larger population requires a smaller peaking factor. Given that the Westside Area Concept Plan study area is relatively small (adding between 1,579 and 1,713 housing units), we used a peaking factor of 4.0.

We assumed the minimum pipe size would be 8-inches in diameter. The slopes will vary; however, we assume a minimum slope of 0.5%. The unit cost for the sanitary sewer system is on a per linear foot basis and includes manholes at 200-foot intervals and service laterals at 50-foot intervals. The unit costs also include miscellaneous items such as utility relocation, abandoning of existing facilities, etc.;

15% increase for general contractor profit and overhead; 25% increase for engineering and administration; and a 30% increase for general contingency.

Gravity Sanitary Sewer Unit Costs	
PVC Pipe Diameter (inches)	Unit Cost ($/LF)
8	365

Concept Plan Description

Gravity Sanitary Sewer Infrastructure Improvements

Westside Concept Plan				
Description	Pipe Diameter	Total Length (ft)	Unit Cost ($/LF)	SubTotal
Connection to Belmont Dr	8	1,100	365	$401,500
Connection to 29th St	8	400	365	$146,000
Connection to 30th St	8	1,360	365	$496,400
Rocky Rd Connection	8	1,800	365	$657,000
Vista Loop Connection to Blackberry	8	810	365	$295,700
Vista Loop Connection to Kesia Ct.	8	600	365	$219,000
Blackberry Dr. – East to Vista Loop	8	730	365	$266,500
East-West Connection to Frankton Rd	8	650	365	$237,300
New North-South (Alignment D) – Wine Country to May Dr.	8	2,650	365	$967,300
May Dr Connection to Align D (East to West and West to East)	8	400	365	$146,000
Sherman Rd Connection to Align D (East to West and West to East)	8	1,900	365	$693,500

High School to Align D	8	650	365	$237,300
Frankton Road to Align D (West to East)	8	1,400	365	$511,000
Adams Extension North from Cascade Av	8	2,190	365	$799,400
Prospect Av Extension East of Adams	8	630	365	$230,000
Montello Av Extension (East to West and West to East)	8	1,230	365	$449,000
Eugene Av Extension to Adams	8	350	365	$127,800
Hazel West Connection	8	380	365	$138,700
Sherman West Connection	8	400	365	$146,000
Sherman Connection to Adams	8	750	365	$273,800
			Total:	$7,439,200

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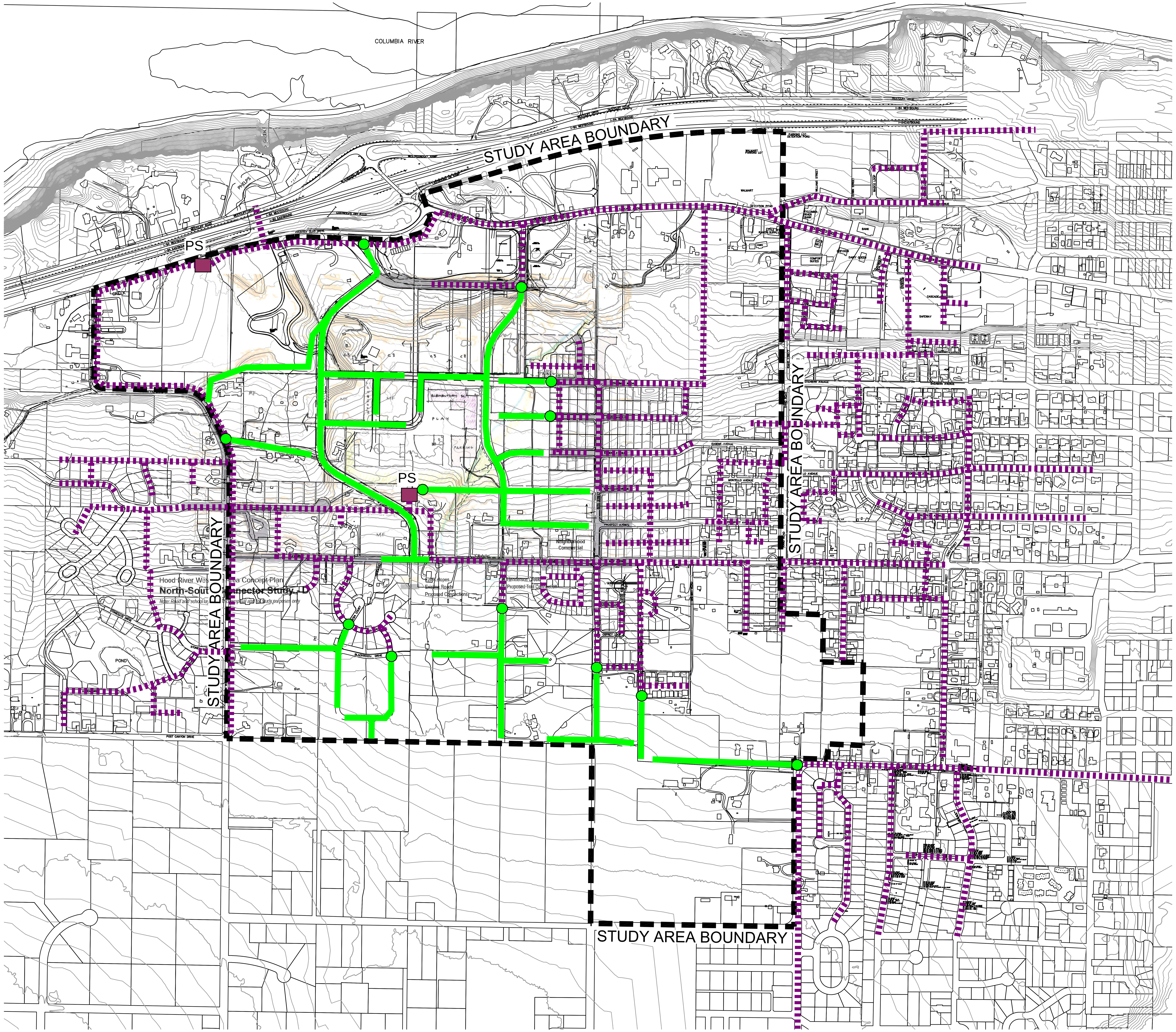

LEGEND

- POINT OF CONNECTION
- STUDY AREA BOUNDARY
- PS EXISTING PUMP STATION
- EXISTING SANITARY SEWER LINE
- FUTURE SANITARY SEWER LINE

0 100 200 400

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PROJECT
HOOD RIVER WESTSIDE CONCEPT PLAN
HOOD RIVER, OREGON

SHEET TITLE
SANITARY SEWER ANALYSIS

NO.	DATE	REVISION	BY

SCALE:
DATE: 5-31-2017
DRN.
CK.

SS1
JOB NO. APGI0000-0005

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DAVID EVANS AND ASSOCIATES INC.

PROJECT MEMORANDUM

DATE:	June 15, 2017
FROM:	Steven Harrison, PE – David Evans and Associates, Inc.
TO:	City of Hood River TAC
SUBJECT:	**Stormwater System Evaluation – Summary Findings and Planning Level Cost Estimates**
PROJECT:	**Hood River Westside Area Concept Plan**
DEA PROJECT NO:	APGI0000-0005

Introduction

This technical memorandum provides an overview of stormwater management systems for the future growth of the Westside Area Concept Plan. The level of analysis was conceptual and intended to plan for sufficient service and capacity of storm water facilities to support the Concept Plan. Planning level costs are provided. This memo also comments on Low Impact Development concepts for use in the project area. The City is updating its Storm Water Master Plan concurrent with the analysis, so all recommendations are preliminary and subject to change.

The City of Hood River constructs, operates, and maintains the public storm drainage system to meet public needs and to comply with current City of Hood River water quality regulations. The City of Hood River (City) maintains open and closed conveyance facilities (i.e., ditches or streams, and storm sewers, etc.) within the study area. The City will own and maintain new systems when constructed within the study area.

Basis of Development of the Stormwater System Components

The primary approach for meeting stormwater management goals will be enforcing stormwater quality and quantity code requirements. The water quantity code requires new developments construct and maintain facilities to limit stormwater runoff to the pre-developed rates for all storm events. Therefore, individual properties are required to construct and maintain on-site detention facilities to limit runoff flows to the public storm system.

Developers are encouraged to use Low Impact Development Approaches (LIDA) for storm water management. LIDA facilities mimic the natural environment resulting from storm water infiltration to protect natural resources. At both the site and regional level, LIDA practices aim to preserve, restore and create green spaces using soils, vegetation, and storm water collection techniques. These facilities preserve and create natural vegetated landscape features and minimize impervious areas to create functional and appealing storm water management amenities. LIDA facilities treat storm water as a resource rather than a waste product.

There are several LIDA practices that are appropriate to the Hood River climate.

- Impervious surfaces can be minimized by promoting shared driveways, reducing the building footprint, or by using pervious pavers or porous pavement. Porous pavement may be either concrete or asphalt.

- Retain native vegetation and trees on undeveloped sites and restore vegetation as much as possible. Vegetation captures, infiltrates, and evaporates storm water runoff.
- Preserve well-draining native soil. Apply compost to restore the health of soil disturbed by construction. Healthy soils store and infiltrate storm water and produce healthy plants that require less water.
- Manage the storm water where it falls by installing small scale vegetated bioretention cells. Bioretention cells are shallow landscaped areas composed of soil and plants to maximize infiltration at many locations throughout the site development. Biofiltration swales are also used to maximize infiltration, but are also used for conveyance.
- Install vegetated or “Green” roofs. Green roofs maximize evaporation and provide a slower release of runoff. There are also studies that show improved building energy efficiency and extended roof life.

By implementing LIDA practices, storm water can be managed in a way that reduces the impact of the built environment and promotes the natural movement of water within the watershed. At a broader scale, LIDA principles can maintain or restore a watershed’s hydrologic and ecological functions.

See Figures 1-6 below for images of implemented LIDA facilities.

Figure 1 – Green Roof Photo 1

Figure 2 – Green Roof Photo 2

Figure 3 – Bio Retention Cell Photo 1

Figure 4 – Bio Retention Cell Photo 2

Figure 5 – Pervious Paver Photo

Figure 6 – Porous Concrete Pavement Photo

Basic Assumptions

The planning area includes areas that are very steep and have narrow stream catchments.

Individual developments are required to detain stormwater runoff to the pre-developed condition. Therefore, the runoff from each site was evaluated at the pre-developed condition, however, anticipating that on-site storm water detention may not always be possible for every development, the pipes were sized to 70% of capacity. The remaining 30% pipe capacity will be available as necessary for developments that cannot meet the detention requirement. For each pipe segment, the upstream area was estimated as combinations of whole or partial geographic basins and the contribution areas proportioned accordingly.

Future pipe sizes were developed using the 10-year, 24-hour storm event, which is 3.3 inches of precipitation. Pipes slopes were estimated based on existing topography.

Table1 – Impervious Area Assumptions

Development Type	Gross Imperviousness (Area-wide) (percent)
Commercial/Industrial	85%
Multi-Family Neighborhood (R3)	70%
Compact Neighborhood (R2A)	60%
Mixed-Use Neighborhood	60%-75%
High School	35%
Park	10%

Table2 – Storm Drain Pipe Unit Cost Assumptions

Pipe Diameter	Estimated Unit Cost ($/LF)
12-inch	$328
15-inch	$368
18-inch	$395
21-inch	$445
24-inch	$566
36-inch	$693

Stormwater Detention and Conveyance

There are two (2) existing creeks located within the Concept Plan Area; Phelps Creek and Henderson Creek. In an effort to mimic the natural environment, these creeks should be utilized for storm water conveyance as much as practical. However, if the creek capacities are exceeded, flooding to adjacent properties will occur. This is not only applicable to the creek stream banks, but also to the culvert crossing capacities.

One way to keep creek flow within their capacities is to make connections to future storm drain pipes within the future roadways. The points of connection will be dependent on the future development of the properties and the associated roadway/storm line alignments.

Another way to maintain the creek capacities is to construct storm water detention facilities. Strategically sized and located, these detention facilities would be able to absorb the high runoff rates associated to higher intensity storm events. The runoff volume would be stored in these detention facilities and slowly released to prevent downstream flooding.

There have been two (2) areas identified within the Concept Plan Area as having had observed flooding. One area is located northwest of the Eugene Avenue/Rand Street intersection. The issue appears to be associated to an existing culvert. This problem flooding had been identified in the 2001 Hood River Capital Facilities Plan and had been planned for remediation under project number C8-H.

The second area is located at the intersection of May Avenue and Ordway Street. This is also an issue with an existing culvert. And, has also been identified in the 2001 Capitals Facilities Plan and planned for remediation under project number C8-G.

The 2001 Capital Facilities Plan did not identify when these remediation projects would be constructed. The City is currently updating its Storm Water Master Plan. It is anticipated that these and other problem flooding areas will be addressed.

Stormwater System Infrastructure Improvements

We evaluated a total of five (5) hydrologic basins (A-E). Basin A is located at the southeast corner of the study area. It includes the area north and west of Belmont Drive; and areas west of the extended 27th Street. Basin A connects to the existing City system at approximately May Avenue/25th Avenue intersection.

Basin B includes areas south of May Avenue at approximately 30th Street. There are also areas between 30th Street and Adams Avenue extension. There are multiple points of connection for Basin B into the existing storm line located in 30th Street.

Basin C includes areas between the extended Adams Blvd and the new Alignment D roadway. It also includes approximately half of the high school site. The mainline of this basin is located within the Adams Blvd roadway. The main point of connection is just north of Cascade Avenue.

Basin D is the remaining area between the new Alignment D and Adams Avenue. It also includes the southwest corner of the study area. The mainline of this basin is located in Alignment D roadway. The point of connection is north of Country Club Drive at Wine Country Road.

Basin E includes the western-most portion of the study area, north and east of Frankton Road. The mainline of this basin is located in Frankton Road. And, the main point of connection is north of Country Club Road.

The proposed future storm drain system includes storm drain pipes ranging from 12-inches to 36-inches in diameter. These storm drain lines will be located within the public right-of-way of the future roadways and/or public storm drain easements.

