CHAPTER 4: FUTURE TRAVEL FORECASTS AND NEEDS ANALYSIS

The travel demand model for the City of Redmond, prepared by ODOT's Transportation Planning Analysis Unit, was used to develop future traffic volumes for the year 2025 throughout the study area street network. Using these volumes, along with the future street network resulting from planned projects through 2025, the transportation system was evaluated and deficiencies were identified through the use of the same analysis procedures previously employed for the existing conditions. This chapter presents the future volumes at study area intersections, describes key assumptions and refinements used in the model development, and discusses the ability of the transportation system to accommodate forecasted growth.

Model Assumptions

The City of Redmond travel demand model is divided into 148 small, internal geographic areas called Transportation Analysis Zones (TAZ) and eight external stations containing information related to base and future year households and employment. TAZs serve as the places where individual trips begin or end. External stations are similar to TAZs, but are located around the perimeter of the model area and represent origins and destinations associated with large geographic areas beyond the limits of the model. The creation of the internal TAZs was primarily based on aggregations of census blocks. Figure 4.1 displays the model TAZ network against the existing transportation system through the City of Redmond.

Trip generation associated with each TAZ is based on household characteristics, such as household size and number of workers, and trip purposes, such as home-based trips (e.g. home to work, school, shopping, and recreation) or non-home-based trips. Therefore, the number of trips generated during a given scenario is primarily dependent on the assumed quantity and locations of housing and employment. Table 4.A presents the total number of households and employees (separated into retail and other) assumed to be present within the model area for the base year 2000 and future year 2025 scenarios and compares them to show the growth experienced over this planning period. Also, Figures 4.3, 4.4, and 4.5 show the growth in housing and employment by TAZ within the model area. It should be noted that a buildable lands inventory was recently completed to provide an updated forecast of future trip patterns in the City of Redmond. This work is being incorporated into the City's Comprehensive Plan and will be used in future transportation planning efforts.

Table 4.A: Assumed Household and Employment Quantities

	Households	Retail Employees	Other Employees
Base Year 2000	7,418	2,330	5,492
Future Year 2025	18,356	4,969	13,040
Growth	147%	113%	137%

Figure 4.1: Redmond Area Model Transportation Analysis Zone System

The generated trips calculated from this information are distributed between TAZs in consideration of each TAZ's trip production and relative attractiveness. The attractiveness of a TAZ as a destination is determined by travel times from origin TAZs and the types of employment and number of households contained within the potential destination TAZ. Origins and destinations can be associated with either TAZs or external stations. When associated with TAZs, these trips are considered to be internal trip ends. External trip ends occur at the external stations surrounding the model area. Identifying the locations of trip ends as internal or external provides an understanding of the nature of travel during the modeled time period. For example, trips with internal origins and destinations indicate travel contained entirely within the model area, while trips with external origins and destinations indicate travel only passing through the model area (see Figure 4.2).

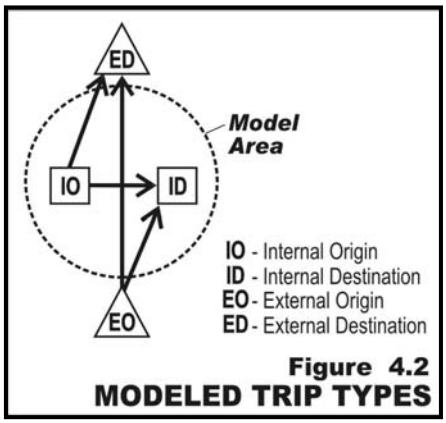

Figure 4.2
MODELED TRIP TYPES

Table 4.B and Figure 4.6 display the assumed number of trips associated with internal and external origins and destinations in the base year 2000 and future year 2025 model scenarios. As shown in Figure 4.6, the travel demand model assumes a majority of trips occurring during the p.m. peak hour have both internal origins and destinations, while a minority of the trips has both external origins and destinations. Furthermore, the growth in local trips (internal – internal) is anticipated to exceed the growth in through traffic (external – external), with an annual growth rate more than two times the growth rate of any other trip type.

