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MEMORANDUM

Date:	June 18, 2018	Project #: 21266.5
To:	Gerald Fisher and Dan Huff, City of Molalla Gail Curtis, Oregon Department of Transportation, Region 1	
From:	Matt Bell and Nick Gross, Kittelson and Associates, Inc.	
Project:	Molalla Transportation System Plan (TSP) Update	
Subject:	Final Tech Memo 6: TSP Solutions (Subtask 5.4)	

This memorandum identifies potential solutions to address the gaps and deficiencies identified in *Tech Memo 4: Existing Transportation System* and the needs identified in *Tech Memo 5: Future Needs Analysis*. The solutions include:

- Transportation System Management and Operations (TSMO)
- Access Management
- Safety
- Pedestrian, Bicycle, and Transit
- Street System Connectivity
- Freight Mobility and Reliability
- Roadway Capacity

The solutions include potential plans, policies, programs, and projects for inclusion in the Molalla Transportation System Plan (TSP) update. The solutions considered complete, incomplete, and no longer viable solutions from the 2001 TSP and identifies new solutions developed throughout the planning process. The solutions were screened for obvious environmental, engineering, and land use fatal flaws and anticipated funding capacity. These solutions were reviewed by the project Technical Advisory Committee (TAC), Project Advisory Committee (PAC), and general public to determine if they should move forward into the Draft TSP update and to identify the highest priorities for limited funding.

TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS

Transportation Demand Management (TDM) and Transportation System Management (TSM) are two complementary approaches to managing transportation and maximizing the efficiency of the existing system. Together, these strategies are referred to as Transportation System Management and Operations (TSMO). TDM addresses the *demand* on the system: the number of vehicles traveling on the roadways each day. TDM measures include any method intended to shift travel demand from single occupant vehicles to non-auto modes or carpooling, travel along less congested roadways, or at less congested times of the day. TSM addresses the *supply* of the system: using strategies to improve the system efficiency without increasing roadway widths or building new roads. TSM measures are focused on improving operations by enhancing capacity during peak times, typically with advanced technologies to improve traffic operations.

Solutions

Successful implementation of TSMO strategies relies on the participation of a variety of public and private entities. Strategies can be implemented by the city, a neighborhood, or particular employer. In addition, they can be categorized as policies, programs, or physical infrastructure investments. Table 1 provides a summary of potential measures that can be implemented within Molalla and which entities are generally in the position to implement each one. As the city continues to grow and redevelop over the next 10 to 20 years, the applicability of these strategies can be further reviewed. Additional information on potential strategy implementation within Molalla is discussed below.

Table 1: Transportation System Management and Transportation Demand Management Solutions

TSMO Strategy	TDM or TSM?	Type of Investment	City	State	Transit Provider	Employers	Developer s
Parking management	TSM/TDM	Policy	P		S	S	S
Limited/flexible parking requirements	TDM	Policy	P			S	S
Access management	TSM/TDM	Policy/ Infrastructure	P	P			
Connectivity standards	TSM/TDM	Policy/ Infrastructure	P	P			
Congestion pricing	TSM/TDM	Policy/ Infrastructure	P	P			
Flexible Work Shifts	TDM	Program/Policy	S			P	
Frequent transit service	TDM	Program	S		P		
Free or subsidized transit passes	TDM	Program	S			P	
Preferential carpool parking	TDM	Program	S			P	
Carpool match services	TDM	Program	P		S	S	
Collaborative marketing	TDM	Program	S			P	
Parking cash out	TDM	Program	S			P	
Carsharing program support	TDM	Program	S			P	
Bicycle facilities	TDM	Infrastructure	P	S	S	S	S
Pedestrian Facilities	TDM	Infrastructure	P	S	S	S	S
Intelligent Transportation Systems (ITS)	TSM	Infrastructure	S	P			
Signal System Improvements	TSM	Infrastructure	S	P			
Advanced signal systems	TSM	Infrastructure	S	P			
Real time traveler information	TSM	Infrastructure	S	P			
Real-time transit information	TSM	Infrastructure	S	P			

TMA: Transportation Management Association – A TMA does not exist in Molalla
P: Primary role
S: Secondary/Support role

The following section provides more detail on programming and infrastructure solutions that may be effective for managing transportation demand and increasing system efficiency in the City of Molalla, especially within the next 10 to 20 years.

Programming

Programming solutions can provide effective and low-cost options for reducing transportation demand. Some of the most effective programming strategies can be implemented by employers and are aimed at encouraging non-single occupancy vehicle (SOV) commuting. These strategies are discussed below.

Carpool Match Services

Municipalities can coordinate rideshare/carpool programs to allow regional commuters to find other commuters with similar routes to work. Similar programs allow commuters to connect and coordinate with others on locations, departure times, and driving responsibilities. Local employers can also play a role in encouraging carpooling by sharing information about the system, providing preferential carpooling parking, and allowing employees to have flexibility in workday schedules.

Collaborative Marketing

Public agencies, local business owners and operators, developers, and transit service providers can collaborate on marketing to get the word out to residents about transportation options that provide an alternative to single-occupancy vehicles.

Policy

Policy solutions can be implemented by cities, counties, regions, or at the statewide level. Regional and state-level policies will affect transportation demand in Molalla, but local policies can also have an impact. These policies are discussed below.

Limited and/or Flexible Parking Requirements

Cities set policies related to parking requirements for new developments. In order to allow developments that encourage multi-modal transportation, cities can set parking maximums and low minimums and/or allow for shared parking between uses. Cities can also provide developers the option to pay in-lieu fees instead of constructing additional parking. This option provides additional flexibility to developers that can increase the likelihood of development, especially on smaller lots where surface parking would cover a high portion of the total property.

Cities can also set policies that require provision of parking to the rear of buildings, allowing buildings in commercial areas to directly front the street. This urban form creates a more appealing environment for walking and window-shopping. In-lieu parking fees support this type of development for parcels that do not have rear- or side-access points.

Parking Management

Parking plays a large role in transportation demand management, and effective management of parking resources can encourage use of non-single occupancy vehicle modes. Cities can tailor policies to charge for public parking in certain areas or impose time limits on street parking in retail centers. Cities can also monitor public parking supply and utilization in order to inform future parking strategy.

Access Management

Access management describes a practice of managing the number, placement, and allowed movements at intersections and driveways that provide access to adjacent land uses. Access management policies can be an important tool to improve transportation system efficiency by limiting the number of opportunities for turning movements on to or off of certain streets.

In addition, well deployed access management strategies can help manage travel demand by improving travel conditions for pedestrian and bicycles. Eliminating the number of access points on roadways allows for continuous sidewalk and bicycle facilities and reduces the number of potential interruptions and conflict points between pedestrians, bicyclists, and motor vehicles.

Access management is typically adopted as a policy in development guidelines. It can be extremely difficult to implement an access management program once properties have been developed along a corridor. Cooperation among and involvement of relevant government agencies, business owners, land developers and the public is necessary to establish an access management plan that benefits all roadway users and businesses. Additional information on potential access management solutions is provided in a following section.

Infrastructure

Some infrastructure solutions can increase the capacity of the transportation system without creating a significant impact to adjacent properties. These solutions are discussed below.

Signal Systems Improvements

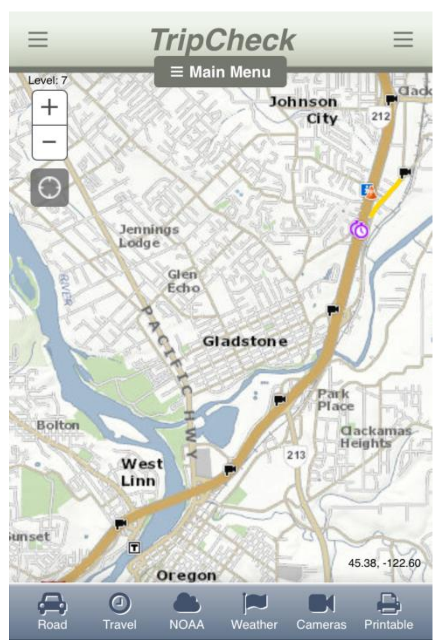
Signal retiming and optimization offer a relatively low-cost option to increase system efficiency. Retiming and optimization refers to updating timing plans to better match prevailing traffic conditions and coordinating signals. Timing optimization can be applied to existing systems or may include upgrading signal technology, such as signal communication infrastructure, signal controllers, or cabinets. Signal retiming can reduce travel times and be especially beneficial to improving travel time reliability. In high pedestrian or desired pedestrian areas, signal retiming can facilitate pedestrian movements through intersections by increasing minimum green times to give pedestrians time to cross during each cycle, eliminating the need to push pedestrian crossing buttons. Signals can also facilitate bicycle movements with the inclusion of bicycle detectors.

Signal upgrades often come at a higher cost and usually require further coordination between jurisdictions. However, upgrading signals provides the opportunity to incorporate advanced signal systems to further improve the efficiency of a transportation network. Strategies include coordinated signal operations across jurisdictions, centralized control of traffic signals, adaptive or active signal control, and transit or freight signal priority. These advanced signal systems can reduce delay, travel time and the number of stops for transit, freight, and other vehicles. In addition, these systems may help reduce vehicle emissions and improve travel time reliability. The following signal system solutions have been identified for consideration within Molalla:

- **Adaptive or active signal control** systems improve the efficiency of signal operations by actively changing the allotment of green time for vehicle movements and reducing the average delay for vehicles. Adaptive or active signal control systems require several vehicle detectors at intersections to detect traffic flows adequately, in addition to hardware and software upgrades.
- **Traffic responsive control** uses data collected from traffic detectors to change signal timing plans for intersections. The data collected from the detectors is used by the system to automatically select a timing plan best suited to current traffic conditions. This system can determine times when peak-hour timing plans begin or end; potentially reducing vehicle delays.
- **Truck signal priority** systems use sensors to detect approaching heavy vehicles and alter signal timings to improve truck freight travel. While truck signal priority may improve travel times for trucks, its primary purpose is to improve the overall performance of intersection operations by clearing any trucks that would otherwise be stopped at the intersection and subsequently have to spend a longer time getting back up to speed. Implementing truck signal priority requires additional advanced detector loops, usually placed in pairs back from the approach to the intersection.

Real-Time Traveler Information

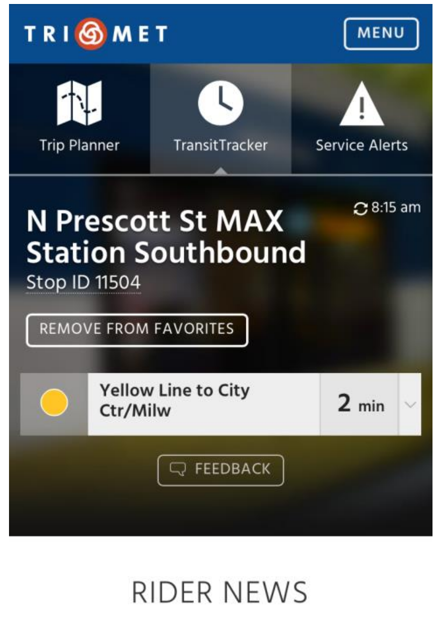
Traveler information consists of collecting and disseminating real-time transportation system information to the traveling public. This includes information on traffic and road conditions, general public transportation and parking information, interruptions due to roadway incidents, roadway maintenance and construction, and weather conditions. Traveler information is collected from roadway sensors, traffic cameras, vehicle probes, and more recently, media access control (MAC) devices such as cell phones or laptops. Data from these sources are sent to a central system and subsequently disseminated to the public so that drivers track conditions specific to their cars and can provide historical and real-time traffic conditions for travelers.



When roadway travelers are supplied with information on their trips, they may be able to avoid heavy congestion by altering a travel path, delaying the start of a trip, or changing which mode they can choose. This can reduce overall delay and fuel emissions. Traveler information projects can be prioritized over increasing capacity on roadway, often with high project visibility among the public.

Real-Time Transit Information

Transit agencies or third-party sources can disseminate both schedule and system performance information to travelers through a variety of applications, such as in-vehicle, wayside, or in-terminal dynamic message signs, as well as the Internet or wireless devices. Coordination with regional or multimodal traveler information efforts can increase the availability of this transit schedule and system performance information. TriMet has implemented this through its Transit Tracker system.



These systems enhance passenger convenience and may increase the attractiveness of transit to the public by encouraging travelers to consider transit as opposed to driving alone. They do require cooperation and integration between agencies for disseminating the information.

Improvements

- Lead or provide support of potential TSM and TDM strategies within the City
- Identify opportunities for collaborative marketing with local business owners and operators, developers, and transit service providers
- Update the Molalla Municipal Code to limit and/or allow for flexible parking requirements – Tech Memo 7: Regulator Solutions identifies potential changes to the Molalla Municipal Code (MMC)
- Develop access management standards for city streets that reflect the functional classification of the roadway – Additional information on potential access management measures is provided below
- Invest in infrastructure improvements that increase the efficiency of the transportation system and provide real-time traveler and transit information for commuters.

ACCESS MANAGEMENT

The Oregon Highway Plan (OHP) defines access management as a set of measures regulating access to streets, roads, and highways, from public roads and private driveways. Measures may include but are not limited to restrictions on the siting of interchanges, restrictions on the type and amount of access to roadways, and use of physical controls, such as signals and channelization including raised medians, to reduce impacts of approach road traffic on the main facility. The OHP requires that new connections to arterials and state highways be consistent with designated access management categories. The intent of this requirement is to provide guidance on the spacing of future extensions and connections along existing and future streets that are needed to provide reasonably direct routes for bicycle and pedestrian travel.

Solutions

The TSP should identify access management techniques and strategies that help to preserve transportation system investments and guard against deteriorations in safety and increased congestion. The City's approach to access management should balance the need for land use activities and property parcels to be served with appropriate access while preserving safe and efficient movement of traffic. Access management solutions include:

- Setting city-wide access spacing standards according to the functional classification plan;
- Obtaining special area designations along ODOT facilities that have alternative access spacing standards;
- Defining a variance process for when the standard cannot be met, and;
- Establishing an approach for access consolidation over time to move in the direction of the standards at each opportunity.

Access Spacing Standards

ODOT Standards

Oregon Administrative Rule 734, Division 51 establishes procedures, standards, and approval criteria used by ODOT to govern highway approach permitting and access management consistent with Oregon Revised Statutes (ORS), Oregon Administrative Rules (OAR), statewide planning goals, acknowledged comprehensive plans, and the OHP. The OHP serves as the policy basis for implementing Division 51 and guides the administration of access management rules, including mitigation and public investment, when required, to ensure highway safety and operations pursuant to this division.

Access spacing standards for approaches to state highways are based on the highway classification, highway designation, area type, and posted speed. Within the Molalla, the OHP classifies OR 213 and OR 211 as District Highways. Future developments along OR 213 and OR 211 (new development, redevelopment, zone changes, and/or comprehensive plan amendments) will be required to meet the OHP access management policies and standards. Table 2 summarizes ODOT's current access management standards for OR 213 and OR 211 per the OHP.

Table 2: OR 213 and OR 211 ODOT Access Spacing Standards

Posted Speed	Spacing Standards Rural Areas[1]	Spacing Standards Rural Areas	Spacing Standards for Areas Designated as UBAs	Spacing Standards for areas Designated as STAs
55 or higher	700	700	-	
50	550	550	-	
40 & 45	500	500	-	
30 & 35	400	350	350[1]	300[2]
25 & lower	400	250	350[1]	300[2]

Note: These access spacing standards do not apply to approaches in existence prior to April 1, 2000 except as provided in OAR 734-051-5120(9).
1. Measurement of the approach road spacing is from the center on the same side of the roadway.
2. Minimum spacing standards for public road approaches is the existing city block spacing (approximately 300 feet in Molalla); private driveways spacing is a minimum of 175 feet.

City Standards

Access spacing standards for approaches to City streets are based on the roadway functional classification. Molalla Municipal Code Section 17.3.3.030 indicates that "minimum distances shall be maintained between approaches and street intersections consistent with the current version of the Public Works Design Standards and Transportation System Plan." Table 3 identifies the City's access spacing standards per the current TSP.

Table 3: Access Spacing Standards

Functional Classification	Public Street (Feet)	Private Access Drive (Feet)
Local Street	150	50
Neighborhood Collector	300	100
Major Collector/Arterial[1]	600	150
Molalla Forest Road	800	N/A[2]

1. ODOT standards supersede these values on ODOT facilities
2. Not allowed unless no other access possible. Access may be limited to right-in, right-out

In addition to access spacing standards, the City could adopt a policy that requires access be taken from lower classification streets whenever possible.

Access Spacing Variances

Access spacing variances may be provided to parcels whose highway/street frontage, topography, or location would otherwise preclude issuance of a conforming permit and would either have no reasonable access or cannot obtain reasonable alternate access to the public road system. In such a situation, a conditional access permit may be issued by ODOT or the City, as appropriate, for a connection to a property that cannot be accessed in a manner that is consistent with the spacing standards. The permit can carry a condition that the access may be closed at such time that reasonable access becomes available to a local public street. The approval condition might also require a given land owner to work in cooperation with adjacent land owners to provide either joint access points, front and rear cross-over easements, or a rear access upon future redevelopment.

The requirements for obtaining a deviation from ODOT's minimum spacing standards are documented in OAR 734-051-3050. For streets under the City's jurisdiction, the City may reduce the access spacing standards at the discretion of the City Engineer if the following conditions exist:

- Joint access driveways and cross access easements are provided in accordance with the standards;
- The site plan incorporates a unified access and circulation system in accordance with the standards;
- The property owner enters into a written agreement with the City that pre-existing connections on the site will be closed and eliminated after construction of each side of the joint use driveway; and/or,

- The proposed access plan for redevelopment properties moves in the direction of the spacing standards.

The City Engineer may modify or waive the access spacing standards for streets under the City's jurisdiction where the physical site characteristics or layout of abutting properties would make development of a unified or shared access and circulation system impractical, subject to the following considerations:

- Unless modified, application of the access standard will result in the degradation of operational and safety integrity of the transportation system.
- The granting of the variance shall meet the purpose and intent of these standards and shall not be considered until every feasible option for meeting access standards is explored.
- Applicants for variance from these standards must provide proof of unique or special conditions that make strict application of the standards impractical. Applicants shall include proof that:
  - Indirect or restricted access cannot be obtained;
  - No engineering or construction solutions can be applied to mitigate the condition; and,
  - No alternative access is available from a road with a lower functional classification than the primary roadway.

No variance shall be granted where such hardship is self-created. Consistency between access spacing requirements and exceptions in the TSP and MMC is an important regulatory solution to be addressed as part of this TSP update.

From an operational perspective, access management measures limit the number of redundant access points along roadways. This enhances roadway capacity, improves safety, and benefits circulation. Enforcement of the access spacing standards should be complemented with provision of alternative access points. Purchasing right-of-way and closing driveways without a parallel road system and/or other local access could seriously affect the viability of the impacted properties. Thus, if an access management approach is taken, alternative access should be developed to avoid "land-locking" a given property.

As part of every land use action, the City should evaluate the potential need for conditioning a given development proposal with the following items in order to maintain and/or improve traffic operations and safety along the arterial and collector roadways.

- Providing access only to the lower classification roadway when multiple roadways about the property.
- Provision of crossover easements on all compatible parcels (considering topography, access, and land use) to facilitate future access between adjoining parcels.
- Issuance of conditional access permits to developments having proposed access points that do not meet the designated access spacing policy and/or have the ability to align with opposing driveways.

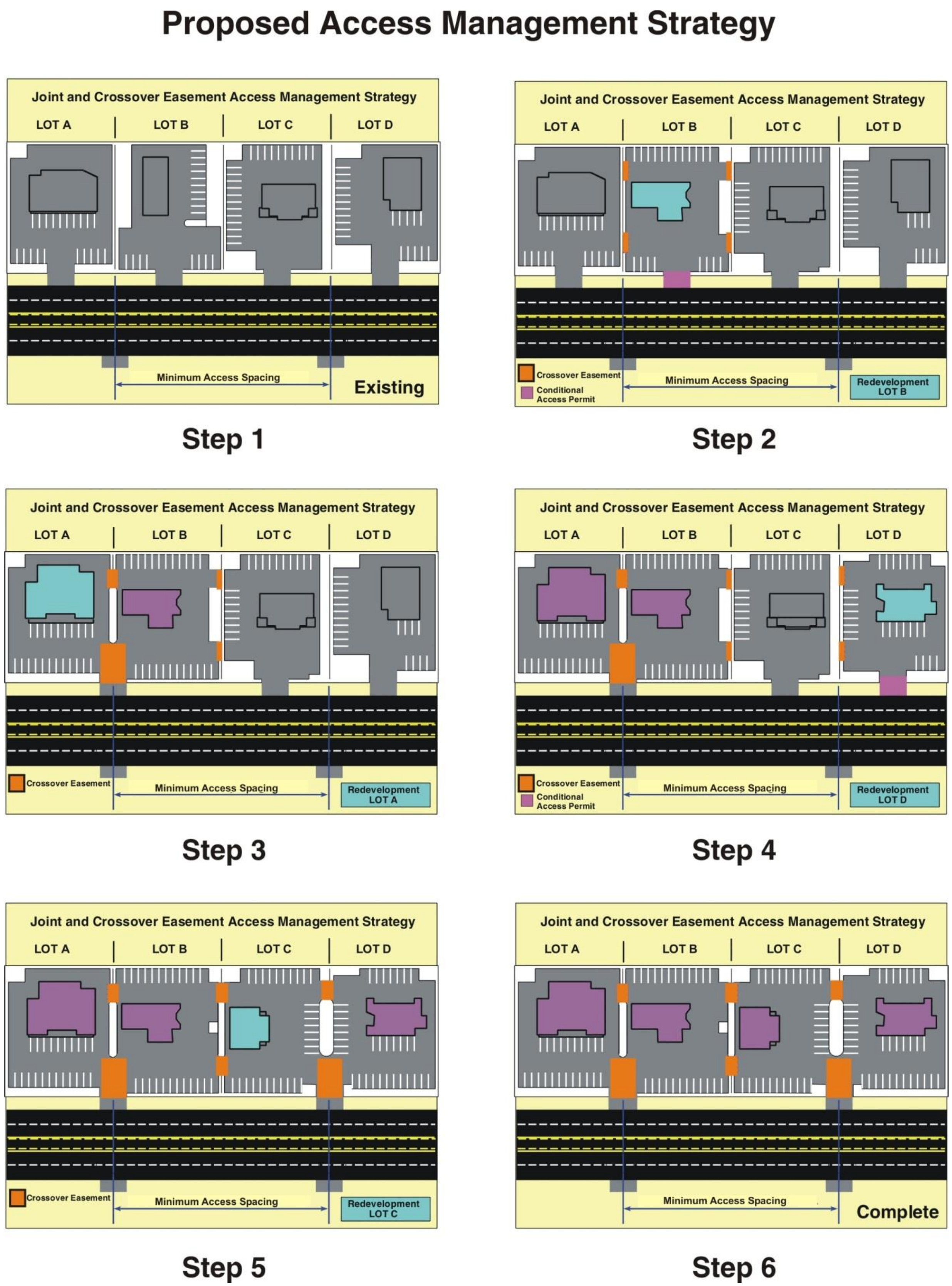
- Right-of-way dedications to facilitate the future planned roadway system in the vicinity of proposed developments.
- Half-street improvements (sidewalks, curb and gutter, bike lanes/paths, and/or travel lanes) along site frontages that do not have full build-out improvements in place at the time of development.