Table 3 – Westside Concept Plan – Stormwater Basin A

Description	**Diameter (inches)**	**Length (feet)**	**Unit Cost ($/LF)**	**Total Cost ($)**
West Extension from Belmont	12	400	$328	$ 131,200
	18	600	$395	$ 237,000
Rand Rd. South Ext from May Ave	18	1,500	$395	$ 592,500
May Extension West from Rand Rd	12	680	$328	$ 223,100
May Extension West from POC	36	430	$693	$ 298,000
			Total:	$1,481,800

Table 4 – Westside Concept Plan – Stormwater Basin B

Description	**Diameter (inches)**	**Length (feet)**	**Unit Cost ($/LF)**	**Total Cost ($)**
30TH Street Extension South	15	1,000	$368	$ 368,000
May Ave Extension East from 30th St (CIP C8-G)	18	600	$395	$ 237,000
Hazel South Ext West from 30th St	12	730	$328	$ 239,500
Sherman Extension West from 30th St	12	700	$328	$ 229,600
Cascade Ave Extension West to POC	15	200	$368	$ 73,600
	18	300	$395	$ 118,500
	21	450	$445	$ 200,300
			Total:	$ 1,366,500

Table 5 – Westside Concept Plan – Stormwater Basin C

Description	Diameter (inches)	Length (feet)	Unit Cost ($/LF)	Total Cost ($)
Rocky Rd Extension South to Study Boundary	15	1,300	$368	$ 478,400
May Dr Extension East from Rocky Rd	12	600	$328	$ 196,800
Prospect Ext West to Adams Ave	12	600	$328	$ 196,800
Montello Ave Ext West to Adams Ave	12	600	$328	$ 196,800
Eugene Ave Ext West to Adams Ave	12	730	$328	$ 239,500
Sherman Extension East to Adams Ave	12	450	$328	$ 147,600
Wine Country Ext East to Adams Ave	15	550	$368	$ 202,400
Adams Ave Ext from May Ave to Cascade Ave	15	700	$368	$ 257,600
	18	1,300	$395	$ 513,500
	24	450	$566	$ 254,700
Cascade Ave Ext West to POC	24	700	$566	$ 396,200
			Total:	$ 3,080,300

Table 6 – Westside Concept Plan – Stormwater Basin D

Description	Diameter (inches)	Length (feet)	Unit Cost ($/LF)	Total Cost ($)
May Ext East from Align D	12	570	$328	$ 187,000
May Ext West from Align D	15	300	$368	$ 110,400
Extension East from Stonegate Dr	12	600	$328	$ 196,800
Extension North to May Ave	12	650	$328	$ 213,200
May Ext East from Frankton	15	600	$368	$ 220,800
May Ext West from Nina Ln	12	350	$328	$ 114,800
W Prospect Ave Ext East	12	300	$328	$ 98,400
	15	300	$368	$ 110,400
North Ext from May to Align D	15	650	$368	$ 239,200
Hazel Ext to Align D	12	600	$328	$ 196,800
Sherman Ext West to Align D	12	600	$328	$ 196,800
Align D Ext from May to POC	15	870	$368	$ 320,200
	18	820	$395	$ 323,900
	24	1,250	$566	$ 707,500
			Total:	$ 3,236,200

Table 7 – Westside Concept Plan – Stormwater Basin E

Description	Diameter (inches)	Length (feet)	Unit Cost ($/LF)	Total Cost ($)
West Ext to Frankton Rd	15	500	$368	$ 184,000
Frankton Ext to the North	15	700	$368	$ 257,600
North Ext from Frankton to Country Club Rd/POC	18	950	$395	$ 375,300
			Total:	$ 816,900

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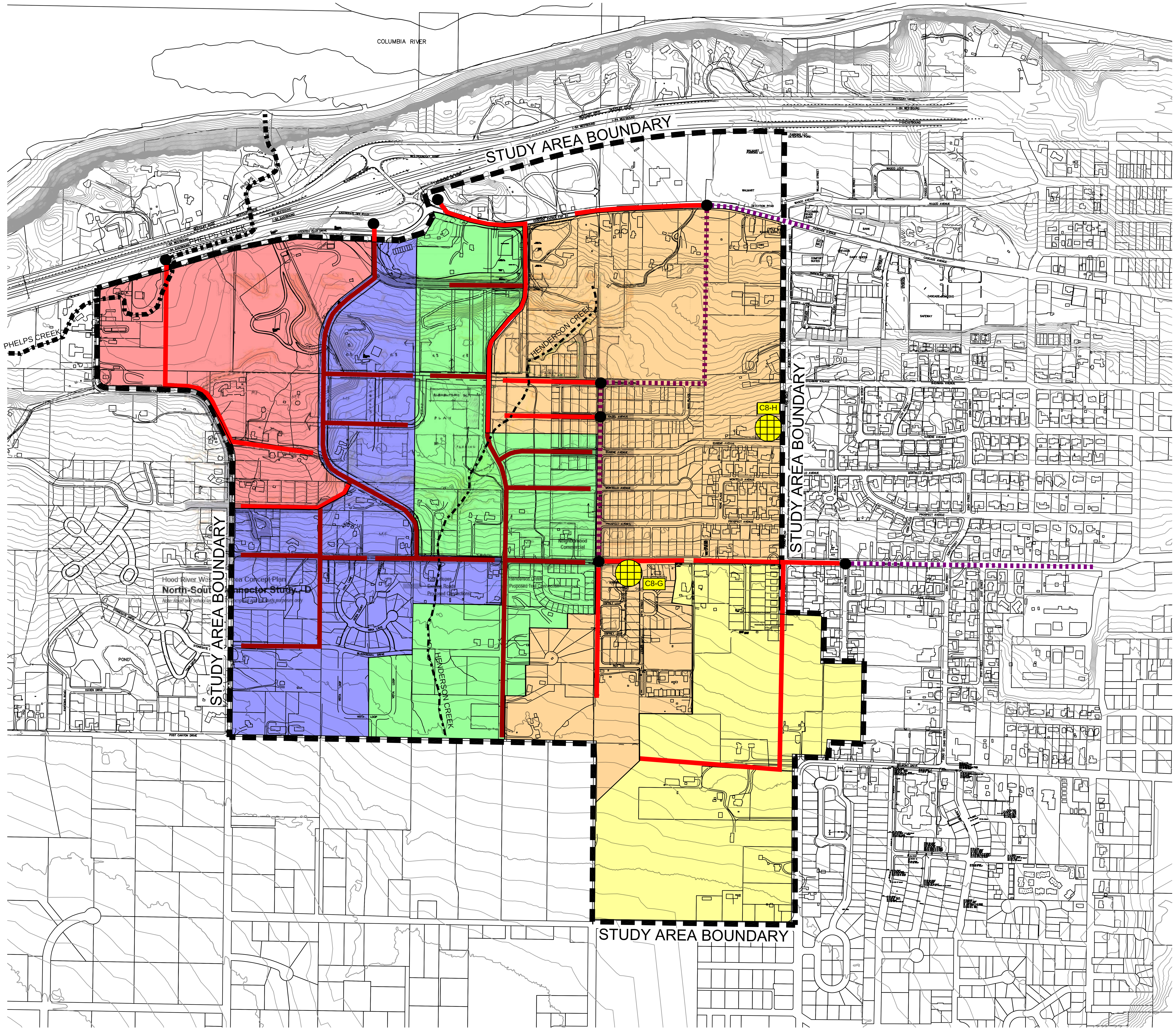

LEGEND

- POINT OF CONNECTION
- STUDY AREA BOUNDARY
- BASIN A
- BASIN B
- BASIN C
- BASIN D
- BASIN E
- EXISTING STORM DRAIN LINE
- FUTURE STORM DRAIN LINE
- EXISTING CREEK
- PROBLEM FLOODING AREA OBSERVED
- C8-H IDENTIFIED CAPITAL IMPROVEMENT PROJECT

0 100 200 400

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PROJECT
HOOD RIVER WESTSIDE CONCEPT PLAN
HOOD RIVER, OREGON

SHEET TITLE
STORM DRAINAGE ANALYSIS

NO.	DATE	REVISION	BY

SCALE:
DATE: 5-31-2017
DRN.
CK.

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JOB NO. APGI0000-0005

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DATE: December 20, 2017
TO: Joe Dills, Angelo Planning Group
FROM: ECONorthwest
SUBJECT: TECHNICAL MEMO 6.1: FUNDING REVIEW AND FUNDING TOOLKIT

ECONorthwest (ECO) is part of a consulting team led by Angelo Planning Group (APG) that is proposing and evaluating land use concepts for Hood River's Westside Area. This memorandum documents: (1) the estimated infrastructure funding costs and revenues for water, sanitary sewer, storm water, transportation and parks; (2) the existing and potential funding tools and programs that could be used to fund those potential funding gaps and implement the Draft Westside Area Concept Plan.

This memorandum is an updated version of the Technical Memorandum 6 (TM6). The project management team and technical advisory team reviewed TM6, which described potential funding sources and system development charge revenue estimates. This was provided as a first informational memo, prior to the availability of infrastructure cost estimates. This memorandum updates TM6 with updated revenue estimates, infrastructure costs, comparison of costs and revenues, cost sharing ideas and specific tools for future consideration. The infrastructure costs were determined through the larger Westside Area Concept Plan process, the details of which are documented in separate memoranda from the team's engineering and planning partners.

Organization and Approach

This memorandum has the following sections:

- **Systems development charge revenue estimates.** Systems development charges (SDCs), fees imposed on new development, are the main revenue source currently available to fund infrastructure in the City of Hood River. As such, we begin with an estimate of the revenues that would be generated from new Westside Area development, and a description of methodology and assumptions underlying those estimates.
- **Funding gap analysis and funding strategies.** This section compares SDC revenues to expected infrastructure costs to estimate whether funding gaps exist for each type of infrastructure, and describes an approach to filling those gaps (as needed) with supplemental revenue sources. ECONorthwest led a funding workshop and subsequent phone meetings with City staff to verify the information and strategies contained in this memo.
- **Impact of development charges / fees on housing affordability.** Housing affordability is a key concern for the City of Hood River. This section describes the relationship between potential increases in development charges and housing affordability. The analysis described in this technical memorandum reflects the City's desire to provide both market-rate and subsidized workforce and affordable housing choices and

discusses the potential impact that any new fees, or changes in fees, assessed on new development will have on new housing prices.

Appendices provide detailed cost estimates and a description of each of the possible funding sources.

This technical memorandum is about *funding;* it identifies funding sources and tools, compares them to costs, and identifies gaps where they exist. While the terms "funding" and "financing" are often used interchangeably, there is an important distinction between the two concepts. Providing infrastructure costs money, and somebody has to pay those costs. The ultimate source of revenue for these costs is *funding*. Funding comes from households and businesses that pay taxes and fees, non-profit contributors, or others that give at various levels to build and maintain the infrastructure. When the funds for the infrastructure costs are borrowed and paid back over time, then these costs have been *financed*. Financing plans are typically undertaken at the transition from planning to implementation of a specific piece of infrastructure (for example, a specific interchange or road network improvement), include cash flow analysis that details ability to repay debt over time with specific assumptions about borrowing capacity, interest rates, and other financing terms accounted for.

Westside Area SDC Revenue Estimates

System development charges (SDCs) are one-time impact fees assessed on new development for various types of infrastructure. They are intended to fund the increased capital costs incurred by a municipality or utility resulting from the infrastructure or other needs associated with new development.

ECONorthwest received estimates of new development in the study area over the planning period from APG. The estimates included number of new single family attached units, single family detached units, and multifamily dwellings (including duplex and 3+ units). APG assumed ten units per non-duplex multifamily building. Using this information, ECONorthwest estimated SDC revenue. We assume current SDC rates for all land uses. Because specific timing of development over the 20-year period is not forecasted, we estimate potential revenue at full-build out in the first year. This approach is a methodological necessity; in reality, development and infrastructure projects will be built over time and SDCs rates may increase. ECONorthwest communicated with City and County staff to verify SDC rates and understand how SDC rates are applied in the study area.

The City of Hood River currently charges four citywide SDCs: water, wastewater, stormwater, and transportation. Additionally, the City collects the Parks and Recreation SDC on behalf of the Parks and Recreation district. Key assumptions about each SDC are below:

- **Water.** SDC is charged per water meter. City staff verified current rates. City staff provided ECONorthwest the following assumptions:
    - Single family units: 0.75" water meter per unit
    - Multifamily units: 1.5" water meter per building

- Schools: two 3″ water meters per middle school
- Commercial/Industrial connections: 1″ or larger[1]

▪ **Wastewater.** SDC is charged per water meter. City staff verified current rates. Assumptions are the same as for the water SDC.

▪ **Stormwater.** The SDC is charged per equivalent residential unit (ERU). Commercial/industrial properties are charged per square foot of impervious area. This was calculated using APG's estimates of net developable land (accounting for environmental constraints and existing right of way) multiplied by the ratio of existing net impervious area to parcel size for commercial and industrial development in the City of Hood River. City staff verified current SDC rates.[2]

▪ **Transportation.** SDC is charged per unit. City staff verified current rates. ECONorthwest assumes:

- Single family detached units: charged single family rate per unit
- Multifamily units: charged multifamily rate per unit
- Retail: charged specialty retail center rate
- Office: charged general office rate
- Flex/Business: 50% charged general office rate, 50% charged light industrial rate
- Government/other: charged government office rate
- Warehouse: charged warehouse rate
- General industrial: charged light industrial rate
- School: charged middle school rate per student

▪ **Parks and Recreation.** SDC is charged per unit. Parks and Recreation staff verified current rates. Parks and Recreation staff provided the following ECONorthwest assumptions:

- Single family units: charged single family rate per unit
- Multifamily units: charged multifamily rate per unit

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[1] In order to determine what share of water connections larger than 1-inch the City of Hood River used 2011 data of the percentage of apartments in terms of all non-house connections (18.2%). This share was then used to estimate the number of apartment connections that could be assumed to be associated with the non-house connection numbers. Using this method, the City determined there were 113 apartments included in the total non-house connections. Subtracting the apartments from the total Commercial/Industrial connections (229) yielded a new total of 116 Commercial/Industrial connections not including apartments. The ratio of Commercial/Industrial accounts with 1-inch or larger meters as compared to single-family residential accounts is 3.3%.

[2] City staff confirmed one ERU is equal to one single-family unit and one multifamily building. The charge per SF of impervious area for commercial and industrial has not increased for FYE 2018 at the time of publishing this memo.

In coordination with City, County, and project staff, ECONorthwest used the following assumptions:

- The study area boundary is completely within the Hood River Urban Growth Boundary. However, part of the study area is outside of the current City limits. ECONorthwest discussed timing of annexation with City and County staff, who agreed that ECONorthwest should assume properties will be annexed at the time of development, and therefore will pay all City SDCs.[3,4]
- In most cases, development does not occur at the maximum amount of zoned capacity. To account for this and ensure that assumptions are not an over estimate, ECONorthwest assumes that development will achieve 80% of the housing estimates prepared for the Concept Plan. The Concept Plan's estimates are consistent with assumptions in the City's Housing Needs Analysis.

Exhibit 1 summarizes SDC revenue generated over the study period in the study area for each infrastructure type. Total SDC revenue totals almost $12.9 million. For a detailed breakdown of SDC revenue by infrastructure type, see Appendix A. This total revenue estimate compares to $9.56 million[5] that is estimated for the base zoning that exists today.

Exhibit 1. SDC Revenue (2017$), Westside Area

City SDCs	
Water	$3,182,629
Wastewater	$1,431,486
Stormwater	$941,112
Transportation	$3,408,317
Total	$8,963,544
Parks and Recreation SDC	$3,901,134
Total SDC Revenue	$12,864,678

Source: Angelo Planning Group, City of Hood River, Hood River Parks and Recreation. Calculated by ECONorthwest.

Funding Gap Analysis and Funding Strategies

This section compares estimated infrastructure costs to revenues to determine whether there is a potential funding gap for each type of infrastructure. The gap analysis is followed by a discussion of possible ways to address the funding shortage. Long range concept plans, such as is being done for the Westside Area, very commonly identify funding gaps for their total area-wide infrastructure, particularly transportation facilities. The reasons for this include: prior

[3] There is a future 20-unit subdivision in the southeastern portion of the study area that will not pay City Water SDCs if constructed because it will be served by the Ice Fountain Water District (IFWD). In addition, the City is processing an annexation application for a nearby parcel that is likely to result in an 18-unit PUD that will be served by IFWD and will not pay City Water SDCs.

[4] Some properties in the western portion of the study area are part of the Frankton Sewer LID and are not contiguous to the city limits, and may only pay the City Sewer SDC upon development (ranging from 67 to 149 units depending on scenario) if annexation is not feasible.