Table 4.B: Redmond Area Model Trip Types, PM Peak Hour

	Trip End Locations (origin – destination)			
	Internal – Internal	Internal – External/ External – Internal	External – External	Total Trips
Base Year 2000	5,235	3,174	1,005	9,414
Future Year 2025	13,100	5,290	1,670	20,060
Growth	150%	67%	66%	113%
Avg. Annual Growth Rate	6.0%	2.7%	2.6%	4.5%

Figure 4.6: Proportion of Trips Types in Redmond Area Model, PM Peak Hour

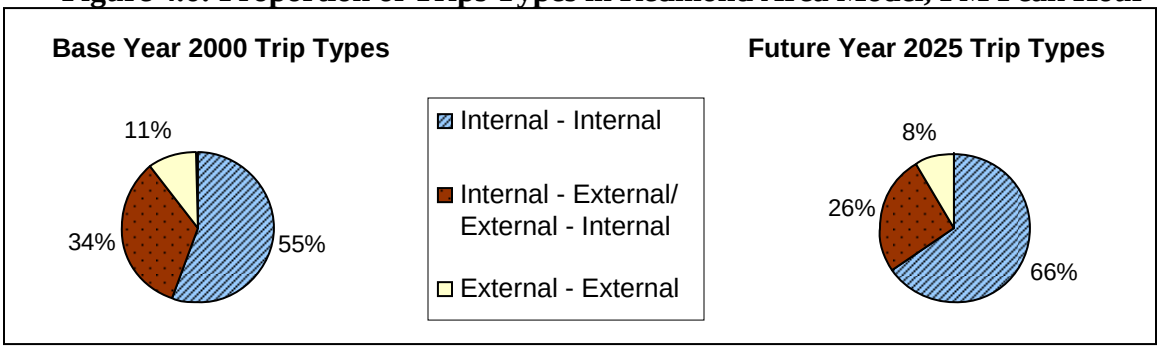

Figure 4.3: Redmond Area Model Household Growth From 2000 to 2025

Figure 4.4: Redmond Area Model Retail Employment Growth From 2000 to 2025

Figure 4.5: Redmond Area Model Non-Retail Employment Growth From 2000 to 2025

Model Network Refinement

The base year 2000 and future year 2025 model scenarios included different street networks, with the base year network closely resembling the existing transportation system and the future year network reflecting conditions planned to exist according to the City of Redmond's Transportation System Plan. Figure 4.7 provides a side-by-side comparison of the networks associated with these scenarios.

Prior to forecasting future volumes, the future year 2025 network was refined to better provide for the needs of this study. Refinements made to the network are listed below.

- Refinement of the US 97 Reroute north interchange area to more accurately reflect the current design;
- Quince Avenue extension from 10th Street to Canal Boulevard;
- Right-in/right-out connection to west side of US 97 Reroute at Larch Avenue;
- Right-in/right-out connection to east side of US 97 Reroute at Hemlock Avenue;
- Right-in/right-out connection to both sides of US 97 Reroute at Antler Avenue;
- Removed centroid connectors from US 97 Reroute and replaced them to local streets to reflect appropriate access restrictions;
- Extended 19th Street to Quarry Road;
- Removed centroid connection from TAZ paralleling east side of US 97 north of Quarry Road and reconnected to 19th Street extension; and
- Added diamond interchange on US 97 at Quarry Road.

Future Year Forecasts

Using the Redmond travel demand model, future year traffic volumes were forecast for streets within the study area. Because the model forecasts average month traffic conditions, a seasonal factor must be applied to these volumes to reflect conditions during the design hour (equivalent to the 30th highest hour of the future year). However, because the growth between the base year model (2000) and future year model (2025) was applied to 2005 volumes that had already been adjusted with a seasonal factor, no further adjustments were necessary to reflect conditions in the desired design hour.