Exhibit 1 illustrates the application of cross-over easements and conditional access permits over time to achieve access management objectives. The individual steps are described in Table 4. As illustrated in the exhibit and supporting table, by using these guidelines, all driveways along the highways can eventually move in the overall direction of the access spacing standards as development and redevelopment occur along a given street.

Table 4: Example of Crossover Easement/Indenture/Consolidation

Step	Process
1	EXISTING – Currently Lots A, B, C, and D have site-access driveways that neither meet the access spacing criteria of 500 feet nor align with driveways or access points on the opposite side of the highway. Under these conditions motorists are into situations of potential conflict (conflicting left turns) with opposing traffic. Additionally, the number of side-street (or site-access driveway) intersections decreases the operation and safety of the highway
2	REDEVELOPMENT OF LOT B – At the time that Lot B redevelops, the City would review the proposed site plan and make recommendations to ensure that the site could promote future crossover or consolidated access. Next, the City would issue conditional permits for the development to provide crossover easements with Lots A and C, and ODOT/City would grant a conditional access permit to the lot. After evaluating the land use action, ODOT/City would determine that LOT B does not have either alternative access, nor can an access point be aligned with an opposing access point, nor can the available lot frontage provide an access point that meets the access spacing criteria set forth for segment of highway.
3	REDEVELOPMENT OF LOT A – At the time Lot A redevelops, the City/ODOT would undertake the same review process as with the redevelopment of LOT B (see Step 2); however, under this scenario ODOT and the City would use the previously obtained cross-over easement at Lot B consolidate the access points of Lots A and B. ODOT/City would then relocate the conditional access of Lot B to align with the opposing access point and provide and efficient access to both Lots A and B. The consolidation of site-access driveways for Lots A and B will not only reduce the number of driveways accessing the highway, but will also eliminate the conflicting left-turn movements the highway by the alignment with the opposing access point.
4	REDEVELOPMENT OF LOT D – The redevelopment of Lot D will be handled in same manner as the redevelopment of Lot B (see Step 2)
5	REDEVELOPMENT OF LOT C – The redevelopment of Lot C will be reviewed once again to ensure that the site will accommodate crossover and/or consolidated access. Using the crossover agreements with Lots B and D, Lot C would share a consolidated access point with Lot D and will also have alternative frontage access the shared site-access driveway of Lots A and B. By using the crossover agreement and conditional access permit process, the City and ODOT will be able to eliminate another access point and provide the alignment with the opposing access points.
6	COMPLETE – After Lots A, B, C, and D redevelop over time, the number of access points will be reduced and aligned, and the remaining access points will meet the access spacing standard.

Exhibit 1: Cross Over Easement



Improvements

- Develop city-wide access spacing standards according to a roadway's functional classification
- Define a variance process for when the standard cannot be met (See above)
- Establishing an approach for access consolidation over time to move in the direction of the standards at each opportunity (See above)

TRAFFIC SAFETY

Traffic safety plays an important role in determining the most appropriate solutions for a given gap or deficiency, particularly in areas where real or perceived safety risks may prevent people from using more active travel modes, such as walking, biking, and taking transit. The real or perceived safety risks may reflect the crash history of an area or the physical and/or operational characteristics of the roadways (narrow travel lanes, winding curves, steep grades, high traffic volumes, high travel speeds, excessive heavy vehicles, etc.). Several methodologies have been developed to analyze and identify solutions for addressing traffic safety within an area. Many of which are documented in the Highway Safety Manual (HSM) as well as several other resources developed by ODOT for addressing safety along roadway segments, at intersections, and for pedestrian and bicyclists.

Solutions

This section summarizes the solutions considered for implementation within the City of Molalla to address traffic safety along roadway segments, at intersections, and/or for pedestrian and bicyclists. Note: many of the solutions overlap with solutions identified under the pedestrian, bicycle, and motor vehicle sections, which illustrates how some solutions address multiple transportation issues.

Roadway Segments

There are a variety of potential safety solutions that can be applied within Molalla to address systemic crashes that occur along roadway segments, such as head-on collisions, sideswipes, and run off the road crashes as well as general speeding and other driver behaviors.

- Enhanced signs and pavement markings for curves (with and without flashing beacons)
- Rumble strips (e.g. centerline, shoulder line, and edge line)
- Tree/vegetation removal
- Traffic calming
- Enhanced enforcement
- Road diet

Intersections

There are a variety of potential safety solutions that can be applied within Molalla to address systemic crashes that occur at intersections, such as angled crashes, turning movement crashes, rear-end crashes, and crashes that involve other travel modes (pedestrian, and bicycles).

- Enhanced signs and pavement markings (e.g. stop signs, warning signs, and/or beacons)
- Application of traffic control devices (signs, markings and signals)
- Signal improvements (e.g. signal timing, signal phasing)
- Left-turn phasing (e.g. permitted, protected, permitted-protected)
- Enhanced enforcement
- Pedestrian and bicycle improvements (see below)
- Intersection lighting
- Traffic calming

Pedestrian and Bicycle

There are a variety of potential safety solutions that can be applied within Molalla to address pedestrian and bicycle safety. The following provides a summary of the solutions by traffic control.

Signalized Intersections

Pedestrian Safety Solutions

- Street lighting
- Right-turn channelization
- Countdown pedestrian heads
- Leading pedestrian interval
- Left-turn phasing
- Vehicle turning movement restrictions
- Curb extensions (bulb-outs, neck downs)

Bicycle Safety Solutions

- Street lighting
- Bicycle signal
- Bicycle detection
- Pavement markings
- Right-turn channelization
- Leading bicycle interval
- Left-turn phasing
- Vehicle turning movement restrictions
- Protected intersection design
- Forward bicycle queueing area (bike box)

Unsignalized intersections

Pedestrian Safety Solutions

- Street lighting
- Enhanced crossing treatments
- Reduced curb radii
- Pedestrian refuge island or median
- Speed reduction treatments
- Vehicle turning movement restrictions
- Raised crosswalks

Bicycle Safety Solutions

- Street lighting
- Enhanced crossing treatments
- Reduced curb radii
- Skip Striping
- Supplemental signs and markings
- Bicycle boulevards
- Longitudinal bike stencil
- Speed reduction treatments
- Vehicle turning movement restrictions
- Strip bike lanes
- Raised crossings

Roadway segment – No traffic control

Pedestrian Safety Solutions

- Street lighting
- In-roadway warning lights
- Pedestrian-activated warning beacons
- Access management
- Sidewalks Street lighting
- Enhanced mid-block crossing treatments
- Road Diet
- Pedestrian refuge island or median

Bicycle Safety Solutions

- Access management
- Bicycle route signage
- Longitudinal bike stencil
- Separated bike lanes
- Dynamic warning signs
- Enhanced mid-block crossing treatments
- Street lighting
- Restrict on-street parking
- Road Diet
- Refuge Island or median

Improvements

A majority of the safety improvements are addressed within subsequent sections of this memorandum for the pedestrian, bicycle, and motor vehicle systems, with the exception of the safety improvements at a few key roadways and intersections described below. Improvements along OR 213 and OR 211 will require coordination with ODOT and approval from the State or Regional Traffic Engineer.

OR 213

The 2001 TSP identifies OR 213 as having inadequate shoulder widths and a narrow roadway cross section between OR 211 and Vick Road. To address these issues, the 2001 TSP recommends that the roadway be widened to include a center turn lane and shoulders. Per the 2001 TSP, the widening is intended to enhance the safety of the roadway by providing space for slowed or stopped vehicles waiting to turn left and by providing space for vehicles to pull off the roadway during an emergency. To ensure the proper amount of widening, the 2001 TSP recommends that the open ditches be filled and replaced with a culvert drainage system. This enhancement would not only increase the shoulder width to address vehicular safety needs but may also increase the available space to accommodate bicyclist and pedestrians (e.g. bike lanes, sidewalks, etc.). The estimated cost of the project (in 2001 dollars) is $500,000 per mile.

Since the adoption of the 2001 TSP, the safety enhancements noted above have not been implemented; however, they are still viable and needed from a safety perspective. As a state facility, ODOT is the appropriate funding source, but City participation would likely be needed.

OR 211

The 2001 TSP identifies Molalla Forest Road as a downtown bypass, rerouting a significant amount of traffic from OR 211 around downtown Molalla, effectively reducing the role of OR 211 as the predominate east-west travel corridor. The 2001 TSP also identifies the need to reconstruct the section of OR 211 east of Molalla Forest Road to include two travel lanes, a center turn-lane, bike lanes, and sidewalks. These improvements were noted as having the ability to reduce the hazards associated with the existing narrow travel lanes and lack of shoulder width. To accommodate the extra roadway width, the 2001 TSP recommends that the existing open drainage ditches be filled in and replaced with a culvert drainage system. This enhancement would not only increase the shoulder width to address vehicular safety needs but may also increase the available space to accommodate bicyclist and pedestrians through their respected facilities (e.g. bike lanes, sidewalks, etc.). The estimated cost of the project (in 2001 dollars) is $500,000 per mile.

Since the adoption of the 2001 TSP, Molalla Forest Road and the safety enhancements noted above have not been constructed. While Molalla Forest Road may no-longer be developed as a downtown bypass, improvements to Molalla Forest Road and the safety enhancements noted above are still viable and needed from a safety perspective. Further details on the potential solutions and improvements to Molalla Forest Road are covered in the Capacity Based Solutions and Freight Mobility Solution sections below.

OR 213/Toliver Road Intersection

As indicated in Tech Memo 4, the observed crash rate at the OR 213/Toliver Road intersection exceeds the critical crash rate by intersection volume as well as the 90th percentile rates for similar facilities shown in Table 4-1 of the ODOT APM. The ODOT Statewide Priority Index System (SPIS) also identifies the OR 213/Toliver Road intersection as a location within the top 10% of statewide SPIS sites over the last five-year period. The crash data shows a trend for angled, turning, and rear-end crashes at the intersection. Therefore, following improvements are being considered at the intersection:

- Widen OR 213 to provide separate left-turn lanes at the northbound and southbound approaches – this solution is consistent with the current TSP.
- Widen OR 213 to provide a continuous center two-way left-turn lane through the intersection.
- Install a traffic signal with protected or protected-permitted phasing at the northbound and southbound approaches when warranted – this solution is consistent with the current TSP. This solution will require widening as well as approval from the State or Regional Traffic Engineer.

OR 213/OR 211 Intersection

As indicated in Tech Memo 4, the observed crash rate at the OR 213/OR 211 intersection exceeds the critical crash rate by intersection volume. The crash data shows a trend of turning crashes at the intersection. Therefore, the following improvements are being considered at the intersection:

- Reduce the posted speed limit at the northbound, southbound, and eastbound approaches to 35 mph.
- Install flashing beacons on the advanced signal warning signs at all approaches and improve the signal hardware (i.e. lenses, reflective back plates, size, and number) to improve the visibility of the signal heads.
- Optimize the signal timing/phasing to improve the efficiency of the traffic signal.

OR 211/Molalla Avenue Intersection

As indicated in Tech Memo 4, the observed crash rate at the OR 211/Molalla Avenue intersection exceeds the critical crash rate by intersection volume. The crash data shows a trend of turning movement as well as rear-end crashes at the intersection. Therefore, the following improvements are being considered at the intersection:

- Install a traffic signal with permitted phasing at all approaches when warranted – this solution is consistent with the current TSP. This solution will require approval from the State or Regional Traffic Engineer.
- Install separate left-turn lanes at the eastbound and westbound approaches and install a traffic signal with protected or protected-permitted phasing when warranted. This solution would result in the removal of on-street parking.
- Prohibit left-turns during peak periods – this solution is consistent with the preferred solution identified in the OR 211 Streetscape Plan. This solution would result in reliance on the local street system and out-of-direction travel.

OR 211/Leroy Avenue

As indicated in Tech Memo 4, the observed crash rate at the OR 211/Leroy Avenue intersection exceeds the 90th percentile rate for similar facilities shown in Table 4-1 of the ODOT APM. The crash data shows a high proportion of rear-end crashes, particularly at the eastbound approach. Therefore, the following improvements are being considered at the intersection:

- Widen OR 211 to provide separate left-turn lanes at the eastbound and westbound approaches – this solution is consistent with the current TSP.
- Widen OR 211 to provide a continuous center two-way left-turn lane through the intersection.
- Install traffic signal with protected or protected-permitted phasing at the eastbound and westbound approaches when warranted – this solution is consistent with the current TSP. This solution will require widening as well as approval from the State or Regional Traffic Engineer.

OR 211/Mathias Road

As indicated in Tech Memo 4, the observed crash rate at the OR 211/Mathias Road intersection exceeds the 90th percentile rate for similar facilities shown in Table 4-1 of the ODOT APM. The crash data shows a high proportion of turn movement crashes involving westbound vehicles attempting to turn left without the right of way. Therefore, the following improvements are being considered at the intersection:

- Reduce posted speed limit along OR 211 to 25 mph prior to the intersection.
- Install enhanced signs with flashing beacons and pavement markings that “SLOW” traffic at the westbound approach.
- Widen OR 211 to provide a separate left-turn lane at the westbound approach.
- Reconfigure the intersection as a conventional “T” intersection – this improvement is consistent with the current TSP.
- Reconfigure the intersection as a roundabout – this improvement is consistent with the current TSP. This solution will require approval from the State or Regional Traffic Engineer.

City-wide

A number of safety issues have been identified throughout the planning process along key corridors through the city, including OR 213, OR 211, Toliver Road, and Molalla Avenue. While several projects have been identified along each of these corridors that will address some of the safety concerns, other concerns may not be addressed. Therefore, the following improvements are being considered to address safety issues throughout the city:

- Evaluate traffic safety along OR 213, OR 211, Toliver Road, Molalla Avenue, and other key corridors to identify appropriate counter measures.

PEDESTRIAN SYSTEM

Pedestrian facilities are the elements of the transportation system that enable people to walk safely and efficiently between neighborhoods, retail centers, employment areas, and transit stops. These include facilities for pedestrian movement along key roadways (e.g., sidewalks, multi-use paths, and trails) and for safe roadway crossings (e.g., crosswalks, crossing beacons, pedestrian refuge islands). Each facility plays an important role in developing a comprehensive pedestrian system.

Solutions

This section summarizes the solutions considered for implementation within the City of Molalla to address existing gaps and deficiencies and future needs in the pedestrian system.

Sidewalks

Sidewalks are the fundamental building blocks of the pedestrian system. They enable people to walk comfortably, conveniently, and safely from place to place. They also provide an important means of mobility for people with disabilities, families with strollers, and others who may not be able to travel on an unimproved roadside surface. Sidewalks are usually 6 to 8-feet wide and constructed from concrete. They are also frequently separated from the roadway by a curb, landscaping, and/or on-street parking. Sidewalks are widely used in urban and suburban settings. Ideally, sidewalks could be provided along both sides of the roadway; however, some areas with physical or right-of-way constraints may require that sidewalk be located on only one side. The sidewalk solutions include:

- Fill in the gaps
- Install sidewalks on one-side of the roadway
- Install sidewalks on both sides of the roadway
- Re-construct existing sidewalks with appropriate width and buffer

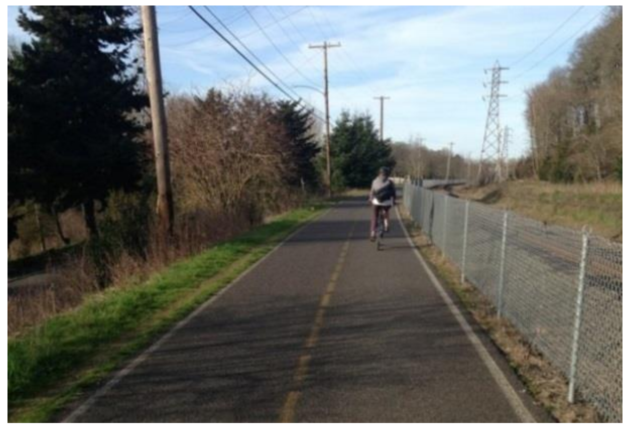
6-foot curb-tight sidewalk


6-foot sidewalk with buffer (landscape strip)

Shared-use Paths and Trails

Shared-use paths and trail are improved (i.e. paved) and unimproved (i.e. dirt and gravel) facilities that serve pedestrians and bicyclists. Shared-use paths and trails can be constructed adjacent to roadways where the topography, right-of-way, or other issues don't allow for the construction of sidewalks and bike facilities. A minimum width of 10 feet is recommended for low-pedestrian/bicycle-traffic contexts; 12 to 20 feet should be considered in areas with moderate to high levels of bicycle and pedestrian traffic. Shared-use paths and trails can be used to create longer-distance links within and between communities and provide regional connections. They play an integral role in recreation, commuting, and accessibility due to their appeal to users of all ages and skill levels.

Shared-use Path



Shared-use Paths and Trails

Enhanced Pedestrian Crossings

Pedestrian crossing facilities enable pedestrians to safely cross streets, railroad tracks, and other transportation facilities. Planning for appropriate pedestrian crossings requires the community to balance vehicular mobility needs with providing crossing locations along the desired routes of walkers. Enhanced pedestrian crossing treatments include:

- Curb extensions
- Raised median islands
- Crosswalk striping
- Crosswalk signs
- Flashing beacons
- Pedestrian signals
- Pedestrian countdown heads
- Leading pedestrian interval

Many of the treatments listed above can be applied together at one crossing location to further alert drivers of the presence of pedestrians in the roadway. See Attachment "A" for a detailed description of enhanced pedestrian crossing treatments.

Improvements

The following improvements have been organized by streets segment, intersection, and off-street improvements. Where there are multiple improvements, the preferred improvements were identified based on an evaluation of environmental, engineering, land use "fatal flaws" and anticipated funding capacity as well as discussions with the project team, advisory committees, and the general public.

Street Segment Improvements

The following street segment improvements have been organized by functional classification. It should be noted that all improvements along ODOT facilities will require coordination with ODOT and all improvements that involve street lighting will require an intergovernmental agreement (IGA) with the City and Portland General Electric (PGE) for maintenance.

Arterials

OR 213

OR 213 has a significant sidewalk gap along the east side of the roadway between Molalla Forest Road and the Safeway Fuel Station. Sidewalks also terminate along the east side of the roadway south of Crompton's Lane. The west side of the roadway does not provide sidewalks with the exception of the segment adjacent to the Les Schwab Tire facility. The pedestrian level of traffic stress (PLTS) analysis indicates that the majority of OR 213 is NOT suitable for most pedestrians. This is primarily due to the sidewalk gaps, lack of a buffer, limited street lighting, and relatively high traffic volumes and travel speeds. Therefore, the following improvements are being considered along the roadway.

- Fill in the gaps on east side of the roadway with new sidewalks of appropriate width by filling in and replacing the open ditches with a culvert drainage system.
- Fill in gaps on both sides of the roadway with new sidewalks of appropriate width by filling in and replacing the open ditches with a culvert drainage system.
- Install street lighting along the full length of the roadway as necessary.

OR 211

OR 211 has significant sidewalk gaps along both sides of the roadway between the western city limits and Molalla Avenue. Continuous sidewalks exist along both sides of OR 211 between Molalla Avenue and Mathias Road. There are no sidewalks east of Mathias Road on both sides of the roadway. The PLTS analysis indicates that the majority of the roadway between the western city limits and Molalla Avenue is NOT suitable for most pedestrians. This is primarily due to sidewalk gaps, lack of buffer, poor sidewalk conditions, limited street lighting, and relatively high traffic volumes and travel speeds. Therefore, the following improvements are being considered along the roadway.

- Fill in the gaps on both sides of the roadway with new sidewalks of appropriate width by filling and replacing the open ditches with a culvert drainage system.

- Evaluate light levels and install street lighting along the full length of the roadway as necessary.

Molalla Avenue

Molalla Avenue has continuous sidewalks along both sides of the roadway from Heintz Street to E 6th Street. The segment of Molalla Avenue between Heintz Street and E 3rd Street has recently undergone a roadway improvement project providing wider sidewalks, street tree plantings, benches, street lighting, and other pedestrian amenities. North and south of this segment, many of the sidewalks are intermittent or lacking entirely. The PLTS analysis indicates that the existing sidewalks north of Heintz Street and south of E 6th Street are NOT suitable for most pedestrians. Therefore, the following improvements are being considered along these sections of roadway.

- Fill in gaps on both sides of the roadway with new sidewalks of appropriate width.
- Remove the existing sidewalk and install new sidewalks of appropriate width along both sides of the roadway with landscape strips.
- Evaluate light levels and install street lighting along the full length of the roadway as necessary.

Molalla Avenue looking south

OR 211 looking west

Collectors

Toliver Road

Toliver Road has a continuous sidewalk on the south side of the roadway between Zimmerman Lane and Molalla Avenue with the exception of a short segment west of Creamery Creek Lane. A shared-use path exists along the south side of Toliver Road between OR 213 and Zimmerman Lane. The north side of Toliver Road has several sidewalk gaps throughout its entire length. The PLTS analysis indicates that the south side of Toliver Road between OR 213 and Molalla Avenue IS suitable for most pedestrians; however, the north side of Toliver Road between OR 213 and Molalla Avenue is NOT suitable for most pedestrian due to the sidewalk gaps. A short segment of sidewalk exists on the south side of Toliver Road west of OR 213, no sidewalks exists on the north side west of OR 213. Therefore, the following improvements are being considered along the roadway.

- Install enhanced pedestrian crossings at multiple locations along Toliver Road to provide access to the sidewalks on the south side of the roadway – see below for potential crossing locations.
- Fill in gaps on north side of the roadway between western city limits and Molalla Avenue with new sidewalks of appropriate width.
- Fill in gaps on both side of the roadway between western city limits and Molalla Avenue with new sidewalks of appropriate width.

Shirley Street

Shirley Street has a continuous sidewalk on the south side of the roadway between Molalla Avenue and Park Avenue. A shared-use path exists from Park Avenue to Steelhead Street on the south side of Shirley Street. There is a sidewalk gap along the south side from south of Steelhead Street to OR 211. No sidewalks are provided along the north side of Shirley Street between Molalla Avenue and Steelhead Street. Sidewalks are present on the north side of Shirley between Steelhead Street and OR 211. The PLTS analysis indicates that the north side of Shirley Street between Molalla Avenue and Steelhead Street is NOT suitable for most pedestrians. This is primarily due to sidewalk gaps. Therefore, the following improvements are being considered along the roadway.

- Fill in gaps on north side of the roadway with new sidewalks of appropriate width.
- Fill in gaps on both sides of the roadway with new sidewalks of appropriate width.
- Install a shared-use path as a continuation of the existing shared-use path along the south side of the roadway between Steelhead Street and OR 211.
- Evaluate light levels and install street lighting along the full length of the roadway as necessary.

Ridings Avenue

Several sidewalk gaps exists along both sides of Ridings Avenue for the full length of the roadway. The PLTS analysis indicates that the roadway is NOT suitable for most pedestrians. This is primarily due to the absence of sidewalk facilities. Therefore, the following improvements are being considered along the roadway.

- Fill in gaps on both sides of the roadway with new sidewalks of appropriate width.
- Evaluate light levels and install street lighting along the full length of the roadway as necessary.

Leroy Avenue

Leroy Avenue provides an important north-south connection between Toliver Road and OR 211 and serves as a primary pedestrian route to access the Molalla River Middle School. Leroy Avenue has a continuous sidewalk along the west side of the roadway for its full length. A significant sidewalk gaps exist along the east side of Leroy Avenue from Toliver Road to West Lane. The PLTS analysis indicates that the east side of the roadway may NOT be suitable for all pedestrians. This is primarily due to the absences of sidewalk facilities. Therefore, the following improvements are being considered along the roadway.