[5] See "Technical Memo 6: Funding Review and Funding Toolkit", page 4, ECONorthwest, February 3, 2017

master plan documents are old with out of date cost estimates; previous funding analysis was citywide or was not conducted at all; revenue sources such as SDCs have not been updated to reflect rising costs; and, new standards, best practices and community ideas add projects and costs. Transportation facilities are particularly expensive projects, often comprising 60-70% of an area's total infrastructure investment, and rarely are fully covered by known revenue sources.

Exhibit 2 provides a comparison of costs and revenues for each type of infrastructure. Its columns show the following for each infrastructure type:

- Column A: Total project costs (see details in Appendix B)
- Column B: Infrastructure costs attributable to Westside Area development. Column A with the following netted out:
    - Portions of projects that are intended to improve a city-wide infrastructure system rather than to support added development capacity in the Westside Area.
    - Portion of costs funded by developers or other non-City sources
- Column C: Portion of Column B that is or should be funded by SDCs
- Column D: SDC Revenue that is generated by development in the Westside Area
- Column E: The funding gap, which compares the assumptions stated

Exhibit 2. Summary: Total Westside Area Infrastructure Cost-Revenue Comparison

	A. Total Cost	B. Cost attributable to Westside	C. Portion of Westside Costs (B) that are SDC-funded	D. Westside SDC Revenue	E. SDC funding gap (C minus D)
Water	$6,148,100	$1,599,993	$1,599,993	$3,182,629	$0
Stormwater	$9,096,300	$2,334,875	$2,334,875	$941,112	$1,393,763
Sewer	$7,074,200	$536,040	$536,040	$1,431,486	$0
Parks	$5.6M to $7.5M***	$5.6M to $7.5M***	$5.6M to $7.5M***	$3,901,134	$1.7M to $3.6M
Transportation	$59,240,000	$16,534,750**	$5.2M to $6.7M*	$3,408,317	$1.8M to $3.3M**
Total	**$92.5M - $94.4M**	**$24.1M to $26.0M**	**$15.2M to $18.7M**	**$12.9M**	**$4.9M to $8.3M**

*See section on transportation for detail regarding assumptions

**The share of costs for projects MV2a and MV2b have not been allocated across the Westside, County, and City, and are therefore not included in the Westside costs or funding gap calculation.

***See section on parks for detail regarding assumptions

Source: APG, DEA, DKS, City of Hood River, Hood River Parks and Recreation. Calculated by ECONorthwest.
Note: 2017 dollars

It is important to note that a "gap" is an estimated numerical difference, based on assumptions. This analysis is a first-ever analysis of costs and revenues for Westside Area projects. Typically, the City approaches funding from a city-wide perspective. What costs and what revenues are attributable to the Westside Area, and therefore what "gap" there is solely reflective of the assumptions stated.

Water, Wastewater, and Stormwater

The City expects developers to fund most of the projects identified in the project cost list. As a result, for water and wastewater, that there will be no funding gap given that developers will absorb the costs for most of these improvements. Therefore, no additional revenue will be needed to fund those projects. Depending on the application of SDC credits in exchange for the provision of infrastructure, which will play out over time as development occurs, the Westside Area may be a net contributor to the City SDC pool in the categories of water and wastewater. The true accounting plays out over time and cannot be determined until the assessment of SDC credits is complete at the individual project level, but this analysis indicates the Westside Area is likely to be have a net positive impact on the city-wide SDC pool.

For stormwater, there is an estimated gap of $1.39 million, about 15% of total costs. A "base case" of existing stormwater costs does not exist, so it unknown how this gap compares existing conditions. The City is currently updating its Storm Water Management Plan and should assess the adequacy of city-wide stormwater SDCs to cover city-wide costs during or after that process.

Parks

The Westside Area Concept Plan assumes that 10.7 acres of parks will be needed to meet the desired the level of service standard. Land acquisition cost is assumed to be $350,000 per acre;[6] the cost of park improvement is assumed at $4-8 per square foot.[7] These assumptions are preliminary, and more detailed design, engineering, and pricing analysis would be needed to understand the cost of providing parks in the Westside Area. Exhibit 3 provides a comparison of costs and revenues.

Exhibit 3. Neighborhood Parks Cost-Revenue Comparison

Improvement Cost	$1,864,368 - $3,728,736
Land Cost	$3,745,000
Total:	**$5,609,368 - $7,473,736**
SDC Revenue	**$3,901,134**
Gap	**$1,706,234 - $3,572,602**

Source: Angelo Planning Group, City of Hood River, Hood River Parks and Recreation. Calculated by ECONorthwest.
Note: All cost and revenue estimates are presented in 2017 dollars.

This is a first cut at parks planning that will require additional analysis. Unlike other types of infrastructure, the location of parks are unknown. However, given this analysis, it is likely that the City will need funds beyond current SDCs to support the parks vision for the Westside Area. As with stormwater, it is unknown how this cost-revenue picture compares to a base case, because there is no parks plan that exists for the Westside today. The City and Parks and Recreation district should consider the following options:

[6] ECONorthwest arrived at the price estimate of $350,000 per acre by surveying properties currently listed for sale, as well as looking at land sales that had occurred within the past two years to determine a likely average price for undeveloped land within the study area.

[7] Assumption provided by APG, based on review of parks costs in Wilsonville and Washington County, built to a relatively high standard. The $4/sq foot end of the range represents a more modest improvement standard. The estimate will need to be updated as more is known about park location, amenity, and other variables.

- Consider applying parks SDCs to commercial and industrial uses as well as residential uses. This would require finding a nexus between development of commercial and industrial uses and the need for park development, given that employees use parks.
- Seek land donations or exaction from developers. A parkland dedication could reduce the City's expenditures on land, but may affect overall Parks SDC revenues due to the issuance of SDC waivers in exchange for dedicated land.
- Seek financial management strategies that reduce or phase in costs. For example, seek opportunities to acquire park land earlier, and hold it for later park development and new housing units are constructed. Given the increase in land costs, this approach could keep costs down.
- Lower costs per acre for improvements. Estimates in this memorandum are preliminary, and may be higher than actual costs for development in Hood River, especially as more is known about the types of park amenity that will best serve the community.
- Increase parks SDCs. Note that this will increase the burden on developers to fund parks, and should be considered in concert with an assessment of impact on development feasibility.
- Grants from the State or Oregon or other sources
- Reduce level of service requirement. A reassessment of the amount of developed parks acreage required per person in Hood River may help lower the City's land and improvement costs.

Transportation

For all infrastructure including transportation, Hood River's SDC collection and allocation system functions City-wide. Revenues from development in Westside Area flow to a City-wide pool, which is allocated to projects across the City regardless of where the revenues were generated. The City intends to treat Westside Area project costs and revenues in the same way. However, as is the case in almost all newly developing areas and cities, transportation is the most expensive and the most underfunded segment of infrastructure, and the City's revenue pool already falls short of City-wide transportation needs. For this reason, it is important to the City to understand Westside Area contributions to the SDC revenue pool relative to the costs required to accommodate Westside Area growth.

Before this concept plan process commenced, the City had already identified a set of transportation projects in the Westside Area that were underfunded relative to available systems development charges. To address overall SDC shortfalls relative to City-wide transportation funding needs, the City has identified a set of projects called "financially constrained" projects and adopted them in the Hood River Transportation System Plan[8]. These are priority projects necessary for adequate system function and to meet requirements of Oregon's Transportation Planning Rule (TPR, OAR 660-12). The Concept Plan's transportation

[8] The financially constrained list is also used in the City's Transportation SDC methodology.

analysis has verified the need for these projects and identified the need for one additional project: as signal or mini-roundabout at the Rand-27th-May intersection. A key new project within the existing TSP, the "Mt Adams Extension" has shifted to the west and is now known as "Alignment D". In addition, the transportation analysis has identified a much needed interim improvement to Exit 62 (a $5 million project), which Hood River's current TSP recognizes as needing a full interchange upgrade (a $27 million project). Based on this analysis, ODOT has stated it will commit to funding the $5 million interim improvements within the planning period (by 2040). ODOT's funding commitment is conditioned on the City adopting "reasonably likely" funding measures and policies for Westside Area's transportation facilities.[9]

In that context, our approach to evaluating the funding gap in transportation used the following steps:

1. Inventory transportation projects in two categories: streets and pedestrian bicycle facilities. In the TSP, streets are called Motor Vehicle facilities (identified with project names beginning with "MV") and are "complete streets" in that they include sidewalks and, where needed, bike paths.
2. Estimate total costs for projects that are located in the Westside Area, by individual transportation project. DKS completed this work, and identified $11.7 million for streets and $2.3 million for pedestrian-bicycle facilities.[10]
3. For each project, determine the portion of total project cost that is attributable to Westside Area development. This is the portion of project cost that is rightly compared to SDC revenues that are generated in the Westside Area to estimate a gap. To do this, for each project based on input from with DKS, APG, and City staff, we identified: (1) whether the project is currently on or should be considered for the City's financially constrained list in the future; (2) whether it is or should be SDC eligible and at what percentage; and (3) what portion of the project's costs should be shared by other sources (ODOT, the County, or broader City-wide SDCs or other funding sources). These assumptions are provided in detail in Appendix B. Depending on which financially constrained scenario the City opts to use as the model for cost estimates, the range of costs for Westside Area transportation projects that are SDC eligible is $5.2 million to $6.7 million[11].
4. Based on a comparison of available SDC revenue generated in the Westside Area to the result of the steps described above, estimate the **SDC funding gap** for financially constrained Westside Area projects, as well as the total funding gap. Our strategies focus on filling the gap for financially constrained projects, as these are the projects that are most critical to the system and to allowing new Westside Area development to occur.

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[9] As of the writing of this memo, the specifics of ODOTs and the City's obligations are under discussion.

[10] DKS Consulting, see Appendix B. This work is preliminary and subject to change.

[11] The financially constrained project costs are preliminary and require additional review. They were determined by developing two development scenarios. A full explanation of all the projects included in each scenario is included in Appendix B.

Given the estimated SDC funds of approximately $3.4 million, the remaining SDC funding gap range is $1.8 million to $3.3 million. If all SDC revenues were used for streets, the SDC funding gap for streets would be $1.6 million to $3.1 million.

The City allocates SDC revenues as part of a City-wide process that evaluates the need for financially constrained projects and projects needed to meet TPR requirements. Given that this analysis focuses on only Westside Area SDC revenues and transportation projects, this analysis provides incomplete information for the City to make decisions. Finding additional revenues will be a challenge, and will require additional analysis, decision-making, and public process. Based on conversations and analysis to date, the following strategies are likely the best starting places for the City to consider as the gap is clarified. Further, the tools are likely to be used in combination:

- Increase Citywide SDC rates. Many of the Westside Area projects benefit the entire City, and development of Westside Area also benefits the City through increasing tax base.
- Apply a sole source SDC in the Westside. Sole source SDCs are charged inside of a particular geographic area and are used to fund investments in that area only (as opposed to the City-wide allocation system currently used). The City of Hood River has not used sole-source SDCs in the past. A rough estimate of the SDC increase that would be needed in the Westside Area to fill the gap is about $1,200.[12] A sole source SDC should be discussed with stakeholders, compared to a City-wide approach, and considered in combination with other potential strategies.
- Local improvement district, reimbursement district, or other kinds of public private partnership. This category of tools generally leverage private funding sources for infrastructure investments. There are a range of creative possibilities in this category that can be explored. They generally work best when a developer or property owner would be highly motivated to construct a particular segment of infrastructure, for example, when one segment of infrastructure serves a large development parcel or parcels, and that infrastructure is necessary to allow development to occur. Alignment D from Wine County Road to Sherman may be one example of this situation.[13]
    - Local improvement districts (LIDs) are special assessment districts in which property owners are assessed a fee to pay for capital improvements, such as streetscape enhancements, underground utilities, or shared open space. LIDs must be supported by a majority of affected property owners. LIDs spread the costs of infrastructure over a number of properties, and are usually levied over time. In some cases, municipalities may choose to borrow against that revenue stream to create up-front funding sources.

[12] To estimate this, we began with the estimate of the portion of SDC revenue that comes from residential development: roughly 60%. We therefore divided 60% of transportation SDC funding gap by the number of units anticipated in the Westside Area for this order-of-magnitude estimate.

[13] Cost estimates included in the Appendix in detail already show a substantial developer investment in this particular project. Total cost burden to the developer would need to be considered.

- o Developer-build approaches. Developers can generally build infrastructure to a lower cost than the public sector. Partnerships with developers can leverage existing public funding sources to bring in additional private funds and lower costs. The City has experience with these types of mechanisms in the past, specifically to fund Mt. Adams and Wine Country Road investment. The City used a pool of public money from ODOT and the City to fund the road, but the developer designed and constructed the road to City standards. The developer agreed to use his own money to fill any funding gaps beyond the pool of resources available to him from the City and ODOT. This approach reduced costs and brought additional private dollars to the project. Reimbursement districts also fall into this category, allowing developers to construct the infrastructure in exchange for reimbursements through SDC credits or other funding sources.

- Financial management approach. While this approach does not reduce costs or increase revenues, the City will seek ways to be more efficient with the resource available as the infrastructure is invested. For example, the City may seek to acquire right-of-way up front and hold it until it is time to construct the facility. As land prices are likely to rise in the future, this can help to manage costs. There may also be opportunities to phase infrastructure investments over time to reduce the costs that are needed up front. For example, for Alignment D from Wine Country to Sherman to connect to Frankton is a logical first phase, while the steeper section that connects to May could be longer term.

- Find opportunities to reduce infrastructure costs. One option for doing this is to reduce mobility standards to bring project costs down. Another is to seek opportunities for value engineering as project are more fully designed for implementation.

- General fund contributions. The City may choose to directly contribute to infrastructure development from its general fund through the typical budgeting and prioritization process. The City may also choose to bond against the general fund (general obligation bond) to increase the amount of funding available up-front to cover infrastructure costs, and then re-pay the bonds over time with general fund dollars. A general obligation bond increases the tax rates on residents and requires a vote of the public. As such, it is typically only used for significant projects that benefit the City as a whole.

- State or grant funding. This funding source may be most appropriate for bike/ped projects, and trail projects, but could potentially be used for other types of projects as well.

Impact of development charges/fees on housing affordability

Affordability of housing in Hood River is an increasingly important issue, and the City is interested in finding as many avenues to address housing affordability as possible. Fees charged on new development (such as systems development charges or other fees) increase the cost of development. The City asked ECONorthwest to consider this relationship and its impacts on housing affordability in this analysis.

Theoretically, increased fees on new development are passed on to future homebuyers, and increase housing price for those homes. The actual relationship between new fees and housing prices, however, is less direct.

It is a common misconception that developers "set the price" of new development to cover costs and profit margins. However much they would like to, developers cannot control how much a homebuyer is willing or able to pay for a new home, and cannot control the price of the competing supply that is available in our free market housing system. They cannot simply increase the sale price to account for a new fee beyond what the market will otherwise bear.

The price of housing is determined no differently than any other good or service in a competitive market—it is established at an equilibrium between the quantity demanded and quantity supplied with similar size and features at a given market price. Thus, for development charges or fees to have an impact on the price of housing, it would need to affect either the demand for, or the supply of housing in the Hood River market.

Development fees and charges would not likely have any impact on housing demand (or the number of people needing to purchase a home and their willingness to pay for it). In other words, a development charge or fee on some homes in Hood River will not result in a change in the number of buyers looking to purchase homes in the Hood River area, nor the amount that those buyers are willing to pay for a given home with a given set of attributes.