Turn movement volumes at study area intersections were primarily obtained through application of a post-processing technique where the incremental differences between the future and base year volumes from the model were added to the seasonally adjusted volumes collected in the field. Additional refinement was required for some intersections where the geometry was modified between the base and future years to ensure forecasted turning movements were consistent with the future year street network. For some movements experiencing extreme or unrealistic changes, a different post-processing technique was applied that included factoring the collected turn movement volumes under existing conditions by the ratio of the future model forecast volume to the base year model volume.

Because of the impact of the US 97 Reroute on north-south travel choices, screenlines were drawn along the major north-south routes in the study area (10th Street, US 97, Canal Boulevard, and the US 97 Reroute) to track north-south volume growth and trip distribution. This technique was used to aid in the assignment of future trips in a corridor where a major facility did not exist in the base year model, making a direct comparison of base and future year conditions difficult.

Figure 4.7: Redmond Area Model Base & Future Year Street Networks

Additional refinements to the forecasted volumes were made to account for the potential trips generated by a proposed Wal-Mart store to be located east of US 97 and north of Maple Avenue. By comparing the trips generated by the TAZs encompassing the approximate area to be developed by the Wal-Mart to the estimated trips generated by the Wal-Mart (as shown in the traffic impact study1), it was found that the proposed Wal-Mart would generate nearly three times the trips forecasted by the model for that property. Therefore, the trips associated with the subject property from the model were removed from the 2025 forecast and replaced with the trips from the proposed Wal-Mart store.

Figure 4.8 displays the forecasted turning movement volumes at study intersections for the year 2025. In addition to the post-processing procedures described above, these values have been balanced to produce reasonable volume fluctuations between adjacent study intersections. The degree of change allowed in traffic volumes between intersections was dependant on the distance between intersections and the quantity and quality of potential destinations and origins located between them.

Compared to the traffic volumes collected in 2005 (displayed in Figure 3.6), the most significant changes in the IAMP area occur on US 97, Maple Avenue, and 19th Street. The addition of the US 97 Reroute appears to have a significant effect on US 97 south of the new US 97/US 97 Reroute interchange, where forecasted volumes for 2025 are actually lower than current volumes experienced in 2005, with reductions ranging from 30 to 50% (approximately 800 to 1,400 vehicles per hour). However, to the north of the US 97 Reroute, traffic volumes on US 97 within the study area are projected to increase by approximately 25% (more than 525 vehicles per hour) over current volumes.

On the City street network, Maple Avenue is significantly impacted following the extension across Dry Canyon and the connection to Negus Way via a grade separated crossing of the US 97 Reroute. With these improvements in place, Maple Avenue will become an attractive east-west route providing connectivity between US 97, the residential properties to the west, and the employment opportunities to the east. To the west of US 97, traffic volumes are projected to increase on Maple Avenue to more than seven times current levels (increase of nearly 1,000 vehicles per hour), while to the east of the US 97 Reroute, an increase of approximately five times current levels (increase of over 600 vehicles per hour) is projected.

In addition, there is significant growth on 19th Street within the IAMP area, with traffic volumes increasing by more than two times current levels (increase of more than 570 vehicles per hour). This growth may be a result of increased housing, as illustrated in Figure 4.3.

Despite being severed by the proposed US 97 Reroute, Canal Boulevard also shows some significant growth north of Maple Avenue (approximately 45%). This growth is most likely the result of new development on properties between US 97 and Canal Boulevard that are currently vacant (see projected employment growth in Figures 4.4 and 4.5).

Positive growth also occurs on other local streets such as 10th Street, King Way, and 17th Street, but total traffic volumes in 2025 will remain relatively low (less than 500 vehicles per hour).

[1] Wal-Mart Traffic Impact Study conducted by Kittelson & Associates, Inc., 2005.

Assumed Future Street Network

As previously described, the future year 2025 travel demand model was refined to account for planned transportation projects in the area that would influence travel choices and change system capacity. To analyze system operations under this scenario, the Synchro model that was used to perform the operational analysis of study area intersections was updated to account for these projects and included several additional refinements of smaller scale that would not have impacted the route choice provided by the travel demand model. Such refinements typically included modifying lane configurations for streets and intersections undergoing improvements and installing traffic signals where they do not exist today. New traffic signals were installed in accordance with planned projects and a listing of intersections in the City Transportation Capital Improvement Plan (CIP) that are noted as being signalized when warranted. These intersections include:

- US 97 at Maple Avenue;
- US 97 at Kingwood Avenue;
- US 97 at Quince Avenue; and
- NW 19th Street at Maple Avenue.