- Fill in gaps on east side of the roadway with new sidewalks of appropriate width for the full length of the roadway.
- Evaluate light levels and install street lighting along the full length of the roadway as necessary.

E 5th Street

E 5th Street has continuous sidewalks along both sides of the roadway from Molalla Avenue to Stowers Road. Sidewalks are not provided east of Stowers Road. The PLTS analysis indicates that E 5th Street IS suitable for most pedestrian with the exception of the segment east of Stowers Road. This is primarily due to the absence of sidewalk facilities. Therefore, the following improvements are being considered along the roadway.

- Fill in gaps on both sides of the roadway with new sidewalks of appropriate width from Stowers Road to Mathias Road.
- Evaluate light levels and install street lighting along the full length of the roadway as necessary.

Cole Avenue

Cole Avenue has continuous sidewalks along the west side of the roadway for its full length. The east side of the roadway has several sidewalk gaps. The PLTS analysis indicates that the east side of the roadway may *NOT* be suitable for most pedestrians as well as the majority of the west side. This is primarily due to sidewalk gaps, poor pavement condition, lack of a buffer, and limited street lighting. Therefore, the following improvements are being considered along the roadway.

- Fill in gaps on both sides of the roadway with new sidewalks of appropriate.
- Evaluate light levels and install street lighting along the full length of the roadway as necessary.

Mathias Road

Mathias Road provides as an important north-south connection along the eastern edge of the city limits. There are no sidewalks provided along the entire length of Mathias Road. The PLTS analysis indicates that the roadway is not suitable for most pedestrians. Therefore, the following improvements are being considered along the roadway.

- Fill in gaps on the both sides of the roadway with new sidewalks of appropriate width.
- Evaluate light levels and install street lighting along the full length of the roadway as necessary.

Frances Street

Frances Street has continuous sidewalks along the north side of the roadway for its full length. The south side of the roadway has a large sidewalk gap between Molalla Avenue and Debra Street. The PLTS analysis indicates that the south side of the roadway is not be suitable for most pedestrians. This is primarily due to the absence of sidewalk facilities. Therefore, the following improvements are being considered along the roadway.

- Fill in gaps on the south side of the roadway with new sidewalks of appropriate width between Molalla Avenue and Debra Street.


Ridings Avenue looking north


Stowers Road looking south

Neighborhood Streets

Neighborhood Streets provide direct access to essential destinations throughout Molalla, such as schools, parks, churches, and commercial areas. Pedestrian facilities should be provided along at least one side of each street to ensure adequate access for pedestrians.

Toliver Drive

Toliver Drive provides an important north-south connection between Bronco Avenue and Toliver Road. There are no sidewalks between Hauser Court and Toliver Road. Therefore, the following improvements are being considered along the roadway:

- Install new sidewalks of appropriate width along both sides of the roadway.
- Evaluate light levels and install street lighting along the full length of the roadway as necessary.

Kennel Avenue

Kennel Avenue provides an important north-south connection between Toliver Road and OR 211 and access to the Molalla Adult Community Center. Sidewalks are provided along both sides of the roadway; however, several sidewalk gaps exist between Ross Street and OR 211. Therefore, the following improvements are being considered along the roadway.

- Fill in gaps on both sides of the roadway with new sidewalks of appropriate width between Ross Street and OR 211.

E Heintz Street

E Heintz Street provides an important east-west connection between Molalla Avenue and Cole Avenue. There are partial sidewalks provided on both sides of the roadway between Molalla Avenue and Grange Avenue. There are no sidewalks provided between Grange Avenue and Fenton Street. Continuous sidewalks are provided on both sides of the roadway between Fenton Street and Park Avenue. Therefore, the following improvements are being considered along the roadway.

- Fill in gaps on both sides of the roadway with new sidewalks of appropriate width between Molalla Avenue and Fenton Street.

Center Avenue

Center Avenue provides an important north-south connection between E Heintz Street and OR 211. There are sidewalks provided along both sides of the roadway; however, street lighting is only provided along the west side of the roadway. Therefore, the following improvements are being considered along the roadway.

- Evaluate street lighting levels and install street lighting along the full length of the south side of the roadway as necessary.

Industrial Way

Industrial Way provides a north-south connection between Toliver Road to OR 211 via an existing non-motorized shared-use path. Sidewalks are provided toward the south end of the roadway; however, there are gaps between Toliver Road and the existing sidewalks. Therefore, the following improvements are being considered along the roadway.

- Fill in gaps on both sides of the roadway with new sidewalks of appropriate width between Toliver Road and the existing sidewalks.

Stowers Road

Stowers Road provides an important north-south connection between OR 211 and E 7th Street. Sidewalks are provided along the east side of Stowers Road between 3rd Street and 7th Street; however, no sidewalks are provided along the west side. Intermittent sidewalk exists along both sides of Stowers Road between 3rd Street and OR 211. Therefore, the following improvements are being considered along the roadway.

- Fill in the gaps on both sides of the roadway with new sidewalks of appropriate width.

E 7th Street

E 7th Street provides an east-west connection between Stowers Road and Mathias Road. There are no sidewalks along both sides of the roadway. Therefore, the following improvements are being considered along the roadway.

- Install new sidewalks of appropriate width along both sides of the roadway.

Heintz Street looking west

Stowers Road looking south

Attachment B contains cross sections that reflect the potential improvements identified above. These cross sections will be refined based on input from the PMT, advisory committees, and general public.

Intersections Improvements

The following intersection improvements have been organized by functional classification. It is important to note that all intersection improvements along ODOT facilities are required to meet Warrants and will require coordination and approval from the State or Regional Traffic Engineer.

OR 213/Meadow Drive

The OR 213/Meadow Drive intersection does not have enhanced crossing treatments to facilitate pedestrian movement through the intersection. An existing bus stop is located on the west side of the intersection; however, in order to access the bus stop, users must cross OR 213 without the assistance of an enhanced crossing. Therefore, the following improvements have been identified to facilitate east-west movement across OR 213.

- Install an enhanced pedestrian crossing at the OR 213/Meadow Drive intersection. The types of enhanced crossing treatments could include:
    - Raised median islands,
    - High visibility pavement markings and signs,
    - Flashing beacons, and
    - ADA accessible curb-ramps with tactile warning strips.

OR 213/Toliver Road

The OR 213/Toliver Road intersection does not have enhanced crossing treatments to facilitate pedestrian movement through the intersection. Toliver Road west and east of OR 213 is identified as a Principle Active Transportation (PAT) Route in the Clackamas County Active Transportation Plan (ATP). Furthermore, as part of the public involvement process associated with the TSP Update, community input was received noting extreme safety issues and poor visibility at this location. Therefore, the following improvements have been identified to facilitate east-west movement across OR 213.

- Install an enhanced pedestrian crossing at the OR 213/Toliver Road intersection. The types of enhanced crossing treatments could include:
    - High visibility pavement markings and signs,
    - Flashing beacons, and
    - ADA accessible curb-ramps with tactile warning strips.

OR 211/Hezzie Lane

OR 211/Hezzie Lane intersection does not have enhanced crossing treatments to facilitate pedestrian movement through the intersection. As part of the public involvement process associated with the TSP Update, community input was received noting the need for an enhanced crossing at this location. The OR 211/Hezzie Lane intersection was also noted as being an important crossing location for children attending the Molalla River Elementary and Molalla River Middle School who live in the apartment buildings south of OR 211. Therefore, the following improvements have been identified to facilitate north-south movement across OR 211.

- Install an enhanced pedestrian crossing at the OR 211/Hezzie Lane intersection. The types of enhanced crossing treatments could include:
    - Raised median islands,
    - High visibility pavement markings and signs,
    - Flashing beacons, and
    - ADA accessible curb-ramps with tactile warning strips.

OR 213/Toliver Road

OR 211/Hezzie Lane

OR 211/Molalla Forest Road

The OR 211/Molalla Forest Road intersection does not have enhanced crossing treatments to facilitate pedestrian movement through the intersection. The Clackamas County ATP identified Molalla Forest Road as an *Ideal* Principal Active Transportation (IPAT) Route. Therefore, the following improvements have been identified to facilitate north-south movement across OR 211.

- Install an enhanced pedestrian crossing at the OR 211/Molalla Forest Road intersection. The types of enhanced crossing treatments could include:
  - Raised median islands,
  - High visibility pavement markings and signs,
  - Flashing beacons, and
  - ADA accessible curb-ramps with tactile warning strips.

OR 211/Grange Avenue/Berkeley Avenue

The 2001 TSP identifies the need to improve pedestrian safety at the OR 211/Grange Avenue/Berkeley Avenue intersection and to eliminate conflicting turning movements. A raised median island with pedestrian refuge was proposed in the center of OR 211 to serve the existing crosswalk and to block left turns into and out of Grange Street. The raised median was proposed to provide an easier crossing for pedestrians wishing to travel to the former grocery store on the north side of Main Street. It was also recommended that prohibiting left turns into and out of Berkley Street would reduce the number of conflict points between through and turning automobiles, and between automobiles and pedestrians. The improvement was noted as requiring the removal of on-street parking on OR 211 between Swiegle and Lola Avenues.

The OR 211/Grange Avenue/Berkeley Avenue intersection has striped crosswalks at the east and west legs of the intersection; however, the striping and visibility of the crosswalk is limited. Therefore, the following improvements have been identified to facilitate north-south movement across OR 211.

- Install an enhanced pedestrian crossing to facilitate movement across OR 211. The types of enhanced crossing treatments could include:
  - Curb extensions,
  - High visibility pavement marking and signs,
  - Flashing beacons, and
  - ADA accessible curb-ramps with tactile warning strips.

OR 211/Cole Avenue

The OR 211/Cole Avenue intersection has a striped crosswalk at the west leg of the intersection; however, the striping and visibility of the crosswalk is limited. Therefore, the following improvements have been identified to facilitate north-south movement across OR 211.

- Install an enhanced pedestrian crossing to facilitate movement across OR 211. The types of enhanced crossing treatments could include:
  - Curb extensions,
  - High visibility pavement markings and signs,
  - Flashing beacons, and
  - ADA accessible curb-ramps with tactile warning strips.

OR 211/Stowers Road

The OR 211/Stowers Road intersection has a striped crosswalk at the south leg of the intersection; however, it does not have enhanced crossing treatments to facilitate pedestrian movement across OR 211. Therefore, the following improvements have been identified to facilitate north-south movement across OR 211.

- Install an enhanced pedestrian crossing at the OR 211/Stowers Road intersection. The types of enhanced crossing treatment could include:
  - Curb extensions,
  - High visibility pavement markings and signs,
  - Flashing beacons, and
  - ADA accessible curb-ramps with tactile warning strips.

OR 211/Metzler Street

The OR 211 Streetscape Plan identifies the need to install curb extensions at the OR 211 Metzler Street intersection. This pedestrian solution is incomplete and remains a viable solution. Therefore, the following improvements have been identified for the intersection:

- Install curb extensions on the north and south sides of the roadway.
- Install ADA accessible curb-ramps with tactile warning strips.

Toliver Road/Industrial Way

The Toliver Road/Industrial Way intersection does not have enhanced crossing treatments to facilitate pedestrian movement through the intersection. Toliver Road is identified as a PAT Route in the Clackamas County ATP. An existing shared-use path exists along the south side of Toliver Road and passes across the south leg of the Toliver Road/Industrial Way intersection. Therefore, the following improvements have been identified to facilitate north-south as well as east-west movement:

- Install an enhanced pedestrian crossing at the east and south legs of the Toliver Road/Industrial Way intersection. The types of enhanced crossing treatments could include:
  - High visibility pavement markings and signs, and
  - ADA accessible curb-ramps with tactile warning strips.

OR 211/Stowers Road

Toliver Road/Industrial Way

Toliver Road/Zimmerman Lane

The Toliver Road/Zimmerman Lane intersection does not have enhanced crossing treatments within the vicinity of the intersection. Toliver Road is identified as a PAT Route in the Clackamas County ATP. The intersection is located just north of the Molalla River Elementary School and serves as an important connection across Toliver Road. Therefore, the following improvements have been identified to facilitate north-south movement.

- Install an enhanced pedestrian crossing at the east leg of the Toliver Road/Zimmerman Lane intersection. The types of enhanced crossing treatments could include:
  - High visibility pavement marking and school crosswalks signs.
  - ADA accessible curb-ramps with tactile warning strips.

Toliver Road/Leroy Avenue

The Toliver Road/Leroy Avenue intersection has a striped crosswalk at the south leg of the intersection; however, it does not have enhanced crossing treatments to facilitate pedestrian movement across Toliver Road. Toliver Road is identified as a PAT Route in the Clackamas County ATP. Leroy Avenue serves as an important connection to Molalla River Middle School from Toliver Road. Therefore, the following improvements have been identified to facilitate north-south movement.

- Install an enhanced pedestrian crossing at the east leg of the Toliver Road/Leroy Avenue intersection. The types of enhanced crossing treatments could include:
  - High visibility pavement marking and school crosswalk signs, and
  - ADA accessible curb-ramps with tactile warning strips.

Toliver Road/Ridings Avenue

The Toliver Road/Ridings Avenue intersection has a striped crosswalk at the south leg of the intersection; however, it does not have enhanced crossing treatments to facilitate pedestrian movement across Toliver Road. Toliver Road is identified as a PAT Route in the Clackamas County ATP. Therefore, the following improvements have been identified to facilitate north-south movement.

- Install an enhanced pedestrian crossing at the west leg of the Toliver Road/Ridings Avenue intersection. The types of enhanced crossing treatments could include:
    - High visibility pavement marking and signs, and
    - ADA accessible curb-ramps with tactile warning strips.

Toliver Road/Kennel Avenue

The Toliver Road/Kennel Avenue intersection has a striped crosswalk at the south leg of the intersection; however, it does not have enhanced crossing treatments to facilitate pedestrian movement across Toliver Road. Toliver Road is identified as a PAT Route in the Clackamas County ATP. Therefore, the following improvements have been identified to facilitate north-south movement.

- Install an enhanced pedestrian crossing at the east leg of the Toliver Road/Kennel Avenue intersection. The types of enhanced crossing treatments could include:
- High visibility pavement marking and signs, and
- ADA accessible curb-ramps with tactile warning strips.

Leroy Avenue/Heintz Street

The Leroy Avenue/Heintz Street intersection has a striped crosswalk at the south leg of the intersection; however, it does not have enhanced crossing treatments to facilitate pedestrian movement across Heintz Street. The intersection is located just north of the Molalla River Middle School and serves as an important connection from Toliver Road to the school. Furthermore, the existing striped crosswalk at the south leg of the intersection is severely worn. Therefore, the following improvements have been identified to facilitate east-west as well as north-south movement.

- Install an enhanced pedestrian crossing at the south and west legs of the Leroy Avenue/Heintz Street intersection. The types of enhanced crossing treatments could include:
    - High visibility pavement marking and school crosswalk signs, and
    - ADA accessible curb-ramps with tactile warning strips.

E 5th Street/May Street

The E 5th Street/May Street intersection does not have enhanced crossing treatments to facilitate pedestrian movement across E 5th Street. The intersection is located just south of the Molalla Public Library and serves as an important connection across E 5th Street Road. Therefore, the following improvements have been identified to facilitate north-south movement.

- Install an enhanced pedestrian crossing at the west leg of the E 5th Street/May Street intersection to facilitate movement across E 5th Street. The types of enhanced crossing treatments could include:
    - High visibility pavement marking and school crosswalk signs, and

- ADA accessible curb-ramps with tactile warning strips.

E 5th Street/Stowers Road

The E 5th Street/Stowers Road intersection does not have enhanced crossing treatments to facilitate pedestrian movement across E 5th Street or Stowers Road. Therefore, the following improvements have been identified to facilitate north-south and east-west movements.

- Install an enhanced pedestrian crossings at each leg of the E 5th Street/Stowers Road intersection to facilitate movement across E 5th Street and Stowers Road. The types of enhanced crossing treatments could include:
  - High visibility pavement marking and school crosswalk signs, and
  - ADA accessible curb-ramps with tactile warning strips.


Toliver Road/Kennel Avenue


E 5th Street/Stowers Road

Off-street Improvements

The following off-street improvements consist primarily of new shared use paths and trails.

Molalla Forest Road Shared-Use Path

A potential shared use path connection is being considered along Molalla Forest Road between OR 211 and S Molalla Avenue. An existing off-street trail exists along Molalla Forest Road between Toliver Road and OR 211. This existing off-street trail could be enhanced to provide a formalized connection between Toliver Road, OR 211, and points south along the proposed Molalla Forest Road shared-use path.

Molalla Western Railway Spur

A potential shared-use path connection is being considered along the former Molalla Western Railway Spur from the northern city limits to E 5th Street to provide further north-south pedestrian and bicycle connectivity while providing a parallel connection west of Molalla Avenue.

BICYCLE SYSTEM

Bicycle facilities are the elements of the transportation system that enable people to travel safely and efficiently by bicycle. These include facilities along key roadways (e.g. shared lane pavement markings, on-street bike lanes, and separated bike facilities) and facilities at key crossing locations (e.g., enhanced bike crossings). These also include end of trip facilities (e.g. secure bike parking, changing rooms, and showers at worksites); however, these facilities are typically addressed through the development code. Each facility plays an important role in developing a comprehensive bicycle system.

Solutions

This section summarizes the solutions considered for implementation within the City of Molalla to address existing gaps and deficiencies and future needs in the bicycle system.

Shared Lane Pavement Markings and signs

Shared lane pavement markings (often called “sharrows”) are not a bicycle facility, but a tool designed to accommodate bicyclists on roadways where bike lanes are desirable but infeasible to construct. Sharrows indicate a shared roadway space for cyclists and motorists and are typically centered in the roadway or approximately four feet from the edge of the travel lane and are recommended to be spaced approximately 50 to 250-feet apart dependent on the levels of traffic volume. Sharrows are suitable on roadways with relatively low travel speeds (<35 mph) and low ADT (<3,000 ADT); however, they may also be used to transition between discontinuous bicycle facilities. Sharrows could be applied along a variety of streets within Molalla where room for on-street bike lanes is limited.

On-Street Bike Lanes

On-street bike lanes are striped lanes on the roadway dedicated for the exclusive use of cyclists. Bike lanes are typically placed at the outer edge of pavement (but to the inside of right-turn lanes and/or on-street parking). Bicycle lanes can improve safety and security of cyclists and (if comprehensive) can provide direct connections between origins and destinations. On-street bike lanes could be applied along a variety of streets within Molalla where space allows.

Buffered Bike Lanes

Buffered bike lanes are enhanced versions of conventional on-street bike lanes that include an additional striped buffer of typically 2-3 feet between the bicycle lane and the vehicle travel lane and/or between the bicycle lane and the vehicle parking lane. They are typically located along streets that require a higher level of separation to improve the comfort of bicycling.

Separated Bike Lanes

Separated bike lanes (often called “cycle tracks”) are bicycle lanes that are physically separated from motor vehicle traffic by a vertical element such as a planter, flexible post, parked car, or a mountable curb. One-way separated bike lanes are typically found on each side of the street, like conventional bike lanes, while two-way separated bike lanes are typically found on one side of the street.

On-street Bike Lanes

Buffered Bike Lanes

Enhanced Crossings

Enhanced bicycle crossing facilities enable cyclists to safely cross streets, railroad tracks, and other transportation facilities. Planning for appropriate bicycle crossings requires the community to balance vehicular mobility needs with providing crossing locations along the desired routes of cyclists. Enhanced bicycle crossings include:

- Bike Boxes – designated space at an intersection that allows cyclists to wait in front of motor vehicles while waiting to turn or continue through the intersection.
- Two-Stage Left-turn Boxes – designated space at a signalized intersection outside of the travel lane that provides cyclists with a place to wait while making a two-stage left-turn.
- Pavement markings through intersections – pavement markings that extend a bike lane through an intersection.
- Bike Only Signals – A traffic signal that is dedicated for cyclists
- Bicycle Detection – Loop or intelligent transportation system (ITS) detection for bicycles

Additional information on the Enhanced bicycle crossing treatments is provided in Attachment A.

Wayfinding Signs

Wayfinding signs are physical signs or travel lane markings located along roadways or at intersections that direct bicyclists between destinations along low-stress and comfortable bicycle routes. Wayfinding signs help inexperienced and/or less confident cyclists overcome perceived barriers by identifying lower speed and lower volume routes that do not require a bicycle facility. They typically include distances and average walk/cycle times. Wayfinding signs are generally used on primary bicycle routes and multiuse paths.

Bicycle Parking

Secure bicycle parking is a vital component of a city's bicycle system and can be provided in a variety of sizes, shapes, and unique pieces of infrastructure that resemble the city's character. Bicycle parking can generally be categorized into two types: short-term and long-term.

- **Short-term bicycle parking** is designed to meet the needs of cyclists visiting businesses, institutions, and other destinations where visits typically last up to two hours. Short-term bicycle parking must be readily accessible, visible, and self-explanatory.
- **Long-term bicycle parking** places an emphasis on security, weather protection and is designed to meet the needs of cyclists who may leave their bicycle unattended for several hours or more. Long-term bicycle parking is typically located at residences or apartment buildings, workplaces, transit centers, and other routinely visited destinations.

Improvements

The following improvements have been organized by streets segment, intersection, and off-street improvements. Where there are multiple improvements, the preferred improvement were identified based on an evaluation of environmental, engineering, land use "fatal flaws" and anticipated funding capacity as well as discussions with the project team, advisory committees, and the general public.

Street Segment Improvements

The following street segment improvements have been organized by functional classification. It should be noted that all improvements along ODOT facilities will require coordination with ODOT.

Arterials

Arterials serve an important function for bicycle access and circulation within Molalla, particularly those that have local transit service. The following provides a summary of the bicycle improvements along arterial streets.

OR 213

OR 213 is a state owned facility that runs north-south throughout the western part of the city. It does not have bicycle facilities on either side of the roadway with the exception of the north and southbound approaches to the OR 213/OR 211 intersection. The Bicycle Level of Traffic Stress (BLTS) analysis indicates that OR 213 is NOT suitable for most cyclists, including the segment of roadway that has bike lanes. This is primarily due to the absence of bicycle facilities, relatively high travel speeds and lack of physical buffer where bike lanes exist. Therefore, the following improvements are being considered along the entire length of OR 213 within the City limits:

- Reduce the posted speed limit to 30 mph and install on-street bike lanes on both sides of the roadway by filling in and replacing the open ditches with a culvert drainage system.

- Reduce the posted speed limit to 35 mph and install buffered bike lanes on both sides of the roadway by filling in and replacing the open ditches with a culvert drainage system.
- Maintain the posted speed limit and install separated bike lanes on one or two sides of the roadway by filling in and replacing the open ditches with a culvert drainage system.
- Maintain the posted speed limit and install a shared-use path on one side of the roadway by filling in and replacing the open ditches with a culvert drainage system.

OR 211

OR 211 is a state owned facility that runs east-west throughout the center of the city. It does not have bike facilities on either side of the roadway with the exception of the east and westbound approaches to the OR 213/OR 211 intersection. The BLTS analysis indicates that OR 211 is NOT suitable for most cyclists with the exception of the segment between Dixon Avenue and Grange Avenue where the posted speed limits is 25 mph. Outside of this segment, the posted speed ranges from 30 to 40 mph and there are no bicycle facilities. Therefore, the following improvements are being considered along the roadway segments where bicycle facilities are absent:

- Reduce the posted speed limit to 30 mph and install on-street bike lanes on both sides of the roadway by filling in and replacing the open ditches with a culvert drainage system.
- Reduce the posted speed limit to 35 mph and install buffered bike lanes on both sides of the roadway by filling in and replacing the open ditches with a culvert drainage system.
- Maintain the posted speed limit and install separated bike lanes on one or two sides of the roadway by filling in and replacing the open ditches with a culvert drainage system.
- Where the posted speed limit is 25 mph, install shared-lane pavement markings and signs.

