8 Street Network Element

The Street Network element of the TSP focuses on maintaining traffic flow and mobility on arterial and collector roadways, protecting residential neighborhoods from excessive through traffic and travel speeds, providing reasonable access to and from residential areas, improving safety, and promoting efficient through-street movement. This chapter summarizes strategies used to evaluate the future needs of Milwaukie's street network, and recommends projects to improve the operations of the motor vehicle system (for automobiles, trucks, buses, and other vehicles).

TSP GOAL AND POLICY FRAMEWORK

Milwaukie has developed a set of goals to guide the development of its transportation system (see Chapter 2). Several of these TSP Goals guide the City's policies on auto mobility and access, and street connectivity, specifically the following:

- **Goal 1 Livability** directs the City to protect residential areas from excessive speed, and minimize the "barrier" effect transportation facilities have on the community.
- **Goal 2 Safety** calls for the use of coordinated street design standards and access control measures.
- **Goal 3 Travel Choices** directs the City to integrate pedestrian and bicycle facilities into existing and new roadways.
- **Goal 4 Quality Design** addresses the need to relate the design of a street to its intended users.
- **Goal 5 Reliability and Mobility** directs the City to enhance street connectivity and maintain traffic flow, especially on arterials and collectors.
- **Goal 7 Efficient and Innovative Funding** calls for an emphasis on maintaining existing facilities.

FUNCTIONAL CLASSIFICATION

Any discussion of the City's street network should begin with the definition of the different types, or functional classifications. Functional street classifications encompass both the design characteristics of streets and the character of service the streets are intended to provide. The City's functional classifications form a hierarchy of streets ranging from those that are primarily for travel mobility (arterials) to those that are primarily for access to property (local streets). The functional classification system is developed with the recognition that individual streets do not act independently of each other but form a network of streets that work together to serve travel needs on a local, citywide and regional level.

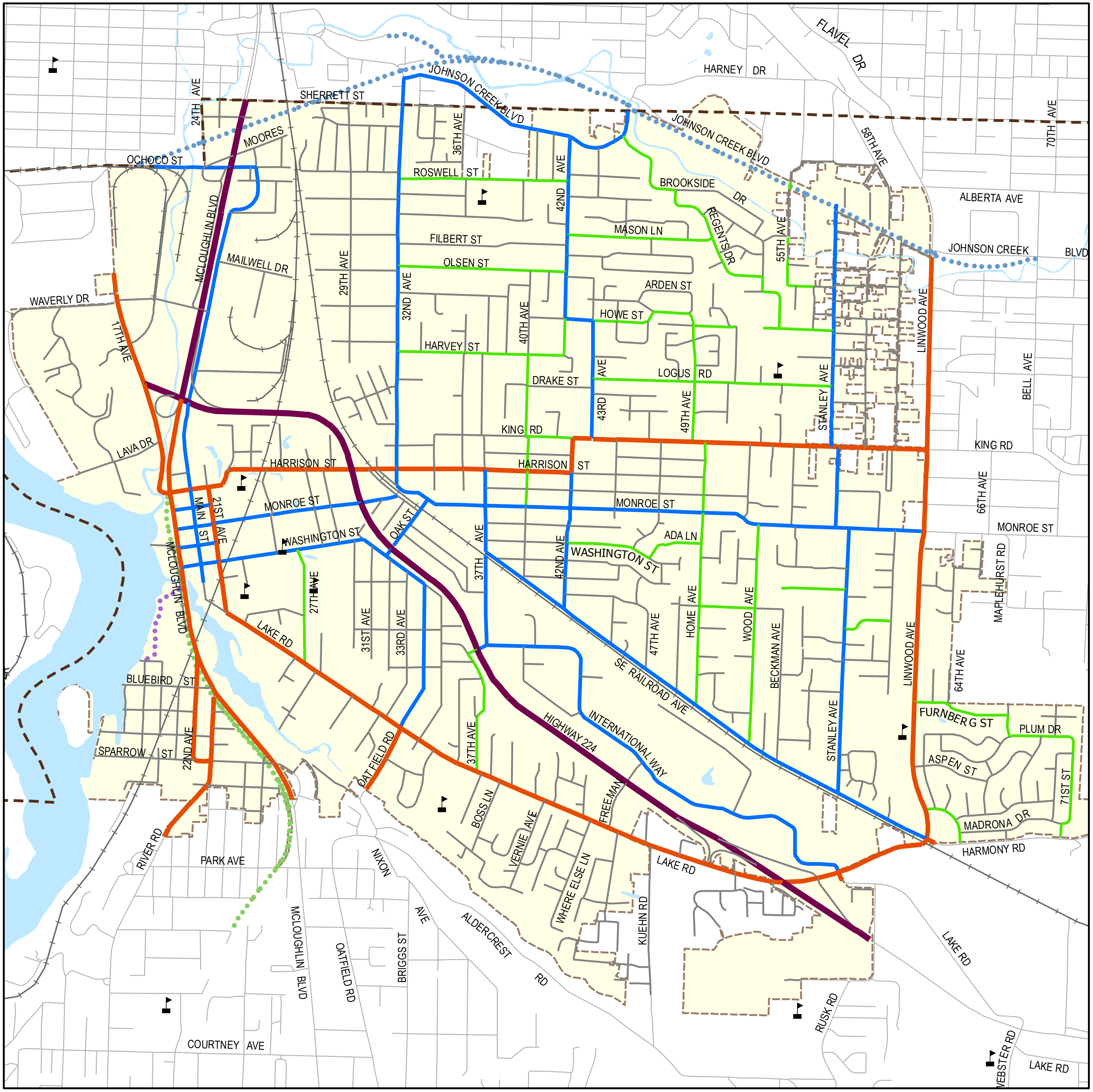
These classifications guide design standards, levels of access, traffic control, law enforcement, and the provision for federal, State, and regional transportation funding. The City's functional classification system includes regional routes, arterials, collectors, neighborhood routes, and local streets. Figure 8-1 shows current functional classifications, including a few small changes from the last TSP update in 2007. Specifically, due to construction of the Portland-Milwaukie Light Rail (PMLR) alignment through downtown, the classification of Lake Rd between 21^{st} Ave and Main St has been changed from "arterial" to "local," the classification of Main St between Lake Rd and Washington St has been changed from "collector" to "local," and the section of Adams St between Main St and 21^{st} Ave has been changed from a "collector" street to not being a street (that section is permanently closed to vehicular traffic). Table 8-1 describes the general characteristics and functions of each of these classifications.

Transportation System Plan

FIGURE 8-1

FUNCTIONAL CLASSIFICATION

November 2013



LEGEND

Functional Classification

- Regional Routes
- Arterials
- Collectors
- Neighborhood Routes
- Local Streets

Other Map Features

- Schools
- Kellogg Creek Trail
- SpringwaterTrail
- Trolley Trail
- Railroad
- County Line
- Water
- City Limits

DKS *Associates*

TRANSPORTATION SOLUTIONS

0 500 1,000 2,000 3,000 4,000 Feet

Table 8-1 City of Milwaukie Functional Classifications

Classification	Description	Typical Total Vehicles per Day	Typical Number of Lanes	Other Street Elements
Regional Routes	• High volume, generally high-speed facilities. • May be used for travel within the city, but typically they are used for trips between cities, especially those that are separated by a significant distance. • Rank high on the mobility scale because they have multiple travel lanes in both directions and limited access points. • Rank low on the access scale because access to private property is generally prohibited. • The City's regional route designation matches the regional definition of these roads by Metro and ODOT.	20,000	4 or more	
Arterials	• High volume, moderate speed streets that carry vehicles within the city and between adjacent cities in the surrounding metropolitan area. • Some are under the jurisdiction of and/or maintained by other agencies, such as ODOT, Clackamas County, and the City of Portland. • Rank high on the mobility scale but also provide limited access to a wide range of land uses. • Link major commercial, residential, industrial, and institutional areas. • Typically spaced about one mile apart to assure mobility and reduce the incidence of cut-through traffic on neighborhood routes and local streets. • Management objective is to provide for safe and efficient traffic flow along with pedestrian and bicycle movements. Within downtown, local access is a priority.	10,000	3 or more	Bicycle lanes and sidewalks
Collectors	• Moderate volume, moderate speed streets that provide access and circulation within and between residential neighborhoods, commercial areas, and industrial areas. • Serve a citywide function of connectivity and are typically spaced about 1/2 mile apart. • Distribute trips between the neighborhood street system and the arterial street system, linking a wide range of land uses. • Access control for collectors is not as high a priority as for arterials, but is especially needed near street intersections. • Since collectors often traverse residential neighborhoods, neighborhood traffic management measures are often needed to manage traffic impacts through these areas.	5,000-10,000	2-3[1]	Bike lanes or shared roadway; sidewalks

[1] As a result, these streets are likely to need turn lanes at some intersections or center left-turn lanes as volumes approach 10,000 vehicles per day.

Classification	Description	Typical Total Vehicles per Day	Typical Number of Lanes	Other Street Elements
Neighborhood Routes	• Moderate volume, low speed streets. • Do not provide citywide circulation, as they mainly serve the immediate neighborhood in which they are located. Typically have residential frontage. • Connect neighborhoods to collectors and arterials. • Neighborhood routes are similar to local streets in design, but they are generally longer in length and have higher traffic volumes. In order to retain the neighborhood character and livability of these streets, additional design treatments in the form of traffic management devices are often needed to manage traffic volume impacts.	1,500 to 5,000	2	Shared roadway, sidewalks, on-street parking
Local Streets	• Low volume, low speed streets that emphasize access to adjacent land uses over mobility. • All streets that are not regional routes, arterials, collectors or neighborhood routes are classified as local streets. • Connect neighborhoods to collectors and arterials • Most local streets are adjacent to residential uses and serve residential transportation needs; however, there are a number of local streets that exclusively serve the city's two industrial areas. • Local streets rank high on the access scale, so driveways and intersections are more closely spaced than on other types of streets.	Less than 1,500	2	Shared roadway, pedestrian facilities, on-street parking.

The design of a roadway can vary from segment to segment due to adjacent land uses and demands, the objective is to have a standard that defines key characteristics provides consistency, and also defines application criteria to provide the flexibility needed to suit conditions. Street design standards and options are discussed in further detail in Chapter 10 Street Design.

TRANSPORTATION NETWORK NEEDS

This section identifies the study area deficiencies for the 2035 baseline scenario, which only includes transportation system improvements that have committed funding (such as STIP and CIP) to be constructed and implemented as a "low build" condition. The increase in vehicle volume as forecasted by the 2035 Metro RTP ("low build") travel demand model and resulting intersection operations are also summarized.

2035 Baseline Network Assumptions

The 2035 base case scenario includes transportation improvements that are reasonably expected to be funded and constructed by the year 2035.[2] This scenario includes both the Transportation Demand Management (TDM) improvements identified later in this chapter and a subset of capacity projects identified in the Regional Transportation Plan (RTP) financially constrained system, shown below in Table 8-2.