Intersections on this list were assumed to be signalized by 2025 where the analysis of the unsignalized condition found operations failing to meet the applicable agency mobility standard and mitigation through other means did not appear feasible. An illustration of assumed traffic controls and lane configurations at study intersections is provided in Figure 4.9.

Future 2025 Operations

An operational analysis of the US 97 corridor and study area intersections for the design hour (future 30th highest hour of annual traffic, referred to as DHV) in 2025 was conducted for the IAMP area using the assumed lane configurations and traffic controls shown in Figure 4.9 and the forecasted traffic volumes documented in Figure 4.8. The analysis methodologies employed and corresponding results are discussed below.

Performance Standards

ODOT has designated US 97 as a Statewide Highway on the National Highway System, with an additional Freight Route designation. North of the Redmond urban growth boundary, US 97 also maintains an expressway designation. Within the IAMP area, ODOT also owns O'Neil Highway, which has been designated as a District Highway. Performance standards for these facilities have been adopted by ODOT in the 1999 Oregon Highway Plan2 (OHP). While these performance standards were amended in August of 2005, the changes made did not affect the study area, as all state highways within it operate with posted speeds of 45 mph or greater. Table 6 in Policy 1F of the OHP displays the maximum allowable volume to capacity ratios for the 30 HV in areas outside of the Portland Metropolitan Area. Sections from that table relevant to the study area are presented below in Table 4.3.

[2] *1999 Oregon Highway Plan*, Oregon Department of Transportation, 1999.

Figure 4.8: 2025 No Build Design Hour Traffic Volumes

Figure 4.9: 2025 Assumed Intersection Control and Lane Configurations

Table 4.C: Maximum Volume to Capacity Ratios Outside Metro*

Highway Category	Land Use Type/Speed Limits	
	Inside Urban Growth Boundary	Outside Urban Growth Boundary
	Non-MPO where non-freeway speed limit > 45 mph	Rural Lands
Statewide Expressways	0.70	0.70
Statewide (NHS) Freight Routes	0.70	0.70
District/Local Interest Roads	0.80	0.75

* Source: 1999 Oregon Highway Plan, Table 6 (Policy 1F), as amended August 2005.

At unsignalized intersections, these standards are applicable only to movements that are not required to stop. For other movements at unsignalized intersections that are required to stop or otherwise yield the right of way, the standards for District/Local Interest Roads shall be applied for areas within urban growth boundaries and a maximum volume to capacity ratio of 0.80 shall be applied for areas outside of urban growth boundaries.

All non-state roadways within the Redmond UGB are under the jurisdiction of the City of Redmond. In addition, as ODOT and the City have formed an agreement that would transfer ownership of the existing US 97 alignment from the new interchange to Veteran's Way (section by-passed by the Reroute) following the construction of the interchange, the study intersections along this corridor were assumed to be under City jurisdiction by 2025 as well. The City has adopted standards for performance of City streets requiring operation of level of service "E" or better during the peak 15 minutes of the peak hour of the average weekday. A lesser standard is allowed at unsignalized intersections with low volume minor street approaches, requiring operation at a volume to capacity ratio less than 0.90 and a 95th percentile vehicle queue less than four vehicles during the peak hour.

For non-state roadways outside of the Redmond UGB, which are under the jurisdiction of Deschutes County, the Deschutes County Transportation System Plan includes a goal to maintain a level of service of "D" or better during the peak hour throughout the County arterial and collector road system over the next 20 years.