Costs of production impact the supply curve, and therefore the market price of a good. For example, a developer will build a house on a vacant lot if the anticipated sales price of the home exceeds the anticipated development costs plus an acceptable rate of return on their capital. If the developer's costs increase—for example, from the imposition of a new fee—then it would reduce their net operating income, and reduce the interest of financers (banks) in underwriting the project. If a developer is not able to achieve a minimally acceptable operating income, they cannot build, and therefore decrease the supply of homes on the market. If the fee is the singular cause of this increase, then the fee could slow new development and result in supply constraints, which would then potentially have an impact on pricing in the entire market. In this way, new fees could theoretically increase housing pricing in Hood River's market.

In the study area, if additional or higher SDCs are charged than in other parts of the City, and if there remains sufficient demand at a higher pricepoint needed to cover the full cost of production so that new development can occur, developers will charge a higher rent or sales price as a result of these fees. The impact of this increase could affect pricing in the entire market, as the new development in the study area serves as new "comps" for appraisals with competing supply.

While in these circumstances fees and SDCs can make a difference for development feasibility and unit pricing, they must be considered in context. It is important to note that while fees increase the costs of development, they are typically a smaller contributor to overall development feasibility than larger market forces such as achievable sales pricing or rents or labor and construction costs. To fully understand the degree of impact, the City would need to conduct analysis at the time that the development is moving forward, as markets change over time in ways that are very consequential.

Achieving a balance between supply of units and demand for those units (ensuring that new construction occurs at rates that match household formation and in-migration) is the best strategy for slowing housing price increases. It is important to ensure that fees and SDCs are not creating a barrier to housing construction that could reduce needed supply. One way to keep fees lower, and reduce the likelihood of housing price impacts associated with fees, is to ensure that development is efficiently using available infrastructure and maximizing the investments of public dollars. These kinds of actions can mean that fees do not have to be increased, or can be spread over a larger total number of units.

Efforts like the one the City is undertaking in the Westside Area Concept Plan Area to ensure that infrastructure is comprehensively planned and that many units are sharing the infrastructure costs are best practice. If higher density scenarios do not also have higher infrastructure costs, then, on a per-unit basis, each individual unit will pay lower fees *and* more units will be added to the market relative to demand to help to slow price increases. From a pricing perspective, this is the best possible outcome.

The City may also want to consider additional tools for funding affordable housing in the study area. The City's adopted Hood River Housing Strategy includes a wide range of tools that can be used for these purposes[14]. It includes three broad strategies: (1) Increase the efficiency of use of land within the Hood River UGB, (2) Regulate and manage secondary and short-term rental housing, and (3) Develop affordable housing. The third strategy lists many recommended actions, including to identify sources of funding to support government-subsidized affordable housing development (for example, TRT), develop a tax abatement program, and work with a nonprofit to develop a community land trust.

[14] *Hood River Housing Strategy* (2015), ECONorthwest. http://centralpt.com/upload/375/2015HousingStudy/19124_HoodRiverHousingStrategy2015Final.pdf

Appendix A: Detail of SDC Revenue Estimates

This appendix provides detailed information and calculations associated with the estimates of SDC revenue included in this memorandum. All assumptions regarding methods for SDC calculations and SDC rates came from the City's SDC rate schedules and were verified through conversations with City staff. Estimates of the amount of Westside Area development (number of residential units, amount of commercial or industrial development) were provided by APG. Estimates of the number of water meters, number of permits, conversions to gross floor area, and other necessary assumptions to translate APGs estimates of amount of new development into units necessary to calculate SDC revenue were provided by and / or discussed and vetted by the City of Hood River. All dollar values are 2017 dollars.

Exhibit A.1: Estimates of Water SDC Revenues, Westside Area Concept Plan Area, City of Hood River, Oregon

Unit: Water Meter	SDC Rate (per water meter)	Number of Water Meters	SDC Revenue
3/4"	$ 4,010	507	$ 2,033,070
1"	$ 6,683	10	$ 66,830
1 1/2"	$ 13,367	71	$ 949,057
2"	$ 21,387	0	$ -
3"	$ 66,836	2	$ 133,672
4"	$ 133,670	0	$ -
6"	$ 267,343	0	$ -
8"	$ 360,911	0	$ -
Total			$ 3,182,629

Source: ECONorthwest, 2017, based on data from DEA and the City of Hood River

Exhibit A.2: Estimates of Wastewater Systems Development Charge Revenues, Westside Area Concept Plan Area, City of Hood River, Oregon

Unit: Water Meter	SDC Rate (per water meter)	Water Meters	SDC Revenue
3/4"	$ 1,804	507	$ 914,628
1"	$ 3,014	10	$ 30,140
1 1/2"	$ 6,008	71	$ 426,568
2"	$ 9,617	0	$ -
3"	$ 30,075	2	$ 60,150
4"	$ 60,133	0	$ -
6"	$ 120,283	0	$ -
8"	$ 162,374	0	$ -
Total			$ 1,431,486

Source: ECONorthwest, 2017, based on data from DEA and the City of Hood River

Exhibit A.3: Estimates of Stormwater Systems Development Charge Revenues, Westside Area Concept Plan Area, City of Hood River, Oregon

Unit	SDC Rate	Number	SDC Revenue
Residential- per permit	$ 673.00	814	$ 547,714
Industrial - per SF impervious	$ 0.26	295,606	$ 76,858
Commercial - per SF impervious	$ 0.26	1,039,738	$ 270,332
School - per SF impervious	$ 0.26	177,725	$ 46,208
Total			$ 941,112

Source: ECONorthwest, 2017, based on data from DEA and the City of Hood River

Exhibit A.4: Estimates of Transportation Systems Development Charge Revenues, Westside Area Concept Plan Area, City of Hood River, Oregon

Unit	SDC Rate	Number	SDC Revenue	Notes
Single Family (per dwelling unit)	$ 1,889	473	$ 893,119	
Multi-family (per dwelling unit)	$ 1,323	618	$ 818,143	
Residential Townhome (per dwelling unit)	$ 1,156	279	$ 322,755	
Specialty Retail Center (per TSFGFA)	$ 3,233	131	$ 424,692	Retail
General Office (per TSFGFA)	$ 2,174	84	$ 183,323	Office (100%) and Flex/Business park (50%)
Government office (per TSFGFA)	$ 13,607	39	$ 529,186	Gov't/other
Warehouse (per TSFGFA)	$ 979	25	$ 24,845	Warehouse
General light industrial (per TSFGFA)	$ 1,376	80	$ 109,854	Flex/Business Park (50%) and General industrial (100%)
Middle School(per student)	$ 128	800	$ 102,400	Ranged from 750-850 students
Total			$ 3,408,317	

ECONorthwest, 2017, based on data from DKS and the City of Hood River
Note: TSFGFA means Thousand Square Feet of Gross Floor Area

Exhibit A.5: Estimates of Parks Systems Development Charge Revenues, Westside Area Concept Plan Area, City of Hood River, Oregon

Unit	SDC Rate	Number	SDC Revenue
Single Family (per unit)	$3,256	752	$ 2,448,512
Multifamily (per unit)	$2,349	618	$ 1,452,622
			$ 3,901,134

ECONorthwest, 2017, based on data from APG and the City of Hood River

Appendix B: Detail of Project Costs

This appendix provides the details of the infrastructure costs used in this memorandum. David Evans and Associates (DEA) provided wastewater, stormwater, and water project costs. DKS Consulting provided transportation costs. Angelo Planning Group (APG) provided parks cost and associated assumptions.

Exhibit B.1: Estimates of Wastewater Project Costs, Westside Area Concept Plan Area, City of Hood River, Oregon

Description	Pipe Diameter	Total Length (ft)	Unit Cost ($/LF)	SubTotal	Funded by City	City Porton of Project Costs
Connection to Belmont Dr	8	1,100	365	$401,500	0%	$0
Connection to 29th St	8	400	365	$146,000	0%	$0
Connection to 30th St	8	1,360	365	$496,400	0%	$0
Rocky Rd Connection	8	1,800	365	$657,000	22%	$144,540
Vista Loop Connection to Blackberry	8	810	365	$295,700	0%	$0
Vista Loop Connection to Kesia Ct.	8	600	365	$219,000	0%	$0
Blackberry Dr. – East to Vista Loop	8	730	365	$266,500	0%	$0
East-West Connection to Frankton Rd	8	650	365	$237,300	50%	$118,650
New North-South (Alignment D) – Wine Country to May Dr.	8	2,650	365	$967,300	0%	$0
May Dr Connection to Align D (East to West and West to East)	8	400	365	$146,000	50%	$73,000
Sherman Rd Connection to Align D (East to West)	8	900	365	$328,500	0%	$0
High School to Align D	8	650	365	$237,300	0%	$0
Frankton Road to Align D (West to East)	8	1,400	365	$511,000	?	
Adams Extension North from Cascade Av	8	2,190	365	$799,400	25%	$199,850
Prospect Av Extension East of Adams	8	630	365	$230,000	0%	$0
Montello Av Extension (East to West and West to East)	8	1,230	365	$449,000	0%	$0
Eugene Av Extension to Adams	8	350	365	$127,800	0%	$0
Hazel West Connection	8	380	365	$138,700	0%	$0
Sherman West Connection	8	400	365	$146,000	0%	$0
Sherman Connection to Adams	8	750	365	$273,800	0%	$0
Total				**$7,074,200**		**$536,040**
SDC Revenue						**$1,431,486**
Gap						**$0**

Source: DEA and the City of Hood River, with SDC revenues calculated by ECONorthwest, 2017

Note: The City is evaluating options for funding Frankton Road to Alignment D (West to East), and will continue to study this along with other projects in this table.

Exhibit B.2: Estimates of Stormwater Project Costs, Westside Area Concept Plan Area, City of Hood River, Oregon

Description	Diameter	Length	Unit Cost ($/LF)	Total Cost	Funded by City	City Porton of Project Costs
Stormwater Basin A						
West Extension from Belmont	12	400	$328	$131,200	0%	$0
	18	600	$395	$237,000	0%	$0
Rand Rd. South Ext from May Ave	18	1,500	$395	$592,500	33%	$195,525
May Extension West from Rand Road	12	680	$328	$223,000	100%	$223,000
May Extension West from POC	24	430	$693	$243,400	100%	$243,400
Total				**$1,427,100**		**$661,925**
Stormwater Basin B						
30TH Street Extension South	15	250	$368	$368,000	0%	$0
May Ave Extension East from 30th St (CIP C8-G)	18	600	$395	$237,000	100%	$237,000
Hazel South Ext West from 30th St	12	365	$328	$239,500	0%	$0
Sherman Extension West from 30th St	12	350	$328	$229,600	0%	$0
Cascade Ave Extension West to POC	18	300	$395	$118,500	0%	$0
Total				**$1,192,600**		**$237,000**
Stormwater Basin C						
Rocky Rd Extension South to Study Boundary	15	1,300	$368	$478,400	25%	$119,600
Prospect Ext West to Adams Ave	12	600	$328	$196,800	0%	$0
Montello Ave Ext West to Adams Ave	12	600	$328	$196,800	0%	$0
Eugene Ave Ext West to Adams Ave	12	730	$328	$239,500	0%	$0
Sherman Extension East to Adams Ave	12	450	$328	$147,600	0%	$0
Adams Ave Ext from May Ave to Cascade Ave	18	1,300	$395	$513,500	0%	$0
	24	450	$566	$254,700	0%	$0
Cascade Ave Ext West to POC	24	700	$566	$396,200	0%	$0
Total				**$2,423,500**		**$119,600**
Stormwater Basin D						
May Ext East from Align D	12	570	$328	$187,000	35%	$65,450
May Ext West from Align D	15	300	$368	$110,400	100%	$110,400
Extension East from Stonegate Dr	12	600	$328	$196,800	0%	$0
Extension North to May Ave	12	650	$328	$213,200	0%	$0
May Ext East from Frankton	15	600	$368	$220,800	50%	$110,400
May Ext West from Nina Ln	12	350	$328	$114,800	100%	$114,800
W Prospect Ave Ext East	12	300	$328	$98,400	100%	$98,400
	15	300	$368	$110,400	0%	$0
North Ext from May to Align D	15	650	$368	$239,200	0%	$0
Hazel Ext to Align D	12	600	$328	$196,800	0%	$0
Sherman Ext West to Align D	12	600	$328	$196,800	0%	$0
Align D Ext from May to POC	15	870	$368	$320,200	0%	$0
	18	820	$395	$323,900	0%	$0
	24	1250	$566	$707,500	0%	$0
Total				**$3,236,200**		**$499,450**
Stormwater Basin E						
West Ext to Frankton Rd	15	500	$368	$184,000	100%	$184,000
Frankton Ext to the North	15	700	$368	$257,600	100%	$257,600
North Ext from Frankton to Country Club Rd/POC	18	950	$395	$375,300	100%	$375,300
Total				**$816,900**		**$816,900**
Total:				$9,096,300		$2,334,875
SDC Revenue						$941,112
Gap						$1,393,763

Source: DEA and the City of Hood River, with SDC revenues calculated by ECONorthwest, 2017

Exhibit B.3: Estimates of Water Project Costs, Westside Area Concept Plan Area, City of Hood River, Oregon

Description	Pipe Diameter	Total Length (ft)	Unit Cost ($/LF)	SubTotal	Funded by City	City Porton of Project Costs
Belmont Dr. West Ext to Rocky Rd	10	2,180	291	$634,400	0%	$0
29th St. Extension South	8	420	270	$113,400	0%	$0
30th St. Extension South	8	400	270	$108,000	0%	$0
Blackberry Dr. from Rocky Rd. to Frankton Rd	10	1,940	291	$564,600	0%	$0
Vista Loo connection to Blackberry Dr.	8	1150	270	$310,500	0%	$0
May Dr. Extension to Frankton Rd	8	650	270	$175,500	60%	$105,300
Elan Dr. Extension to Frankton Rd	8	420	270	$113,400	0%	$0
Frankton Rd South Extension from Blackberry Dr.	8	650	270	$175,500	100%	$175,500
Frankton Rd - May St. to Blackberry Dr.	8	650	270	$175,500	100%	$175,500
Frankton Rd – May St. to Country Club	8	2650	270	$715,500	100%	$715,500
Country Club Rd Extension to Frankton	8	1180	270	$318,600	0%	$0
New North-South Arterial (Alignment D) – Wine Coun	8	2680	270	$723,600	0%	$0
East-West Connection from Align D to Frankton Rd	8	720	270	$194,400	50%	$97,200
Prospect Av from Align D to Frankton Rd	8	980	270	$264,600	50%	$132,300
Adams Extension North to 30th St.	8	2,230	270	$602,100	33%	$198,693
Sherman Extension West to Align D	8	1680	270	$453,600	0%	$0
High School from Sherman to Align D	8	950	270	$256,500	0%	$0
Hazel Extension West to Adams	8	470	270	$126,900	0%	$0
Eugene Extension West to Adams	8	450	270	$121,500	0%	$0
Total:				**$6,148,100**		**$1,599,993**
SDC Revenue						**$3,182,629**
Gap						$0

Source: DEA and the City of Hood River, with SDC revenues calculated by ECONorthwest, 2017

Exhibit B.4: Estimates of Park Project Costs, Westside Area Concept Plan Area, City of Hood River, Oregon

Land to be purchased	10.7 acres
Estimated land costs	$3,745,000
Park SF in plan	466,092
Assumed improvement cost PSF	$4 - $8
Total Costs	$5,609,368 - $7,473,736
SDC Revenue	$3,901,134
Total Funding Gap	$1,708,324 - $3,572,602

Source: DEA and the City of Hood River, with SDC revenues calculated by ECONorthwest, 2017

Note: Acreage estimate assumes that some portion of the open space is accommodated through the open space available at the school site.