---

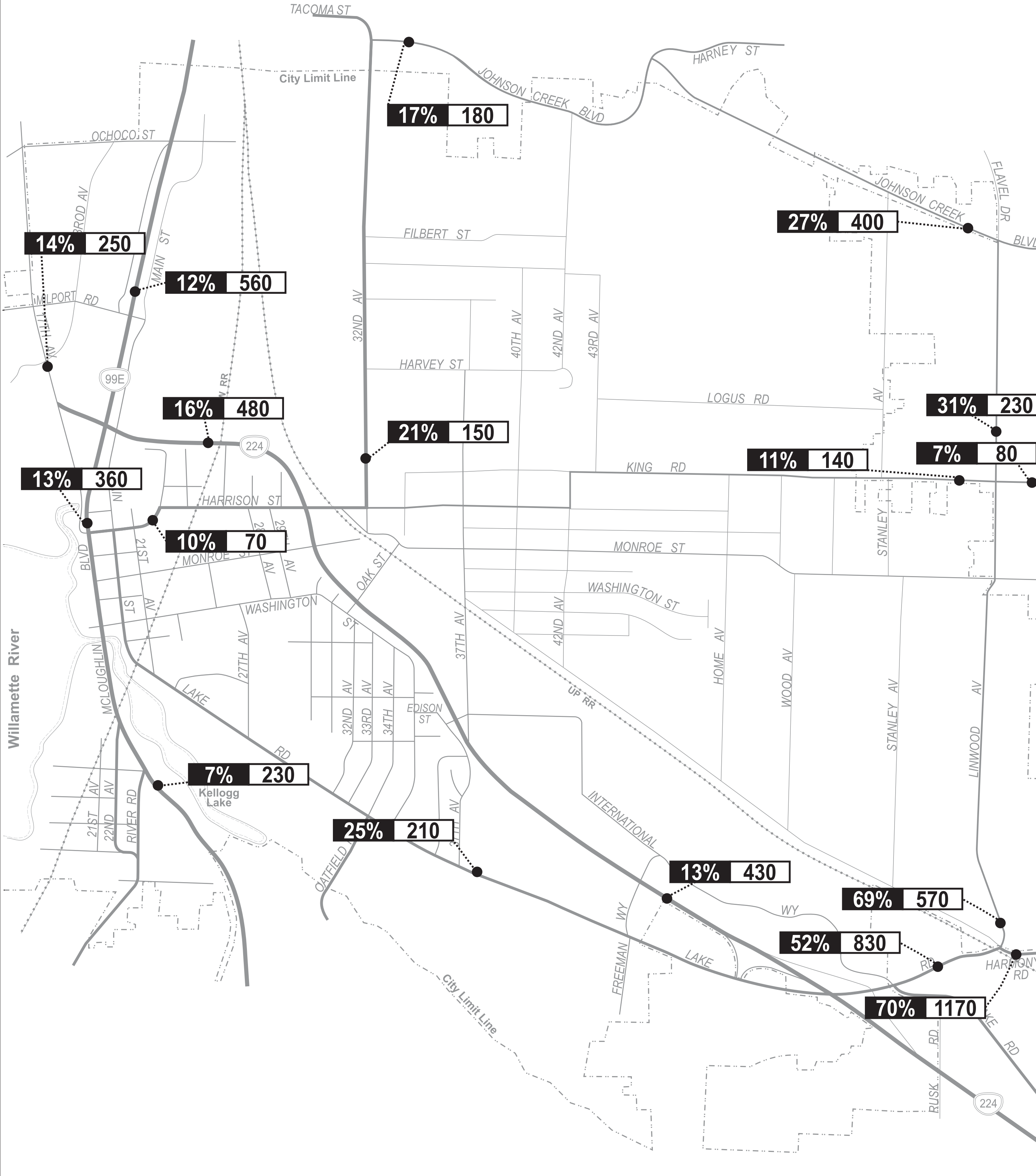
[2] Forecasting for the 2035 base case scenario takes into consideration PMLR as a factor as part of the region's transportation system.

Table 8-2 RTP Financially Constrained Motor Vehicle Capacity Improvements

RTP Project #	Location	Improvement	Jurisdiction	Timeline	2007 Cost ($1,000s)
10002	Johnson Creek Blvd (45th Ave to 82nd Ave)	Widen from 3 to 5 lanes and widen bridge over Johnson Creek	Clackamas Co.	2018-2025	$30,000
10003	Harmony Rd (Hwy 224 to 84th Ave)	Widen to 3 lanes with bike lanes and sidewalks where needed	Clackamas Co.	2008-2017	$20,000
10005	West Monterey (82nd Ave to Fuller Rd)	New two-lane extension	Clackamas Co.	2018-2025	$6,200
10009	Fuller Rd (Otty Rd to Johnson Creek Blvd)	Widen Street and add turn lanes, sidewalks, on-street parking, central median, and landscaping	Clackamas Co.	2008-2017	$4,000
10019	West Sunnybrook Rd (82nd Ave to Harmony Rd)	Construct 3-lane extension	Clackamas Co.	2008-2017	$6,970
10869	Sunrise Project (JTA Portion)	Improvements consistent with Supplemental EIS (2-lane mainline from I-205 to 122nd)	ODOT	2008-2017	$150,000

2035 Baseline Traffic Volumes

As can be seen in Figure 8-2a, traffic volumes at the study locations are projected to increase by approximately 10% to 70% during the p.m. peak hour, with most locations generally projected to have approximately 10% to 25% growth. This corresponds to increases of approximately 140 vehicles during the p.m. peak hour on King Rd and 230 to 570 vehicles on Linwood Ave. The traffic volumes on McLoughlin Blvd are projected to increase by over 500 vehicles north of Hwy 224, and by 230 vehicles south of River Rd. On Hwy 224, about 500 more vehicles are expected in the p.m. peak hour east of McLoughlin Blvd, and 430 vehicles are expected west of the interchange with Lake Rd. The largest projected traffic increase is on Harmony Rd east of Linwood Ave (to over 1,000 vehicles), which is related to future transportation projects that will change capacity and circulation in the area such as the Harmony Rd extension to Sunnybrook Rd and the construction of the Jobs & Transportation Act (JTA) portion of the Sunrise Corridor. The forecasted increase in volume means that many of the study intersections will fail to meet the performance standards of the City of Milwaukie or the Oregon Department of Transportation (ODOT) in 2035.



LEGEND

00% - Percentage Increase 2012 - 2035

00 - Volume Difference 2012 - 2035

DKS

No Scale

Figure **8-2A**

PERCENT INCREASE IN PM PEAK HOUR VOLUMES

2035 Baseline Corridor Operations

Assessing traffic volumes alone does not consider the ability for transportation facilities to handle traffic demand. A volume-to-capacity (V/C) plot provides a comparison between traffic demand and available capacity. These plots are generally used as a high-level measure to provide an overall quality of the transportation system, since the plots do not consider the full spectrum of operational details (such as traffic control, signal timing, etc) that affect transportation facility performance. Rather, such plots provide a general assessment that can identify corridors or segments that may have insufficient capacity or require additional analysis.

Figure 8-2b shows the 2035 p.m. peak period V/C for major corridors in the study area. Many streets in Milwaukie would continue to have a V/C ratio below 0.85, indicating generally uncongested conditions during the peak hour. Two primary corridors, Linwood Ave and Hwy 224, would be approaching capacity, with V/C ratios nearing 1.0. Both Hwy 99E and 17th Ave would be over capacity (V/C > 1.0). These corridors would be unable to fully accommodate traffic demand during the p.m. peak hour. The excess traffic demand would extend the duration of congestion at these locations or would divert to other routes that have additional capacity.

2035 Baseline System Measures

Travel Time Reliability

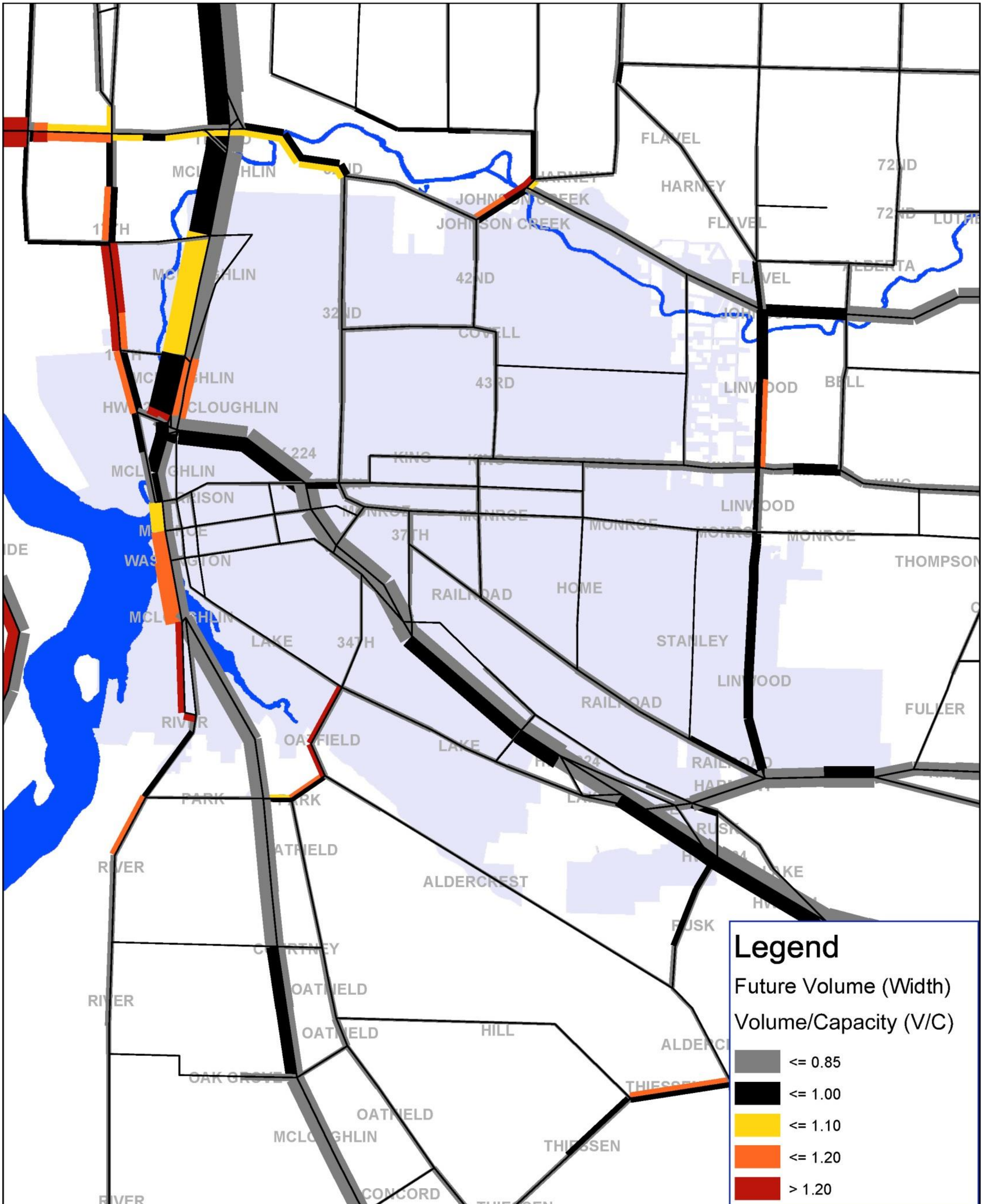
Travel time reliability on Hwy 99E (McLoughlin Blvd) and Hwy 224 was assessed using the travel demand model and creating daily (for each hour) traffic profiles using the Hours of Congestion tool developed by DKS Associates working in conjunction with ODOT. The daily traffic profiles were used to estimate the travel time along the corridor by time of day to create daily corridor speed profiles. In addition, a summary metric of buffer index (BI) was produced to quantify the travel time variability throughout the day. In general, a higher BI score indicates more variability (less reliability) in travel times.