Intersection Operations

Study intersections within the IAMP area were analyzed through the use of the updated Synchro model that was used to examine existing conditions, along with the traffic volume data shown in Figure 4.8. From this analysis, intersection levels of service and volume to capacity ratios were obtained using Highway Capacity Manual3 methodologies for signalized and unsignalized intersections for comparison with the applicable jurisdiction's adopted performance standards. The results of this analysis are shown below in Table 4.4, and further illustrated in Figure 4.10. It should be noted that for unsignalized intersections, the operation of the critical movement (usually stop-controlled) is often of most interest. Therefore, the results provided in Table 4.4 for these intersections show the volume to capacity ratios and levels of service for the critical movements only.

[3] *Highway Capacity Manual*, Transportation Research Board, Washington, D.C., 2000.

When comparing this table to Table 3.H, which displays the results of the existing conditions analysis, it is noticed that operations at the intersections on US 97 at Maple Avenue and Kingwood Avenue have been improved, with US 97 at Maple Avenue meeting the City's adopted performance standards. Factors in the improved operations of these intersections included signalization and the addition of turn lanes at Maple Avenue, adding separate left turn lanes on the Kingwood Avenue approaches, and the drop in traffic volumes along US 97 resulting from the construction of the Reroute.

The intersection on US 97 at O'Neil Highway is left as the only intersection on state facilities failing to meet ODOT's performance standards. There are no planned projects to mitigate this intersection and the side-street volumes on O'Neil Highway and Pershall Way appear to be too low to justify signal installation on a high-speed, rural expressway. If safety becomes a concern at this location, the appropriate mitigation may be to offset the east and west approaches or restrict turning movements to right-in/right-out only. However, it should be recognized that issues such as topography, proximity to the proposed interchange, and availability of alternate routes may impact the decision on how to best mitigate this intersection.

While the intersection on US 97 at Kingwood Avenue will not meet the City's preferred performance standard, it may meet the lesser standard requiring operation at a volume to capacity ratio less than 0.90 and a 95th percentile vehicle queue less than four vehicles. The installation of a traffic signal "when warranted" is listed in the City CIP as a future project, but the side-street volumes on Kingwood Avenue appear to be too low to satisfy the signal warrants provided in the Manual on Uniform Traffic Control Devices4. As future development patterns surrounding this intersection may differ from those assumed in the City-wide demand model used, creating localized impacts to side-street volumes, this intersection should be monitored to note if side-street volumes increase enough to warrant signalization.

Also on the City street network, the intersection on Maple Avenue at 19th Street required mitigation including signalization and turn lanes in accordance with planned projects in the City's CIP calling for capacity improvements and a traffic signal. The only City intersection, other than US 97 at Kingwood Avenue, shown to be failing is on Maple Avenue at 9th Street. There is a project listed in the City CIP for this intersection calling for capacity improvements, but it appears a traffic signal may be necessary to meet the adopted performance standard.

Very little change is noticed in the operation of County intersections from the existing condition to the future condition, with all locations operating well within adopted performance standards.

Highway/Interchange Operations

In addition to analyzing the operations at study area intersections, US 97 and the new US 97 Reroute were also examined from O'Neil Highway to Larch Avenue. This included capacity analysis of the highway segments between O'Neil Highway and the new interchange and between the new interchange and Larch Avenue, as well as an analysis of the merging and diverging movements to and from the interchange ramps. All analysis conducted was in accordance with Highway Capacity Manual methodologies.
The results of the analysis, provided in Table 4.E, show that US 97 and the US 97 Reroute will operate well within ODOT's adopted performance standards throughout the study area.

[4] *Manual on Uniform Traffic Control Devices*, Federal Highway Administration, Washington, D.C., 2003, p. 4C-1.