Transportation Financially Constrained Scenario Table Header Descriptions

- **Part of 2011 TSP Financially Constrained Project list?** – Notes all projects that are included in the financially constrained project list within the 2011 Hood River TSP. These are priority projects necessary for adequate system function and to meet requirements of Oregon's Transportation Planning Rule (TPR, OAR 660-12). Source: DKS and City of Hood River
- **Should be on Financially Constrained list?** – Notes the project team's assessment of each project for potential inclusion or removal from future financially constrained project lists. This column includes details on two different financially constrained project list scenarios shown in Exhibit B5 and B6. Source: Project team and City of Hood River.
- **% SDC Eligible** – Notes the share of current or potential new project SDC funding eligibility based on the 2011 Hood River TSP and project team assessment. Source: DKS and City of Hood River.
- **Total Project Costs** – An initial assessment of project costs prepared by DKS.
- **Developer Costs (Local Road Equivalent)** – The portion of total costs that have been identified as being local road equivalent improvements and are the responsibility of developers. Source: DKS
- **Westside Costs** – Total project costs attributable to the Westside that are not considered local road equivalent projects. Source: DKS
- **Financially Constrained SDC Eligible Westside Project Costs** – An estimate of SDC eligible projects costs based on the % SDC Eligible column.
- **ODOT Cost, Other city sources, and County funded** – These columns provide initial estimates of additional funding from other city, county, and state funding sources. These estimates are based project team conversations with City staff, and county and ODOT stakeholders.

Exhibit B.5: Transportation Financially Constrained Scenario A

ID	Project	Part of 2011 TSP Financially Constrained Project list?	Should be on Financially Constrained list?	% SDC Eligible	Total Cost Estimate	Developer Cost (Local Road Equivalent)	Westside Cost	Financially Constrained SDC Eligible Westside Projects Cost	ODOT cost	Other city sources	County funded
MV1/MV2 Interim	I-84 Exit 62 Interchange	no	no	0%	$5,000,000	$0	$0	$0	$5,000,000	$0	$0
MV2a	Cascade Avenue	no	no	0%	$1,306,000	$0	$1,306,000	$0	$0	$0	$0
MV2b	Cascade Avenue	no	no	0%	$906,000	$0	$906,000	$0	$0	$0	$0
MV3	Cascade Ave at Mt. Adams Ave	yes	yes	100%	$844,000	$0	$844,000	$844,000	$0	$0	$0
MV4.1	30^{th} Street (May Street to Fairview Drive)	no	no	0%	$7,120,000	$3,560,000	$3,560,000	$0	$0	$0	$0
MV4.2	Alignment D (Wine Country Avenue to May Street)	yes	no	100%	$13,602,000	$8,259,000	$1,335,750	$1,335,750	$0	$4,007,250	$0
MV4.3	May Street/Alignment D	yes	no	100%	$350,000	$0	$87,500	$87,500	$0	$262,500	$0
MV5	Sherman Avenue (Rand Road to Alignment D)	no	yes	100%	$7,814,000	$6,570,000	$1,244,000	$1,244,000	$0	$0	$0
MV6	Rand Road (May Street to Belmont)	no	no	0%	$2,971,000	$2,325,000	$323,000	$0	$0	$323,000	$0
MV7	Belmont Avenue (Rand Road to Frankton Road)	no	no	0%	$9,808,000	$7,440,000	$1,184,000	$0	$0	$1,184,000	$0
MV11	Mt Adams Avenue/Cascade Avenue	yes	yes	100%	$399,000	$0	$199,465	$199,465	$0	$0	$199,465
MV13	Rand Road/Cascade Avenue	yes	yes	100%	$1,750,000	$0	$1,000,000	$1,000,000	$750,000	$0	$0
MV12.1	Wine Country Avenue/Alignment D	yes	yes	100%	$498,000	$0	$124,500	$124,500	$0	$373,500	$0
MV25	Rand Road/27^{th} Street/May Street	no	yes	100%	$350,000	$0	$175,000	$175,000	$0	$175,000	$0
Subtotal MV Projects					**$52,718,000**	**$28,154,000**	**$12,289,215**	**$5,010,215**	**$5,750,000**	**$6,325,250**	**$199,465**
P13	Historic Columbia River Highway Trail, south side of Cascade Avenue	no	no	0%	$1,185,000	$1,185,000	$0	$0	$0	$0	$0
P14	Westside Community Trail extension to Cascade Avenue	no	no	0%	$67,000	$0	$67,000	$0	$0	$0	$0
P4	Westside Community Trail	yes	no	0%	-	-	-	$0	$0	$0	$0
BL7	Rand Road	no	no	0%	$239,000	$0	$119,500	$0	$0	$119,500	$0
BL6a	May Street (Frakton Road to Rand Road)	yes	no	33%	$516,000	$0	$516,000	$168,732	$0	$0	$0
P15	Upper Terrace Neighborhood Trail	no	no	0%	$1,322,000	$0	$1,322,000	$0	$0	$0	$0
P16	Post Canyon Drive Bike Lanes and Sidewalks	no	no	0%	$778,000	$0	$0	$0	$0	$0	$0
P17	West Community Trail extension west to Frankton Road	no	no	0%	$103,000	$0	$103,000	$0	$0	$0	$0
P18	Trail from Sherman Avenue to Frankton Road	no	no	0%	$112,000	$0	$112,000	$0	$0	$0	$0
P19	Henderson Creek Trail	no	no	0%	$620,000	$0	$620,000	$0	$0	$0	$0
P20	Ridgeline Trail north of Sherman Ave	no	no	0%	$776,000	$0	$776,000	$0	$0	$0	$0
BL2	Frankton Bike Lanes	no	no	0%	$388,000	$0	$194,000	$0	$0	$194,000	$0
BL1	Country Club Bike Lanes	no	no	0%	$416,000	$0	$416,000	$0	$0	$0	$0
Subtotal Ped and Bike Projects					**$6,522,000**	**$1,185,000**	**$4,245,500**	**$168,732**	**$0**	**$313,500**	**$0**
Total Cost					**$59,240,000**	**$29,339,000**	**$16,534,715**	**$5,178,947**	**$5,750,000**	**$6,638,750**	**$199,465**

Source: Data provided by DKS and the City of Hood River

Note: Column subtotals and totals for Westside, ODOT, other city sources, and county funded subject to change as more is known about how total costs are allocated.

Exhibit B.6: Transportation Financially Constrained Scenario B

ID	Project	Part of 2011 TSP Financially Constrained Project list?	Should be on Financially Constrained list?	% SDC Eligible	Total Cost Estimate	Developer Cost (Local Road Equivalent)	Westside Cost	Financially Constrained SDC Eligible Westside Projects Cost	ODOT Cost	Other city sources	County funded
MV1/MV2 Interim	I-84 Exit 62 Interchange	no	no	0%	$5,000,000	$0	$0	$0	$5,000,000	$0	$0
MV2a	Cascade Avenue	no	no	0%	$1,306,000	$0	$1,306,000	$0	$0	$0	$0
MV2b	Cascade Avenue	no	no	0%	$906,000	$0	$906,000	$0	$0	$0	$0
MV3	Cascade Ave at Mt. Adams Ave	yes	yes	100%	$844,000	$0	$844,000	$844,000	$0	$0	$0
MV4.1	30th Street (May Street to Fairview Drive)	no	no	0%	$7,120,000	$3,560,000	$3,560,000	$0	$0	$0	$0
MV4.2	Alignment D (Wine Country Avenue to May Street)	yes	yes	100%	$13,602,000	$8,259,000	$1,335,750	$1,335,750	$0	$4,007,250	$0
MV4.3	May Street/Alignment D	yes	yes	100%	$350,000	$0	$87,500	$87,500	$0	$262,500	$0
MV5	Sherman Avenue (Rand Road to Alignment D)	no	yes	100%	$7,814,000	$6,570,000	$1,244,000	$1,244,000	$0	$0	$0
MV6	Rand Road (May Street to Belmont)	no	yes	100%	$2,971,000	$2,325,000	$323,000	$323,000	$0	$323,000	$0
MV7	Belmont Avenue (Rand Road to Frankton Road)	no	yes	100%	$9,808,000	$7,440,000	$1,184,000	$1,184,000	$0	$1,184,000	$0
MV11	Mt Adams Avenue/Cascade Avenue	yes	yes	100%	$399,000	$0	$199,500	$199,500	$0	$0	$199,500
MV13	Rand Road/Cascade Avenue	yes	yes	100%	$1,750,000	$0	$1,000,000	$1,000,000	$750,000	$0	$0
MV12.1	Wine Country Avenue/Alignment D	yes	yes	100%	$498,000	$0	$124,500	$124,500	$0	$373,500	$0
MV25	Rand Road/27th Street/May Street	no	yes	100%	$350,000	$0	$175,000	$175,000	$0	$175,000	$0
Subtotal MV Projects					**$52,718,000**	**$28,154,000**	**$12,289,250**	**$6,517,250**	**$5,750,000**	**$6,325,250**	**$199,500**
P13	Historic Columbia River Highway Trail, south side of Cascade Avenue	no	no	0%	$1,185,000	$1,185,000	$0	$0	$0	$0	$0
P14	Westside Community Trail extension to Cascade Avenue	no	no	0%	$67,000	$0	$67,000	$0	$0	$0	$0
P4	Westside Community Trail	yes	no	0%	-	-	-	$0	$0	$0	$0
BL7	Rand Road	no	no	0%	$239,000	$0	$119,500	$0	$0	$119,500	$0
BL6a	May Street (Frakton Road to Rand Road)	yes	no	33%	$516,000	$0	$516,000	$168,732	$0	$0	$0
P15	Upper Terrace Neighborhood Trail	no	no	0%	$1,322,000	$0	$1,322,000	$0	$0	$0	$0
P16	Post Canyon Drive Bike Lanes and Sidewalks	no	no	0%	$778,000	$0	$0	$0	$0	$778,000	$0
P17	West Community Trail extension west to Frankton Road	no	no	0%	$103,000	$0	$103,000	$0	$0	$0	$0
P18	Trail from Sherman Avenue to Frankton Road	no	no	0%	$112,000	$0	$112,000	$0	$0	$0	$0
P19	Henderson Creek Trail	no	no	0%	$620,000	$0	$620,000	$0	$0	$0	$0
P20	Ridgeline Trail north of Sherman Ave	no	no	0%	$776,000	$0	$776,000	$0	$0	$0	$0
BL2	Frankton Bike Lanes	no	no	0%	$388,000	$0	$194,000	$0	$0	$193,766	$0
BL1	Country Club Bike Lanes	no	no	0%	$416,000	$0	$416,000	$0	$0	$0	$0
Subtotal Ped and Bike Projects					**$6,522,000**	**$1,185,000**	**$4,245,500**	**$168,732**	**$0**	**$1,091,266**	**$0**
Total Cost					$59,240,000	$29,339,000	$16,534,750	$6,685,982	$5,750,000	$7,416,516	$199,500

Source: Data provided by DKS and the City of Hood River

Note: Column subtotals and totals for Westside, ODOT, other city sources, and county funded subject to change as more is known about how total costs are allocated.

Appendix C: Documentation of Funding Sources

This section describes the universe of funding sources that could be used in the Westside Area Concept Plan area. The tools are organized in the following categories:

- **Existing funding tools**. These are tools the City of Hood River currently uses which could be applied in the Westside Area.
- **Potential new funding tools**. These are tools the City of Hood River does not currently use, but that are used in other communities in Oregon to fund the types of infrastructure considered in this analysis.
- **Infrequently used or challenging tools.** While technically possible, these tools are problematic and/or rarely used.

Existing funding tools

The City of Hood River has these tools in place, and could apply them in the Westside Area. They are: Systems Development Charges, Fuel Tax, Local Improvement District, Property Tax: bonds, and cost sharing.

System Development Charge

How it works

System Development Charges (SDCs) are one-time impact fees assessed on all new development for various types of infrastructure. They are intended to fund the increased capital costs incurred by a municipality or utility resulting from the infrastructure or other needs associated with new development. Local jurisdictions must adopt a method that complies with state statutes for calculating the charges that sets the fee to reflect the actual cost of the needed capital improvements to which the fee is related. The City of Hood River currently charges transportation, water, wastewater, and stormwater SDCs. Additionally, properties in Hood River must pay the County Parks and Recreation District's SDC.

What it can be used for

SDC revenue can be spent on projects specifically outlined in a master plan, capital improvement plan, or other similar plan to be funded by, or in-part by SDC revenue. The project list can be updated or modified.

Key considerations

SDCs are paid by developers when they obtain permits, and contribute to a pool of SDCs that are then used to pay for approved projects across the City. Understanding immediate capacity to pay for the necessary up-front capital investment in infrastructure in the study area therefore requires an understanding both of the amount of revenue generated in the study area *and* the available city-wide SDCs.

Development fees can affect the financial feasibility of development, because they increase the costs of construction for developers. See section 3 below for further explanation.

Local Fuel Tax

How it works

A fuel tax is on the sale of gasoline and other fuels, levied as a fixed dollar amount per gallon. The City of Hood River currently has a three-cent per gallon gas tax that generates about $300,000 in revenue annually, but the City could increase the tax amount by a public vote (ORS 319.950).

What it can be used for

Local fuel tax revenue can be spent on the same types of projects as the state's fuel tax revenue: "exclusively for the construction, reconstruction, improvement, repair, maintenance, operation and use of public highways, roads, streets and roadside rest areas" (Oregon Constitution, Article IX, Section 3a).

Key considerations

Local fuel taxes in Oregon range from one cent to five cents per gallon, averaging 2.6 cents (not including the City of Portland's new 10 cent fuel tax). Only three cities, Warrenton, Woodburn, and Portland have fuel taxes over three cents. Increasing Hood River's fuel tax would make it one of the highest in the state. Because the City already has a local fuel tax, it would be relatively easy to administer citywide. However, passing a citywide fuel tax would be politically challenging if revenues were only spent on one area in the City. To pass, revenue would likely need to spent on projects throughout the City, decreasing the revenue available for infrastructure in the study area.

Transient Room Tax

How it works

A transient lodging tax is a fee charged to customers for overnight lodging, generally for periods of less than 30 consecutive days. The fee is a percentage of lodging charges incurred by the customer, though some jurisdictions levy a fee per room night. Typical tax rates range between 3% and 9%. These local tax rates are in addition to the State transient lodging tax of 1%. The City of Hood River's Transient Room Tax is currently 8%.

What it can be used for

Although local jurisdictions use transient lodging tax revenues to fund a wide variety of programs, the State enacted new legislation in 2003 that requires new or increased local transient lodging taxes to dedicate at least 70% of net revenue to fund tourism promotion or tourism-related activities. This significantly limits the amount of revenue that could be used for infrastructure from a transient lodging tax.

Key considerations

This tool requires a more detailed cost-benefit analysis. Because Hood River already has a transient lodging tax, an increased tax would be easy to administer. Revenue generation would likely be high, as Hood River's has a large tourist economy. However, limited funding could be used for infrastructure in the study area. Additionally, it may be politically challenging to implement, as the tax is currently relatively high.