Table 8-3 Summary of Travel Time Reliability Measures by Corridor

Corridor	Direction	Year 2010		Year 2035		Change (2035-2010)	
		Ave Speed (mph)	Buffer Index*	Ave Speed (mph)	Buffer Index*	Ave Speed (mph)	Buffer Index[3]
Hwy 99E	Northbound	28	**2.5**	22	**2.6**	-6	+0.1
	Southbound	30	1.9	23	**2.2**	-7	+0.3
Hwy 224	Eastbound	40	0.6	30	**2.3**	-10	+1.7
	Westbound	42	0.2	36	1.0	-6	+0.8

Based on an assessment of the average daily travel time, each corridor would drop approximately 5-10 miles per hour. The largest drop in speed is projected to occur along Hwy 224 in the eastbound direction (10 miles per hour speed reduction), which also has the largest increase in buffer index, indicating that future travel times will be much less reliable than current conditions.

[3] A buffer index (BI) score of 0.0 is free-flow, with larger numbers indicating increased speed variability. Generally, a buffer index between 1.0 and 2.0 represents corridors with significant peak period congestion and values above 2.0 represent severe congestion that spreads into multiple hours. Corridors with a buffer index greater than 2.0 are shown highlighted in bold font.



Milwaukie TSP	FIGURE 8-2B
Note: Raw Travel Demand Model Plot	2035 PM Peak Hour Volume/Capacity for Major Roads

Vehicle Miles Traveled per Capita (VMT/capita)

Another system measure of effectiveness is vehicle miles traveled (VMT), which is the total vehicle miles of travel associated with the study-area trips (vehicle trips beginning and/or ending in the study area) on roadways within the Metro region boundary. The VMT per person living in the study area is estimated by traffic volumes from the travel demand model and the 2035 population estimates provided by Metro.

A system planning-level evaluation of the transportation conditions in the existing year and the "low build" alternative scenario was conducted using the travel demand model. This analysis considered the magnitude of system impacts, rather than the site-specific benefit that a particular improvement project could provide to the localized area. The VMT/capita for the base year (2010) was 3.44; under the "low build" scenario, the VMT/capita for 2035 is 2.99, a 13% drop from the base year.

2035 Baseline Intersection Capacity Analysis

This section presents the results of the capacity analysis to determine the potential intersection improvements that would be necessary as part of a long-range master plan. The improvements outlined in the following section are a guide to be used in defining the specific types of rights-of-way and street improvements that will be needed as traffic growth and infill development occurs.

Table 8-4 summarizes the results of the needs analysis to forecast how the TSP study intersections will perform, given the 2035 base case scenario. Based on the analysis, approximately half (14 of 24) of the study intersections would meet acceptable jurisdictional operating standards in 2035; however, 10 of the 24 intersections would not meet standard. The locations that would not meet standard are generally located along the major regional facilities, Hwy 99E and Hwy 224. The Minimum Acceptable Measures of Effectiveness for intersections during the peak hour are as follows:

- City of Milwaukie = Level of Service D
- Metro/ODOT = 0.99/0.99 (1.10/0.99 in designated Town Centers & Specific Corridors)

Table 8-4 2035 Base Case Intersection Level of Service (P.M. Peak Hour)

Intersection	Existing 2012			Future 2035 Base Case		
	Level of Service (LOS)	Average Delay (Seconds)	Volume/ Capacity (V/C)	Level of Service (LOS)	Average Delay (Seconds)	Volume/ Capacity (V/C)
Two-Way Stop Controlled Intersections						
McLoughlin Blvd @ 22nd Ave	A/D	26.4	0.01	A/**E**	**38.7**	0.01
Harrison St @ 21st Ave	A/C	18.0	0.10	A/C	17.1	0.25
King Rd @ 42nd Ave	A/B	14.3	0.26	A/C	18.6	0.44
Monroe St @ Linwood Ave	A/D	31.2	0.51	A/**F**	**>50**	**>1.0**
All-Way Stop Controlled Intersections						
Harrison St @ Main St	B	13.2	0.39	C	17.0	0.71
42nd Ave @ Harrison St	B	12.8	0.22	C	23.7	0.86
Johnson Creek Blvd @ 32nd Ave	**F**	**>50.0**	**0.77**	**F**	**>50.0**	**1.45**
Signalized Intersections						
McLoughlin Blvd @ Ochoco St	B	10.1	0.85	C	26.8	1.04
McLoughlin Blvd @ Milport Rd	A	4.4	0.78	A	7.9	0.91
McLoughlin Blvd@ Harrison St	D	47.1	0.99	**E**	**79.0**	**1.18**
McLoughlin Blvd @ Washington St	C	20.0	0.88	**E**	**68.4**	**1.14**
Hwy 224 @ 17th Ave	C	20.7	0.59	C	23.2	0.74
Hwy 224 @ Harrison St	D	40.0	0.89	**E**	**74.7**	**1.13**
Hwy 224 @ Monroe St	B	19.0	0.75	C	27.1	0.87
Hwy 224 @ Oak St	D	44.1	0.88	**E**	**58.3**	1.01
Harrison St @ 32nd Ave	B	10.5	0.45	B	18.6	0.70
McLoughlin Blvd @ River Rd	D	35.5	0.99	**F**	**>80.0**	**1.14**
Lake Rd @ Oatfield Rd	D	36.0	0.62	D	42.2	0.81
Hwy 224 @ 37th Ave	C	25.5	0.82	**F**	**>80.0**	**1.26**
Hwy 224 @ Freeman Way	C	30.5	0.94	D	52.7	**1.06**
Hwy 224 @ Lake Rd	B	16.1	0.68	D	35.3	0.89
Johnson Creek Blvd @ Linwood Ave	D	53.6	0.97	**F**	**>80.0**	**1.55**
Linwood Ave @ King Rd	D	47.5	0.83	**E**	**61.1**	0.94
Linwood Ave @ Harmony Rd	**E**	**64.5**	0.94	**F**	**>80.0**	**1.55**

Notes: A/A=major street LOS/minor street LOS.
Signalized and all-way stop delay = average vehicle delay in seconds for entire intersection.
Unsignalized delay = highest minor street approach delay.
Intersections shown in **bold type** exceed jurisdictional standards.
Intersections and corresponding LOS or V/C are illustrated in Figure 8-3

Milwaukie's needs, in terms of capacity improvements, are generally greater on regionally significant routes such as Hwy 99E (McLoughlin Blvd) and Hwy 224 due to the role these routes play in carrying people to destinations throughout the region while passing through the city.

Two of the study intersections currently do not meet the City's Minimum Acceptable Measure of Effectiveness of LOS D: (1) Johnson Creek Blvd at 32nd Ave, and (2) Linwood Ave at Harmony Rd.

- **Johnson Creek Blvd at 32nd Ave:** As part of the PMLR project, a traffic signal and westbound left-turn lane are planned to be constructed for this intersection by TriMet. Table 8-4 considers the intersection as-is and so represents the projected LOS if the planned improvements are NOT made.
- **Linwood Ave at Harmony Rd:** This intersection is within the jurisdiction of Clackamas County and is being addressed as part of the County's current TSP update project. Milwaukie City Council has indicated willingness to consider the current LOS E to be acceptable, given neighborhood concerns about the traffic implications of a major improvement to the intersection.

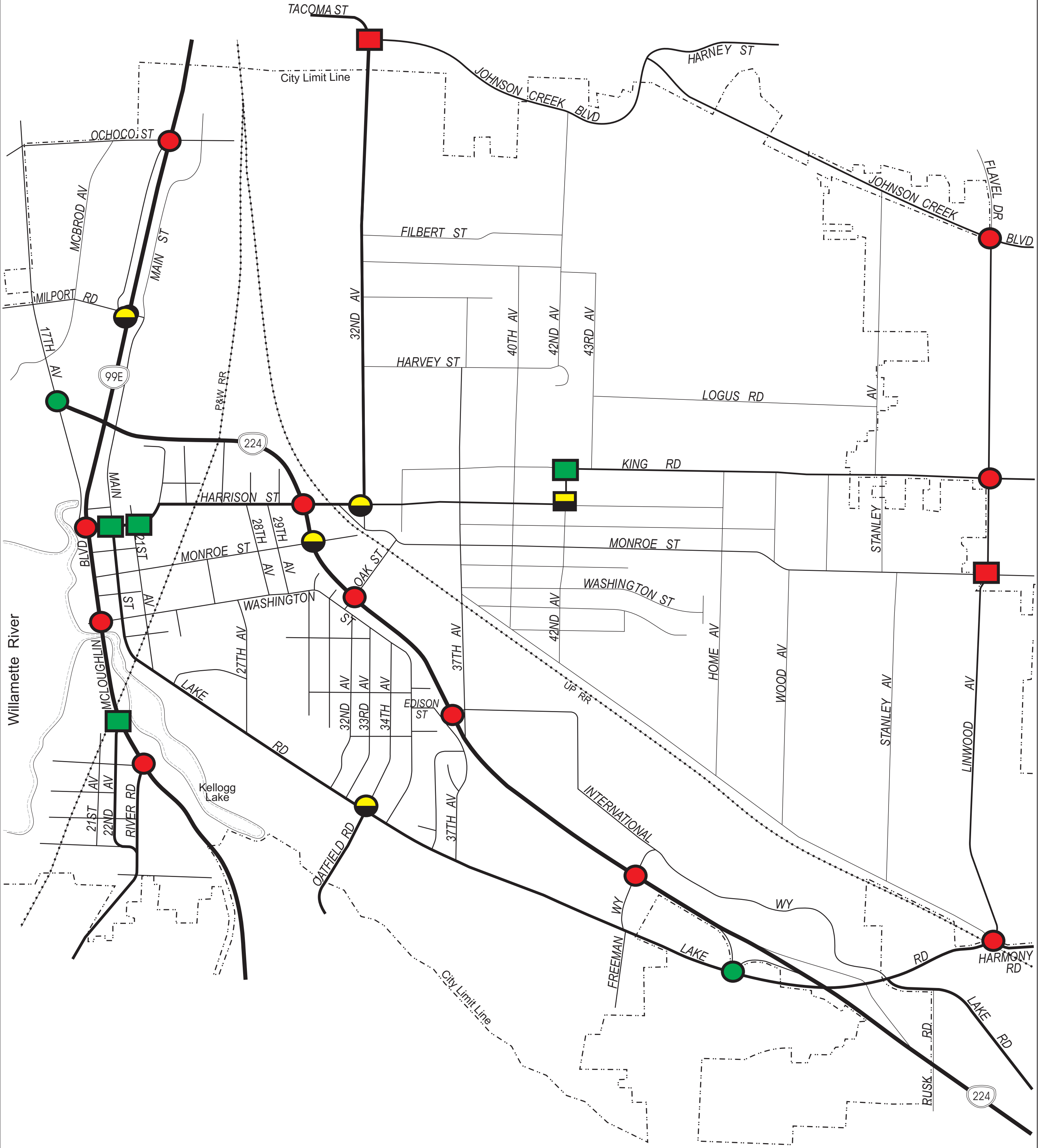
Figure 8-3 depicts the study area intersections with good, adequate, or poor operational performance during the p.m. peak hour in the year 2035. As can be seen in this figure, approximately half (10 of 24) of the study intersections will operate under poor conditions in 2035. The high growth in volumes along regional facilities such as McLoughlin Blvd and Hwy 224 will not only bring those facilities close to capacity but will also create significant delay on side streets. The future operational analysis for each intersection is outlined in the following sections.