OR 211 looking West

OR 213 looking South

Molalla Avenue

Molalla Avenue is a city owned facility that runs north-south throughout the center of the city. It does not have bicycle facilities on either side of the roadway. The BLTS analysis indicates that the roadway IS suitable for most cyclists with the exception of the segment between Glory Lane and the northern city limits. This is primarily due to the posted speed limit of 35 mph. Therefore, the following improvements are being considered along the roadway north of Glory Lane.

- Reduce the posted speed limit to 25 mph north of Glory Lane and install shared-lane pavement markings and signs.
- Reduce the posted speed limit to 30 mph north of Glory Lane and install bike lanes on both sides of the roadway.
- Maintain the posted speed limit and install buffered bike lanes on both sides of the roadway.
- Where the posted speed limit is 25 mph, install shared-lane pavement markings and signs.

Collectors

Toliver Road

Toliver Road is a city owned facility and has been identified as a Principle Active Transportation (PAT) Route in the Clackamas County Active Transportation Plan (ATP). It has on-street bike lanes between Zimmerman Lane and Molalla Avenue. The BLTS analysis indicates that the roadway is NOT suitable for most cyclists between the western city limits and Industrial Way. This is primarily due to the posted speed limit exceeding 25 mph and the lack of on-street bicycle facilities. It should be noted that a shared-use path exists along the south side of Toliver Road between OR 213 and Industrial Way. In order to accommodate a majority of cyclists, the following improvements are being considered along the roadway.

- Reduce the posted speed limit to 25 mph between the western city limits and Industrial Way and install shared-lane pavement markings and signs.
- Reduce the posted speed limit to 30 mph and install bike lanes on both sides of the roadway between the western city limits and Industrial Way.
- Maintain the posted speed limit and install separated bike lanes on both sides of the roadway – this improvement could be applied to the entire length of Toliver Road.

Shirley Street

Shirley Street is a city owned facility. It does not have bicycle facilities on either side of the roadway; however, the BLTS analysis indicates that the roadway IS suitable for most cyclists. To increase the level of comfort and to improve wayfinding, the following improvements are being considered along the roadway.

- Install shared-lane pavement markings and signs along both sides of the roadway.

Ridings Avenue

Ridings Avenue is a city owned facility. It does not have bicycle facilities on either side of the roadway; however, the BLTS analysis indicates that the roadway IS suitable for most cyclists. To increase the bicycle level of comfort and to improve wayfinding, the following improvements are being considered along the roadway.

- Install shared-lane pavement markings and signs along both sides of the roadway.

Leroy Avenue

Leroy Avenue is a city owned facility. It does not have bicycle facilities on either side of the roadway; however, the BLTS analysis indicates that the roadway IS suitable for most cyclists. To increase the bicycle level of comfort and to improve wayfinding, the following improvements are being considered along the roadway.

- Install shared-lane pavement markings and signs along both sides of the roadway.
- Install on-street bike lanes on both sides of the roadway.
- Install separated bike lanes on both sides of the roadway.

E 5th Street

E 5th Street is a city owned facility. It has bike lanes along both side of the roadway between Molalla Avenue and Stowers Road with the exception of the segment between May Street and Eckerd Avenue on the south side of the roadway. The BLTS analysis indicates that the roadway IS suitable for most cyclists including where bikes lanes do not exist. This is primarily due to the posted speed limit of 25 mph. To increase the bicycle level of comfort and to improve wayfinding, the following improvements are being considered along the roadway.

- Install shared-lane pavement markings and signs along the south side of the roadway between May Street and Eckerd Avenue.
- Install on-street bike lanes on the south side of the roadway between May Street and Eckerd Avenue and on both sides between Stowers Road and Mathias Road.

Cole Avenue

Cole Avenue is a city owned facility. It does not have bicycle facilities on either side of the roadway; however, the BLTS analysis indicates that the roadway IS suitable for most cyclists. To increase the level of comfort and to improve wayfinding, the following improvements are being considered along the roadway.

- Install shared-lane pavement markings and signage along the full length of the roadway.
- Install on-street bike lanes on both sides of the roadway – this potential solution is consistent with the current TSP.

Frances Street

Frances Street is a city owned facility. It does not have bicycle facilities on either side of the roadway; however, the BLTS analysis indicates that the roadway IS suitable for most cyclists. To increase the bicycle level of comfort and to improve wayfinding, the following improvements are being considered along the roadway.

- Install shared-lane pavement markings and signage along the full length of the roadway.

Ridings Avenue looking north

E 5th Street looking east

Neighborhood Streets

Neighborhood streets also play an important role in providing bicycle connectivity within the city. The following neighborhood streets have been identified as playing a critical role in providing connectivity to essential destinations. The types of treatments considered along these roadways include shared lane pavement markings and signs, including wayfinding signs that direct cyclists to essential destinations (including distance and time).

- Meadow Drive, from OR 213 to Meadowlawn Place
- Village Drive, from Meadowlawn Place to Toliver Road
- Thunderbird Street, from N Molalla Avenue to Bronco Avenue
- Bronco Avenue, from Thunderbird Street to Toliver Drive
- Toliver Drive, from Bronco Avenue to Toliver Road
- Kennel Avenue, from Toliver Road to OR 211
- Heintz Street, from Leroy Avenue to Cole Avenue
- Center Avenue, from Heintz Street to OR 211
- Industrial Way, from Toliver Road to southern terminus
- Stowers Road, from OR 211 to E 7th Street
- E 7th Street, from Stowers Road to Mathias Road

Attachment B contains cross sections that reflect the potential improvements identified above. These cross sections will be refined based on input from the PMT, advisory committees, and general public.

Intersection Improvements

OR 213/OR 211

The OR 213/OR 211 intersection has on-street bike lanes at all intersection approaches; however, there are no enhanced crossing treatments to facilitate movement through the intersection. Therefore, the following improvements have been identified for the intersection.

- Install skip striping along OR 213 through the intersection with green paint in the conflict areas – implement this treatment at all major intersections along OR 213 and in all conflict areas.
- Install skip striping along OR 211 through the intersection with green paint in the conflict areas – implement this treatment at all major intersections along OR 211 and in all conflict areas.

OR 213/Toliver Road

The OR 213/Toliver Road intersection does not have enhanced crossings treatments to facilitate bicycle movement through the intersection. As previously noted, Toliver Road is identified as a PAT Route in the Clackamas County ATP. Therefore, the following improvements have been identified for the intersection to help facilitate east-west movement across OR 213.

- Install an enhanced bicycle crossing at the OR 213/Toliver Road intersection. The types of enhanced crossing treatments are yet to be determined.
- Install advanced warning signage to alert motorist of enhanced bicycle crossing.

OR 211/Molalla Avenue

The OR 211/Molalla Avenue intersection does not have enhanced crossing treatments to facilitate bicycle movement through the intersection. As part of the recommendation to reduce the posted speed limit to 35 mph and install buffered bike lanes along both sides of OR 211, the following improvements have been identified for the intersection.

- Install skip striping along OR 211 through the intersection with green paint in the conflict areas – implement this treatment at all major intersections along OR 211 in all conflict areas.
- Install skip striping along Molalla Avenue through the intersection with green paint in the conflict areas.

OR 213/OR 211 intersection

OR 211/Molalla Avenue intersection

Off-street Improvements

The Molalla Municipal Code requires bicycle parking with all new development or where a change of use occurs, particularly for non-residential uses. However, a municipal bicycle parking facility located within a prominent area within the downtown could provide residents and visitors with additional opportunities to park their bikes and walk.

TRANSIT

Public transit can provide important connections to destinations for people that do not drive or bike and can provide an additional option for all transportation system users for certain trips. Public transit links to walking, bicycling, or driving trips: users can walk to and from transit stops and their homes, shopping or work places, people can drive to park-and-ride locations to access a bus, or people can bring their bikes on transit vehicles and bicycle from a transit stop to their final destination.

Providing transit service in smaller cities is generally led by a local or regional transit agency and is dependent on having the land use and densities that can support service. The city can plan for transit-supportive land use patterns and support future transit viability by designing and building streets that will comfortably accommodate transit stops and include the right-of-way that could allow for transit stops to be located as close as possible to important destinations. At a minimum, a transit stop should be well-signed and have a comfortable space to wait. Benches and shelter from the weather can improve user comfort and secure bicycle parking near bus stops allows people the option to leave their bicycle at one trip-end instead of bringing it on the bus.

Solutions

This section summarizes the solutions considered for implementation within the City of Molalla to address existing gaps and deficiencies and future needs in the transit system.

New or Re-routed Fixed-Route Service

Fixed-route service enhancement can include:

- Increase the service frequency by reducing headways or time between arrivals.
- Increase hours of service by providing service earlier in the morning and/or later in the evening.
- Increase service coverage by re-routing existing service or implementing new service.

Stop Enhancements

Transit stops are designated locations where residents can access local transit service. Transit stops are normally located at major intersections. The types of amenities provided at each transit stop (i.e. pole, bench, shelter, ridership information, trash receptacles) tend to reflect the level of usage.

- Pole and bus stop sign – All bus stops require a pole and bus stop sign to identify the bus stop location. Some transit agencies prefer the bus stop signs to be provided on a separate dedicated pole instead of an existing utility pole, column, or other location.
- Bus stop shelters – Shelters are typically provided at stops with 50 or more boardings per day but may be considered at stops served by infrequent service (headways greater than 17 minutes) with 35 or more boardings per day.
- Seating – Seating can be considered at any stop as long as it is accessible and as long as the, safety and accessibility of the adjacent sidewalk or other facility are not compromised by seating placement.
- Trash cans – Trash cans can be considered at any stop; however, they are most commonly located at stops with shelters and/or seating. Trash cans will require pick-up from the local garbage company.
- Lighting – Lighting is an important amenity for bus stops as it provides visibility and increased security for transit users waiting, boarding, and aligning transit service.

Park-and-Ride Facilities

Park-and-ride facilities provide parking for people who wish to transfer from their personal vehicle to public transportation or carpools/vanpools. Park-and-rides are frequently located near major intersections, at commercial centers, or on express and commuter bus routes. It is Oregon state policy to encourage the development and use of park-and-ride facilities at appropriate urban and rural locations adjacent to or within the highway right-of-way. Park-and-ride facilities can provide an efficient method to provide transit service to low density areas such as Molalla, connecting people to jobs, and providing an alternate mode to complete long-distance commutes.

Park-and-ride facilities may be either shared-use, such as at a school or shopping center, or exclusive-use. Shared-use facilities are generally designated and maintained through agreements reached between the local public transit agency or rideshare program operator and the property owner. Shared-use lots can save the expense of building a new parking lot, increase the utilization of existing spaces, and avoid utilization of developable land for surface parking. In the case of shopping centers, the presence of a shared-use park-and-ride has frequently been shown to be mutually beneficial, as park-and-riders tend to patronize the businesses in the center.


TriMet Stop (Before)


TriMet Stop (After)

Improvements

New or Re-routed Fixed-Route Service

The following streets are being considered for new or re-routed fixed-route service to address the needs for additional service coverage within the surrounding area:

- Shirley Street from Cole Avenue to OR 211,
- OR 211 from Shirley Street to Mathias Road,
- Mathias Road from OR 211 to 5th Avenue, and
- 5th Avenue from Mathias Road to Swiegle Avenue.

Stop Enhancements

The following bus stops are being considered for stop enhancements due to existing inadequate bus stop conditions:

- OR 213/Meadow Drive (northbound) – relocate existing sign to south side of the intersection to increase the visibility of the stop.
- OR 213/Toliver Road – Install bus stops at the far side of the northbound and southbound approaches to the intersection.
- OR 211/OR 213 (eastbound) – install a shelter within the public right of way or obtain an easement from the adjacent property owner.
- OR 211/Leroy Avenue (eastbound) – install a bus stop sign on the east side of the intersection to increase the visibility of the stop
- OR 211/Kennel Avenue (eastbound) – install a bus stop sign on the east side of the intersection to increase the visibility of the stop.
- Meadow Drive/Meadowlawn Place/Toliver Road – identify the location for designated transit stops between OR 213 and Kennel Avenue.

Park-and-Ride Facilities

The following location has been identified as a potential location for a park-and-ride facility.

- E Ross Street/Marson Court - The City should work with adjacent businesses to determine the potential for park-and-rides in the public parking lot.

Other Transit Improvements

- Reconfigure the Molalla City bus to improve the efficiency of the service.
- Relocated all existing bus stop signs to separate dedicated poles as feasible.

MOTOR VEHICLE SYSTEM

Streets serve a majority of trips within Molalla across all travel modes. In addition to motorists, pedestrians, bicyclists, and public transit riders use streets to access areas locally and regionally.

Solutions

This section summarizes the solutions considered for implementation within the City of Molalla to address existing gaps and deficiencies and future needs in the motor vehicle system.

Street System Connectivity Solutions

Portions of the downtown and areas of southeast Molalla are generally built on a grid system; however, much of the more recently developed areas north of Toliver Road are generally built on a network of cul-de-sacs and stub streets prohibiting the potential for future connections. These streets can be desirable to residents because they tend to have lower traffic volumes and travel speeds; however, cul-de-sacs and stub streets result in longer trip distances, increased reliance on arterials for local trips, and limited options for people to walk and bike to the places they want to go.

The future street system needs to balance the benefits of providing a well-connected grid system with the challenges faced through the increased demand of residential development. Incremental improvements to the street system can be planned carefully to provide route choices for motorists, bicyclists, and pedestrians while accounting for potential neighborhood impacts. In addition, the quality of the transportation system can be improved by making connectivity improvements to the pedestrian and bicycle system separate from street connectivity, as discussed through solutions presented in the previous sections.

The following are potential connectivity solutions that can be applied in the City of Molalla.

- Update the cross sections in the current TSP to provide more flexibility in the design and construction of the street system.
- Re-designate roadways with higher or lower functional classifications to improve the order and function of the street system.
- Construct new roadways or extend existing roadways to improve street system connectivity within the city.

Capacity Based Solutions

Turn Lanes

Separate left and right-turn lanes, as well as two-way left-turn lanes (TWLT) can provide separation between slowed or stopped vehicles waiting to turn left and through vehicles. The design of turn lanes is largely determined based on a traffic study that identifies the need for the turn lane and the storage length needed to accommodate vehicle queues. Turn lanes are commonly used at intersections where the turning volumes warrant the need for separation.

Traffic Signals

Traffic signals allow opposing streams of traffic to proceed in an alternating pattern. National and state guidance indicates when it is appropriate to install traffic signals at intersections. Intersections along state facilities, such as OR 213 and OR 211 require approval from the State or Regional Traffic Engineer. When used, traffic signals can effectively manage high traffic volumes and provide dedicated times in which pedestrians and bicyclists can cross roadways. Because they continuously draw from a power source and must be periodically re-timed, signals typically have higher maintenance costs than other types of intersection control. Signals can improve safety at intersections where signal warrants are met, however, they may result in an increase in rear-end crashes compared to other solutions. Signals have a significant range in costs depending on the number of approaches, how many through and turn lanes each approach has, and, if it is in an urban or rural area. The cost of a new traffic signal ranges from approximately $450,000 in rural areas to $850,000 in urban areas.

Signal Timing/Phasing Optimization

Signal timing/phasing optimization refers to updating signal timing/phasing plans to better match prevailing traffic conditions. Timing optimization can be applied to existing systems or may include upgrading signal technology, such as signal communication infrastructure, signal controllers, or cabinets. Signal timing/phasing optimization can reduce travel times and be especially beneficial to improving travel time reliability. In high pedestrian or desired pedestrian areas, signal retiming/phasing optimization can facilitate pedestrian movements through intersections by increasing minimum green times to give pedestrians time to cross during each cycle. Signals can also facilitate bicycle movements with the inclusion of bicycle detectors.

Signal upgrades often come at a higher cost than signal timing/phasing optimization and usually require further coordination between jurisdictions. However, upgrading signals provides the opportunity to incorporate advanced signal systems to further improve the efficiency of a transportation network. Strategies include coordinated signal operations across jurisdictions, centralized control of traffic signals, adaptive or active signal control, and transit or freight signal priority as described above. These advanced signal systems can reduce delay, travel time and the number of stops for transit, freight, and other vehicles. In addition, these systems may help reduce vehicle emissions and improve travel time reliability.

Roundabouts

Roundabouts are circular intersections where entering vehicles yield to vehicles already in the circle. They are designed to slow vehicle speeds to 20 to 30 mph or less before they enter the intersection, which promotes a more comfortable environment for pedestrians, bicyclists, and other non-motorized users. Roundabouts have fewer conflict-points and have been shown to reduce the severity of crashes, as compared to signalized intersections. Roundabouts can be more costly to design and install when compared to other intersection control types, but they have a lower operating and maintenance cost than traffic signals. Topography must be carefully evaluated in considering a roundabout, given that slope characteristics at an intersection may render a roundabout infeasible. The cost of a new roundabouts ranges from approximately $1 million to $2 million depending upon the number of lanes and the slope conditions.

Traffic Signal

Roundabout

Freight Mobility and Reliability Solutions

Designated freight routes have been identified to address freight mobility and reliability within the City. Additional TSMO solutions are identified above for truck signal priority and capacity based solutions identified below at several key intersections along OR 213, OR 211, and Molalla Avenue to further address freight mobility and reliability.

Improvements

The following improvements have been organized by street connectivity, capacity based, and freight mobility and reliability improvements. Where there are multiple improvements, the preferred improvements were identified based on an evaluation of environmental, engineering, land use “fatal flaws” and anticipated funding capacity as well as discussions with the project team, advisory committees, and the general public. Improvements along OR 213 and OR 211 will require coordination with ODOT and approval from the State or Regional Traffic Engineer.

Street System Connectivity Improvement

The following identifies potential street system connectivity improvements, including potential changes to the city’s functional classification plan and new street connections. The following improvements have been organized by functional classification.

Arterials

New East-West Arterial Streets

A review of the existing arterial system indicates that there may be a need for new arterials that connect OR 213 to Molalla Avenue and Molalla Avenue to OR 211 north or the UGB and a new arterial that connects OR 213 to Molalla Road south of the UGB. While the following potential connections are located outside of the UGB, they could help improve street system connectivity in the future.

- Classify Vick Road as an arterial if/when it is incorporated into the City UGB – Vick Road could also be extended east to Vaughn Road to improve east-west connection between OR 213 and OR 211.
- Classify Vaughn Road as an arterial if/when it is incorporated into the City UGB.

Collectors

5th Street Extension

5th Street provides a continuous east-west connection between Hart Avenue, S Molalla Avenue, and Mathias Road. The 2001 TSP identifies the need to extend 5th Street from Hart Avenue northwest to OR 211 at Leroy Avenue. This street system connectivity solution is incomplete and still serves as a viable improvement.

New North-South Collector

OR 213 and Molalla Avenue are located approximately 1.4 miles apart; therefore, a new collector could be identified between the two streets to improve collector connectivity within the area north of the UGB. The 2001 TSP identifies Ridings Avenue as a potential connection; however, existing development patterns preclude the future connection. Therefore, Mary Drive could be re-designated as a collector and a new north-south collector could be constructed from Mary Drive at the north city limits to the north.

New North-South Collector

OR 211 and Molalla Avenue are located approximately 1.0 mile apart; therefore, a new collector could be identified between the two streets to improve collector connectivity within the area north of the UGB. The 2001 TSP identifies an extension of Cole Avenue as a potential north-south connection. This street system connectivity solution is incomplete and still serves as a viable improvement.

Molalla Forest Road

The 2001 TSP identifies Molalla Forest Road as an arterial. This designation was primarily based on the notion that Molalla Forest Road would become a downtown bypass and a freight route allowing vehicles and trucks to bypass the downtown area. Based on the existing functionality of OR 211 and Molalla Forest Road as well as conversations with City staff, Molalla Forest Road will be amended to reflect a major collector designation for the TSP Update.

Mathias Road

The 2001 TSP identifies Mathias Road as an arterial. This designation was primarily based on the notion that Mathias Road would become part of the downtown bypass and a freight route allowing vehicles and trucks to bypass the downtown area. Based on the existing functionality of Mathias Road as well as conversations with City staff, Mathias Road will be amended to reflect a major collector designation for the TSP Update.

Neighborhood Streets

Meadow Drive

The 2001 TSP identifies Meadow Drive as a major collector from OR 213 to Meadowlawn Place. Based on the existing functionality of Meadow Drive as well as conversations with City staff, Meadows Drive will be amended to reflect a neighborhood Street for the TSP update.

New North-South Neighborhood Streets

OR 213 and Leroy Avenue are approximately 0.75 miles apart; therefore, a new neighborhood street could be identified between the two streets to improve connectivity. The 2001 TSP identifies three new neighborhood street connections, including an extension of Industrial Way south to OR 211, an extension of Ona Way north from OR 211 to Toliver Road, and an extension of Hezzie Lane north from the Hezzie Lane Terminus north of OR 211 to the Hezzie Lane terminus south of Toliver Road . The industrial Way connection is still viable today but was completed as a shared-use path. The One Way connection is still viable but may follow a different path than what is shown in the TSP and the Hezzie Lane connection is still viable and under construction.

New Neighborhood Street Extensions

Several neighborhood street extensions are also identified in the current TSP that are still viable today. The extensions include:

- Cascade Lane to the north of the UGB
- Harvey Lane to the north of the UGB
- Church Street to the east of the UGB
- Affolter Avenue to Francis Street and to the north of the UGB
- Commercial Parkway south to the private road

Local Streets

Three local street connection opportunities were identified to improve residential connectivity. These connectivity improvements include:

- Faurie Street from roadway terminus to Miller Street
- Eric Drive from roadway terminus to north
- Rachel Lane from roadway terminus to north

Capacity Based Improvements

Arterials

OR 213 (North City Limits to OR 211)

OR 213 between the north city limits and OR 211 has a mix of a two and three-lane cross sections. In order to improve access and circulation to adjacent streets and land uses, a continuous three-lane cross section should be constructed throughout this segment of OR 213 – this improvement is consistent with the current TSP.

OR 211 (OR 213 to Shaver Road)

OR 211 between OR 213 and Shaver Road has a mix of a two and three-lane cross section. In order to improve access and circulation to adjacent streets and land uses, a continuous three-lane cross section should be constructed throughout this segment of OR 211 – this improvement is consistent with the current TSP.

Molalla Avenue Widening (Heintz Street to north city limits)

The 2001 TSP identifies the need to widen Molalla Avenue to a three-lane cross section between Robbins Street and the north UGB, to accommodate the volume of traffic it will carry and to develop an important bicycle and pedestrian link to downtown. This capacity-based solution is incomplete but remains a viable solution to improve access and circulation along this segment of Molalla Avenue.

Molalla Avenue Widening (3rd Avenue to south city limits)

Molalla Avenue between 3rd Avenue to the southern city limits has a two-lane cross section. In order to improve access and circulation within this segment of roadway, a three-lane cross section should be constructed including on-street bike lanes and sidewalks on both sides.

Molalla Forest Road (OR 211 to S Molalla Avenue)

The 2001 TSP identifies the need to reconstruct and widened Molalla Forest Road between OR 211 and S Molalla Avenue to provide one travel lane in each direction, a landscaped median, bike lanes, and sidewalks. It was noted that access should be limited to public street connections and property with no other public street access. This street system connectivity solution is incomplete and while it may no longer be viable as a “downtown bypass”, it is still viable as a way to improve access and circulation within the industrial areas located south of OR 211.