Local Improvement District (LID)

How it works

An LID is a special assessment district where property owners are assessed a fee to pay for capital improvements, such as streetscape enhancements, underground utilities, or shared open space. LIDs must be supported by a majority of affected property owners.

What it can be used for

City Code states that "street, water, sewer, sidewalk, stormwater, or other local improvement" LIDs are permitted.

Key considerations

The City of Hood River has municipal code that guides use of LIDs, and has used LIDs in the past. LIDs are often used for greenfield developments with relatively few property owners who can pay in proportion to their benefit.

An LID is a good mechanism for gathering contributions from key willing property owners who must have infrastructure for development to occur and will therefore benefit from their own investment.

Property Tax: Bonds

How it works

There are two major types of bonds: General Obligation (GO) Bonds and revenue bonds. In Oregon, both are commonly levied against municipal property taxes, though revenue bonds can be levied against any steady stream of public tax revenue. The funding source is therefore the property tax.

- GO bonds: Local property taxes are committed to pay debt service on a city-issued GO Bond. GO bond levies typically last for 15 to 30 years for capital projects, and must be approved by a public vote. The effective property tax levied to support GO bond obligations can vary over time, based on the total assessed value of property within the jurisdiction that issued the bonds and the scheduled GO bond payment obligations.
- Revenue bonds: City-issued revenue bonds are used to finance revenue-generating projects. Income from the projects a pay debt service on the revenue bonds. The City of Hood River currently has various mechanisms to share costs for infrastructure improvements with affected property owners. Municipal Code Chapter 3.16 established

a special revolving fund to pay for improvements and established procedures for alternate financing and loans.

What it can be used for

GO and revenue bonds can be used for all types of infrastructure in this analysis.

Key considerations

GO bonds require a public vote. Therefore, they are typically only used for projects that benefit all voters in a community. For this reason, revenue bonds may be more appropriate for infrastructure in the study area.

Utility Fee

How it works

A utility fee is a fee assessed to all businesses and households in the jurisdiction for use of specified types of infrastructure or public utilities, based on the amount of use (either measured or estimated). A utility fee can be applied citywide or in a smaller area within a city. The City of Hood River currently has a monthly stormwater utility fee, for maintenance and repair of the stormwater system.

What it can be used for

Utility fees are common practice for a wide-range of services, including garbage, water, electricity, and other traditional utilities. In recent years, municipalities have become more creative in defining "utilities" to include other types of infrastructure like street lighting, transportation maintenance, and emergency services (both capital projects and operations and maintenance). Several other Oregon Communities have used utility fees to fund infrastructure and public works investments. Oregon City, for example, used a temporary monthly utility fee to fund a new public safety building, and Lake Oswego has a street maintenance utility fee.

Key considerations

Utility fees are increasingly used to fund infrastructure projects.

Often, utility fee methodologies involve tradeoffs between fairness and simplicity, where the simplest fee structures may not do a great job of fairly allocating costs, and improving the fairness of the methodology may increase the complexity, making it more difficult to administer and understand.

Partnerships: Cost-Sharing

How it works

The City of Hood River currently uses cost-sharing agreements to leverage funding from various public and private partners. A recent example is the cost-sharing for the traffic signal improvement at the intersection of Cascade Avenue and Rand Road, between the City and private developers. The agreement requires developers to pay their proportionate share of the improvements, based on number of PM peak-hour trips generated.

Other examples of cost-sharing include public private development deals (cost sharing with private developers), local improvement districts (cost sharing with property owners), and any number of possible configurations of intergovernmental agreements (cost sharing with other government entities).

What it can be used for

Cost sharing can be used for all types of infrastructure in this analysis, provided that there is a willing partner who also benefits from the infrastructure investments.

Key considerations

Cost sharing mechanisms require partnerships. There must be a willing partner, who also benefits from improvements to infrastructure, to begin to discuss cost sharing approaches. Typically, these are negotiated on an ad-hoc basis and are specific to a particular infrastructure investment.

The City has existing cost-sharing agreements in place with the Oregon Department of Transportation (ODOT) and other developers for some intersections in the Westside Area Concept Plan area. When infrastructure costs are determined in future phases, the Westside Area Concept Plan should consider changes to existing cost sharing methodologies to fill the funding gap.

Potential New Funding Tools for the Westside Area Concept Plan Area

The City may need to explore additional tools, beyond those that are already available, to fill gaps in the Westside Area Concept Plan Area. This subsection describes sole source SDCs, supplemental SDCs, urban renewal, utility fees, and special service districts as tools that could be considered. Some of these tools (like urban renewal) are in use in other parts of the City of Hood River, but would require additional policy action to be used in the Westside Area Concept Plan Area.

Sole Source SDC

How it works

SDC's are one-time fees based on proposed new use or increase in use of a property. Sole Source SDSs retains SDCs paid by developers within the limited geographic area that directly benefits from new development.

What it can be used for

Sole Source SDCs can only be spent on new development in the geographic area in which it is collected. The revenue is allocated separately from Citywide SDCs.

Key considerations

Sole Source SDCs can be administratively challenging to implement and manage, but they do ensure that revenues collected in an area are used in that area, and for that reason can sometimes be more acceptable to engaged property owners and developers.

Supplemental SDC

How it works

Supplemental SDCs are additional SDCs charged on a specific sub-area of a city and are supplemental to the city's existing SDC. Sometimes, supplemental SDCs are charged only in certain geographies (supplemental SDCs charged in a sole source SDC area).

What it can be used for

Supplemental SDCs can only be spent on new development in the geographic area in which it is collected. They are allocated separately from Citywide SDCs.

Key considerations

Supplemental SDCs can be administratively challenging to implement and manage, but can they do ensure that property owners pay in proportion to their benefit.

Urban Renewal

How it works

Tax increment finance revenues are generated by the increase in total assessed value in an urban renewal district from the time the district is first established. The governing body, usually acting on the recommendation of Technical and Advisory Committees, creates an urban renewal district with specific boundaries and identities improvements to be funded within the district. Bonds may be issued to fund improvements. As property values increase in the district, the increase in total property taxes (e.g., city, county, school portions) is used to pay off the bonds. When the bonds are paid off, the entire valuation is returned to the general property tax rolls.

What it can be used for

Urban renewal funds can be invested in the form of low-interest loans and/or grants for a variety of capital investments in blighted areas: redevelopment projects, economic development strategies, streetscape improvements, land assembly, transportation enhancements, historic preservation projects, and parks and open spaces.

Key considerations

The City of Hood River already has three urban renewal areas (none of which overlap the study area), and therefore may be approaching statutory limits on the amount of area that can be in a URA at any given time. This would require investigation. Further, URAs can be politically challenging to implement, as they divert revenues that would otherwise flow to overlapping service providers who must nonetheless serve new development inside the URA boundary. However, they are powerful funding / financing mechanisms that are designed to support investments in infrastructure that are needed to allow redevelopment to occur.

Special Service District

How it works

A special service district can take several forms in Oregon, but in general, they use property taxes, service fees, or a combination of the two to finance infrastructure or other investments. Parks districts, fire districts, and county service districts are examples. A boundary for a potential special service district would need to be evaluated. Hood River Valley Parks and Recreation District is a special service district. Another example is in the North Bethany area of Washington County, where a new County Service District was put in place to fund infrastructure investments to support development.

What it can be used for

Except in limited circumstances, special service districts are typically used to fund specific types of infrastructure (such as schools, or parks) rather than multiple types. They are also typically used for entire cities or larger geographic areas, rather than subareas.

Key considerations

Implementing a special service district would require more analysis to determine (1) which segment of infrastructure should be funded with a special service district, and (2) the impact on the overall property tax rate.

A special service district would be politically challenging to implement in a subarea of the City.

Infrequently used or challenging tools

The following tools are technically possible but are problematic and/or rarely used for a variety of reasons.

- **Income Tax.** An income tax is a tax on income, typically calculated as a surcharge on state income tax. Could apply to people, corporations, or both. Relatively low rates (1-3%) have potential to generate substantial levels of revenue. Local income taxes are politically challenging to implement and difficult to administer, while possible, are very rarely used.
- **Sales Tax.** A tax on retail sales, typically added to the price at the point of sale. Sales taxes are generally considered regressive because low-income people pay a higher percentage of their income than high-income people. There is no state sales tax in Oregon, but local governments could adopt a local sales tax. Essential goods like food, medicine, and housing are typically exempt from a sales tax. There is low likelihood of political acceptability for adopting a sales tax to fund growth.
- **Payroll tax.** A tax on wages and salaries paid by employers or by employees as a payroll deduction. A payroll tax generates revenue from people who work inside, but live outside of the area in which the tax is applied. Low rates (<1%) have potential to generate substantial levels of revenue. A local payroll tax can be administratively

challenging. The City of Hood River does not currently have the facilities or infrastructure to implement it.

- **Income Tax Sequestration.** A variation on a local income tax is income tax sequestration. This concept identifies some group of income tax payers and diverts some or all state income tax revenues to a specific project. There is currently no State-sanctioned program in Oregon that would allow income tax sequestration, so a new program would need to be created.
- **Construction Excise Tax.** A tax levied on the value of new construction. Only school district and affordable housing related projects can be funded from Construction Excise Tax revenue. Hood River County School District currently implements a construction excise tax paid in association with building permits. Hood River County is also leading a discussion of implementing a construction tax for affordable housing.
- **Permit/Record Surcharge.** A fee charged to property owners for new construction, additions, or remodeling property. The amount of the building permit fee typically depends on the value of the construction. This source typically generates very limited amounts of funding.
- **Business License Fee.** A fee charged on businesses. There are a variety of ways that jurisdictions could choose to charge fees on businesses, including a one-time fee, to an annual fee based on sales, number of employees, size of building, amount of parking, or other factors. License fees can apply to all businesses or only certain businesses such as automobile dealers or service stations. A business license fee would generate limited amounts of funding. Additionally, a Citywide business license fee has no direct connection to the benefits received by infrastructure in the study area.

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LAND USE PLANNING
TRANSPORTATION PLANNING
PROJECT MANAGEMENT

MEMORANDUM

Park Lands Acquisition: Code Research and Case Studies

City of Gresham

DATE	August 1, 2017
TO	Ken Koblitz and Michelle Kimble, City of Gresham
FROM	Jamin Kimmell, Angelo Planning Group Joe Dills, Angelo Planning Group Cathy Corliss, Angelo Planning Group

The purpose of this memo is to document the research performed by Angelo Planning Group (APG) on approaches to acquiring land for parks through the development review or annexation process for the City of Gresham. The memo is organized into five sections:

1. Background information on the issue and purpose of the research;
2. Legal considerations/questions;
3. Precedent examples of from other jurisdictions;
4. Findings of three case studies of jurisdictions in Oregon; and
5. Preliminary recommendations

NOTE: APG is not a law firm and therefore cannot provide legal advice. This memorandum is intended for general information. The City should discuss these issues with its legal counsel.

1. BACKGROUND

The purpose of this research memo is to assess options for establishing a more clear and objective procedure for acquiring land for parks through the development review or annexation process. The City of Gresham does not currently require that lands designated for parks be dedicated or acquired by the City during either the annexation or development review process. Currently, the City asks for the cooperation of developers and property owners to voluntarily sell land that is planned for parks to the City either prior to development or during development review. This process is undefined, administratively complex, and does not ensure that land will be preserved for parks in the locations designated by local plans. The City desires a more clear and objective procedure that is integrated with the annexation or development review process.

City staff have discussed the possibility of establishing a regulatory procedure to address this issue in the past. In 2007, staff considered options for requiring land be preserved for parks within the

Pleasant Valley area, where development had been proposed. Staff determined that the Pleasant Valley Plan District and Master Plan provisions were not intended to require that park land be dedicated to the City. The Plan District and the Master Plan provisions encouraged that the locations of parks be identified in future Master Plans for new development, but did not stipulate that those lands must be dedicated to or acquired by the City. In response, planning staff proposed options for establishing this requirement, including amending the Development Code or the annexation policies in the Comprehensive Plan. Legal staff considered the potential amendments and recommended that any requirements be based on objective standards, such as a formula that calculates the amount of required land based on the number of dwelling units proposed in the development. An objective standard would be more consistent with established legal standards that govern development exactions. The City did not move forward with adopting any code or policy amendments at the time.

2. LEGAL CONSIDERATIONS/QUESTIONS

Requiring dedication or acquisition of park land

The legal basis for requiring park lands to be dedicated or acquired by the City is one of the primary questions related to such regulations. APG conducted research on national cases and best practices to identify case law or statutes that directly prohibit local governments from requiring that land be dedicated or acquired for parks. No cases or statutes were found to directly prohibit this requirement; however, the requirement appears to fall under the general legal framework associated with "takings". The Fifth Amendment of the U.S. Constitution guarantees that in no case will "private property be taken for public use, without just compensation." If a property is appropriated by the government without just compensation, it is considered a takings and a violation of the Constitution.

It is our understanding that the City proposes to compensate property owners for the fair market value of any land acquired for parks and avoid takings claims. In most cases, the City desires to cooperate and negotiate with property owners to engage in a voluntary agreement to acquire land. The purpose of this research is to lay out some of the procedures and limitations that might apply should the property owner be unwilling to sell the land for a public park. There are three types of government actions that, in some circumstances, could be considered a taking if the local government does not proceed within the applicable limitations:

- **Direct condemnation.** A direct condemnation occurs when a government directly requires a property owner to sell land. If the land is acquired for a legitimate public use and the property owner is paid just compensation, then it is not a taking. In Oregon, condemnation of land for use as a park is considered a legitimate public use and permitted by statute.[1]

[1] See ORS 226.320 Authority to acquire land for certain purposes

- **Regulatory taking.** A land use regulation that completely eliminates or greatly lowers the value of land, without just compensation, could be considered a regulatory taking. For example, if the City were to adopt a requirement that all park lands be acquired by the City at the time of development, and a planned park constituted all or the great majority of a property owner's land, the property owner could argue that the regulation effectively eliminates the value of the land for development, and thus is a regulatory taking. In this case, the City may be obligated to compensate the land owner at the point when the regulation went into effect, as it was the regulation itself that eliminated or greatly reduced the value of the land. The determination of whether the regulation constitutes a taking is complex and depends on a number of factors. The City should closely evaluate the potential for any park land acquisition requirement to be construed as a regulatory taking for some property owners in specific circumstances. There may be methods of drafting the code language to reduce this risk.
- **Exaction.** An exaction is a fee or cost imposed on a developer or property owner intended to offset or mitigate the impacts of a proposed development. The City currently collects System Development Charges (SDCs) for parks, which are a form of development exaction. Exactions may be considered takings if they violate two criteria established in the "Nollan/Dolan" cases that were decided by the U.S. Supreme Court.[2]
    - Nexus: There must be a "rational nexus" between the exaction and the impact of the development. In other terms, the exaction must be related to an impact that is clearly attributable to the development. In the case of park land acquisition, this criteria is relatively easy to demonstrate, as the land for the park will be located in close proximity and clearly serve the residents of a proposed development.
    - Proportionality: The exaction must be "roughly proportional" to the impact created by the development. Proportionality should be demonstrated by objective measures and standards to the greatest extent possible. For parks, proportionality is usually operationalized as a "level of service" standard that is measured as a number of acres of parkland needed per dwelling unit. The City's SDCs are calculated based on a proportional, level of service standard.