The introduction of the light rail line may affect operational performance at key intersections downtown. As a result, a future update to the TSP may need to include new intersections on the study list (e.g., Washington St and Main St, Washington St and 21st Ave).

Table 8-5 summarizes the existing and future needs that have been identified and lists potential strategies to address each need.

CITY OF MILWAUKIE

Transportation System Plan



LEGEND

- Good Operations (LOS A, B, or C, & V/C < 0.84)
- Acceptable Operations (LOS D & 0.84 < V/C < 0.95)
- Poor to Failed Operations (LOS E or F & V/C > 0.95)
- Unsignalized Intersection
- Signalized Intersection

*Note: Table 8-2 contains the LOS and V/C for each intersection.

DKS

NO SCALE

Figure 8-3

2035 FUTURE NO-BUILD OPERATIONS STUDY AREA INTERSECTIONS

Table 8-5 Summary of Motor Vehicle System Gaps and Needs

Reference ID	Location	Need	Potential Strategies to Address Need				
			Intersection Control	Lane Channelization	Alternative Route Improvements	Transportation System Management & Operations (TSMO)	Corridor Extension/ Widening
Existing Intersection Needs							
N1	Johnson Creek Blvd @ 32nd Ave	Intersection capacity	X	X	X	X	
N2	Linwood Ave @ Harmony Rd	Intersection capacity		X	X	X	
N3	Hwy 224 @ Lake Rd	Safety improvements	X	X			
Future Intersection Needs							
N4	Monroe St @ Linwood Ave	Intersection capacity	X	X	X	X	
N5	Hwy 224 @ Harrison St	Intersection capacity		X	X	X	
N6	McLoughlin Blvd (Hwy 99E) @ Harrison St	Intersection capacity		X	X	X	
N7	McLoughlin Blvd (Hwy 99E) @ Washington St	Intersection capacity		X	X	X	
N8	McLoughlin Blvd (Hwy 99E) @ River Rd	Intersection capacity		X	X	X	
N9	Hwy 224 @ 37th Ave	Intersection capacity		X	X	X	
N10	Hwy 224 @ Freeman Way	Intersection capacity		X	X	X	
N11	Johnson Creek Blvd @ Linwood Ave	Intersection capacity		X	X	X	
N12	Linwood Ave @ King Rd	Intersection capacity		X	X	X	
Future Corridor Needs							
N13	Johnson Creek Blvd	Corridor capacity			X	X	X
N14	Linwood Ave	Corridor capacity			X	X	X
N15	McLoughlin Blvd (Hwy 99E)	Corridor capacity			X	X	X
N16	Oatfield Rd	Corridor capacity			X	X	X
Arterial/Collector Grid System Gaps							
N17	Johnson Creek Blvd (near 42nd Avenue) to Lake Rd (near Oatfield Rd)	North-south arterial connection					X
N18	McLoughlin Blvd (Hwy 99E) to Linwood Ave (between Johnson Creek Blvd and Harrison St/King Rd)	East-west collector connection					X
N19	Railroad Ave (near Home Ave) to Aldercrest Rd (near Kellogg Rd)	North-south collector connection					X

STRATEGIES

The future street system needs in Milwaukie cannot be met through a single "fix-all" cure. Instead, a set of interrelated strategies need to be implemented to meet performance standards, serve future growth and conform to the city's future needs. Strategies for managing the forecasted future travel demand are multifaceted.

The impact of future growth to Milwaukie would be severe without investment in both capital improvements and operating improvements. Strategies for meeting automobile facility needs include Transportation System Management and Operations (TSMO), Transportation Demand Management (TDM), and adding capacity to roads and intersections.

The following sections outline the types of improvements that could be used to manage the system given future growth. Phasing of implementation is necessary, since funding and staging constraints limit the City's ability to implement all improvements at once. This requires prioritization of projects and periodic updating to reflect current needs. Most importantly, it should be understood that as regional growth outpaces local growth, the improvements outlined in the following sections are a guide to managing the increased traffic volume in the city as it occurs over the next 22 years.

Transportation System Management and Operations (TSMO)

Transportation System Management and Operations (TSMO) focuses on low cost strategies within the existing transportation infrastructure to enhance operational performance. The strength of a TSMO approach is it focuses on maximizing urban mobility while treating all modes of travel as a coordinated system. TSMO strategies include signal improvements, traffic signal coordination, traffic calming, access management, local street connectivity, and intelligent transportation systems (ITS). Traffic signal coordination and ITS projects typically provide the most significant tangible benefits to the traveling public. The primary focus of TSMO measures are improvements that result in regional-scale benefits. However, there are a number of TSMO measures that could be used in a smaller scale environment such as Milwaukie.

Intelligent Transportation Systems (ITS)

ITS involves the application of advanced technologies and management techniques to relieve congestion, enhance safety, provide services to travelers, and assist transportation system operators in implementing suitable traffic management strategies. An ITS program focuses on increasing the efficiency of existing transportation infrastructure, enhancing the performance of the overall system and reducing the need to add capacity (e.g. travel lanes). Efficiency is achieved by providing services and information to travelers so they can make better travel decisions, and also to transportation system operators so they can better manage the system and improve system reliability.

Clackamas County has prepared an ITS plan for the urbanized area of Clackamas County. The Clackamas County ITS Plan[4] has identified arterial signal control ITS projects on major streets throughout the county. Within the TSP study area, McLoughlin Blvd, Hwy 224, Johnson Creek Blvd, King Rd, and Harmony Rd have been identified for planned fiber optic cable, transit priority corridor status, and closed-circuit cameras at several major intersections.

Other ITS projects to consider within Milwaukie may include:

- Transit signal priority
- Signal coordination and optimization

[4] Clackamas County ITS Plan, DKS Associates, Inc. and Zenn Associates, February 2003.

- Traffic monitoring and surveillance
- Information availability
- Incident management

To support future ITS projects, including traffic signal operations, the City of Milwaukie and Clackamas County could require that roadway improvement projects include the installation of three-inch conduit along arterial and selected collector roadways to serve new ITS equipment in the corridor. A three-inch conduit would ensure adequate wiring capacity to accommodate future ITS projects.

Neighborhood Traffic Management

There are some Neighborhood Traffic Management elements, such as speed humps, in place in Milwaukie. The City should continue this effort with additional traffic-calming measures (where applicable) and work with the community to find the traffic-calming solution that best meets their needs and maintains roadway function. Neighborhood Traffic Management techniques are covered in more detail in Chapter 11.

Access Management

Access Management is a policy tool that seeks to balance mobility (efficient, safe, and timely travel) with property access. Proper implementation of access management techniques should result in reduced congestion, accident rates, roadway widening, air pollution, and energy consumption.

The presence of numerous driveways can erode the capacity of arterial and collector roadways. Access management is the practice of limiting the number and spacing of driveways and intersections on arterial and collector facilities to maintain the capacity of the facilities and preserve their functional integrity. Preservation of capacity is particularly important for maintaining the traffic flow on higher volume roadways such as Linwood Ave and King Rd. The city needs a balance of streets that provide access with streets that serve mobility.

Several access management strategies have been identified to improve local access and mobility in Milwaukie:

- Develop specific access management plans for regional routes, arterial and collector streets in Milwaukie to maximize the capacity of the existing facilities and protect their functional integrity.
- Work with land use development applications to consolidate driveways where feasible.
- Provide left-turn lanes where warranted for access onto cross streets.
- Construct raised medians to limit driveway access to right-in/right-out turning movements, as appropriate.

New development and roadway projects on city streets should meet the City's adopted access spacing standards, which are summarized in Table 8-6.

Table 8-6 Access Spacing Standards for City Street Facilities

Access Treatment	Functional Classification	Intersection				Desirable Signal Spacing[5]	Median Control
		Public Road		Private Drive			
		Type	Spacing	Type	Spacing		
Full control (freeway)	Arterials	Interchange	2-3 mi	None	N/A	None	Full
Partial control	Arterials	At grade	530-1000 ft	Lt/Rt Turns	300 ft	1000 ft	Partial/None
Partial control	Collectors	At grade	300-600 ft	Lt/Rt Turns	150 ft	1,000 ft	None

Many existing roadways and driveways do not meet these standards because they were installed when traffic volumes were substantially lower and before the City established access spacing criteria. As traffic volumes increase, controlling access on arterial and collector roadways will be important to maintaining a safe and functioning street network.

Access Management for State Facilities

The Oregon Highway Plan (OHP) defines access spacing standards on State facilities for roadways such as McLoughlin Blvd and Hwy 224. These standards are shown in Table 8-7. Preserving capacity on State facilities is especially important, since substandard performance due to a lack of capacity could force drivers to look for alternative routes along city streets.

Table 8-7 Access Spacing Standards for ODOT Facilities

Facility	Location	Highway Classification	National Highway System	Truck Route	Freight Route	Access Spacing Standard (ft)
McLoughlin Blvd (Hwy 99E)	North city limits to Hwy 224	Statewide	Yes	Yes	Yes	990
	Hwy 224 to Scott St	District	No	Yes	No	500
	Scott St to River Rd	District (Special Transportation Area)*	No	Yes	No	175*
	River Rd to South city limits	District	No	Yes	No	500
Hwy 224	17th Ave to McLoughlin Blvd	District	No	No	Yes	500
	McLoughlin Blvd to East city limits	Statewide (Expressway)	Yes	Yes	Yes	2640

*Minimum access management spacing for public road approaches is the existing city block spacing or the city block spacing as identified in the local comprehensive plan. Public road connections are preferred over private driveways, and in Special Transportation Areas, driveways are discouraged. However, where driveways are allowed and where land use patterns permit, the minimum access management spacing for driveways is 175 feet (55 meters) or midblock if the current city block is less than 350 feet (110 meters).[6]

Traffic Signal Spacing

Traffic signals that are spaced too closely on a corridor can result in poor operating conditions and safety issues due to the lack of adequate storage for queuing vehicles. Milwaukie is built-

[5] Generally, signals should be spaced to minimize delay and disruptions to through traffic. Signals may be spaced at intervals closer than those shown to optimize capacity and safety.
[6] Oregon Department of Transportation (ODOT), 1999 Oregon Highway Plan (OHP).

out, and as a result there will not likely be many new roads constructed within the city. However, as traffic volumes increase as a result of in-fill development and regional growth, new signals on the existing street system may be necessary to manage traffic flow. When this is the case, the City will evaluate traffic signal warrants to determine if a traffic signal is an appropriate solution. Traffic signals should only be implemented when deemed necessary by the City Engineering Director to enhance safety and promote mobility. P.M. peak-hour signal warrants have already been met for the intersections at Johnson Creek Blvd/32nd Ave and Harrison St/42nd Ave. Future year 2035 traffic volume projections at the intersection of Linwood Ave/Monroe St would trigger peak-hour signal warrants.

Local Street Connectivity

The local street network in Milwaukie is nearly built out and is not well connected in many neighborhoods. Access opportunities for entering or exiting neighborhoods are limited. There are many long blocks or cul-de-sacs outside of the downtown area that force out-of-direction travel when traveling between and within neighborhoods. Additionally, Milwaukie has many barriers that limit connectivity such as McLoughlin Blvd, Hwy 224, and the Union Pacific Railroad (UPRR) tracks. The combination of these barriers and the lack of connectivity cause many intracity trips to travel along the few through streets that do connect across these barriers.

Increasing connectivity between neighborhoods has many benefits, including: reducing out-of-direction travel and VMT, enhancing accessibility between various travel modes, balancing traffic levels between streets, and reducing public safety response time.