Collectors

Mathias Road

The 2001 TSP identifies the need to widen the Mathias Road as part of the Downtown Bypass project (Mathias Road section) to three lanes, with bike lanes and sidewalks, between Main Street and Molalla Forest Road. This street system connectivity solution is incomplete and while it may no longer be viable as a "downtown bypass", it is still viable as a way to improve access and circulation along this segment of Mathias Road.

Toliver Road Widening

The 2001 TSP identifies the need to widen Toliver Road to better serve traffic from future residential development in northern Molalla. In order to accommodate this anticipated residential growth, it was recommended that Toliver Road be improved to a major collector street standard, including a three-lane cross section, bike lanes, and sidewalks.

Since the adoption of the 2001 TSP, the designation of Toliver Road has been changed to a major collector; however, the roadway consists of a two-lane cross section bike lanes, and partial sidewalks on both sides.

Attachment B contains cross sections that reflect the potential improvements identified above. These cross sections will be refined based on input from the PMT, advisory committees, and general public.

Intersections

The following intersection improvements include improvement necessary to address traffic conditions under land use scenarios 1 and 2 as described in *Tech Memo 5: Future Needs*. It is important to note that all intersection improvements along ODOT facilities are required to meet Warrants and will require coordination and approval from the State or Regional Traffic Engineer. *Attachment C contains the operational analysis results for all intersection improvements described below.*

OR 213/Meadows Road

The OR 213/Meadows Road intersection is projected to exceed its mobility target under year 2040 traffic conditions – Scenario 2. This is primarily due to the relatively high delay at the westbound approach. Therefore, the following improvements are being considered at the intersection.

- Reconfigure the OR 213/Meadows Road intersection to provide a center two-way left-turn lane along OR 213 – this improvement is consistent with the capacity-based solution identified above along OR 213 (Scenario 2).
- Reconfigure the OR 213/Meadows Road intersection to provide a left-turn acceleration lane along OR 213 (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
2	No-build	>1.0	>80.0	F	v/c = 0.90	No
	Center two-way left-turn lane	0.48	29.2	D	v/c = 0.90	Yes
	Acceleration lane	0.55	36.0	E	v/c = 0.90	Yes

OR 213/Toliver Road

The OR 213/Toliver Road intersection is projected to exceed its mobility target under year 2040 traffic conditions – Scenarios 1 and 2. This is primarily due to the relatively high delay at the westbound approach. Therefore, the following improvements are being considered at the intersection.

- Widen OR 213 to provide a center two-way left-turn lane along OR 213 – this improvement is consistent with the capacity-based solution identified above along OR 213 (Scenarios 1 and 2).
- Widen OR 213 to provide separate left-turn lanes at the northbound and southbound approaches and install a traffic signal when warranted with protected or protected-permitted phasing at the northbound and southbound approaches – this improvement is consistent with the current TSP (Scenario 1).
- Widen OR 213 to provide separate left-turn lanes at the northbound and southbound approaches and widen Toliver Road to provide separate left-turn lanes at the eastbound and westbound approaches. Install a traffic signal when warranted with protected or protected-permitted phasing at the northbound and southbound approaches and permitted phasing at the eastbound and westbound approaches (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
1	No-build	>1.0	>80.0	F	v/c = 0.90	No
	Center two-way left-turn lane	>1.0	>80.0	F	v/c = 0.90	No
	Left-turn lanes/traffic signal	0.79	20.4	C	v/c = 0.90	Yes
2	No-build	>1.0	>80.0	F	v/c = 0.90	No
	Center two-way left-turn lane	>1.0	>80.0	F	v/c = 0.90	No
	Left-turn lanes/traffic signal	0.85	24.5	C	v/c = 0.90	Yes

OR 213/OR 211

The OR 213/OR 211 intersection is projected to exceed its mobility standards under year 2040 traffic conditions – Scenarios 1 and 2. This is primarily due to the relatively high delay at the westbound approach. Therefore, the following improvements are being considered at the intersection.

- Install a separate right-turn lane at the southbound approach (Scenario 1)
- Install a separate right-turn lane at the southbound approach and optimize the signal timing/phasing to improve the efficiency of the intersection – this improvement assumes an increase in the peak hour factor from 0.92 to 0.95 over the 22 year period and a portion of the eastbound and westbound through movements are rerouted to the south along Molalla Forest Road (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
1	No-build	0.95	48.6	D	v/c = 0.90	No
	Right-turn lane	0.88	39.0	D	v/c = 0.90	Yes
2	No-build	>1.0	>80.0	F	v/c = 0.90	No
	Right-run lane/signal timing/phasing optimization	0.89	42.4	D	v/c = 0.90	Yes

OR 211/Ona Way

The OR 211/Ona Way intersection is projected to exceed its mobility target under year 2040 traffic conditions – Scenario 2. This is primarily due to the relatively high delay at the northbound approach. Therefore, the following improvements are being considered at the intersection.

- Provide additional north-south connectivity to the area located between OR 211 and Molalla Avenue and south of OR 211 – the street system connectivity improvements identified above include two potential future connections (Scenario 2).
- Widen OR 211 to provide a separate westbound left-turn lane, install a northbound right-turn lane, and install a traffic signal when warranted – this improvement assumes a portion of the westbound left, northbound left, and northbound right-turn movements reroute to the new north-south streets to the east and a portion of the eastbound and westbound through movements are rerouted to the south along Molalla Forest Road (Scenario 2).
- Widen OR 211 to provide two lanes in both directions and a westbound left-turn lane, install a northbound right-turn lane, and install a traffic signal when warranted – this improvement does not assume any re-routing of traffic as a result of the new connectivity (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
2	No-build	>1.0	>80.0	F	v/c = 0.90	No
	Left/right-turn lane/traffic signal	0.82	15.3	B	v/c = 0.90	Yes
	5-lane cross section/traffic signal	0.71	13.5	B	v/c = 0.90	Yes

OR 211/Leroy Avenue

The OR 211/Leroy Avenue intersection is projected to exceed its mobility target under year 2040 traffic conditions – Scenarios 1 and 2. This is primarily due to the relatively high delay at the southbound approach. Therefore, the following improvements are being considered at the intersection.

- Provide additional north-south connectivity to the area located between OR 211 and Leroy Avenue and north of OR 211 – the street system connectivity improvements identified above include three potential future connections (Scenarios 1 and 2).
- Widen OR 211 to provide a center two-way left-turn lane – this improvement is consistent with the capacity-based improvements identified above (Scenario 1).
- Widen OR 211 to provide an eastbound left-turn lane, install a southbound right-turn lane, and install a traffic signal when warranted – this improvement assumes a portion of the

eastbound left, southbound left, and southbound right-turn movements reroute to the new north-south streets to the west and a portion of the eastbound and westbound through movements are rerouted to the south along Molalla Forest Road (Scenario 2).

- Widen OR 211 to provide two lanes in both directions and an eastbound left-turn lane, install a northbound right-turn lane, and install a traffic signal when warranted – this improvement does not assume any re-routing of traffic as a result of the new connectivity (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
1	No-build	>1.0	>50.0	F	v/c = 0.90	No
	Center two-way left-turn lane	0.67	42.7	E	v/c = 0.90	Yes
2	No-build	>1.0	>50.0	F	v/c = 0.90	No
	Left/right-turn lane/traffic signal	0.85	21.2	C	v/c = 0.90	Yes
	5-lane cross section/traffic signal	0.69	14.2	B	v/c = 0.90	Yes

OR 211/Riding Avenue

The OR 211/Riding Avenue intersection is projected to exceed its mobility target under year 2040 traffic conditions – Scenario 2. This is primarily due to the relatively high delay at the southbound approach. Therefore, the following improvements are being considered at the intersection.

- Provide additional north-south connectivity to the area located between Leroy Avenue and N Molalla Avenue (Scenario 2).
- Widen OR 211 to provide an eastbound left-turn lane – this improvement assumes a portion of the eastbound and westbound through movements are rerouted to the south along Molalla Forest Road (Scenario 2).
- Widen OR 211 to provide an eastbound left-turn lane and install a traffic signal when warranted – this improvement does not assume any re-routing of traffic (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
2	No-build	>1.0	>50.0	F	v/c = 0.90	No
	Center two-way left-turn lane	0.80	62.7	F	v/c = 0.90	Yes
	Left-turn lanes/traffic signal	0.90	21.1	C	v/c = 0.90	Yes

OR 211 (Main Street)/Molalla Avenue

The OR 211 (Main Street)/Molalla Road intersection is projected to exceed its mobility target under year 2040 traffic conditions – Scenarios 1 and 2. This is primarily due to the relatively high delay at all approaches. Therefore, the following improvements are being considered at the intersection.

- Install a traffic signal when warranted with permitted phasing at all approaches (Scenario 1).
- Restrict the northbound and southbound left-turn movements during peak time periods and install a traffic signal when warranted with permitted phasing at all approaches (Scenario 2) – this improvement is consistent with the current TSP.

- Restrict all left-turn movements during peak time periods and install a traffic signal when warranted with permitted phasing at all approaches – this improvement is consistent with the OR 211 Streetscape Plan (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
1	No-build	>1.0	>80.0	F	v/c = 1.0	No
	Traffic Signal	0.95	63.5	C	v/c = 1.0	Yes
2	No-build	>1.0	>80.0	F	v/c = 1.0	No
	Traffic Signal – Restrict NB/SB Left	0.98	74.8	C	v/c = 1.0	Yes
	Traffic Signal – Restrict All Left	0.74	42.6	B	v/c = 1.0	Yes

N Molalla Avenue/Toliver Road

The N Molalla Avenue/Toliver Road intersection is projected to exceed its mobility standard under year 2040 traffic conditions – Scenario 2. This is primarily due to the relatively high delay at the eastbound approach. The 2001 TSP identifies a traffic signal; however, this capacity-based solution is incomplete and is no longer a viable solution based on the updated TSP future conditions analysis. Therefore, the following improvements are being considered at the intersection.

- Widen N Molalla Avenue to provide a center two-way left-turn lane along Molalla Avenue – this improvement is consistent with the capacity-based improvements identified above along N Molalla Avenue (Scenario 2).
- Install an eastbound right-turn lane when warranted (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
2	No-build	>1.0	>50.0	F	LOS E	No
	Center Two-way Left-turn Lane	0.73	26.8	D	LOS E	Yes
	Center Two-way Left-turn Lane/Right-turn Lane	0.49	15.1	C	LOS E	Yes

N Molalla Avenue/Shirley Street

The N Molalla Avenue/Shirley Street intersection is projected to exceed its mobility standard under year 2040 traffic conditions – Scenario 2. This is primarily due to the relatively high delay at the westbound approach. The 2001 TSP identifies a traffic signal; however, this capacity-based solution is incomplete and is no longer a viable solution based on the future conditions analysis. Therefore, the following improvements are being considered at the intersection.

- Widen N Molalla Avenue to provide a center two-way left-turn lane along N Molalla Avenue – this improvement is consistent with the capacity-based improvements identified above along N Molalla Avenue (Scenario 2).
- Install a westbound right-turn lane when warranted (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
2	No-build	>1.0	>50.0	F	LOS E	No
	Center Two-way Left-turn Lane	0.73	35.5	E	LOS E	Yes
	Center Two-way Left-turn Lane/Right-turn Lane	0.54	28.5	D	LOS E	Yes

N Molalla Avenue/Heintz Street

The N Molalla Avenue/Heintz Street intersection is projected to exceed its mobility standard under year 2040 traffic conditions – Scenario 2. This is primarily due to the relatively high delay at the westbound approach. Therefore, the following improvements are being considered at the intersection.

- Widen N Molalla Avenue to provide a center two-way left-turn lane along N Molalla Avenue – this improvement is consistent with the capacity-based improvements identified above along N Molalla Avenue (Scenario 2).
- Reconfigure the intersection as all-way stop control (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
2	No-build	0.92	>50.0	F	LOS E	No
	Center Two-way Left-turn Lane	0.43	22.6	C	LOS E	Yes
	Center Left-turn Lane/All-way Stop	0.98	>50.0	F	LOS E	No

S Molalla Avenue/5th Street

The S Molalla Avenue/5th Street intersection is projected to exceed its mobility standard under year 2040 traffic conditions – Scenario 2. This is primarily due to the relatively high delay at the eastbound and westbound approaches. Therefore, the following improvements are being considered at the intersection.

- Widen S Molalla Avenue to provide a center two-way left-turn lane along S Molalla Avenue – this improvement is consistent with the capacity-based improvements identified above along S Molalla Avenue (Scenario 2).
- Reconfigure the intersection as all-way stop control (Scenario 2).

Scenario	Improvement	V/C	Delay	LOS	Mobility Standard/Target	Meets Standard/Target?
2	No-build	>1.0	>50.0	F	LOS E	No
	Center Two-way Left-turn Lane	>1.0	>50.0	F	LOS E	No
	Center Left-turn Lane/All-way Stop	0.81	31.9	D	LOS E	Yes

Freight Mobility and Reliability Improvements

Designated Freight Routes

There are no state designated freight routes within Molalla; however, the Clackamas County TSP identifies OR 213 and OR 211 as truck freight routes and the current Molalla TSP identifies OR 213 and

OR 211 along with Molalla Avenue, Mathias Road, and Feyrer Road as main truck freight routes within the city. The city could establish designated freight routes within the city.

Freight Mobility Solutions

Downtown Bypass

The 2001 TSP identifies Molalla Forest Road as a downtown bypass that could reroute freight traffic around the downtown area. The bypass would utilize Molalla Forest Road from OR 211 to Mathias Road and Mathias Road from Molalla Forest Road to OR 211 to provide access to the industrial area south of OR 211 and the downtown area. While the notion of a bypass around downtown may no longer be viable, developing Molalla Forest Road to accommodate truck traffic and provide access to the industrial areas south of OR 211 remains a viable solution.

Molalla Avenue Freight Restriction

Restricting freight movement along Molalla Avenue was voiced as a need through the project's public involvement process. In order to accommodate the delivery of goods to retail/commercial destinations in the downtown area while meeting the needs of the public, a potential designated freight route system could be signed to circulate trucks via Heintz Street and Grange Avenue north of OR 211 and Shaver Avenue and Section Street south of OR 211.

Attachment A Enhanced Crossing Treatments

PEDESTRIAN CROSSING TREATMENTS

Pedestrian crossing facilities enable pedestrians to safely cross streets, railroad tracks, and other transportation facilities. Planning for appropriate pedestrian crossings requires the community to balance vehicular mobility needs with providing crossing locations that the desired routes of walkers.

Unmarked Crosswalks

Under Oregon law, pedestrians have the right-of-way at all unsignalized intersections. On narrow, low-speed streets unmarked crosswalks are generally sufficient for pedestrians to cross the street safely, as the low-speed environment makes drivers more responsive to the presence of pedestrians. However, drivers are less likely to yield to pedestrians at unmarked crosswalks on high-speed and/or high-volume roadways, even when the pedestrian has stepped onto the roadway. In these situations, enhanced pedestrian crossing facilities are needed to remind drivers that they must yield when pedestrians are present.

Marked Crosswalks

Marked crosswalks are painted roadway markings that indicate the location of a crosswalk to motorists. Marked crosswalks can be accompanied by signs, curb extensions and/or median refuge islands, and may occur at intersections or at mid-block locations. Research has shown that marked crosswalks in certain situations do not improve pedestrian safety and can even make it worse. Recent research indicates that on multi-lane roadways (more than two lanes), marked crosswalks should not be installed without accompanying treatments, such as Rectangular Rapid Flash Beacons (RRFBs) or Pedestrian Hybrid beacons.

Rectangular Rapid Flashing Beacon (RRFB)

RRFBs are user-actuated amber lights that have an irregular flash pattern similar to emergency flashers on police vehicles. These supplemental warning lights are used at unsignalized intersections or mid-block crosswalks to improve safety for pedestrians using a crosswalk. RRFBs could be used at any unsignalized intersection or mid-block crossing where warrants require a higher level of crosswalk protection.

Pedestrian Hybrid Beacon

A Pedestrian Hybrid Beacon (sometimes called a HAWK signal) is a user-actuated signal that is unlit when not in use. It begins with a yellow light alerting drivers to slow, and then displays a solid red light requiring drivers to remain stopped while pedestrians cross the street. The beacon then shifts to flashing red lights to signal that motorists may proceed, after stopping, and after pedestrians have completed their crossing. A Pedestrian Hybrid Beacon can be used at mid-block crossings or, in some cases, at unsignalized intersections (the MUTCD suggests that the beacons be located at least 100-feet from an intersection). Pedestrian Hybrid Beacons could be used at any unsignalized intersection or mid-block crossing where warrants require a higher level of crosswalk protection.

Pedestrian Signal

Pedestrian Signals provide pedestrians with a signal-controlled crossing at a mid-block location or, in some cases at a previously stop-controlled intersection where pedestrian volumes warrant full signalization (the MUTCD no longer allows half signals at intersections). The signal remains green for the mainline traffic movements until actuated by a pushbutton to call a red signal for traffic. They are typically located at midblock crossings with high pedestrian or bicycle demand and/or high traffic volumes, such as where multi-use paths intersect with roadways.

Pedestrian Countdown Heads

Pedestrian Countdown heads inform pedestrians of the time remaining to cross the street with a countdown timer at the signalized crossing. The countdown should include enough time for a pedestrian to cross the full length of the street, or in rare cases, reach a refuge island. The 2009 Manual on Uniform Traffic Control Devices (MUTCD) requires all new pedestrian signals, and any retrofitted signals to include pedestrian countdown signals.

Leading Pedestrian Interval (LPI)

Leading pedestrian intervals allow pedestrians to start crossing the street at a signalized intersections five to seven seconds before conflicting vehicles are given a green light and allowed to enter the intersection. They are most commonly used at signalized intersections where left- or right-turning vehicles interfere with pedestrian crossing movements. LPI could be applied at all existing or potential future traffic signals to improve crossing conditions for pedestrians.

Geometric Considerations

There are a number of geometric enhancements that can be considered at pedestrian crossings that may be implemented in conjunction with previously discuss treatments.

Curb Extensions

Curb extensions create additional space for pedestrians at crosswalks and allow pedestrians and vehicles to better see each other. Curb extensions are typically installed at intersections and midblock crossings located along roadways with on-street parking to help reduce crossing distances and the amount of exposure pedestrians have to vehicle traffic. Curb extensions can narrow the vehicle path, slow down traffic, and prohibit fast turns. Curb extensions could be applied along any street where on-street parking is allowed or where there is sufficient shoulder width so the curb extension does not conflict with on-street bike lanes.

Raised Median Island

Raised median islands provide a protected area in the middle of the roadway where pedestrians can stop while crossing the street. Raised median islands allow pedestrians to complete two-stage crossings if needed. Raised median islands can narrow the vehicle path and slow down traffic along the roadway. Raised median islands could be applied along any street where they would not interfere with turning movements at driveways and intersecting roadways.

Other Considerations

Street Furniture and Lighting

Street furniture includes pedestrian seating, information / wayfinding structures, and trash cans. Street furniture and lighting can be used to enhance the pedestrian experience and encourage pedestrian activity on a street.

Bicycle Crossing Treatments

Pavement Markings Through Intersections

Pavement markings can be extended through the intersection for bicyclists. Green paint can be used in “conflict zones” where vehicles and bicycles may cross paths in intersections, at driveways, or at right-turn pockets. These pavement marking are typically used at signalized intersections to emphasize a connection in a larger bicycle network. They could be used along at all signalized intersections and in other select “conflict zones”.

Bike Box

Bicycle boxes are designated spaces at signalized intersections, placed between a set-back stop bar and the pedestrian crosswalk, that allow bicyclists to queue in front of motor vehicles at red lights. Bike boxes are typically used at signalized intersections to facilitate turn movements as well as other movements for cyclists.

Two-Stage Left-Turn Bike Box

Two-stage left-turn bike boxes allow bicyclists to safely and comfortably make left-turns at multilane intersections from a right-side bicycle lane or cycle track. Bicyclists arriving on a green light travel into the intersection and pull out into the two-stage turn queue box away from through-moving bicycles and in front of cross street traffic, where they can wait to proceed through on the side-street green signal. Two-stage left-turn bike boxes can be applied at signalized intersections to improve bicycle crossing conditions.

Bike only signal

Bicycle-only signals can be used at intersections to provide a separate signal phase that is dedicated to bicyclists. At this stage, the MUTCD does not allow bicycle signal to operation concurrent with permissive vehicle phases.

Bicycle Detection

Many traffic signals along are actuated, meaning that green indication is given to a movement when a vehicle is detected. However, actuating a signal as a cyclist can be difficult. Bicycle detection allows cyclists to actuate the traffic signal from the bicycle lane with a detector that is calibrated to recognize a bicycle. Pavement markings could be added to show cyclists where to stand to actuate a signal. Bicycle detection is typically applied at signalized intersections that accommodate bicycles and can be used at all of the signalized intersection to improve bicycle crossing conditions.

Other Considerations

Bicycle Parking

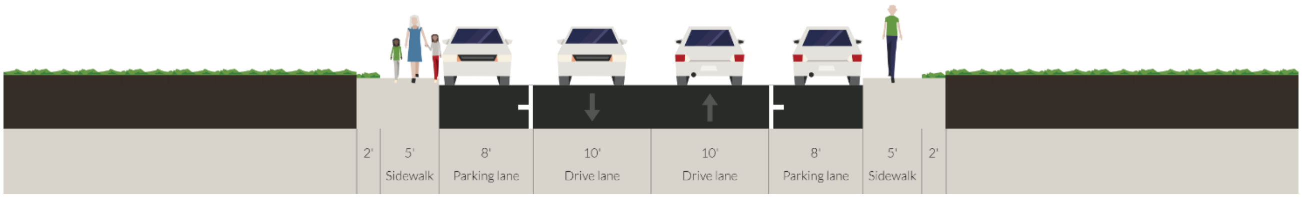
Bicycle parking facilities provide safe and secure places for people to park their bicycles. The most common bicycle parking facility is the “staple”, which provides space for up to two bicycles and is typically located along the side of the road in a commercial area or near the main entrance to a building. Bicycle parking could be applied along streets located adjacent to commercial properties.

Wayfinding Signs

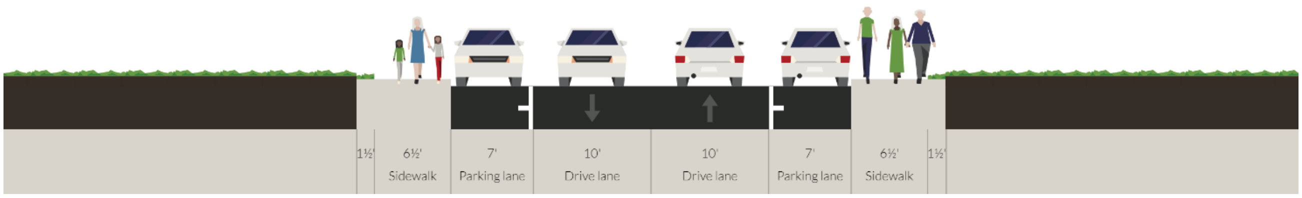
Wayfinding signs are signs located along roadways or at intersections that direct bicyclists towards destinations in the area and/or to define a bicycle route. They typically include distances and average walk/cycle times. Wayfinding signs are generally used on primary bicycle routes and multiuse paths.