Implications for park land acquision

The City seeks to achieve acquisition of park lands while minimizing or eliminating the possibility of a takings claim, and in the spirit of a fair and transparent process. The City has the authority to acquire land for parks, but the procedure for doing so depends on the situation.

In the case of a development review, the process could potentially proceed as follows:

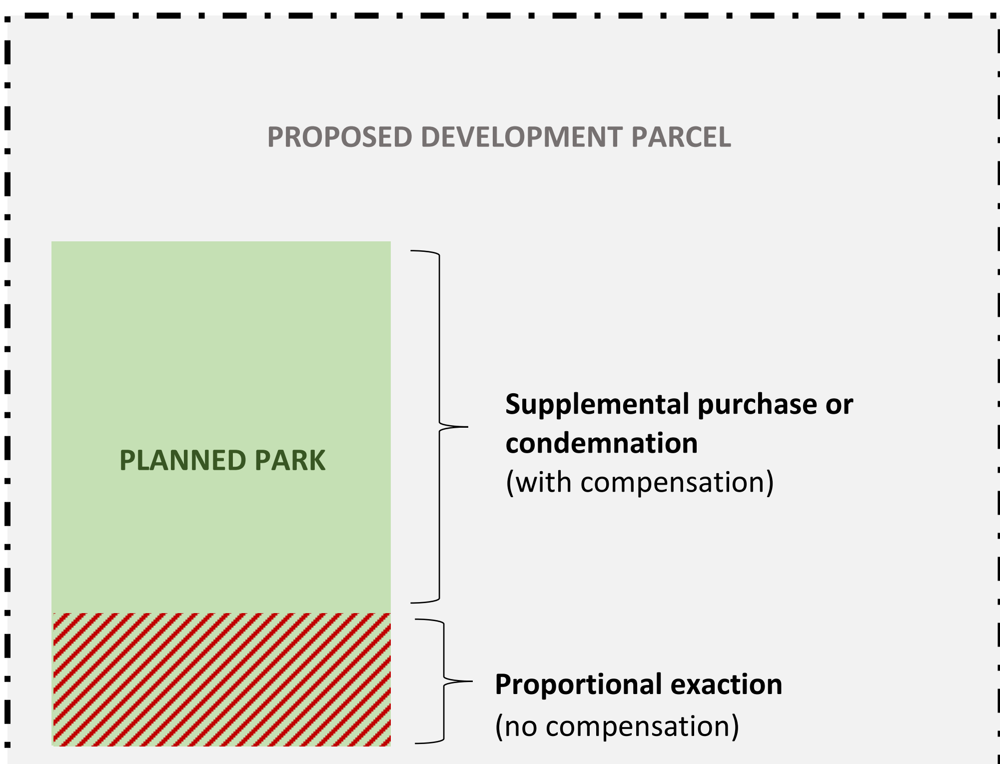
1. **Proportional exaction**. The City would require, based on adopted code, that the developer dedicate or allow the City to purchase an amount of land that is proportional to the impact

[2] *Nollan v. California Coastal Commission*, 483 U.S. 825 (1987) and *Dolan v. City of Tigard*, 512 U.S. 374 (1994)

of the development. Proportionality would be based on a level of service standard, ideally consistent with or equal to the standard used to calculate the portion of Parks SDCs that covers the costs of land acquisitions. Proportional exactions do not require dedication; the land could be purchased by the City. However, if a developer dedicates the land, they could be credited the value of the dedication. If the developer requests the City purchase the land, then no SDC credits would be applied. If the proportional exaction of land is sufficient to cover the amount of land that is needed for the park and owned by the developer, then the acquisition is complete.

2. **Supplemental purchase.** If the proportional exaction is insufficient based on the amount of land owned by the developer in relation to the identified park boundaries, then the City could offer to purchase the remaining land at fair market value (see Figure 1). Any compensation would likely need to be paid in cash rather than an SDC credit, because it would be over and above the amount of the Parks SDC, which is proportional to the impact of the development. If the City were to adopt a regulation that <u>requires</u> the land be dedicated or acquired by the City, then having that adopted requirement could be considered a regulatory taking in some circumstances. The City is also free to offer "carrots" to incentivize the supplemental purchase, e.g. waiver of all or part of the SDCs for the proportional exaction, or other regulatory or financial incentives.

Figure 1. Illustration of Example Park Land Acquisition Scenario



3. **Condemnation (if necessary).** If the developer does not agree to comply with the supplemental purchase, the City could acquire the land through a condemnation procedure. The developer would still be compensated fair market value. This process would need to conform with the general procedures for condemnation prescribed by state statute.[3] The developer could still proceed with development of the surrounding area.

Annexation agreements

It may be possible for the City to require more land to be dedicated or acquired than what is proportional to the impact of the development if the transaction is included as part of an annexation agreement. If the developer or property owner has not yet annexed to the City, and sees significant value in doing do, then they may be willing to agree to dedicate or sell the land if it enables annexation. As a "voluntary" contract between two parties, annexation agreements may not be subject to the limitations on exactions required by Nollan/Dolan. If the property owner did not want to sign the agreement, they could always elect to not annex into the City.

In contractual agreements between two parties, one party may waive its constitutional rights when voluntarily entering into the contract. This waiver would be included as a term of the agreement.[4] Therefore, the proportionality criterion that limits exactions would not be applicable. The only limitation is the voluntary cooperation of the developer or property owner in entering the contract. The City would need to consider how any requirements to dedicate or sell land for parks would affect the overall negotiation with the property owner and weigh the costs and benefits of the requirement.

Development agreements

Development agreements may be another method for requiring more land be dedicated or acquired than what is proportional to the development; however, it is unclear if the limitations on exactions apply to development agreements. LUBA has ruled that development agreements made pursuant to ORS 94.504 are land use decisions and subject to LUBA's jurisdiction.[5] It is not clear whether the implication of this ruling is that development agreements, as land use decisions, may include waivers of Nollan/Dolan rights as a term of the agreement. We recommend the City seek legal counsel on this question.

3. PRECEDENT EXAMPLES

APG collected examples of jurisdictions across the country and in the state of Oregon that have adopted park land dedication ordinances. The following examples are relevant and potentially

[3] See ORS Chapter 35.
[4] The City of Canby has codified this authority. See Canby Municipal Code, Division VI, Chapter 16.84.040. Available at http://canbyoregon.gov/Chap16/16.84ANNEXATIONS.pdf
[5] LUBA No 2007-265. Available at: http://www.oregon.gov/LUBA/docs/opinions/2008/07-08/07256.pdf

useful as references for guidelines and best practices when drafting policy or code amendments to address this issue:

- Three large cities were found to have adopted specific park land dedication requirements: Lakewood, Colorado; Austin, Texas; and St. Paul, Minnesota.[6]
- The State of Pennsylvania has adopted state law that enables local jurisdictions to require park land dedications. The Pennsylvania Land Trust publishes guidelines for jurisdictions to implement this requirement.[7]
- The Tennessee Parks and Recreation Association has organized conference sessions on this topic that include useful guidance for drafting clear and defensible code provisions.[8]

Within the state of Oregon, we identified the following jurisdictions with adopted park land dedication or acquisition requirements: Bend, Washington County (North Bethany Subarea), Sandy, Veneta, Canby, and Pendleton. Other than Washington County, we did not identify any other jurisdictions in the Portland Metro area that have adopted park land dedication requirements. The City of Tualatin requires public land acquisition for greenways and natural areas, which often include trails; however, these lands are usually located in riparian corridors that are not developable. The City of Oregon City acquires park land as a condition of approval of an annexation in some cases, but the amount of land required or the location of parks is not specified in code or policies. Several cities require open space in Planned Unit Developments but the open space is not required to be in public ownership as it can be owned and maintained by a homeowners association. Many cities achieve the majority or all park land acquisition through proactive negotiations with property owners prior to a proposed development or rely on voluntary cooperation of developers or property owners when development is proposed.

4. CASE STUDIES

This section of the memo summarizes the findings for three case studies of jurisdictions in Oregon that have adopted park land acquisition or dedication requirements: the City of Bend, Washington County, and the City of Sandy. In addition to reviewing relevant code provisions and planning documents, phone interviews with staff from each jurisdiction were conducted to assess the effectiveness of the requirements and guidelines for implementation.

City of Bend

Steve Jorgenson, Parks Planner, Bend Parks and Recreation District
Phone interview on May 25, 2017

[6] See the following links for the code provisions: Lakewood, Austin, and St. Paul
[7] Pennsylvania Public Land Trust: Public Dedication of Land and Fees-in-Lieu for Parks and Recreation.
[8] Park Land Dedication Ordinances, Tennessee Parks and Recreation Conference, November 2015.

The City of Bend requires that land designated for parks be transferred (with compensation) to the Bend Parks and Recreation District wherever the proposed development meets certain criteria. The code provision is part of the City's Public Improvement Standards.[9] The requirement applies citywide, but is only intended to require land acquisition for neighborhood parks (it does not apply to community or regional parks). In order to meet the criteria, the proposed development must be in a park service area with an identified park need in an adopted plan, be at least 10 acres in size, and include land that is suitable for a public park. The Bend Parks and Recreation Master Plan indicates park service areas—areas with a need for a neighborhood park—and in some cases identifies the specific location of parks (Figure 1). The code provides that the City can determine the specific location and size of land for the park. The price of the land is based on its appraised value under the base zoning requirements, prior to development approval. The code includes a reference to the Nollan/Dolan principles: the City must demonstrate that the required dedication is consistent with regulations that govern all conditions of approval, which stipulate that the conditions must be related to and roughly proportional to the impact of the development.

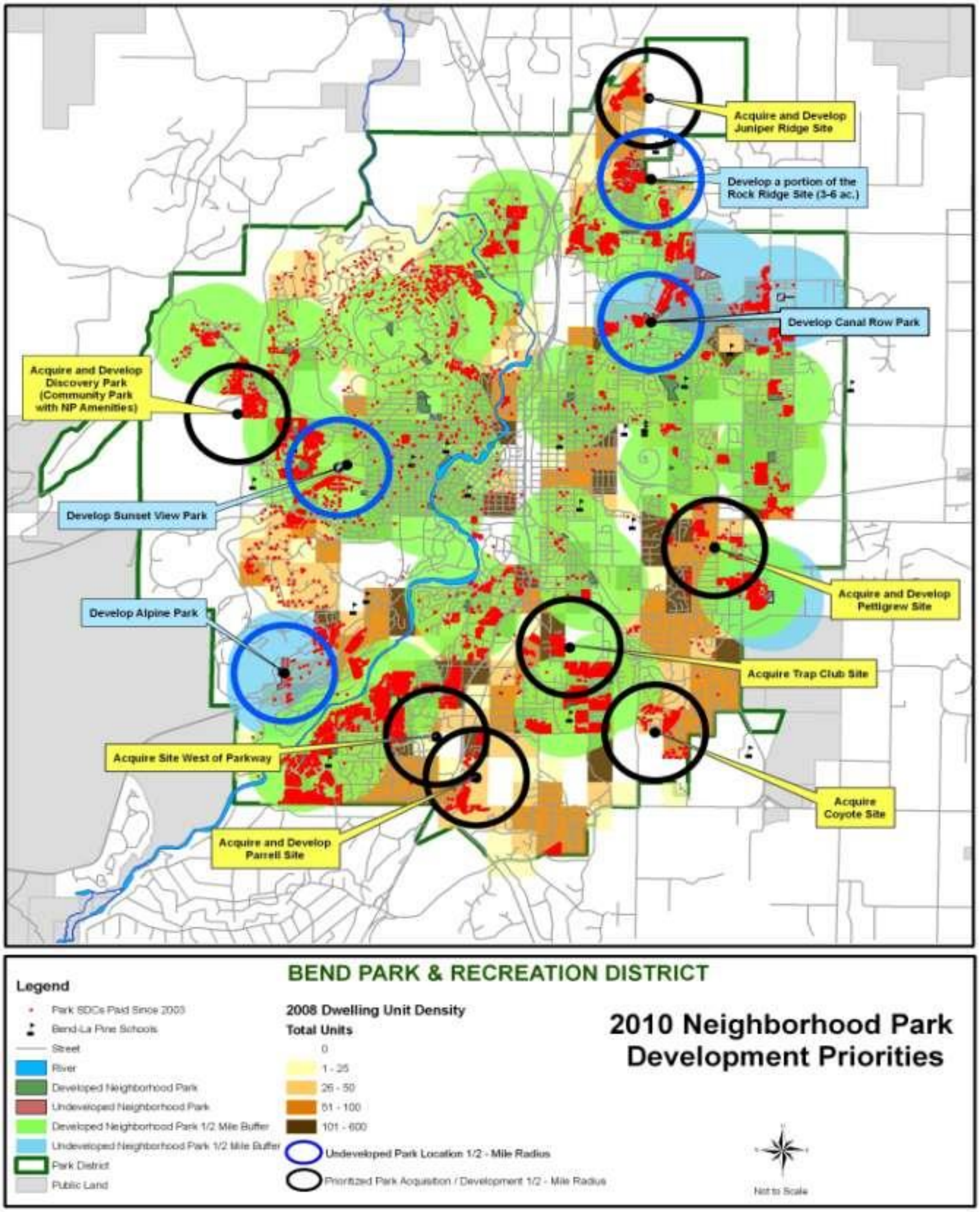
The City of Bend has not acquired a significant amount of land for parks by applying these code requirements. Most land needed for parks has been acquired through proactive negotiation with property owners prior to a proposed development. However, staff did note that the existence of the code requirement may incentivize property owners to engage in negotiations as they may be required to dedicate the land prior to approval of any future development. The City applies similar code provisions for trails, however, which are used widely and successfully to acquire lands for trails through development review.

One strength of Bend's code is that is requires the appraisal of the land value—which is used to determine the purchase price for acquisition—to occur prior to approval of the development. If the appraisal occurred after approval, it is possible that the appraisal may be based on the value of the land as if it were subdivided and entitled for development, which increases the value and thus the cost to the public agency.

There are some limitations to Bend's approach, however. The requirement cannot be applied to land needed for community parks, because there is no specific plan for community parks that designates their location, establishes a service area, or defines a level of service (LOS) standard that could be used to calculate the amount of land needed for parks as a result of any particular development. Additionally, the code does not address whether a development would be eligible for System Development Charge (SDC) credits if land is dedicated to or acquired by a public agency.

[9] Bend Development Code, Chapter 3.4, Section 3.4.300 Public Use Areas.

Figure 2. Bend Neighborhood Parks Plan



Washington County

Jeannine Rustad, Parks Planner, Tualatain Hills Parks and Recreation District
Phone interview on May 22, 2017

Washington County, in coordination with the Tualatin Hills Parks and Recreation District (THPRD), requires that land designated for parks in the North Bethany Subarea be transferred to public ownership under THPRD. The requirement is included in the County's Public Facility and Service Requirements.[10] It only applies in the North Bethany Subarea and is limited to neighborhood parks, trails, or other off-street pedestrian routes. North Bethany is a 700-acre Urban Growth Boundary expansion area that is similar to Pleasant Valley in that it has a Concept Plan and an adopted Community Plan. Most of the neighborhood parks are identified in a fixed location in the North Bethany Subarea Plan, but some parks are designated for a more general area (Figure 2). The location of the park is determined—or adjusted if already determined by the subarea plan—if the location meets certain criteria defined in the code. Intent for the land to be acquired by THPRD must be documented prior to development approval; however, the purchase price and other terms of the agreement may be specified at a later date.