Topography and environmental conditions limit the potential for connectivity in several areas of Milwaukie. However, in several areas there is potential to connect streets over time. Figure 8-4 shows the Proposed Street Connectivity Plan for Milwaukie. Some of the localized congestion on roads such as Linwood Ave, King Rd, 32nd Ave, or Monroe St could be improved through enhanced street connectivity. Several short roadway connections are needed to connect disjointed local streets and reduce out-of-direction travel for vehicles, pedestrians, and bicyclists. In limited cases, a short length of new road would be necessary for improved connectivity.

The arrows on Figure 8-4 represent potential connections and the general direction for the placement of the connection. In each case, the specific alignments and design will be determined upon development review. If a connection is made that increases neighborhood connectivity, such a change could trigger reclassification of a street from a "local" to a "neighborhood route." When the opportunity arises during land development, the City requires new local connections that will result in a grid of vehicle access every 530 feet and bicycle/pedestrian access every 300 feet.[7]

The arrows shown on Figure 8-4 indicate priority local and neighborhood connections only. Local connections for existing stub end streets, cul-de-sacs, or extended cul-de-sacs in the road network are, for the most part, not identified on this figure. Pedestrian connections from any cul-de-sac should be considered mandatory as future development and redevelopment occur. The goal is improved connectivity for all modes of transportation.

There are several large parcels (5 acres or greater) in Milwaukie that are either undeveloped or that are developed but have land value that exceeds the building value based on an

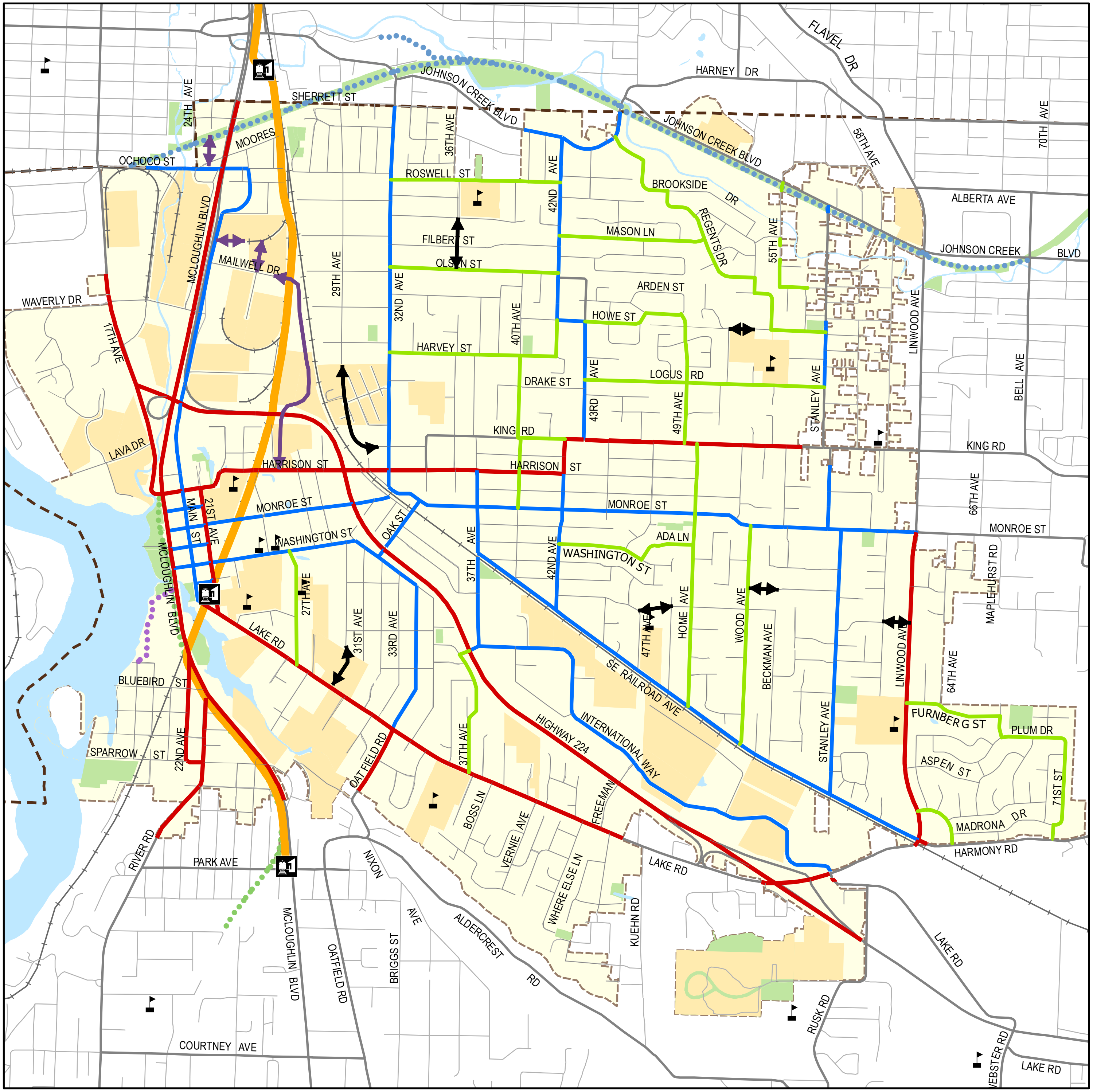
[7] This standard meets the Metro RTP access spacing requirements for new residential or mixed use developments.

Transportation System Plan

FIGURE 8-4

PROPOSED STREET CONNECTIVITY PLAN

October 2018



LEGEND

Functional Classication

- Arterial
- Collector
- Neighborhood Route
- Local

Street Connectivity

- Lots greater than 5 acres
- Proposed Street Extension
- Potential Future Street Extension

Other Map Features

- Schools
- Light Rail Station
- Light Rail Transit
- Kellogg Creek Trail
- SpringwaterTrail
- Trolley Trail
- Major Roads
- Railroad
- County Line
- Water
- Parks
- City Limits

DKS *Associates*

TRANSPORTATION SOLUTIONS

0 500 1,000 2,000 3,000 4,000 Feet

assessment of available GIS data. Figure 8-4 shows the locations of these parcels. Each of these sites already has frontage on a public street, but only 1 or 2 of the parcels are located where a future street connection would be useful and practical. Figure 8-4 shows where future street connections are desired near these sites. The City's Public Works Standards and the standards for public facility improvements found in the City's Zoning Ordinance will ensure that adequate street connections are established as needed at the time of development or redevelopment of any of these particular sites.

Arterial and Collector Street Connectivity

According to the principles established in Metro's 2035 RTP, arterial streets should be spaced no farther than 1 mile apart and collector streets should be accessible within 1/2 mile of any point in Milwaukie.[8] Given the pattern of existing development in Milwaukie and the various constraints that have influenced it to date, there are not many opportunities to improve the existing network of arterial and collector streets.

The following is an assessment of the gaps identified using the Metro 2035 RTP standards:

- **Gap 1** (arterial gap on Johnson Creek Blvd between 32nd Ave and 45th Ave): The 2007 TSP update downgraded the classification of Johnson Creek Blvd between 40th Ave and Brookside (the section within Milwaukie city limits) from arterial to collector to better coordinate with the street's neighborhood collector designation in the City of Portland and to reflect the low-density residential land surrounding the corridor.

- **Gap 2** (arterial gap on 42nd Ave between Johnson Creek Blvd and King Rd): From Johnson Creek Blvd, 42nd Ave does not connect directly to King Rd; instead, the connection is made by either going 1 block east on Howe St to 43rd Ave or 2 blocks west on Harvey St to 40th Ave. Extending 42nd Ave as an arterial would require significant property acquisition in an established low-density residential neighborhood. There are also 3 historic properties along 42nd Ave between Johnson Creek Blvd and King Rd.

- **Gap 3** (arterial gap on 42nd Ave between Harrison St and Railroad Ave): The existing route is a collector street that goes through an established low-density residential neighborhood.

- **Gap 4** (arterial gap between Railroad Ave and Lake Rd): Establishing an arterial connection would involve crossing an active rail line and going through an existing industrial park. A new connection would require improvement of a very problematic intersection (International Way, 37th Ave, and Hwy 224) as well as crossing Hwy 224 and going into an established residential neighborhood at a different angle than the existing grid alignment there.

- **Gap 5** (collector gap along Kelvin/Howe/Willow St between Hwy 99E and Linwood Ave): Establishing a collector connection would involve bisecting the city’s primary manufacturing/industrial area and crossing two active freight rail lines and the new light rail. The existing residential streets are not well aligned to allow easy crossing of other intersecting collectors. The eastern end of the connection would be through an unimproved roadway with a steep slope adjacent to a large wetland property on the north.

- **Gap 6** (collector gap at Home Ave between Railroad Ave and Lake Rd): The connection south from Home Ave would have to cross an active rail line and a protected water quality resource, then cross Hwy 224. A connection between Hwy 224 and Lake Rd would be at an angle to the existing alignment in an established low-density residential neighborhood.

[8] Regional Transportation Functional Plan, Title 1, 3.08.110.C.

- **Gap 7** (collector gap at Vernie/Maplewood from Lake Rd to Aldercrest Dr): A collector connection would be very close to protected wetlands, go through an existing low-density residential neighborhood, and have to cross Kellogg Creek to get to Aldercrest Dr (in Clackamas County's jurisdiction).

This assessment of gaps does not represent a proposal to establish arterials or collectors in the identified areas. Rather, it is presented to show existing conditions in Milwaukie with respect to specific connectivity standards in Metro's 2035 RTP.

Transportation Demand Management

Transportation Demand Management (TDM) is a general term used to describe any action that removes single-occupant vehicle trips from the roadway network during peak travel demand periods. As growth occurs, the number of vehicle trips and travel demand in the area will also increase. The ability to change a user's travel behavior and provide alternative mode choices will help to minimize the potential growth in trips.

Generally, TDM focuses on promoting alternative modes of travel for large employers as a way to reduce the VMT. This is due in part to the Employee Commute Options (ECO) rules that were passed by the Oregon Legislature in 1993 to help protect the health of Portland area residents from air pollution and to ensure that the area complied with the Federal Clean Air Act.[9]

Currently, Metro supports an online tool, "Drive less. *Connect*," (through the Regional Travel Options program) that promotes a ride-matching service connecting carpoolers and bike buddies. Since its launch in 2011, commuters avoided using approximately 50,000 gallons of gasoline and saved roughly $308,000 collectively by joining carpools, biking, and riding transit.

Research has shown that a comprehensive set of complementary policies implemented over a large geographic area can have a measured effect on the VMT to/from that area.[10] However, the same research indicates that for TDM measures to be effective, they should go beyond the low-cost, noncontroversial measures commonly used such as carpooling, establishing transportation coordinators or associations, and designation of priority parking spaces.

The more effective TDM measures include parking and congestion pricing, improved services for alternative modes of travel, and other market-based measures. However, TDM includes a wide variety of actions that are specifically tailored to the individual needs of an area. In general, TDM elements and programs have a potential trip reduction ranging between 1% and 10%. To help implement TDM measures in the future, the City should consider setting TDM goals and policies for new development.

With an increase in the number of projected regional trips through the city, regional TDM measures should help to reduce congestion and be a benefit to the City of Milwaukie and the region. The RTP includes TDM projects for the Milwaukie area in the 2035 financially constrained plan. These measures are identified in Table 8-8.