Attachment B Roadway Cross Sections

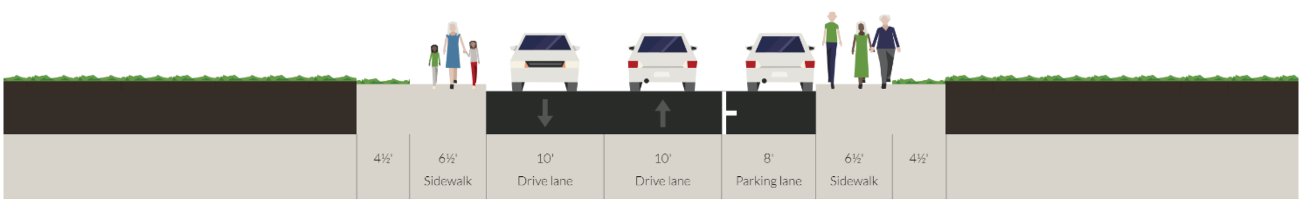
Exhibit A-1: Local Street Cross Sections



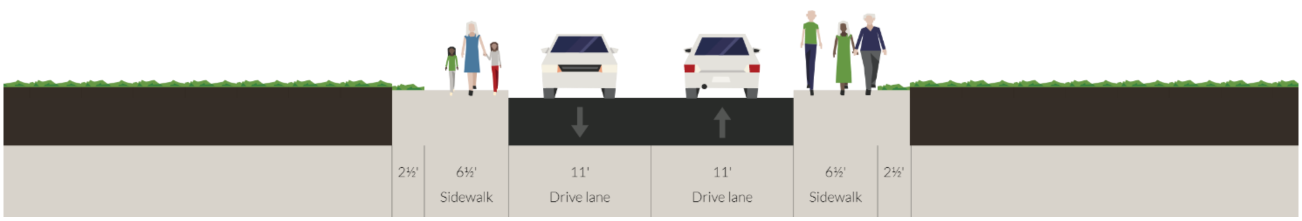
Local Street – Current TSP (50-foot ROW, 36-foot Paved Width)



Local Street with Parking on Both Sides (50-foot ROW, 34-foot Paved Width)



Local Street with Parking on One Side (50-foot ROW, 28-foot Paved Width)



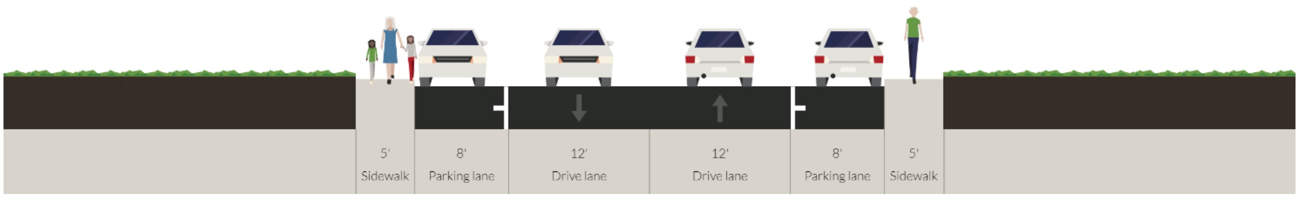
Local Street with No Parking (40-foot ROW, 22-foot Paved Width)

Table A-1: Local Street Cross Section Standards

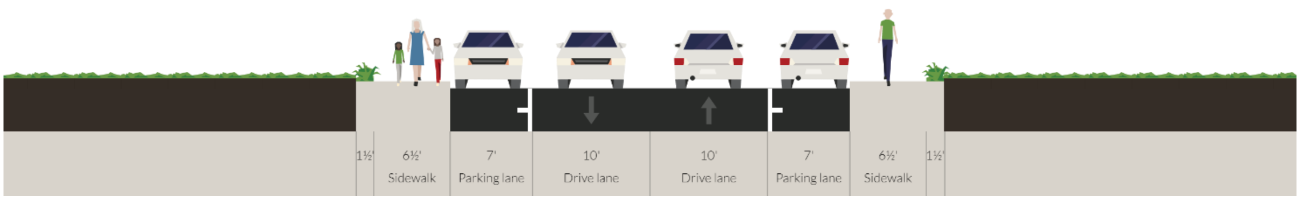
Standards[3]	Local Streets
Vehicle Lane Widths	10-11 feet
On-Street Parking	7-8 feet[1]
Sidewalks	5-6 feet
Landscape Strips	5-6 feet[2, 3]
Median/Turn Lane Widths	None
Neighborhood Traffic Management	At the discretion of the Public Works Director

1. On-street parking may be reduced or removed at the discretion of the Public Works Director.
2. Landscape strips may be required at the discretion of the Public Works Director.
3. The Public Works Director may recommend green street variations of each cross section. These variations may include installing rain gardens or swales, using pervious material for the sidewalks, and in some cases providing a sidewalk on only one side of the street.

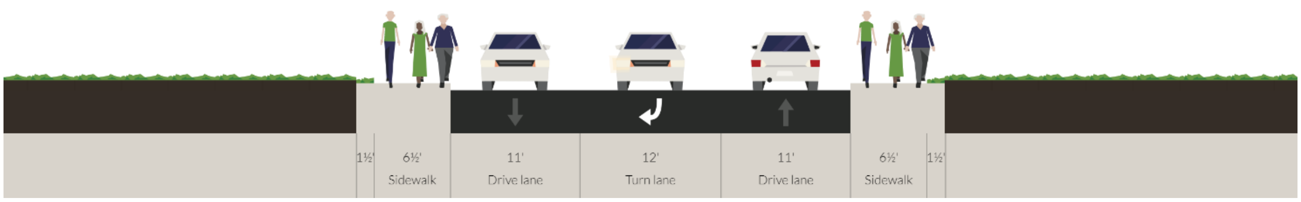
Exhibit 2: Neighborhood Route/Minor Collector Cross Sections



Neighborhood Route – Current TSP (50-foot ROW, 40-foot Paved Width)



Neighborhood Route with Parking on Both Sides (50-foot ROW, 34-foot Paved Width)



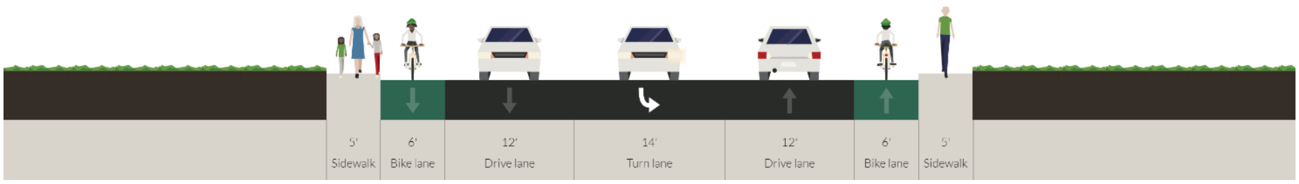
Neighborhood Route with Center Turn Lane – Intersection Treatment (50-foot ROW, 34-foot Paved Width)

Table 5: Neighborhood Route Cross Section Standards

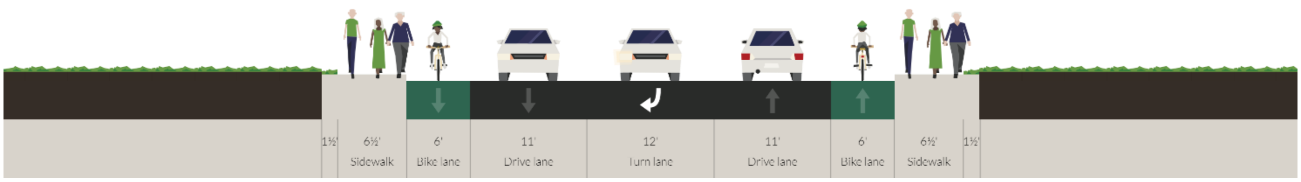
Standards[4]	Neighborhood Routes
Vehicle Lane Widths	10-12 feet
On-Street Parking	7-8 feet[1]
Sidewalks	5-6 feet
Landscape Strips	5-6 feet[2,3]
Median/Turn Lane Widths	12-14 feet
Neighborhood Traffic Management	At the discretion of the Public Works Director

1. On-street parking may be reduced or removed at the discretion of the Public Works Director.
2. Landscape strips may be required at the discretion of the Public Works Director.
3. The Public Works Director may recommend green street variations of each cross section. These variations may include installing rain gardens or swales, using pervious material for the sidewalks, and in some cases providing a sidewalk on only one side of the street.

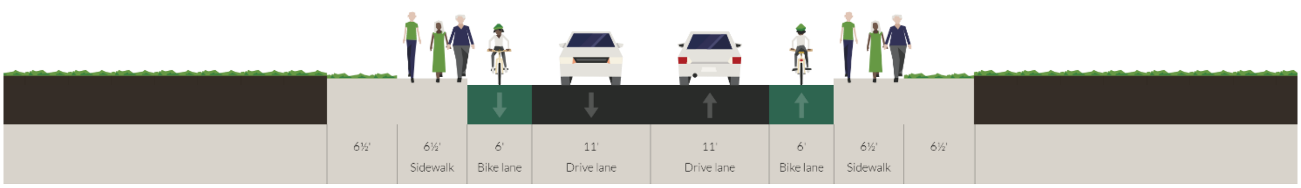
Exhibit 3: Major Collector Cross Sections



Major Collector – Current TSP (60-foot ROW, 50-foot paved Width)



Major Collector (62-foot ROW, 46-foot Paved Width)



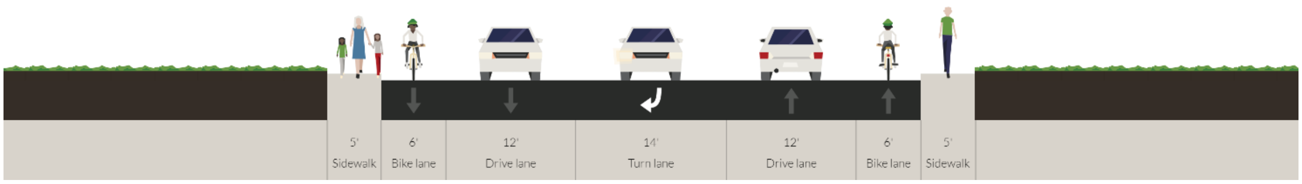
Major Collector Constrained (60-foot ROW, 34-foot Paved Width)

Table 6: Major Collector Cross Section Standards

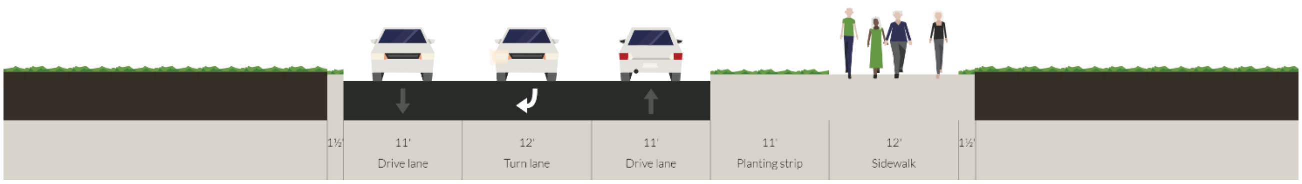
Standards[5]	Collector
Vehicle Lane Widths	10-12 feet
On-Street Parking	Optional (7-8 feet)[1]
Bike Lanes	5-6 feet[2,3]
Sidewalks	5-6 feet
Landscape Strips	5-6 feet[4, 6]
Median/Turn Lane Widths	12-14 feet[5]
Neighborhood Traffic Management	Not Appropriate

1. On-street parking may be allowed at the discretion of the Public Work Director.
2. Bike lanes are required where future traffic volumes are greater than 3,000 ADT.
3. Cycle tracks may be required where travel speeds are > 30 mph in lieu of bike lanes.
4. Landscape strips may be required at the discretion of the Public Works Director.
5. Center turn lane may be omitted where future traffic volumes < 5,000 ADT or at the discretion of the Public Works Director.
6. The Public Works Director may recommend green street variations of each cross section. These variations may include installing rain gardens or swales, using pervious material for the sidewalks, and in some cases providing a sidewalk on only one side of the street.

Exhibit 4: Major Collector (Molalla Forest Road) Cross Sections



Major Collector – Current TSP (60-foot ROW, 50-foot Paved Width)

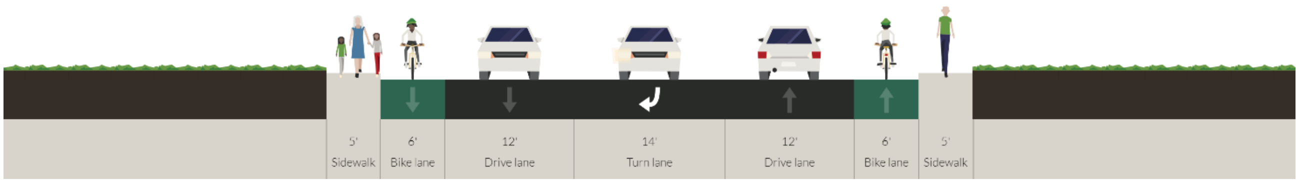


Major Collector with Shared-use Path (51-foot ROW, 35-foot Paved Width)

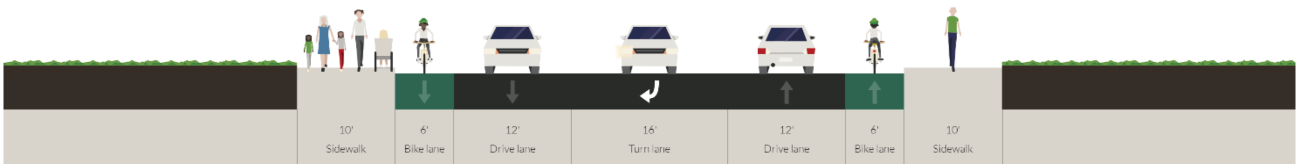
Table 7: Major Collector (Molalla Forest Road) Cross Section Standards

Standards[5]	Collector
Vehicle Lane Widths	10-12 feet
On-Street Parking	None
Bike Lanes	None
Sidewalks	None
Landscape Strips	None
Median/Turn Lane Widths	12-14 feet
Neighborhood Traffic Management	Not Appropriate

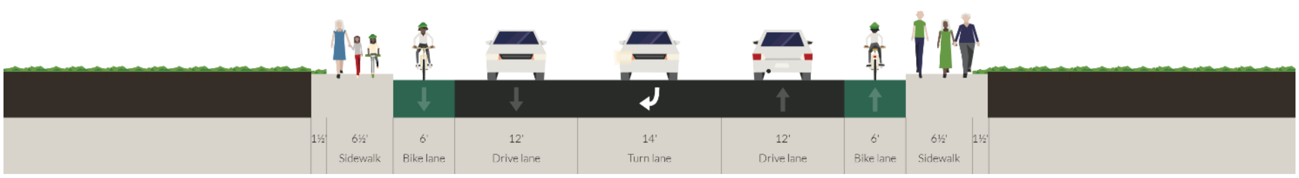
Exhibit 5: Arterial Cross Sections



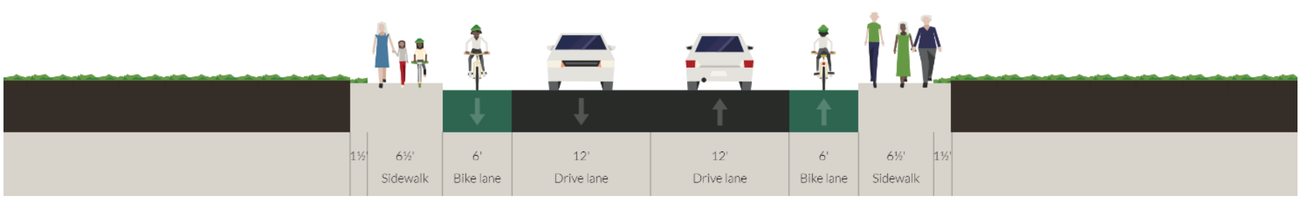
Arterial – Current TSP (60-foot ROW, 50-foot Paved Width)



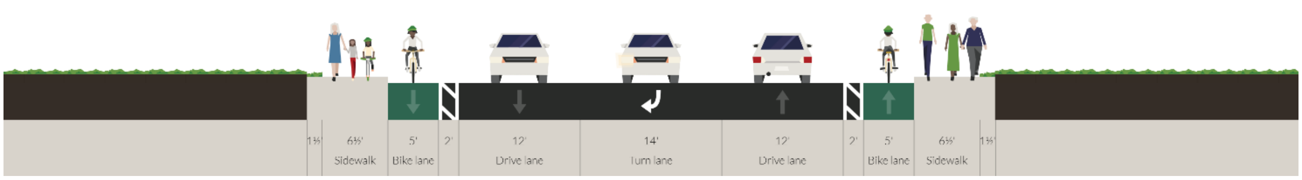
Arterial – OR 211 Streetscape Plan Corridor Cross Section (60-foot ROW, 52-foot paved width)



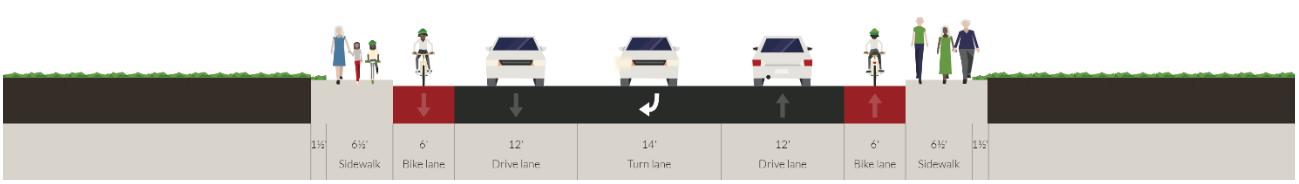
Arterial (66-foot ROW, 50-foot Paved Width)



Arterial Constrained (52-foot ROW, 36-foot Paved Width)



Arterial with Buffered Bike Lanes (68-foot ROW, 52-foot Paved Width)



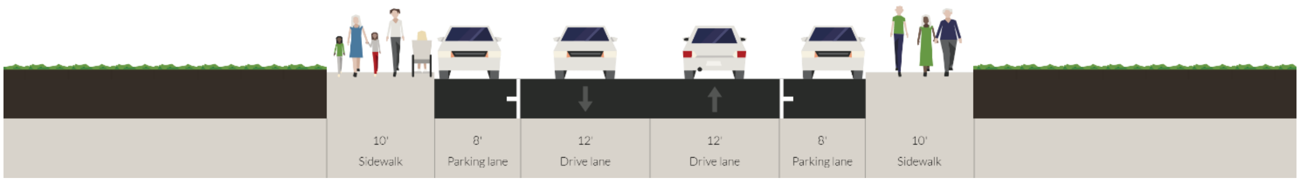
Arterial with Cycle Tracks (60-foot ROW, 50-foot Paved Width)

Table 8: Arterial Cross Section Standards

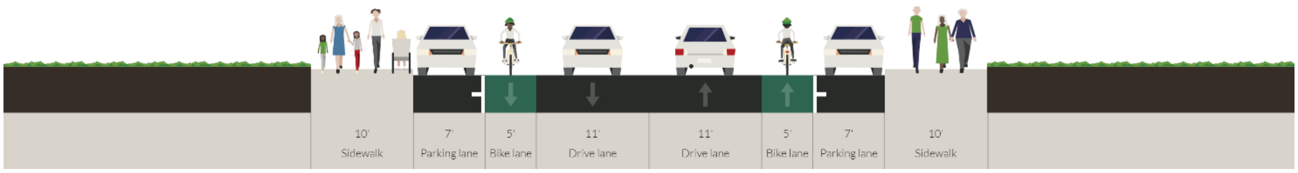
Standards[5]	Collector
Vehicle Lane Widths	10-12 feet
On-Street Parking	Optional (7-8 feet)[1]
Bike Lanes	5-6 feet[2,3,4]
Sidewalks	6-8 feet
Landscape Strips	5-6 feet[5,7]
Median/Turn Lane Widths	12-14 feet[6]
Neighborhood Traffic Management	Not Appropriate

1. On-street parking may be allowed at the discretion of the Public Work Director.
2. Bike lanes are required where future traffic volumes > 3,000 ADT.
3. Buffered lanes may be required where speeds > 30 mph in lieu of bike lanes.
4. Cycle tracks may be required where speeds > 35 mph in lieu of bike lanes.
5. Landscape strips may be required at the discretion of the Public Works Director.
6. Center turn lane may be omitted where future traffic volumes < 5,000 ADT or at the discretion of the Public Works Director.
7. The Public Works Director may recommend green street variations of each cross section. These variations may include installing rain gardens or swales, using pervious material for the sidewalks, and in some cases providing a sidewalk on only one side of the street.

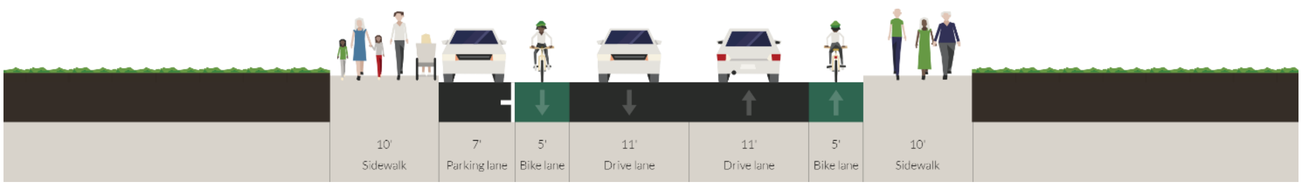
Exhibit 6: Arterial (Downtown District) Cross Sections



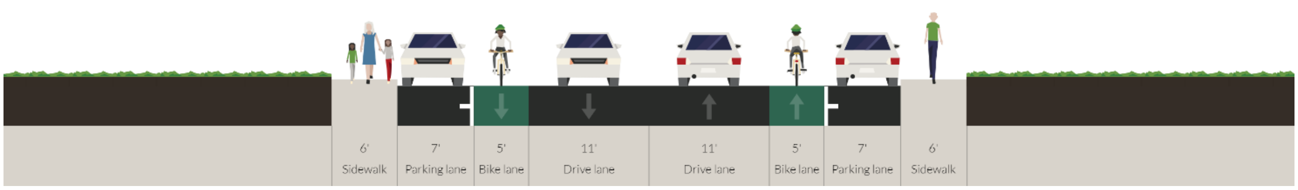
Arterial – Current TSP (60-foot ROW, 40-foot Paved Width)



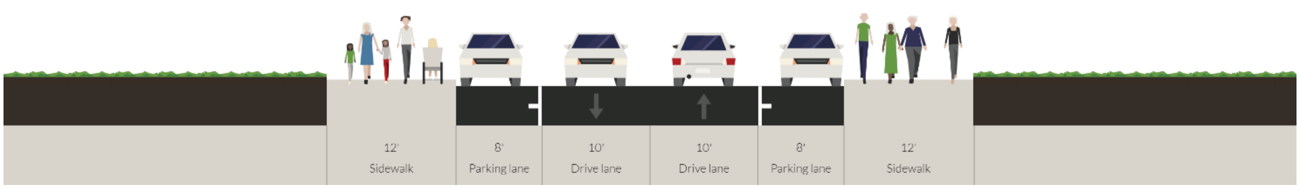
Arterial – OR 211 Streetscape Plan Preferred Cross Section (66-foot ROW, 46-foot Paved Width)



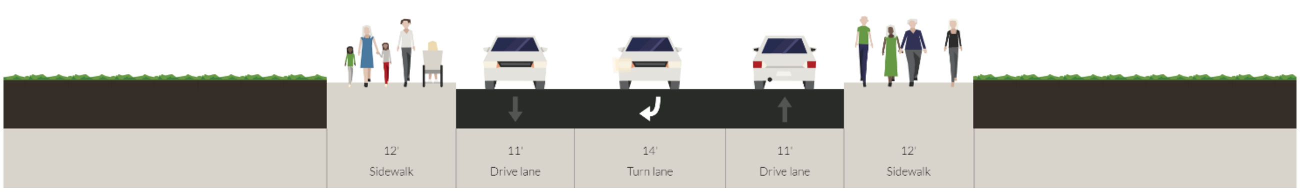
Arterial – OR 211 Streetscape Plan Option 1 Cross Section (59-foot ROW, 39-foot Paved Width)



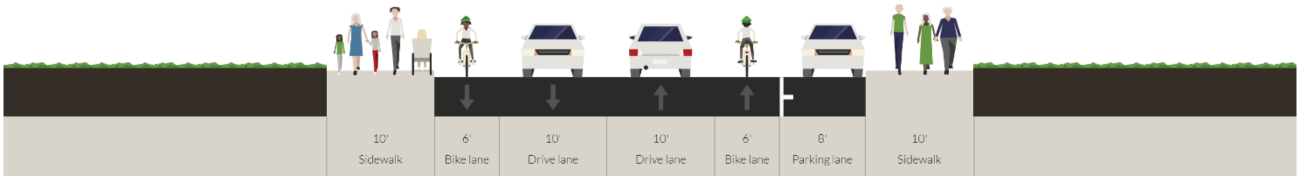
Arterial – OR 211 Streetscape Plan Option 2 Cross Section (58-foot ROW, 46-foot Paved Width)



Arterial with On-Street Parking (60-foot ROW, 36-foot Paved Width)



Arterial with Center Turn Lane – Intersection Treatment (60-foot ROW, 36-foot Paved Width)



Arterial with On-street Parking on One Side and Bike Lanes (60-foot ROW, 40-foot Paved Width)

Table 9: Arterial (Downtown District) Cross Section Standards

Standards[5]	Collector
Vehicle Lane Widths	10-12 feet
On-Street Parking	7-8 feet[1]
Bike Lanes	5-6 feet[2,3, 4]
Sidewalks	5-6 feet
Landscape Strips	5-6 feet[3, 4]
Median/Turn Lane Widths	12-14 feet
Neighborhood Traffic Management	Not Appropriate

1. On-street parking may be reduced or removed at the discretion of the Public Works Director.
2. Bike lanes are required where future traffic volumes > 3,000 ADT.
3. Landscape strips may be required at the discretion of the Public Works Director.
4. The Public Works Director may recommend green street variations of each cross section. These variations may include installing rain gardens or swales, using pervious material for the sidewalks, and in some cases providing a sidewalk on only one side of the street.