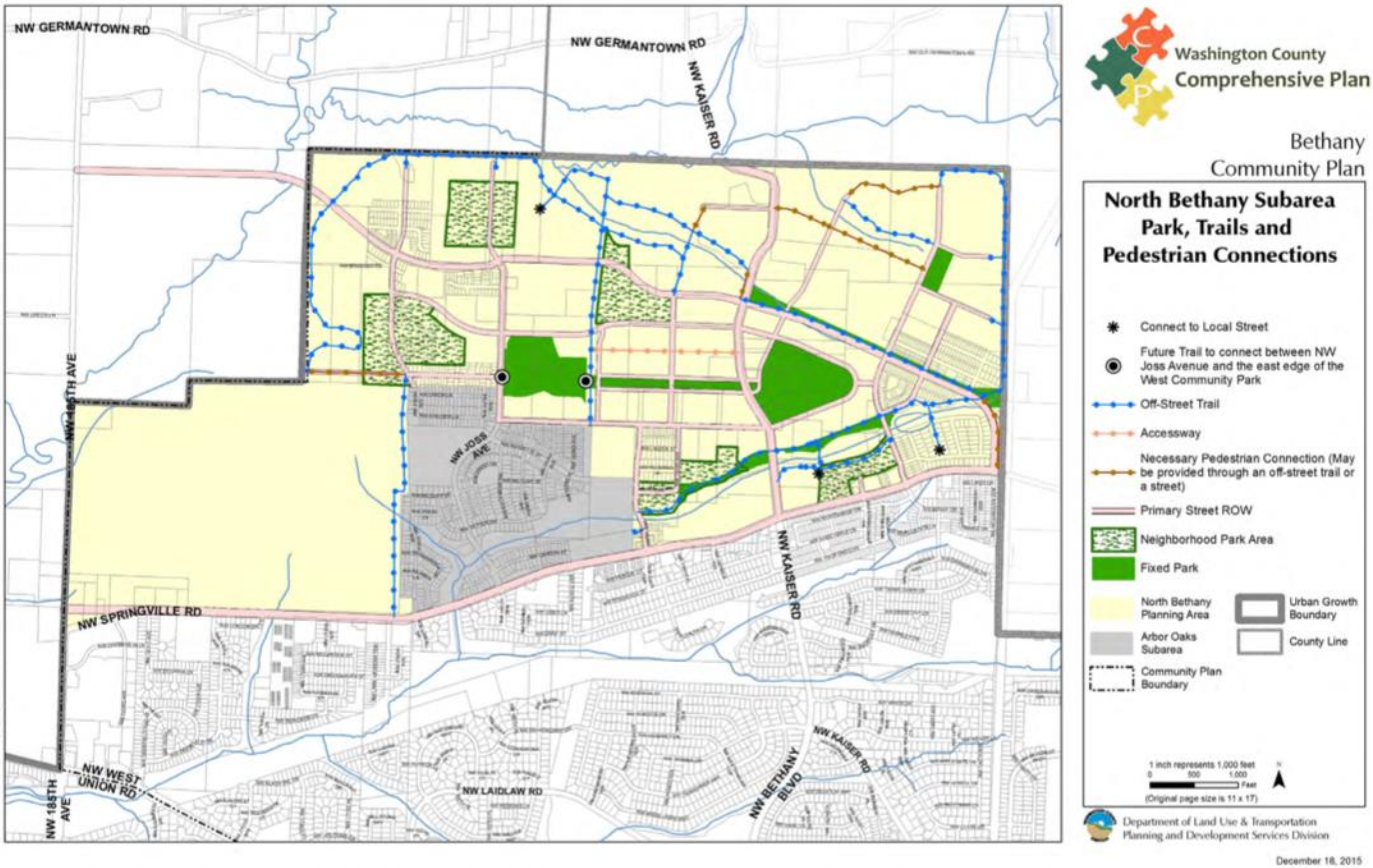
County staff generally perceive the code provisions specific to the North Bethany subarea as having allowed the County and THPRD to acquire more land for parks than in other subareas where the requirement does not apply. However, the requirement can be complex to administer, primarily because the parks plan for the area does not specify the location of all parks and the code does not define all of the procedures by which the land will be acquired. THPRD staff have needed to dedicate a significant amount of time to negotiating with developers about the location of parks and the purchase price for the land.

Because the code does not specify the assumptions underlying the appraisal of land value, THPRD and developers must agree to a fair and reasonable valuation of the land. Generally, THPRD believes the land value should be based on the development capacity of the base zone with no improvements and no entitlements (subdivision or development approval). The developers and property owners have argued that the appraisal should include the value of the land if it were entitled for development.

A second challenge with Washington County's approach is that the timing of acquisition related to collecting SDCs can create cash flow issues. The County's parks and recreation SDCs are formulated to include the cost of land acquisition. Therefore, if a developer conveys land to THPRD for a park, the developer does not receive a credit on their SDCs for the cost of the land because the developer has already been compensated for that cost. The County recovers the cost of acquiring the land, or a portion of the cost, when it receives the SDC payment from the developer upon approval of building permits. Thus, the County must make an outlay of cash to acquire the land prior to collecting the revenue from SDCs that is intended to cover that cost.

[10] Washington County Community Development Code, Article V, Chapter 501, Section 501-10 Standards for Development Within the North Bethany Subarea Plan Area

Figure 2. North Bethany Subarea Parks Plan



The City of Sandy

Kelly O'Neill, Community Development Director, Bend Parks and Recreation District
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The City of Sandy has adopted a park land dedication ordinance that has been in place since the 1990s. The regulations are located within the City's general development regulations.[11] The code requires land to be dedicated to the City or a fee paid in-lieu of land dedication. The City's parks SDCs do not include the cost of land acquisition—they are limited to the cost of development and capital improvements—therefore, this park land dedication requirement functions as a fee to recover this portion of the cost of parks. The code applies to all subdivisions, partitions, Planned Developments, or multi-family developments. The amount of the land, or the fee-in-lieu, is based on a population factor determined by the Parks Master Plan (number of acres of parks per person). The City has the authority to either accept the land or the fee-in-lieu, depending on the proposed development. If the City decides to accept a fee-in-lieu, the amount of the fee is calculated based on a standardized rate (dollar value per acre) that applies to all land in the city.

Overall, staff report that the park land dedication code is a necessary and effective means for the City to ensure implementation of the Parks Master Plan. The fee-in-lieu option is used extensively—significantly more often than the land dedication requirement—as the City is relatively selective about the lands they will accept for parks uses. If land is accepted, the land is almost always identified for park use on the Parks Master Plan.

The system is generally received favorably by developers and property owners. On occasion, a developer will attempt to dedicate land to the City that is not suitable for a park use, and thus the City must require that the developer pay the fee-in-lieu despite having proposed a land dedication. The City finds the procedure to be relatively simple to administer. The amount of land is based on a standardized formula and the determination of whether land is suitable for a park is usually directly linked to the Parks Master Plan. The land need formula includes both neighborhood parks and community parks.

The amount of the fee-in-lieu is also relatively straightforward to determine as it is based on a standardized rate rather than an appraisal specific to a tract of land. However, one challenge associated with the standardized rate is that it must be increased over time and may not keep pace with the actual cost of the land. The code also includes a provision that allows a developer to split the fee into two payments, before and after final plat approval. This allows the developer to generate some revenue after final plat—but before building permits are issued—to pay for the cost of the fee. This provision has been well-received by developers.

[11] City of Sandy Municipal Code, Chapter 17.86, Parkland and Open Space.

6. PRELIMINARY RECOMMENDATIONS

This section of the memo presents preliminary recommended strategies for the City to consider to acquire land for parks. As detailed below, we recommend an overall strategy of pursing proactive acquisition of land prior to annexation or development. If the property owner is unwilling to sell, then the City may pursue acquisition as a part of a broader annexation agreement or as a code requirement to be addressed in a development application.

Proactive acquisition

A key finding of this research is that no jurisdictions we contacted or interviewed use the development review process as the primary method of acquiring park land. All jurisdictions we spoke with sought to acquire land for parks through proactive contacts and negotiations with property owners prior to annexation or development. The advantage of this approach is that land may be acquired prior to it being marketable for development, when developers may be attempting to purchase the land or the property owners may be interested in developing it themselves. This approach, of course, relies on the property owner being willing to sell and the City being able to provide an attractive offer. Proactive acquisition is worth pursuing in all cases, given some of the limitations and complexities of acquiring land through annexation or development review.

Acqusition through annexation agreements

If proactive acquisition is not feasible, we recommend strategies for land acquisition be integrated into both the annexation and development review processes. A key concept to consider regarding this overall approach is the proportionality of the requirement related to the impact or size of the development. As noted above, the proportionality limits related to exactions may not apply to the annexation process. Thus, the City could utilize annexation agreements to acquire lands needed to completely implement park plans, even if the acquisition may not meet a strict test of proportionality.

Annexation may offer a more flexible and strategic approach to land acquisition than what can be accomplished through the development review process. The City Attorney and legal staff should be consulted to clearly define the legal requirements applicable to annexation. This initial research found that the Nollan/Dolan principles may not be applicable to annexation agreements when Nollan/Dolan criteria are waived within the agreements; however, legal counsel is needed to confirm this finding. We identified two examples of other cities in Oregon that use annexation agreements that require the waiver of Nollan/Dolan criteria.[12]

[12] The City of Canby has codified this waiver be required in annexation or development agreements. See Canby Municipal Code, Division VI, Chapter 16.84.040. Available at http://canbyoregon.gov/Chap16/16.84ANNEXATIONS.pdf

See provision number 8 in this example annexation agreement from the City of Bend: http://bend.granicus.com/MetaViewer.php?view_id=5&clip_id=299&meta_id=6602

If legal counsel agrees with this interpretation, the City should consider the following approach to annexation:

1. **Update annexation policies and procedures**. The City should review and revise annexation policies and procedures to ensure that they sufficiently establish the City's authority to require that land for parks be dedicated or acquired, and that annexation may be conditioned on the assurance that land for parks will be conveyed to the City. The policy should describe the importance of complete implementation of community plans and provision of the full range of services, including parks and associated recreation facilities. The policy should also state that the amount and location of the land will be based on adopted plans, but may be revised to account for a change in circumstances. The policy may also establish that annexation agreements include time limits to ensure that the proposed development occurs in a reasonable timeframe. The City may also consider including provisions that SDC credits will be made available toward future development in exchange for land dedications.
2. **Leverage annexation agreements to assure acquisition of park lands.** The City should utilize the flexible and voluntary nature of annexation agreements to assure that sufficient land will be conveyed to the City for parks. The terms of the annexation agreement should specify the amount and approximate location of land to be acquired. The final boundaries of the park may be platted at the development review stage. Satisfying the terms of the annexation agreement will be a condition of approval for any proposed development.

Acquisition through development review

Some planned parks are located on lands already annexed into the City of Gresham; thus, absent a friendly sale, parks would need to be acquired through the development review process. As outlined above, the legal context for a regulatory requirement that land be acquired for parks during development review is subject to more scrunity related to takings claims than an annexation agreement. The Development Code should specify the criteria, standards, and process that will govern the land acquisition. The following is an outline of the general code concepts that need to be addressed and discussion of potential options for how to structure the regulations.

1. **Authority and Purpose.** The code will need to establish that the City has the authority to require dedication or acquisition, with compensation, pursuant to the provisions of the code section. This section may also establish the general purpose of the code provision to ensure the implementation of the parks plan and create complete communities.
2. **Relationship to Parks SDCs.**
    - *Purpose in Conjunction with SDCs.* The code should explain the relationship of this requirement to the parks SDCs. An initial recommendation is to describe that the parks SDCs provide a revenue source to pay for the cost of land acquisition but do no ensure that specific location are preserved for park uses. This code provision, as part of the City's land use regulations, ensures that lands designated for parks are used for parks.

- *SDC Credits.* A developer may receive a credit on the parks SDC for the cost of land if the land is dedicated to the City. If the developer is compensated for the land then they will not be eligible for a SDC credit, except if making park-related improvements.

3. **Applicability.** The code should specify the applicability of this regulation to both the park locations and the types of development.
   - *Park locations.* The Gresham Parks Master Plan does not include a map of planned parks. However, the parks SDC Methodology includes a specific list and map of planned park projects. Parks are also identified in the Pleasant Valley Plan District. The code should specify the planned park locations that will be the primary basis for determining lands that need to be acquired for parks. Additionally, the City may elect to include a discretionary criterion that allows for the location of the park to be adjusted or a new park location determined in order to meet an identified need in the Parks Master Plan, or other City requirement, such as conditions of approval of a development agreement.
   - *Types of development.* The code should specify the types and sizes of development that will be subject to this requirement. A minimum size of the subdivision may be established, for example. The City should consider if the requirement should be applicable to Planned Developments or multi-family developments. The code may also address how this provision applies to phased developments.
4. **Proportional Dedication.** This section could establish that the City will require a dedication of land that is proportional to the impact of the development, based on a level of service standard. If the land is dedicated to the City (not purchased), then the developer would be eligible for a SDC credit for the value of the dedication. If the land is purchased, then the developer has been compensated and they are still obligated to contribute SDCs. As noted above, the City has options for how to set the level-of-service standard that will apply:
   - *Single Citywide Standard.* The City may adopt a single citywide standard for how much park land is required based on the size of the development (number of dwelling units). The City has adopted LOS standards in both the Parks Master Plan and the SDC Methodology. Either standard may be used, but legal counsel should advise on the legal basis of the standard. In some cases, the amount of land owned and proposed for development in an area designated for a park may be greater than the amount of land that can be required of the developer under a proportional calculation.
   - *District Standards.* As defined by the City's SDC methodology, the City may define multiple standards based on the location of the development. The SDC methodology defines standards for the City generally, the Pleasant Valley area, and the Springwater area. The advantage of this approach is that the City can ensure that the amount of land dedicated is sufficient to meet the specific park needs of different areas of the City.
5. **Supplemental Purchase.** This section could establish that, in some circumstances, the City will offer to purchase additional land to be used for the park. The City could consider language that states that the acquisition of land is required in order to approve the development; however, legal counsel should advise as to whether the adoption of such a

requirement (in conjuction with a map identifying specific properties) in itself could be argued to represent an action that requires compensation (regulatory taking). As noted above, in the case of an unwilling seller, the City has an option to consider condemnation.

6. **Procedures.** The code should establish the procedures by which the land will be dedicated or acquired, including the following.
   - *Documentation*. The code should define the legal documentation necessary to convey the land and when it must be finalized relative to approval of the development.
   - *Land valuation*. The City has options for how to determine the market value of the land for the purposes of public acquisition, or in the case of dedication, SDC credits.
     - The valuation could be based on a standardized rate applied citywide or based on a subarea of the city. This may be the same rate used in the SDC Methodology. The advantage of this approach is that it is simple to administer. The disadvantages include that it may not be sufficient to cover the actual cost of land if the rate is not representative of the cost in areas where parks are needed, or that the rate does not keep up with the cost of land as it increases over time.
     - The valuation could be based on an appraisal of the land. The code should specify some terms of the appraisal, including when it occurs relative to development approval and what assumptions are made about the status of the land and capacity for development. The City may consider consulting a land appraiser when drafting this section.
   - *Status of land.* The code may specify standards for the status of the land at the time it is acquired. An environmental assessment may be required prior to acquisition. The City may require that the developer clear, fill, and/or grade the land, or even install frontage improvements.