[9] Oregon Administrative Rules, Chapter 340, Division 30.
[10] *The Potential for Land Use Demand Management Policies to Reduce Automobile Trips*, ODOT, by ECO Northwest, June 1992.

Table 8-8 TDM Improvements included in the RTP Financially Constrained System

Metro Project ID	Location	Improvement	Jurisdiction	Timeline	Cost ($1,000s)
10020	Countywide	Advanced transportation system management and ITS program	Clackamas County	2008-2017	$6,514
10901	Regionwide	Milwaukie Light Rail Extension	TriMet	2008-2017	$1,148,000
10159	Regionwide	Springwater Trail Access Improvements	Portland	2008-2017	$3,032
11331	Regionwide	Frequent Service Bus Capital Improvements (Phase 1)	TriMet	2008-2017	$16,000
11230	Regionwide	Frequent Service Bus Capital Improvements (Phase 2)	TriMet	2008-2017	$15,000
11332	Regionwide	I-205 BRT	TriMet	2008-2035	$30,000
10990	Regionwide	Park-and-Ride Management Strategy Implementation	TriMet	2008-2035	$1,000
10988	Regionwide	Incremental Increases in Park-and-Ride Lots and Capacities	TriMet	2008-2017	$20,000
11333	Regionwide	Bus Stop Improvements	TriMet/SMART	2008-2035	$14,000
11042	Regionwide	Bus Priority Treatments	TriMet	2008-2035	$5,029
11043	Regionwide	Priority Pedestrian Access to Transit Improvements	TriMet	2008-2035	$5,000

The Metro regional travel model includes assumptions about which modes of transportation people choose to use. Targets for trips using non-single-occupant-vehicle (non-SOV) modes have been set for some 2040 Plan areas. For Milwaukie, the model forecast assumes completion of the projects included in the RTP financially constrained scenario, with a non SOV Modal Target of 45% to 55% in the designated Town Center area and 40% to 45% in Industrial/Employment areas. All other areas within Milwaukie do not have a non-SOV target.[11] Milwaukie will only be able to achieve these targets through a continued effort to implement TDM strategies and promote alternative modes of travel.

Parking Requirements

The City of Milwaukie currently has off-street parking ratios (minimum and maximum) and standards that are consistent with the Transportation Planning Rule (TPR) and RTP parking ratio requirements. Chapter 12 outlines the specific parking strategies for downtown Milwaukie.

Roadway and Intersection Operational and Capacity Improvements

The TSP process identified a number of roadway and intersection capacity improvements. This section summarizes the evaluation of intersection of the three types of capacity and connectivity improvements:

- City Street and Intersection Improvements
- McLoughlin Blvd (Hwy 99E) Alternatives
- Hwy 224 Alternatives
- Hwy 224/99E Refinement Plan

[11] Information related to non-SOV target percentages and designated areas can be found in the Metro Regional Transportation Plan, Table 1.3 page 1-65, and on Figure 3.5 page 3-14.

Conceptual diagrams illustrating the recommended improvements can be found in Appendix D, Conceptual Design Options.

City Street and Intersection Improvements

Most of the study intersections that are on city streets will require improvements to meet City standards under forecasted 2035 conditions. Table 8-9 summarizes the improvements needed for these study intersections to meet City standards; more detailed descriptions of the improvements follow.

Table 8-9 Improvements Needed for City Intersections to Meet City Standards

Intersection	Improvement	Before	After
Linwood Ave @ Monroe St	Signalization	A/F	B
Johnson Creek Blvd @ 32nd Ave*	Signalization with westbound left-turn lane	F	D
Johnson Creek Blvd @ Linwood Ave	Add eastbound (EB) right-turn lane Add westbound (WB) right-turn lane Add northbound (NB) right-turn lane	F	D
Linwood Ave @ King Rd	Protected/permissive left-turn phasing northbound (NB) and southbound (SB)	E	D

*This intersection is in the City of Portland. As such, improvements will be determined by the City of Portland. Project is planned by TriMet as part of the PMLR project.

- **Linwood Ave/Monroe St:** This location would meet traffic signal warrants for the p.m. peak hour with year 2035 traffic volumes. The addition of the traffic signal would allow Monroe Street traffic to access or cross Linwood Avenue by providing gaps in traffic. The addition of the traffic signal would significantly reduce delay and improve operations on Monroe St (LOS F to LOS B), though additional delay would be added to traffic on Linwood Ave that does not currently stop.

- **Johnson Creek Blvd/32nd Ave:** This intersection is in the city of Portland which has an operating standard of LOS D. P.M. peak-hour signal warrants are currently met at this intersection. Installing a traffic signal and a westbound left-turn lane would improve the LOS at this intersection from F to D.[12] This improvement is consistent with TriMet plans as part of the PMLR project. As an alternative improvement, widening the existing bridge north of 32nd Ave would be necessary to provide a southbound left-turn lane at this intersection and realign the intersection so that 32nd Ave would form a T-intersection with Johnson Creek Blvd. While this realignment would be more conducive to serve traffic demands along Johnson Creek Blvd, the primary travel corridor, bridge widening would significantly increase the project cost. A roundabout may be an alternative for this location.

  While not studied, the two all-way stop controlled intersections east of 32nd Ave (36th and 42nd Aves) would likely require similar treatment (traffic signal with turn lanes) to meet operational standards. As with the 32nd Ave intersection, the scale of the improvements does not fit well in the residential neighborhood setting. Limiting the project to signals alone would not bring the intersection operations to the desired standard but would relieve traffic congestion.

  The City of Portland has jurisdiction of Johnson Creek Blvd from Tacoma St to just west of 40th Ave, the section that includes the 32nd Ave intersection. Portland does not have plans to

[12] Signalization alone would improve the delay from approximately 135 seconds to 110 seconds, and the intersection would still operate at LOS F in the TSP forecast year, 2035. Changes to the intersections in this corridor should be coordinated to ensure that they work together to improve safety and are designed for the posted speed (25 mph).

modify the bridge or the roadway. Clackamas County has jurisdiction north of Brookside Dr and continuing eastward. The County's TSP includes a project to widen the bridge over Johnson Creek.

Milwaukie has jurisdiction over the intersection of Johnson Creek Blvd/42nd Ave, and will coordinate with Portland and Clackamas County if improvements are considered in this corridor. The project listed in the master plan is for signalization only at 42nd Ave. This project is intended to balance the needs of the affected neighborhood and other stakeholders. The number and location of the existing stop signs along Johnson Creek Blvd serve to reduce traffic speeds, which is valued by the adjacent neighborhood. Therefore, before a traffic signal is installed at the intersection of Johnson Creek Blvd and 42nd Ave, the City shall conduct a study that analyzes the advantages of the traffic signal to the adjacent neighborhood and the City's transportation system.

- **Johnson Creek Blvd/Linwood Ave:** Adding eastbound, westbound, and northbound right-turn lanes would improve the operations at this intersection from F to D. No additional improvement would be necessary for the operation of this intersection to meet City standards. Any intersection improvements should protect, if not improve, the Springwater Trail crossing through this intersection.
- **Linwood Ave/King Rd:** Aside from modifying phasing at this intersection or increasing street connectivity throughout the city with parallel routes to Linwood Ave and King Rd, there are no simple solutions to improve operation of this intersection.

McLoughlin Blvd (Hwy 99E) Alternatives

While most intersections along McLoughlin Blvd (Hwy 99E) do not meet future operating standards (V/C of 1.1 within the Town Center), the intersections of McLoughlin Blvd with Ochoco St and Milport St are near capacity but still operate within the ODOT operating standards. Because access is severely restricted from McLoughlin Blvd, the City and ODOT have investigated options for improving freight-related access and circulation for the North Industrial Area. Since both of these intersections are forecasted to meet standards in 2035, improvements focus on access and circulation, not capacity improvements. These potential improvements are outlined in more detail in Chapter 9 Freight Element and Appendix D.

The intersection of McLoughlin Blvd and 17th Ave is primary portal to downtown Milwaukie from McLoughlin Blvd, especially for vehicles traveling to Milwaukie from the north. Improvements to this intersection would be difficult because of the intersection's geometry[13] and phasing, and the proximity of Johnson Creek Blvd.

The phasing for eastbound and westbound traffic is currently split phase (one side operates independent of the other side). This phasing arrangement increases the amount of time required for vehicles traveling on Harrison St/17th Ave and also decreases the potential time for northbound and southbound vehicle movements.

Shifting traffic away from this intersection and can improve how it functions (its V/C ratio). One way to do this would be to restrict eastbound left turns from 17th Ave onto McLoughlin Blvd Travelers needing to make this turn could instead be directed through the intersection, to turn left at the next intersection (Harrison St/Main St) and left on Scott St, and right onto northbound McLoughlin Blvd. Forcing this movement would allow for the split phasing at the intersection of Harrison St and McLoughlin Blvd to be removed and improve intersection operations. This

[13] 17th Ave is perpendicular to McLoughlin Blvd for only a short distance of less than 100 feet. After this distance, the road makes a 90-degree bend to the north and runs parallel to McLoughlin Blvd. This geometry is a result of the close proximity of Johnson Creek and the Willamette River.

option could redirect up to 20 drivers, who normally access McLoughlin Blvd via this intersection, into downtown Milwaukie during the p.m. peak hour.

The interchange of McLoughlin Blvd and Hwy 224 currently connects southbound traffic on McLoughlin Blvd to eastbound on Hwy 224 and westbound traffic on Hwy 224 to northbound on McLoughlin Blvd. It does not provide for a direct connection of the northbound McLoughlin Blvd or eastbound Hwy 224 to southbound McLoughlin Blvd traffic. The construction of a full interchange between McLoughlin Blvd and Hwy 224 would shift vehicles to the interchange and improve operations at the intersection of McLoughlin Blvd and 17th Ave. This interchange, along with the rest of the McLoughlin Blvd/Hwy 224 corridor between Tacoma St and 17th Ave should be studied as part of a Hwy 224/99E Refinement Plan to determine the most cost-effective set of improvement options for the corridor and the City of Milwaukie.

Improvement of the intersection of 17th Ave and Harrison St could involve any number of options, including an increase in the intersection's capacity, improved local connectivity, and parallel routes to decrease demand at the intersection. The City should work with ODOT and Metro to create a solution to maintain operational levels at this intersection while minimizing possible negative impact of any improvements to the intersection. Any improvement recommended by the Hwy 224/99E Refinement Plan should also include improvements to this intersection.

McLoughlin Blvd and River Rd

Without improvements, the intersection of McLoughlin Blvd/River Rd would operate at unacceptable levels during the p.m. peak hour in 2035 (V/C of 1.14 exceeds Town Center target of 1.1). A sketch-level operational analysis conducted for two potential improvement alternatives found that either would improve the intersection to the point of meeting operational mobility standards. The two alternatives are described below.

- **Alternative 1:** One possible improvement would leave the intersection of McLoughlin Blvd and 22nd Ave open in its current configuration. The intersection of McLoughlin Blvd and River Rd would require a second northbound left-turn lane and additional right-of-way to operate within ODOT standards (a V/C ratio of 1.10). This option would improve the operations of the intersection (V/C ratio of 1.06) in a similar manner to the second option (the current geometry requires an exclusive pedestrian phase that limits the intersection operations for motor vehicles).[14] However, this alternative would be less disruptive and is preferred by the Island Station Neighborhood District Association.