Attachment C Intersection Operations Worksheets

Intersection						
Int Delay, s/veh	3					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	71	55	504	84	160	827
Future Vol, veh/h	71	55	504	84	160	827
Conflicting Peds, #/hr	0	0	0	1	1	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	100	150	-
Veh in Median Storage, #	2	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	4	8	9	5	1	9
Mvmt Flow	76	59	542	90	172	889

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1776	543	0	0	543	0
Stage 1	543	-	-	-	-	-
Stage 2	1233	-	-	-	-	-
Critical Hdwy	6.44	6.28	-	-	4.11	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.372	-	-	2.209	-
Pot Cap-1 Maneuver	90	528	-	-	1031	-
Stage 1	578	-	-	-	-	-
Stage 2	273	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 75	527	-	-	1031	-
Mov Cap-2 Maneuver	206	-	-	-	-	-
Stage 1	577	-	-	-	-	-
Stage 2	227	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	29.2	0	1.5
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	281	1031	-
HCM Lane V/C Ratio	-	-	0.482	0.167	-
HCM Control Delay (s)	-	-	29.2	9.2	-
HCM Lane LOS	-	-	D	A	-
HCM 95th %tile Q(veh)	-	-	2.5	0.6	-

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

Intersection	
Int Delay, s/veh	3.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	71	55	504	84	160	827
Future Vol, veh/h	71	55	504	84	160	827
Conflicting Peds, #/hr	0	0	0	1	1	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	100	150	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	4	8	9	5	1	9
Mvmt Flow	76	59	542	90	172	889

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1776	543	0	0	543	0
Stage 1	543	-	-	-	-	-
Stage 2	1233	-	-	-	-	-
Critical Hdwy	6.44	6.28	-	-	4.11	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.372	-	-	2.209	-
Pot Cap-1 Maneuver	90	528	-	-	1031	-
Stage 1	578	-	-	-	-	-
Stage 2	273	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 75	527	-	-	1031	-
Mov Cap-2 Maneuver	175	-	-	-	-	-
Stage 1	577	-	-	-	-	-
Stage 2	227	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	36	0	1.5
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	247	1031	-
HCM Lane V/C Ratio	-	-	0.549	0.167	-
HCM Control Delay (s)	-	-	36	9.2	-
HCM Lane LOS	-	-	E	A	-
HCM 95th %tile Q(veh)	-	-	3	0.6	-

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

Intersection	
Int Delay, s/veh	45.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	7	34	68	108	19	72	27	505	175	178	681	8
Future Vol, veh/h	7	34	68	108	19	72	27	505	175	178	681	8
Conflicting Peds, #/hr	0	0	1	1	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	2	-	-	2	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	4	2	2	0	2	4	9	20	11	8	0
Mvmt Flow	8	37	74	117	21	78	29	549	190	193	740	9

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1885	1931	747	1891	1840	644	750	0	0	739	0	0
Stage 1	1133	1133	-	703	703	-	-	-	-	-	-	-
Stage 2	752	798	-	1188	1137	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.54	6.22	7.12	6.5	6.22	4.14	-	-	4.21	-	-
Critical Hdwy Stg 1	6.1	5.54	-	6.12	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.54	-	6.12	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.036	3.318	3.518	4	3.318	2.236	-	-	2.299	-	-
Pot Cap-1 Maneuver	55	65	413	~ 53	76	473	850	-	-	828	-	-
Stage 1	249	276	-	428	443	-	-	-	-	-	-	-
Stage 2	405	395	-	230	279	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	33	48	412	~ 28	56	473	849	-	-	828	-	-
Mov Cap-2 Maneuver	103	141	-	~ 84	166	-	-	-	-	-	-	-
Stage 1	240	211	-	413	428	-	-	-	-	-	-	-
Stage 2	311	382	-	119	214	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	36.2	$ 401.6	0.4	2.2
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	849	-	-	230	128	828	-	-
HCM Lane V/C Ratio	0.035	-	-	0.515	1.69	0.234	-	-
HCM Control Delay (s)	9.4	-	-	36.2	$ 401.6	10.7	-	-
HCM Lane LOS	A	-	-	E	F	B	-	-
HCM 95th %tile Q(veh)	0.1	-	-	2.7	16.1	0.9	-	-

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)	7	34	68	108	19	72	27	505	175	178	681	8
Future Volume (vph)	7	34	68	108	19	72	27	505	175	178	681	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.99			1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.92			0.95		1.00	0.96		1.00	1.00	
Flt Protected		1.00			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1669			1727		1735	1634		1626	1757	
Flt Permitted		0.98			0.75		0.29	1.00		0.16	1.00	
Satd. Flow (perm)		1642			1335		521	1634		281	1757	
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)	8	37	74	117	21	78	29	549	190	193	740	9
RTOR Reduction (vph)	0	59	0	0	23	0	0	14	0	0	0	0
Lane Group Flow (vph)	0	60	0	0	193	0	29	725	0	193	749	0
Confl. Peds. (#/hr)			1	1			1					1
Heavy Vehicles (%)	0%	4%	2%	2%	0%	2%	4%	9%	20%	11%	8%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		15.5			15.5		43.0	41.3		54.5	48.3	
Effective Green, g (s)		15.5			15.5		43.0	41.3		54.5	48.3	
Actuated g/C Ratio		0.20			0.20		0.54	0.52		0.69	0.61	
Clearance Time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		322			261		309	854		341	1074	
v/s Ratio Prot							0.00	c0.44		c0.06	c0.43	
v/s Ratio Perm		0.04			c0.14		0.05			0.33		
v/c Ratio		0.18			0.74		0.09	0.85		0.57	0.70	
Uniform Delay, d1		26.5			29.9		9.1	16.2		10.5	10.4	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.3			10.8		0.1	7.9		2.2	2.0	
Delay (s)		26.8			40.6		9.2	24.0		12.6	12.4	
Level of Service		C			D		A	C		B	B	
Approach Delay (s)		26.8			40.6			23.5			12.4	
Approach LOS		C			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	20.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	79.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	76.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	197.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	55	86	182	33	72	27	502	224	173	710	12
Future Vol, veh/h	10	55	86	182	33	72	27	502	224	173	710	12
Conflicting Peds, #/hr	0	0	1	1	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	2	-	-	2	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	4	2	2	0	2	4	9	20	11	8	0
Mvmt Flow	11	60	93	198	36	78	29	546	243	188	772	13

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1938	2003	780	1958	1888	667	786	0	0	789	0	0
Stage 1	1155	1155	-	726	726	-	-	-	-	-	-	-
Stage 2	783	848	-	1232	1162	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.54	6.22	7.12	6.5	6.22	4.14	-	-	4.21	-	-
Critical Hdwy Stg 1	6.1	5.54	-	6.12	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.54	-	6.12	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.036	3.318	3.518	4	3.318	2.236	-	-	2.299	-	-
Pot Cap-1 Maneuver	50	~ 59	395	~ 48	71	459	824	-	-	792	-	-
Stage 1	242	269	-	416	433	-	-	-	-	-	-	-
Stage 2	390	375	-	217	272	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	27	~ 43	394	~ 19	52	459	823	-	-	792	-	-
Mov Cap-2 Maneuver	87	132	-	~ 57	159	-	-	-	-	-	-	-
Stage 1	233	205	-	401	418	-	-	-	-	-	-	-
Stage 2	285	362	-	~ 89	207	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	72.7	$ 1390	0.3	2.1
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	823	-	-	201	81	792	-	-
HCM Lane V/C Ratio	0.036	-	-	0.817	3.851	0.237	-	-
HCM Control Delay (s)	9.5	-	-	72.7	$ 1390	11	-	-
HCM Lane LOS	A	-	-	F	F	B	-	-
HCM 95th %tile Q(veh)	0.1	-	-	5.9	32.5	0.9	-	-

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)	10	55	86	182	33	72	27	502	224	173	710	12
Future Volume (vph)	10	55	86	182	33	72	27	502	224	173	710	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.91		1.00	0.90		1.00	0.95		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	1657		1766	1682		1735	1612		1626	1756	
Flt Permitted	0.68	1.00		0.60	1.00		0.24	1.00		0.15	1.00	
Satd. Flow (perm)	1298	1657		1110	1682		444	1612		249	1756	
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)	11	60	93	198	36	78	29	546	243	188	772	13
RTOR Reduction (vph)	0	62	0	0	62	0	0	18	0	0	1	0
Lane Group Flow (vph)	11	91	0	198	52	0	29	771	0	188	784	0
Confl. Peds. (#/hr)			1	1			1					1
Heavy Vehicles (%)	0%	4%	2%	2%	0%	2%	4%	9%	20%	11%	8%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	17.8	17.8		17.8	17.8		47.6	45.7		57.7	51.3	
Effective Green, g (s)	17.8	17.8		17.8	17.8		47.6	45.7		57.7	51.3	
Actuated g/C Ratio	0.21	0.21		0.21	0.21		0.56	0.54		0.68	0.61	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	273	349		233	354		279	871		292	1066	
v/s Ratio Prot		0.05			0.03		0.00	c0.48		c0.06	0.45	
v/s Ratio Perm	0.01			c0.18			0.06			0.38		
v/c Ratio	0.04	0.26		0.85	0.15		0.10	0.88		0.64	0.74	
Uniform Delay, d1	26.6	27.8		32.1	27.2		9.7	17.1		12.5	11.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.4		24.0	0.2		0.2	10.6		4.8	2.7	
Delay (s)	26.6	28.2		56.1	27.4		9.9	27.7		17.4	14.5	
Level of Service	C	C		E	C		A	C		B	B	
Approach Delay (s)		28.1			45.6			27.1			15.0	
Approach LOS		C			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	24.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	84.5	Sum of lost time (s)	13.5
Intersection Capacity Utilization	83.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	217	556	237	355	190	49	248	176	321	395	171
v/c Ratio	0.49	0.83	0.74	0.50	0.26	0.25	0.67	0.40	0.91	0.76	0.36
Control Delay	20.2	47.4	35.4	32.0	4.9	29.0	53.9	8.2	62.3	51.7	20.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.2	47.4	35.4	32.0	4.9	29.0	53.9	8.2	62.3	51.7	20.8
Queue Length 50th (ft)	83	379	92	203	0	26	188	0	203	305	55
Queue Length 95th (ft)	168	#678	#271	364	53	53	275	56	#288	435	122
Internal Link Dist (ft)		1906		2602			1480			1933	
Turn Bay Length (ft)	275		230		230	250		250	200		100
Base Capacity (vph)	480	761	319	764	764	291	781	738	353	766	665
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.73	0.74	0.46	0.25	0.17	0.32	0.24	0.91	0.52	0.26

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	200	468	43	218	327	175	45	228	162	295	363	157
Future Volume (vph)	200	468	43	218	327	175	45	228	162	295	363	157
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	5.3		5.0	5.3	5.3	5.0	5.3	5.3	5.0	5.3	5.3
Lane Util. Factor	1.00	1.00		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		1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1597	1794		1687	1776	1524	1492	1845	1505	1719	1810	1455
Flt Permitted	0.44	1.00		0.15	1.00	1.00	0.32	1.00	1.00	0.31	1.00	1.00
Satd. Flow (perm)	734	1794		264	1776	1524	503	1845	1505	552	1810	1455
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)	217	509	47	237	355	190	49	248	176	321	395	171
RTOR Reduction (vph)	0	2	0	0	0	115	0	0	139	0	0	61
Lane Group Flow (vph)	217	554	0	237	355	75	49	248	37	321	395	110
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	13%	5%	0%	7%	7%	6%	21%	3%	5%	5%	5%	11%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8			4		4	6		6	2		2
Actuated Green, G (s)	56.9	44.6		63.4	48.1	48.1	31.5	25.3	25.3	45.6	34.4	34.4
Effective Green, g (s)	56.9	44.6		63.4	48.1	48.1	31.5	25.3	25.3	45.6	34.4	34.4
Actuated g/C Ratio	0.47	0.37		0.52	0.40	0.40	0.26	0.21	0.21	0.38	0.28	0.28
Clearance Time (s)	4.5	5.3		5.0	5.3	5.3	5.0	5.3	5.3	5.0	5.3	5.3
Vehicle Extension (s)	2.3	5.0		2.3	5.0	5.0	2.3	2.0	2.0	2.3	2.0	2.0
Lane Grp Cap (vph)	432	660		317	705	605	181	385	314	355	514	413
v/s Ratio Prot	0.05	c0.31		c0.09	0.20		0.01	0.13		c0.11	0.22	
v/s Ratio Perm	0.18			0.30		0.05	0.06		0.02	c0.23		0.08
v/c Ratio	0.50	0.84		0.75	0.50	0.12	0.27	0.64	0.12	0.90	0.77	0.27
Uniform Delay, d1	20.1	35.0		22.1	27.5	23.1	34.7	43.8	38.8	31.9	39.7	33.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	10.2		8.5	1.2	0.2	0.5	2.8	0.1	25.2	6.1	0.1
Delay (s)	20.7	45.2		30.7	28.7	23.3	35.2	46.5	38.9	57.0	45.8	33.7
Level of Service	C	D		C	C	C	D	D	D	E	D	C
Approach Delay (s)		38.3			28.0			42.5			47.6	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	39.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	121.1	Sum of lost time (s)	20.6
Intersection Capacity Utilization	85.4%	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)	223	403	46	304	279	202	46	224	164	335	407	193
Future Volume (vph)	223	403	46	304	279	202	46	224	164	335	407	193
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	5.3		5.0	5.3	5.3	5.0	5.3	5.3	5.0	5.3	5.3
Lane Util. Factor	1.00	1.00		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		1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1597	1791		1687	1776	1524	1492	1845	1505	1719	1810	1455
Flt Permitted	0.58	1.00		0.14	1.00	1.00	0.45	1.00	1.00	0.26	1.00	1.00
Satd. Flow (perm)	976	1791		249	1776	1524	706	1845	1505	476	1810	1455
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	235	424	48	320	294	213	48	236	173	353	428	203
RTOR Reduction (vph)	0	3	0	0	0	131	0	0	143	0	0	83
Lane Group Flow (vph)	235	469	0	320	294	82	48	236	30	353	428	120
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	13%	5%	0%	7%	7%	6%	21%	3%	5%	5%	5%	11%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8			4		4	6		6	2		2
Actuated Green, G (s)	53.1	38.8		67.9	49.1	49.1	25.4	22.4	22.4	49.3	41.3	41.3
Effective Green, g (s)	53.1	38.8		67.9	49.1	49.1	25.4	22.4	22.4	49.3	41.3	41.3
Actuated g/C Ratio	0.42	0.30		0.53	0.38	0.38	0.20	0.18	0.18	0.39	0.32	0.32
Clearance Time (s)	4.5	5.3		5.0	5.3	5.3	5.0	5.3	5.3	5.0	5.3	5.3
Vehicle Extension (s)	2.3	5.0		2.3	5.0	5.0	2.3	2.0	2.0	2.3	2.0	2.0
Lane Grp Cap (vph)	475	543		403	682	585	158	323	263	396	584	470
v/s Ratio Prot	0.06	c0.26		c0.15	0.17		0.01	0.13		c0.15	0.24	
v/s Ratio Perm	0.15			0.27		0.05	0.05		0.02	c0.19		0.08
v/c Ratio	0.49	0.86		0.79	0.43	0.14	0.30	0.73	0.12	0.89	0.73	0.26
Uniform Delay, d1	25.6	42.0		28.9	29.0	25.6	42.7	49.8	44.4	31.7	38.4	31.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	14.5		9.9	0.9	0.2	0.6	7.1	0.1	21.2	4.1	0.1
Delay (s)	26.1	56.5		38.7	30.0	25.8	43.4	57.0	44.4	52.9	42.4	32.0
Level of Service	C	E		D	C	C	D	E	D	D	D	C
Approach Delay (s)		46.4			32.3			50.8			44.1	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	42.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	127.8	Sum of lost time (s)	20.6
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	947	124	116	881	151	207
Future Volume (vph)	947	124	116	881	151	207
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5	4.5	4.5	4.5
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	1787		1805	1792	1805	1615
Flt Permitted	1.00		0.12	1.00	0.95	1.00
Satd. Flow (perm)	1787		225	1792	1805	1615
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	1018	133	125	947	162	223
RTOR Reduction (vph)	4	0	0	0	0	135
Lane Group Flow (vph)	1147	0	125	947	162	88
Confl. Bikes (#/hr)		1				
Heavy Vehicles (%)	5%	0%	0%	6%	0%	0%
Turn Type	NA		Perm	NA	Prot	Perm
Protected Phases	4			8	2	
Permitted Phases			8			2
Actuated Green, G (s)	62.6		62.6	62.6	12.8	12.8
Effective Green, g (s)	62.6		62.6	62.6	12.8	12.8
Actuated g/C Ratio	0.74		0.74	0.74	0.15	0.15
Clearance Time (s)	4.5		4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1325		166	1329	273	244
v/s Ratio Prot	c0.64			0.53	c0.09	
v/s Ratio Perm			0.55			0.05
v/c Ratio	0.87		0.75	0.71	0.59	0.36
Uniform Delay, d1	7.9		6.4	6.0	33.4	32.1
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	6.2		17.4	1.8	3.4	0.9
Delay (s)	14.0		23.8	7.8	36.8	33.0
Level of Service	B		C	A	D	C
Approach Delay (s)	14.0			9.7	34.6	
Approach LOS	B			A	C	

Intersection Summary			
HCM 2000 Control Delay	15.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	84.4	Sum of lost time (s)	9.0
Intersection Capacity Utilization	83.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1147	144	136	1081	171	227
Future Volume (vph)	1147	144	136	1081	171	227
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5	4.5	4.5	4.5
Lane Util. Factor	0.95		1.00	0.95	1.00	1.00
Frpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3391		1805	3406	1805	1615
Flt Permitted	1.00		0.10	1.00	0.95	1.00
Satd. Flow (perm)	3391		185	3406	1805	1615
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	1233	155	146	1162	184	244
RTOR Reduction (vph)	11	0	0	0	0	194
Lane Group Flow (vph)	1377	0	146	1162	184	50
Confl. Bikes (#/hr)		1				
Heavy Vehicles (%)	5%	0%	0%	6%	0%	0%
Turn Type	NA		pm+pt	NA	Perm	Perm
Protected Phases	4		3	8		
Permitted Phases			8		2	2
Actuated Green, G (s)	36.6		49.1	49.1	13.1	13.1
Effective Green, g (s)	36.6		49.1	49.1	13.1	13.1
Actuated g/C Ratio	0.51		0.69	0.69	0.18	0.18
Clearance Time (s)	4.5		4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1743		309	2348	332	297
v/s Ratio Prot	c0.41		0.05	c0.34		
v/s Ratio Perm			0.27		c0.10	0.03
v/c Ratio	0.79		0.47	0.49	0.55	0.17
Uniform Delay, d1	14.2		9.6	5.2	26.4	24.5
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	2.5		1.1	0.2	2.0	0.3
Delay (s)	16.7		10.8	5.4	28.4	24.7
Level of Service	B		B	A	C	C
Approach Delay (s)	16.7			6.0	26.3	
Approach LOS	B			A	C	

Intersection Summary			
HCM 2000 Control Delay	13.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	71.2	Sum of lost time (s)	13.5
Intersection Capacity Utilization	64.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Intersection						
Int Delay, s/veh	4.1					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	141	955	780	83	52	116
Future Vol, veh/h	141	955	780	83	52	116
Conflicting Peds, #/hr	3	0	0	3	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	2	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	4	5	6	4	0	2
Mvmt Flow	150	1016	830	88	55	123

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	921	0	-	0	2193	877
Stage 1	-	-	-	-	877	-
Stage 2	-	-	-	-	1316	-
Critical Hdwy	4.14	-	-	-	6.4	6.22
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.236	-	-	-	3.5	3.318
Pot Cap-1 Maneuver	733	-	-	-	~ 50	348
Stage 1	-	-	-	-	410	-
Stage 2	-	-	-	-	253	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	733	-	-	-	~ 40	347
Mov Cap-2 Maneuver	-	-	-	-	173	-
Stage 1	-	-	-	-	409	-
Stage 2	-	-	-	-	201	-

Approach	EB	WB	SB
HCM Control Delay, s	1.4	0	42.7
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	733	-	-	-	265
HCM Lane V/C Ratio	0.205	-	-	-	0.674
HCM Control Delay (s)	11.2	-	-	-	42.7
HCM Lane LOS	B	-	-	-	E
HCM 95th %tile Q(veh)	0.8	-	-	-	4.4

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	216	909	796	143	115	199
Future Volume (vph)	216	909	796	143	115	199
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	0.95	0.95	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1649	1717	1756		1805	1583
Flt Permitted	0.11	0.87	1.00		0.95	1.00
Satd. Flow (perm)	185	1489	1756		1805	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	230	967	847	152	122	212
RTOR Reduction (vph)	0	0	5	0	0	187
Lane Group Flow (vph)	207	990	994	0	122	25
Confl. Peds. (#/hr)	3			3		
Heavy Vehicles (%)	4%	5%	6%	4%	0%	2%
Turn Type	pm+pt	NA	NA		Perm	Perm
Protected Phases	7	4	8			
Permitted Phases	4				6	6
Actuated Green, G (s)	81.6	81.6	66.2		12.2	12.2
Effective Green, g (s)	81.6	81.6	66.2		12.2	12.2
Actuated g/C Ratio	0.79	0.79	0.64		0.12	0.12
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	302	1206	1130		214	187
v/s Ratio Prot	0.07	c0.09	c0.57			
v/s Ratio Perm	0.47	0.56			c0.07	0.02
v/c Ratio	0.69	0.82	0.88		0.57	0.13
Uniform Delay, d1	20.9	6.3	15.0		42.8	40.6
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	6.3	4.6	8.0		3.6	0.3
Delay (s)	27.2	10.9	23.0		46.5	40.9
Level of Service	C	B	C		D	D
Approach Delay (s)		13.7	23.0		42.9	
Approach LOS		B	C		D	

Intersection Summary			
HCM 2000 Control Delay	21.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	102.8	Sum of lost time (s)	13.5
Intersection Capacity Utilization	116.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	236	1109	996	163	135	219
Future Volume (vph)	236	1109	996	163	135	219
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1736	3438	3331		1805	1583
Flt Permitted	0.11	1.00	1.00		0.95	1.00
Satd. Flow (perm)	200	3438	3331		1805	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	251	1180	1060	173	144	233
RTOR Reduction (vph)	0	0	14	0	0	196
Lane Group Flow (vph)	251	1180	1219	0	144	37
Confl. Peds. (#/hr)	3			3		
Heavy Vehicles (%)	4%	5%	6%	4%	0%	2%
Turn Type	pm+pt	NA	NA		Perm	Perm
Protected Phases	7	4	8			
Permitted Phases	4				6	6
Actuated Green, G (s)	50.2	50.2	32.0		11.2	11.2
Effective Green, g (s)	50.2	50.2	32.0		11.2	11.2
Actuated g/C Ratio	0.71	0.71	0.45		0.16	0.16
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	441	2451	1514		287	251
v/s Ratio Prot	c0.11	0.34	c0.37			
v/s Ratio Perm	0.29				c0.08	0.02
v/c Ratio	0.57	0.48	0.81		0.50	0.15
Uniform Delay, d1	12.3	4.4	16.5		27.1	25.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.7	0.1	3.2		1.4	0.3
Delay (s)	14.0	4.6	19.7		28.4	25.8
Level of Service	B	A	B		C	C
Approach Delay (s)		6.2	19.7		26.8	
Approach LOS		A	B		C	

Intersection Summary			
HCM 2000 Control Delay	14.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	70.4	Sum of lost time (s)	13.5
Intersection Capacity Utilization	64.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Intersection						
Int Delay, s/veh	5.8					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	115	927	840	68	61	116
Future Vol, veh/h	115	927	840	68	61	116
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	0	5	5	9	14	2
Mvmt Flow	120	966	875	71	64	121

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	946	0	-	0	2115	910
Stage 1	-	-	-	-	910	-
Stage 2	-	-	-	-	1205	-
Critical Hdwy	4.1	-	-	-	6.54	6.22
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	2.2	-	-	-	3.626	3.318
Pot Cap-1 Maneuver	734	-	-	-	~ 51	333
Stage 1	-	-	-	-	374	-
Stage 2	-	-	-	-	268	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	734	-	-	-	~ 43	333
Mov Cap-2 Maneuver	-	-	-	-	146	-
Stage 1	-	-	-	-	374	-
Stage 2	-	-	-	-	224	-

Approach	EB	WB	SB
HCM Control Delay, s	1.2	0	62.7
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	734	-	-	-	231
HCM Lane V/C Ratio	0.163	-	-	-	0.798
HCM Control Delay (s)	10.9	-	-	-	62.7
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0.6	-	-	-	5.9

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	115	1127	1040	68	61	116
Future Volume (vph)	115	1127	1040	68	61	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	1.00	1.00		1.00	
Frt	1.00	1.00	0.99		0.91	
Flt Protected	0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1805	1810	1790		1604	
Flt Permitted	0.06	1.00	1.00		0.98	
Satd. Flow (perm)	119	1810	1790		1604	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	120	1174	1083	71	64	121
RTOR Reduction (vph)	0	0	2	0	66	0
Lane Group Flow (vph)	120	1174	1152	0	119	0
Heavy Vehicles (%)	0%	5%	5%	9%	14%	2%
Turn Type	pm+pt	NA	NA		Perm	
Protected Phases	7	4	8			
Permitted Phases	4				6	
Actuated Green, G (s)	79.6	79.6	69.6		12.5	
Effective Green, g (s)	79.6	79.6	69.6		12.5	
Actuated g/C Ratio	0.79	0.79	0.69		0.12	
Clearance Time (s)	4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	185	1425	1232		198	
v/s Ratio Prot	0.04	c0.65	c0.64			
v/s Ratio Perm	0.47				c0.07	
v/c Ratio	0.65	0.82	0.94		0.60	
Uniform Delay, d1	23.3	6.5	13.8		41.9	
Progression Factor	1.00	1.00	1.00		1.00	
Incremental Delay, d2	7.6	4.0	13.0		5.1	
Delay (s)	30.9	10.5	26.7		47.0	
Level of Service	C	B	C		D	
Approach Delay (s)		12.4	26.7		47.0	
Approach LOS		B	C		D	

Intersection Summary			
HCM 2000 Control Delay	21.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	101.1	Sum of lost time (s)	13.5
Intersection Capacity Utilization	87.0%	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)	105	528	167	19	438	64	190	140	28	89	144	149
Future Volume (vph)	105	528	167	19	438	64	190	140	28	89	144	149
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.5			4.5			4.5	
Lane Util. Factor		1.00	1.00		1.00			1.00			1.00	
Frpb, ped/bikes		1.00	0.98		1.00			1.00			0.99	
Flpb, ped/bikes		1.00	1.00		1.00			1.00			1.00	
Frt		1.00	0.85		0.98			0.99			0.95	
Flt Protected		0.99	1.00		1.00			0.97			0.99	
Satd. Flow (prot)		1779	1516		1746			1661			1699	
Flt Permitted		0.83	1.00		0.96			0.59			0.85	
Satd. Flow (perm)		1480	1516		1675			1005			1454	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	109	550	174	20	456	67	198	146	29	93	150	155
RTOR Reduction (vph)	0	0	92	0	8	0	0	5	0	0	35	0
Lane Group Flow (vph)	0	659	82	0	535	0	0	368	0	0	363	0
Confl. Peds. (#/hr)	7		2	2		7	5		6	6		5
Heavy Vehicles (%)	5%	6%	4%	7%	7%	2%	11%	10%	0%	5%	5%	1%
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)		29.8	29.8		29.8			24.7			24.7	
Effective Green, g (s)		29.8	29.8		29.8			24.7			24.7	
Actuated g/C Ratio		0.47	0.47		0.47			0.39			0.39	
Clearance Time (s)		4.5	4.5		4.5			4.5			4.5	
Vehicle Extension (s)		3.0	3.0		3.0			3.0			3.0	
Lane Grp Cap (vph)		694	711		786			390			565	
v/s Ratio Prot												
v/s Ratio Perm		c0.45	0.05		0.32			c0.37			0.25	
v/c Ratio		0.95	0.11		0.68			0.94			0.64	
Uniform Delay, d1		16.1	9.5		13.1			18.7			15.8	
Progression Factor		1.00	1.00		1.00			1.00			1.00	
Incremental Delay, d2		22.3	0.1		2.4			31.3			2.5	
Delay (s)		38.4	9.5		15.6			50.1			18.3	
Level of Service		D	A		B			D			B	
Approach Delay (s)		32.4			15.6			50.1			18.3	
Approach LOS		C			B			D			B	

Intersection Summary			
HCM 2000 Control Delay	28.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	63.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	112.9%	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)	177	546	303	20	458	73	0	259	30	0	243	268
Future Volume (vph)	177	546	303	20	458	73	0	259	30	0	243	268
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.5			4.5			4.5	
Lane Util. Factor		1.00	1.00		1.00			1.00			1.00	
Frpb, ped/bikes		1.00	0.98		1.00			1.00			0.98	
Flpb, ped/bikes		1.00	1.00		1.00			1.00			1.00	
Frt		1.00	0.85		0.98			0.99			0.93	
Flt Protected		0.99	1.00		1.00			1.00			1.00	
Satd. Flow (prot)		1773	1516		1744			1714			1689	
Flt Permitted		0.73	1.00		0.97			1.00			1.00	
Satd. Flow (perm)		1305	1516		1688			1714			1689	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	184	569	316	21	477	76	0	270	31	0	253	279
RTOR Reduction (vph)	0	0	132	0	7	0	0	6	0	0	53	0
Lane Group Flow (vph)	0	753	184	0	567	0	0	295	0	0	479	0
Confl. Peds. (#/hr)	7		2	2		7	5		6	6		5
Heavy Vehicles (%)	5%	6%	4%	7%	7%	2%	11%	10%	0%	5%	5%	1%
Turn Type	Perm	NA	Perm	Perm	NA			NA			NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)		43.5	43.5		43.5			22.3			22.3	
Effective Green, g (s)		43.5	43.5		43.5			22.3			22.3	
Actuated g/C Ratio		0.58	0.58		0.58			0.30			0.30	
Clearance Time (s)		4.5	4.5		4.5			4.5			4.5	
Vehicle Extension (s)		3.0	3.0		3.0			3.0			3.0	
Lane Grp Cap (vph)		758	881		981			510			503	
v/s Ratio Prot								0.17			c0.28	
v/s Ratio Perm		c0.58	0.12		0.34							
v/c Ratio		0.99	0.21		0.58			0.58			0.95	
Uniform Delay, d1		15.5	7.5		9.9			22.3			25.7	
Progression Factor		1.00	1.00		1.00			1.00			1.00	
Incremental Delay, d2		30.9	0.1		0.8			1.6			28.2	
Delay (s)		46.4	7.6		10.7			23.9			53.9	
Level of Service		D	A		B			C			D	
Approach Delay (s)		34.9			10.7			23.9			53.9	
Approach LOS		C			B			C			D	

Intersection Summary			
HCM 2000 Control Delay	32.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	74.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	109.0%	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)	0	546	303	0	458	73	0	259	30	0	243	268
Future Volume (vph)	0	546	303	0	458	73	0	259	30	0	243	268
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.5			4.5			4.5	
Lane Util. Factor		1.00	1.00		1.00			1.00			1.00	
Frpb, ped/bikes		1.00	0.98		1.00			1.00			0.99	
Flpb, ped/bikes		1.00	1.00		1.00			1.00			1.00	
Frt		1.00	0.85		0.98			0.99			0.93	
Flt Protected		1.00	1.00		1.00			1.00			1.00	
Satd. Flow (prot)		1792	1518		1747			1715			1692	
Flt Permitted		1.00	1.00		1.00			1.00			1.00	
Satd. Flow (perm)		1792	1518		1747			1715			1692	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	569	316	0	477	76	0	270	31	0	253	279
RTOR Reduction (vph)	0	0	182	0	12	0	0	9	0	0	83	0
Lane Group Flow (vph)	0	569	134	0	541	0	0	292	0	0	449	0
Confl. Peds. (#/hr)	7		2	2		7	5		6	6		5
Heavy Vehicles (%)	5%	6%	4%	7%	7%	2%	11%	10%	0%	5%	5%	1%
Turn Type		NA	Perm		NA			NA			NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)		18.1	18.1		18.1			15.5			15.5	
Effective Green, g (s)		18.1	18.1		18.1			15.5			15.5	
Actuated g/C Ratio		0.42	0.42		0.42			0.36			0.36	
Clearance Time (s)		4.5	4.5		4.5			4.5			4.5	
Vehicle Extension (s)		3.0	3.0		3.0			3.0			3.0	
Lane Grp Cap (vph)		761	644		742			624			615	
v/s Ratio Prot		c0.32			0.31			0.17			c0.27	
v/s Ratio Perm			0.09									
v/c Ratio		0.75	0.21		0.73			0.47			0.73	
Uniform Delay, d1		10.3	7.7		10.2			10.4			11.7	
Progression Factor		1.00	1.00		1.00			1.00			1.00	
Incremental Delay, d2		4.0	0.2		3.6			0.6			4.5	
Delay (s)		14.4	7.9		13.8			10.9			16.2	
Level of Service		B	A		B			B			B	
Approach Delay (s)		12.1			13.8			10.9			16.2	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	13.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	42.6	Sum of lost time (s)	9.0
Intersection Capacity Utilization	88.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	10.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	67	319	297	202	300	74
Future Vol, veh/h	67	319	297	202	300	74
Conflicting Peds, #/hr	0	3	3	0	0	3
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	0	1	4	2	3	3
Mvmt Flow	70	332	309	210	313	77

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1183	357	393	0	-	0
Stage 1	354	-	-	-	-	-
Stage 2	829	-	-	-	-	-
Critical Hdwy	6.4	6.21	4.14	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.309	2.236	-	-	-
Pot Cap-1 Maneuver	211	689	1155	-	-	-
Stage 1	715	-	-	-	-	-
Stage 2	432	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	154	685	1152	-	-	-
Mov Cap-2 Maneuver	290	-	-	-	-	-
Stage 1	713	-	-	-	-	-
Stage 2	315	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	26.8	5.5	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1152	-	554	-	-
HCM Lane V/C Ratio	0.269	-	0.726	-	-
HCM Control Delay (s)	9.3	-	26.8	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	1.1	-	6	-	-

Intersection	
Int Delay, s/veh	7.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	67	319	297	202	300	74
Future Vol, veh/h	67	319	297	202	300	74
Conflicting Peds, #/hr	0	3	3	0	0	3
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	100	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	0	1	4	2	3	3
Mvmt Flow	70	332	309	210	313	77

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1183	357	393	0	-	0
Stage 1	354	-	-	-	-	-
Stage 2	829	-	-	-	-	-
Critical Hdwy	6.4	6.21	4.14	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.309	2.236	-	-	-
Pot Cap-1 Maneuver	211	689	1155	-	-	-
Stage 1	715	-	-	-	-	-
Stage 2	432	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	154	685	1152	-	-	-
Mov Cap-2 Maneuver	290	-	-	-	-	-
Stage 1	713	-	-	-	-	-
Stage 2	315	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.2	5.5	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1152	-	290	685	-	-
HCM Lane V/C Ratio	0.269	-	0.241	0.485	-	-
HCM Control Delay (s)	9.3	-	21.3	15.1	-	-
HCM Lane LOS	A	-	C	C	-	-
HCM 95th %tile Q(veh)	1.1	-	0.9	2.7	-	-

Intersection	
Int Delay, s/veh	7.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	168	106	392	173	147	479
Future Vol, veh/h	168	106	392	173	147	479
Conflicting Peds, #/hr	0	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	150	-
Veh in Median Storage, #	2	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	10	5	4	0	5	2
Mvmt Flow	171	108	400	177	150	489

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1281	492	0	0	581	0
Stage 1	492	-	-	-	-	-
Stage 2	789	-	-	-	-	-
Critical Hdwy	6.5	6.25	-	-	4.15	-
Critical Hdwy Stg 1	5.5	-	-	-	-	-
Critical Hdwy Stg 2	5.5	-	-	-	-	-
Follow-up Hdwy	3.59	3.345	-	-	2.245	-
Pot Cap-1 Maneuver	176	571	-	-	978	-
Stage 1	598	-	-	-	-	-
Stage 2	434	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 148	569	-	-	978	-
Mov Cap-2 Maneuver	320	-	-	-	-	-
Stage 1	596	-	-	-	-	-
Stage 2	367	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	35.5	0	2.2
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	385	978	-
HCM Lane V/C Ratio	-	-	0.726	0.153	-
HCM Control Delay (s)	-	-	35.5	9.3	-
HCM Lane LOS	-	-	E	A	-
HCM 95th %tile Q(veh)	-	-	5.6	0.5	-

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

Intersection						
Int Delay, s/veh	5.1					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	168	106	392	173	147	479
Future Vol, veh/h	168	106	392	173	147	479
Conflicting Peds, #/hr	0	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	100	-	-	150	-
Veh in Median Storage, #	2	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	10	5	4	0	5	2
Mvmt Flow	171	108	400	177	150	489

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1281	492	0	0	581	0
Stage 1	492	-	-	-	-	-
Stage 2	789	-	-	-	-	-
Critical Hdwy	6.5	6.25	-	-	4.15	-
Critical Hdwy Stg 1	5.5	-	-	-	-	-
Critical Hdwy Stg 2	5.5	-	-	-	-	-
Follow-up Hdwy	3.59	3.345	-	-	2.245	-
Pot Cap-1 Maneuver	176	571	-	-	978	-
Stage 1	598	-	-	-	-	-
Stage 2	434	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 148	569	-	-	978	-
Mov Cap-2 Maneuver	320	-	-	-	-	-
Stage 1	596	-	-	-	-	-
Stage 2	367	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	22.4	0	2.2
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	320	569	978	-
HCM Lane V/C Ratio	-	-	0.536	0.19	0.153	-
HCM Control Delay (s)	-	-	28.5	12.8	9.3	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	3	0.7	0.5	-

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

Intersection	
Int Delay, s/veh	4.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	29	31	44	23	80	26	482	16	99	528	27
Future Vol, veh/h	10	29	31	44	23	80	26	482	16	99	528	27
Conflicting Peds, #/hr	3	0	6	6	0	3	4	0	5	5	0	4
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	2	-	-	2	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	0	0	7	0	0	3	17	3	0	0	2	0
Mvmt Flow	10	30	32	46	24	83	27	502	17	103	550	28

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1395	1352	574	1378	1358	518	582	0	0	524	0	0
Stage 1	774	774	-	570	570	-	-	-	-	-	-	-
Stage 2	621	578	-	808	788	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.27	7.1	6.5	6.23	4.27	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.363	3.5	4	3.327	2.353	-	-	2.2	-	-
Pot Cap-1 Maneuver	120	151	509	123	150	556	922	-	-	1053	-	-
Stage 1	394	411	-	510	509	-	-	-	-	-	-	-
Stage 2	478	504	-	378	405	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	86	131	504	95	130	552	917	-	-	1050	-	-
Mov Cap-2 Maneuver	223	279	-	233	286	-	-	-	-	-	-	-
Stage 1	381	369	-	493	492	-	-	-	-	-	-	-
Stage 2	374	487	-	291	364	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18.8	22.6	0.4	1.3
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	917	-	-	333	355	1050	-	-
HCM Lane V/C Ratio	0.03	-	-	0.219	0.431	0.098	-	-
HCM Control Delay (s)	9	-	-	18.8	22.6	8.8	-	-
HCM Lane LOS	A	-	-	C	C	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.8	2.1	0.3	-	-

Intersection	
Intersection Delay, s/veh	43.5
Intersection LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	29	31	44	23	80	26	482	16	99	528	27
Future Vol, veh/h	10	29	31	44	23	80	26	482	16	99	528	27
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles, %	0	0	7	0	0	3	17	3	0	0	2	0
Mvmt Flow	10	30	32	46	24	83	27	502	17	103	550	28
Number of Lanes	0	1	0	0	1	0	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	1	1
HCM Control Delay	11.9	13.2	44.3	53
HCM LOS	B	B	E	F

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1	SBLn2
Vol Left, %	100%	0%	14%	30%	100%	0%
Vol Thru, %	0%	97%	41%	16%	0%	95%
Vol Right, %	0%	3%	44%	54%	0%	5%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	26	498	70	147	99	555
LT Vol	26	0	10	44	99	0
Through Vol	0	482	29	23	0	528
RT Vol	0	16	31	80	0	27
Lane Flow Rate	27	519	73	153	103	578
Geometry Grp	7	7	2	2	7	7
Degree of Util (X)	0.054	0.922	0.151	0.301	0.192	0.995
Departure Headway (Hd)	7.171	6.396	7.476	7.072	6.707	6.197
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	501	571	478	507	537	590
Service Time	4.889	4.114	5.544	5.126	4.422	3.913
HCM Lane V/C Ratio	0.054	0.909	0.153	0.302	0.192	0.98
HCM Control Delay	10.3	46.1	11.9	13.2	11	60.5
HCM Lane LOS	B	E	B	B	B	F
HCM 95th-tile Q	0.2	11.5	0.5	1.3	0.7	14.5

Intersection	
Int Delay, s/veh	95.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	130	81	6	25	62	312	1	125	28	239	235	88
Future Vol, veh/h	130	81	6	25	62	312	1	125	28	239	235	88
Conflicting Peds, #/hr	5	0	0	0	0	5	0	0	2	2	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	2	-	-	2	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	3	33	6	0	0	0	4	5	4	2	0
Mvmt Flow	144	90	7	28	69	347	1	139	31	266	261	98

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1210	1015	310	1048	1049	161	359	0	0	172	0	0
Stage 1	841	841	-	159	159	-	-	-	-	-	-	-
Stage 2	369	174	-	889	890	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.53	6.53	7.16	6.5	6.2	4.1	-	-	4.14	-	-
Critical Hdwy Stg 1	6.1	5.53	-	6.16	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.53	-	6.16	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.027	3.597	3.554	4	3.3	2.2	-	-	2.236	-	-
Pot Cap-1 Maneuver	161	237	663	202	229	889	1211	-	-	1393	-	-
Stage 1	362	379	-	834	770	-	-	-	-	-	-	-
Stage 2	655	753	-	332	364	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 67	191	663	129	185	883	1211	-	-	1386	-	-
Mov Cap-2 Maneuver	~ 89	280	-	176	275	-	-	-	-	-	-	-
Stage 1	362	306	-	832	768	-	-	-	-	-	-	-
Stage 2	360	751	-	187	294	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 519.6	32.6	0.1	3.5
HCM LOS	F	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1211	-	-	123	554	1386	-	-
HCM Lane V/C Ratio	0.001	-	-	1.96	0.8	0.192	-	-
HCM Control Delay (s)	8	-	-	$ 519.6	32.6	8.2	-	-
HCM Lane LOS	A	-	-	F	D	A	-	-
HCM 95th %tile Q(veh)	0	-	-	19.4	7.7	0.7	-	-

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

Intersection	
Intersection Delay, s/veh	24.7
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	130	81	6	25	62	312	1	125	28	239	235	88
Future Vol, veh/h	130	81	6	25	62	312	1	125	28	239	235	88
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	0	3	33	6	0	0	0	4	5	4	2	0
Mvmt Flow	144	90	7	28	69	347	1	139	31	266	261	98
Number of Lanes	0	1	0	0	1	0	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	1	1
HCM Control Delay	18.4	31.9	16.1	24.3
HCM LOS	C	D	C	C

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1	SBLn2
Vol Left, %	100%	0%	60%	6%	100%	0%
Vol Thru, %	0%	82%	37%	16%	0%	73%
Vol Right, %	0%	18%	3%	78%	0%	27%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	1	153	217	399	239	323
LT Vol	1	0	130	25	239	0
Through Vol	0	125	81	62	0	235
RT Vol	0	28	6	312	0	88
Lane Flow Rate	1	170	241	443	266	359
Geometry Grp	7	7	2	2	7	7
Degree of Util (X)	0.003	0.389	0.512	0.808	0.585	0.716
Departure Headway (Hd)	8.826	8.243	7.642	6.56	8.037	7.29
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	407	439	475	550	451	499
Service Time	6.54	5.958	5.642	4.653	5.737	4.99
HCM Lane V/C Ratio	0.002	0.387	0.507	0.805	0.59	0.719
HCM Control Delay	11.6	16.1	18.4	31.9	21.5	26.3
HCM Lane LOS	B	C	C	D	C	D
HCM 95th-tile Q	0	1.8	2.9	7.9	3.7	5.7