- **Alternative 2:** The second alternative would involve consolidating the three intersections into one. Currently, vehicles turning from 22nd Ave onto McLoughlin Blvd are limited to right-in and right-out turns. River Rd has one shared lane to access McLoughlin Blvd, and vehicles access River Rd from McLoughlin Blvd via Bluebird St. The consolidation of the three intersections would greatly decrease the number of access points (and conflict points) to McLoughlin Blvd, and therefore result in safer, more efficient operations. To improve operations to acceptable standards, a second northbound left-turn to access McLoughlin Blvd would be necessary at this new intersection. An eastbound right-turn lane would also be necessary to accommodate the high right-turn volume from the highway, and would result in a V/C ratio of 1.06.

[14] It should be noted that ODOT STIP project titled "OR99E: Kellogg Creek - MP 9.19" (key# 12855) will eliminate the exclusive pedestrian phase and provide signal interconnection between the River Rd intersection and the intersection of McLoughlin Blvd at Washington St. This project is scheduled for construction in 2007.

Hwy 224 Alternatives

Four of the seven study intersections along Hwy 224 are projected to exceed ODOT's V/C ratio requirements (1.1 within the Town Center, 0.99 outside of the Town Center) during 2035 peak-hour operations. Both short-term and long-term solutions are necessary to achieve an acceptable level of mobility on Hwy 224, while allowing for cross-city connectivity.

Short-Term Solutions

Short-term solutions are designed to relieve congestion at multiple intersections. They may not completely alleviate congestion, but can be implemented with relatively low cost at specific locations (versus the generally high cost, large-scale long-term solution). The intersections of Harrison St at Hwy 224 and Oak St at Hwy 224 are the two locations for short-term solutions. The short-term solution is to provide signal-protected left turns. This would require three types of changes: signal phasing, optimizing the signal timing to balance mobility and cross-street connectivity, and some physical modifications at the Harrison St intersection. The physical changes would convert the existing shared through/left-turn lanes at Harrison St into left-turn lanes and restripe the intersection as necessary to align the left-turn lanes. The intersection of Hwy 224/Oak St already has left-turn lanes on Oak St and would not require restriping. ODOT approval would be required for modifications to both intersections. A detailed traffic study would be required to ensure that the new phasing does not detrimentally affect the intersection operations and a signal progression study would be required.

Modifying the intersection of Hwy 224 and 37th Ave may be an additional short-term improvement. The northern leg of the intersection of Hwy 224 and 37th Ave is difficult because 37th Ave currently splits just north of the highway into 37th Ave and International Way. This geometric layout is confusing and increases the potential for possible conflicts. The consolidation of these two approaches into one would improve safety and traffic operations by creating a simpler intersection with one northern approach.

Long-Term Solutions

Long-term solutions for Hwy 224 address mobility along the corridor and cross street connectivity within the city, and require major investments that exceed the forecasted revenue. The alternatives that have been explored in order to meet the Oregon Highway Plan v/c target are outlined below. Alternatives 1-3 have been determined to be infeasible due to the improvement cost and limited forecasted revenue out to 2035. Alternative 4 is the recommended approach for the Hwy 224 corridor for the current planning period, along with establishing alternative mobility targets through a refinement plan.

- **Alternative 1—Seven-Lane:** The Hwy 224 seven-lane cross section alternative would involve increasing the number of through lanes for each direction from two to three, beginning north of Harrison St to south of Lake Rd. This option would require the acquisition of right-of-way, and increase the crossing distance at the intersections. It would solve the future operational deficiencies at the study intersections out to 2035.

  While widening Hwy 224 does allow for adequate intersection operations at study area intersections, it would create an even greater barrier to local connectivity. For this reason, some additional alternatives were evaluated to help reduce the potential side street delay and improve the potential east/west connectivity across Hwy 224. In addition, capacity improvements such as widening facilities along the entire corridor are not consistent with Metro's regional prioritization of transportation improvements (which place more focus on intersection or system management improvements).

- **Alternative 2—Modified Split Diamond Interchange:** Construction of a modified split diamond interchange between Harrison St and 37th Ave would involve elevating Hwy 224 from Harrison St to 37th Ave and constructing two tight urban interchanges (which require less right-of-way space than standard freeway interchanges), Monroe St and Oak St would pass under Hwy 224 with a frontage road under Hwy 224 to connect between Harrison St and 37th Ave. To improve connectivity within the city, this option includes the construction of an at-grade rail crossing along Monroe St and the extension of Monroe St to 32nd Ave. This configuration allows for much better intersection operations due to the removal of the Hwy 224 traffic through the intersections. A planning-level operational analysis revealed that the intersections would operate within the State's mobility standards.
- **Alternative 3—Hwy 224 Overpass/Underpass:** Grade separation of the highway would improve the localized intersection operations, but would divert traffic bound for or leaving Hwy 224 to other streets. An overpass over Hwy 224 could be placed at several locations, including Harrison St, Freeman Way and International Way/37th Ave. An option to the overpasses would be to construct Hwy 224 below grade with City streets passing over the highway. This alternative improves intracity connectivity by removing the barrier effect caused by Hwy 224.
- **Alternative 4—Hwy 224 TSMO Improvements:** Improve arterial corridor operations by expanding traveler information and upgrading traffic signal equipment and timings. Install upgraded traffic signal controllers, establish communications to the central traffic signal system, provide arterial detection (including bicycle detection where appropriate), and routinely update signal timings. Provide real-time and forecasted traveler information on arterial roadways including current roadway conditions, congestion information, travel times, incident information, construction work zones, current weather conditions, and other events that may affect traffic conditions. TSMO improvements also include ongoing maintenance and parts replacement (such as monitoring systems; providing power; and replacing cameras, loops, or other data collectors and devices).

Hwy 224/99E Refinement Plan

The City and ODOT should complete a Refinement Plan to determine and recommend alternative mobility targets.[15] The Refinement Plan would provide options for alternative mobility targets, which could include expanding the number of hours beyond the current two-hour measure, establishing a travel-time measure, or other measures. This plan should also consider ways to reduce the highway's barrier effect for all modes through an increased level of connectivity across the facility, consistent with City goals. The Refinement Plan should be completed within one to five years of the adoption of the October 2013 updates to the TSP.

RECOMMENDATIONS

To meet the TSP goals and policies outlined in Chapter 2, the City should take the following steps for improving the street network:

- Manage and improve the entire roadway system consistent with the City's transportation policies and street classifications.

[15] Provisions for alternative mobility targets are allowed per the Regional Functional Plan, Title 1, 3.08.230 and Oregon Highway Plan, Policy 1F3. The Oregon Transportation Commission shall approve the alternative mobility targets in order for them to become effective.

- Work with ODOT and Clackamas County to implement their access control standards on their facilities to reduce conflicts among vehicles and trucks, as well as conflicts between vehicles and pedestrians.
- Identify local street system improvements that are cost-effective in improving State facility conditions. These projects could be candidates for State financial assistance.
- Work with Metro to develop travel forecasts for the City that are used to assess future regional travel needs. The City will participate in verifying housing and employment forecasts to be used when Metro updates the Regional Transportation Plan.
- Coordinate with ODOT regarding implementation of the Oregon Highway Plan for expressways and Special Transportation Areas, including developing alternative mobility targets for Hwy 224 and McLoughlin Blvd.

Master Plan

The Street Network Master Plan is the list of projects needed to mitigate motor vehicle street network deficiencies. Figure 8-5 depicts the approximate locations of the Street Network Master Plan projects, which are also summarized in Table 8-10. This list is a "wish list" of motor vehicle related projects in Milwaukie. Some projects from the master plan were selected for inclusion in the Street Network Action Plan, which consists of projects that the community has identified as its top priorities for allocating and/or pursuing funding. As development occurs, streets are rebuilt, or other opportunities arise, projects on the master plan should be addressed.

The planning-level cost estimates in Table 8-10 are based on general unit costs for transportation improvements, but do not reflect the unique project elements that can significantly add to project costs. For each of these projects, the City will refine the cost estimate to include right-of-way requirements and costs associated with special design details at the time of development.

Transportation System Plan

FIGURE 8-5

STREET NETWORK MASTER PLAN

October 2018

LEGEND

Proposed Street Network Improvements

- Travel Route Improvement
- Corridor Refinement Plan
- Roadway Widening Project
- Intersection

- Schools
- Kellogg Creek Trail
- SpringwaterTrail
- Trolley Trail
- Light Rail Station
- Light Rail Transit
- Major Roads
- Streets
- Railroad
- County Line
- Water
- Parks
- City Limits

PROPOSED PROJECTS

- A Prohibit left turn movement at 17th Ave/McLoughlin Blvd and include in Refinement Plan
- B Signalize Harrison St/42nd Ave
- C Conduct Refinement Plan for HWY 99E/HWY 224 focused on motor vehicle and freight mobility.
  - HWY 99E Project Limits: Tacoma St to 17th Ave
  - HWY 224 Project Limits: HWY 99E to Lake Rd Interchange
- D Reconfigure intersection to consolidate 37th Ave/ Industrial Way
- E Add eastbound/westbound right turn lanes and integrate the trail crossing
- G Implement protected/permitted phasing for northbound and southbound left turns
- H Widen Linwood Ave to standard three lane cross section
- I Widen Railroad Ave to standard three lane cross section
- J Redesign intersections of River Rd and 22nd Ave to consolidate intersections; or Add northbound left turn pocket on River Rd
- K Widen Harrison St to standard three-lane cross section
- L Add left turn-lanes and protected signal phasing on Harrison St approaches
- M Widen Lake Rd to standard three-lane cross section
- N Replace 3-way stop with signal when warranted and appropriate. (Coordinate with the City of Portland)
- O Enhance connection between King Rd and Harrison St
- P Add protected signal phasing on Oak St approaches
- Q Improve intersection/modify access at HWY 224 and Freeman Way
- R Enhance connection along Stanley Ave at King Rd
- S Enhance connection along Stanley Ave at Monroe St
- V Improve safety of Trolley Trail crossing at 22nd Ave
- W Realign intersection to improve traffic between 42nd Ave and King Rd east of 42nd Ave
- X Connect local streets within Tacoma Station Area (see Fig 8-4)
- Y Construct street improvements on Stubb St, Beta St, Ochoco St, Hanna Harvester Dr and Mailwell Dr
- AA McBrod Ave demonstration project with green street/shared facilities
- AB Ochoco St and Milport Rd intersection redesign for wayfinding, circulation, and safety
- AC Green street demonstration project between Downtown Milwaukie and Springwater Pedestrian Bridge
- AD Moores St/Ochoco St/ 23rd Ave area reconfiguration
- AE Create public right-of-way from Mailwell Dr to 26th Ave

Table 8-10 Street Network Master Plan Projects

Map ID[16]	Priority	Type	Project Name	Project Description	From	To	Cost ($1,000s)[17]
High Priority Projects							
C	High	C	Hwy 224 & Hwy 99E Refinement Plan	Conduct refinement study to establish alternative mobility targets for Hwy 224 and McLoughlin Blvd for locations not meeting applicable State targets, and explore ways to minimize barrier effect and improve auto and freight mobility.	Hwy 99E Project Limits: Tacoma St to River Rd	Hwy 224 Project Limits: Hwy 99E to Lake Rd Interchange	$270
D	High	C	Intersection Improvements at Hwy 224 and 37th Ave	Consolidate the two northern legs of 37th Ave and International Way into one leg at Hwy 224.	Location-specific	Location-specific	$2,100
H	High	C	Linwood Ave Capacity Improvements (north)	Widen to standard three lane cross section. Widen bridge over Johnson Creek.	Johnson Creek Blvd	King Rd	$9,300
H	High	C	Linwood Ave Capacity Improvements (south)	Widen to standard three lane cross section.	King Rd	Harmony Rd	$12,500
P	High	C	Intersection Improvements at Hwy 224 and Oak St	Add left-turn-lanes and protected signal phasing on Oak St approaches.	Location-specific	Location-specific	$20
R	High	C	Stanley Ave Connectivity at King Rd	Enhance connection along Stanley Ave at King Rd.	Location-specific	Location-specific	$60
S	High	C	Stanley Ave Connectivity at Monroe St	Enhance connection along Stanley Ave at Monroe St.	Location-specific	Location-specific	$60
V	High	C	Intersection Improvements at McLoughlin Blvd and 22nd Ave	Improve safety of Trolley Trail crossing at 22nd Ave.	Location-specific	Location-specific	$200

[16] See Figure 8-5.
[17] Project costs are order-of-magnitude estimates and are in 2012 dollars. Future costs may be more due to inflation. In the case of operational projects, estimated costs are for the entire 22-year planning period.

Map ID[16]	Priority	Type	Project Name	Project Description	From	To	Cost ($1,000s)[17]
Medium Priority Projects							
A	Med	C	Intersection Improvements at McLoughlin Blvd and 17th Ave	Prohibit left-turn movement from 17th Ave to northbound McLoughlin Blvd and include in Hwy 224 & Hwy 99E Refinement Plan.	Location-specific	Location-specific	$20
E	Med	C	Intersection Improve-ments at Johnson Creek Blvd and Linwood Ave	Add eastbound right-turn lane and westbound right-turn lane.	Location-specific	Location-specific	$880
G	Med	C	Intersection Improvements at Linwood Ave and King Rd	Implement protected/permissive left-turn phasing for northbound and southbound approaches.	Location-specific	Location-specific	$20
J	Med	C	Intersection Improvements at McLoughlin Blvd and River Rd	Consolidate a single access point for the area at Bluebird St with full intersection treatment and signalization or add second northbound left-turn lane at River Rd.	Location-specific	Location-specific	$980
K	Med	C	Harrison St Capacity Improvements	Widen to standard three lane cross section.	32nd Ave	42nd Ave	$2,800
L	Med	C	Intersection Improvements at Harrison St and Hwy 224	Add left-turn-lanes and protected signal phasing on Harrison St approaches.	Location-specific	Location-specific	$20
O	Med	C	Harrison St and King Rd Connection	Enhance connection between King Rd and Harrison St	King Rd	Harrison St	$60
Low Priority Projects							
B	Low	C	Intersection Improvements at 42nd Ave and Harrison St	Signalize intersection to facilitate dominant traffic flow.	Location-specific	Location-specific	$280
I	Low	C	Railroad Ave Capacity Improvements	Widen to standard three lane cross section.	37th Ave	Linwood Ave	$14,200
M	Low	C	Lake Rd Capacity Improvements	Widen to standard three lane cross section.	21st Ave	Oatfield Rd	$8,100
N	Low	C	Johnson Creek Blvd and 42nd Ave Signalization	Replace 3-way stop with signal when warranted.	Location-specific	Location-specific	$270

Map ID[16]	Priority	Type	Project Name	Project Description	From	To	Cost ($1,000s)[17]
Q	Low	C	Hwy 224 Access Modifications at Freeman Way	Modify access at Freeman Way to improve intersection functioning.	Location-specific	Location-specific	$1,400
W	Low	C	Intersection Improvements at 42nd Ave and King Rd	Realignment of intersection to improve traffic movements between 42nd Ave and King Rd east of 42nd Ave.	Location-specific	Location-specific	$200
X	Low	C	Local Street Connections in Tacoma Station Area	Connect local streets within Tacoma station area: 24th Ave between Ochoco St/Moores St & Clatsop St; Omark St between Mailwell Dr & Beta St (w/midblock connection from Main St); and Mailwell Dr to Harrison St via 26th Ave. (NMIA Plan)	Location-specific	Location-specific	$8,120
Y	Low	C	Local Street Improvements in Tacoma Station Area	Construct street improvements on Stubb St, Beta St, Ochoco St, Hanna Harvester Dr, and Mailwell Dr. (NMIA Plan)	Location-specific	Location-specific	$5,280
Priority to be Determined							
AA	-	C	McBrod Ave green street	Develop McBrod Ave as a demonstration project, where appropriate, that integrates green street/shared facility approaches to treat both the right-of-way and adjacent development.	Location-specific	Location-specific	-
AB	-	C	NMIA intersection redesign	Based on the outcomes, redesign the Ochoco St and Milport Rd intersections to improve wayfinding, circulation and pedestrian safety. Improvements should include geometric and wayfinding/signage improvements.	Location-specific	Location-specific	-
AC	-	C	NMIA McLoughlin Blvd green street demonstration	Partner with ODOT to develop a green street demonstration project for McLoughlin Boulevard between Downtown Milwaukie and the Springwater Corridor Pedestrian Bridge.	Location-specific	Location-specific	-
AD	-	C	NMIA navigability reconfiguration	Reconfigure the Moores St/Ochoco St/23rd Ave area to be more navigable and easier to develop adjacent properties.	Location-specific	Location-specific	-
AE	-	C	NMIA right-of-way road design	Create a public right-of-way from Mailwell Dr through the existing loading docks to 26th Ave. Road design should restrict large trucks from entering the adjacent neighborhoods south of the project area.	Location-specific	Location-specific	-

Notes:

C = Capital Project
O = Operational Project
P = Policy Project

High = High priority
Med = Medium priority
Low = Low priority

NMIA Plan = North Milwaukie Innovation Area Plan

Action Plan

The Street Network Action Plan (Table 8-11) identifies the highest priority projects that are reasonably be expected to be funded with local funds by 2035, which meets the requirements of the State's Transportation Planning Rule.[18] The action plan project list is based upon a 2007 citywide project ranking process. In 2007, all of the modal master plan projects were ranked by the TSP Advisory Committee after consideration of the Working Groups' priorities, other public support for the project, and how well each project implements the TSP goals and policies. For the 2013 TSP Update, City staff reassessed the prioritization of all projects, incorporating public comments gathered at and around a public meeting in June 2013. Action plan projects that were completed since 2007 were removed from the action plan and new projects identified as top priorities were added.

Table 8-11 Street Network Action Plan

Map ID	Project Name	Project Description	From	To	Project Cost ($1,000s)	Direct Funding or Grant Match
P	Intersection Improvements at Hwy 224 Crossings (Oak St)	Add left-turn lanes and protected signal phasing on Oak St approaches.	Location-specific	Location-specific	$20	Match
V	Intersection Improvements at McLoughlin Blvd and 22nd Ave	Improve safety of Trolley Trail crossing at 22nd Ave.	Location-specific	Location-specific	$200	Match
C	Hwy 224 & Hwy 99E Refinement Plan	Conduct refinement study to establish alternative mobility targets for Hwy 224 and McLoughlin Blvd for locations not meeting applicable State targets, and explore ways to minimize barrier effect and improve auto and freight mobility.	Hwy 99E Project Limits: Tacoma St to River Rd	Hwy 224 Project Limits: Hwy 99E to Lake Rd Interchange	$270	Match

The completion of the action plan project list would improve transportation operations at several locations in Milwaukie. The study intersections would operate as listed in Table 8-12 with the inclusion of action plan projects during the year 2035 p.m. peak hour. Approximately one third of study intersections (8 of 24 locations) would not meet performance standards with the inclusion of the action plan projects. Six of these intersections would be located on ODOT facilities (McLoughlin Blvd or Hwy 224), while the remaining two locations would be on City of Milwaukie facilities (Linwood Ave). Additional refinement plans for McLoughlin Blvd and Hwy 224 are needed to identify appropriate improvements and/or alternate mobility targets for traffic mobility along the corridors.

[18] *OAR Chapter 660*, Department of Land Conservation and Development, Division 012, Transportation Planning, adopted on March 15, 2005, effective April 2005.

Table 8-12 2035 Action Plan Intersection Level of Service (P.M. Peak Hour)

Intersection	Existing 2012			Future 2035 Action Plan Scenario		
	Level of Service (LOS)	Average Delay (Seconds)	Volume/ Capacity (V/C)	Level of Service (LOS)	Average Delay (Seconds)	Volume/ Capacity (V/C)
Two-Way Stop Controlled Intersections						
McLoughlin Blvd @ 22nd Ave	A/D	26.4	0.01	A/**E**	**38.7**	0.01
Harrison St @ 21st Ave	A/C	18.0	0.10	A/C	17.3	0.24
King Rd @ 42nd Ave	A/B	14.3	0.26	A/C	18.9	0.46
Monroe St @ Linwood Ave	A/D	31.2	0.51	B	11.6	0.66
All-Way Stop Controlled Intersections						
Harrison St @ Main St	B	13.2	0.39	C	19.4	0.78
42nd Ave @ Harrison St	B	12.8	0.22	C	24.4	0.86
Johnson Creek Blvd @ 32nd Ave[19]	**F**	**>50.0**	**0.77**	D	46.9	0.93
Signalized Intersections						
McLoughlin Blvd @ Ochoco St	B	10.1	0.85	C	32.8	1.08
McLoughlin Blvd @ Milport Rd	A	4.4	0.78	A	9.5	0.95
McLoughlin Blvd@ Harrison St	D	47.1	**0.99**	**F**	**83.8**	**1.20**
McLoughlin Blvd @ Washington St	C	20.0	0.88	**E**	**67.3**	**1.14**
Hwy 224 @ 17th Ave	C	20.7	0.59	C	24.2	0.77
Hwy 224 @ Harrison St	D	40.0	0.89	**E**	**79.6**	**1.17**
Hwy 224 @ Monroe St	B	19.0	0.75	C	31.8	0.97
Hwy 224 @ Oak St	D	44.1	0.88	**E**	**66.9**	1.06
Harrison St @ 32nd Ave	B	10.5	0.45	B	17.3	0.72
McLoughlin Blvd @ River Rd	D	35.5	0.99	**F**	**>80.0**	**1.14**
Lake Rd @ Oatfield Rd	D	36.0	0.62	D	42.7	0.80
Hwy 224 @ 37th Ave	C	25.5	0.82	**F**	**>80.0**	**1.30**
Hwy 224 @ Freeman Way	C	30.5	0.94	**E**	**58.4**	**1.08**
Hwy 224 @ Lake Rd	B	16.1	0.68	D	39.1	0.91
Johnson Creek Blvd @ Linwood Ave	D	53.6	0.97	**F**	**>80.0**	**1.23**
Linwood Ave @ King Rd	D	42.6	0.79	D	42.0	0.88
Linwood Ave @ Harmony Rd	**E**	**65.0**	0.94	**F**	**>80.0**	**1.55**

Notes: A/A=major street LOS/minor street LOS
Signalized and all-way stop delay = average vehicle delay in seconds for entire intersection
Unsignalized delay = highest minor street approach delay
Intersections shown in **bold type** exceed jurisdictional standards

[19] Intersection is assumed to have a traffic signal and westbound left-turn lane constructed by TriMet.

REGIONAL TRANSPORTATION PLAN (RTP) COMPLIANCE

The projects identified in the master plan list and further refined in the action plan list are consistent with the Metro 2035 Regional Transportation Plan (RTP) goals for regional mobility and non-SOV modal targets. It is expected that the City would continue coordination with Metro and Clackamas County as other plans are updated to maintain consistency and coordination on projects that are regionally implemented.