Table 4.D: 2025 No Build Design Hour Intersection Operations

	Intersection	Volume to Capacity Ratio		Level of Service		Performance Standard Met?
		Measured	required	measured	required	
	ODOT Facilities – Volume to Capacity Ratio Determines Performance Standard					
U	US 97 / O'Neil Hwy	>1.0 (EB)*	0.80	F (EB/WB)	E	No
U	US 97 / NB US 97 Reroute	0.14 (NB)	0.85	A (NB)	E	Yes
U	US 97 / SB US 97 Reroute	0.14 (EB)	0.85	A (WB)	E	Yes
U	US 97 Reroute / Larch Ave	0.76 (EB)	0.80	D (EB)	E	Yes
U	O'Neil Hwy / Canal Blvd	0.22 (NB)	0.80	B (NB)	E	Yes
	City of Redmond Facilities – Level of Service Determines Performance Standard					
U	US 97 / Quince Ave	0.40 (EB)	0.80	C (EB)	E	Yes
S	US 97 / Wal-Mart Access	0.59	0.70	D	E	Yes
S	US 97 / Maple Ave	0.69	0.70	C	E	Yes
U	US 97 / Kingwood Ave	0.72 (WB)	0.80	F (WB)	E	No
U	Canal Blvd / Kingwood Ave	0.30 (WB)	-	C (WB)	E	Yes
U	Canal Blvd / King Way	0.15 (NB)	-	B (WB)	E	Yes
U	Canal Blvd / Negus Way	0.71 (WB)	-	D (WB)	E	Yes
U	Negus Way / Canal Blvd	0.36 (SB)	-	C (SB)	E	Yes
U	Quince Ave / 10th St	0.27 (WB)	-	B (EB/WB)	E	Yes
U	Maple Ave / 9th St	4.57 (SB)	-	F (NB/SB)	E	No
S	Maple Ave / 19th St	0.90	-	D	E	Yes
U	Kingwood Ave / 9th St	0.10 (NB)	-	B (WB)	E	Yes
U	Negus Way / 9th St	0.25 (NB)	-	B (NB)	E	Yes
	Deschutes County Facilities – Level of Service Determines Performance Standard					
U	Yucca Ave / 17th St	0.06 (EB)	-	A (EB)	D	Yes
U	17th St / King Way	0.03 (EB)	-	A (EB)	D	Yes
U	Pershall Way /10th St	0.09 (NB)	-	B (NB)	D	Yes

Notes: (XX) = critical movement

S = signalized intersection * EB approach has no capacity

U = unsignalized intersection

Table 4.E: 2025 No Build Design Hour Multi-lane Highway & Ramp Analysis

Location	Direction of Travel	Measured V/C Ratio	Required V/C Ratio
O'Neil Hwy to North Interchange	Southbound	0.36	0.70
	Northbound	0.46	0.70
Off-ramp Diverge to Old US 97	Southbound	0.22	0.70
On-ramp Merge from Old US 97	Northbound	0.24	0.70
Off-ramp Diverge to Old US 97	Southbound	0.36	0.70
On-ramp Merge from Old US 97	Northbound	0.41	0.70
North Interchange to Larch Ave.	Southbound	0.27	0.70
	Northbound	0.44	0.70

Future 2025 Deficiencies

Traffic Operations

As previously discussed, and illustrated in Figure 4.10, most of the study area intersections are projected to operate within adopted performance standards in 2025. In addition, the US 97 Reroute and US 97 north of the new interchange will have adequate capacity to serve the forecasted future demand. In focusing on the operational deficiencies, three locations are identified:

- The intersection on US 97 at O'Neil Highway;
- The intersection on Maple Avenue at 9th Street; and
- The intersection on US 97 at Kingwood Avenue.

US 97 at O'Neil Highway

This intersection was shown to be failing to meet performance standards under existing conditions with the stop-controlled approaches operating at level of service F and v/c ratios greater than 1.00. While the volumes of traffic attempting to leave the stop-controlled approaches are fairly low, the high volumes of traffic on US 97 do not provide enough gaps in traffic to serve them. With traffic volumes projected to increase by 2025, this condition worsens.

While the installation of a traffic signal would mitigate operations to be well within the adopted standards, the volumes of traffic on the stop-controlled approaches appear to be too low to meet the required warrants for such an installation. In addition, given the isolated, rural nature of the surrounding area and the high travel speeds on US 97, the installation of a traffic signal at this intersection may conflict with driver expectations and could create a safety hazard.

With a majority of the traffic on the stop-controlled approaches being associated with right turn movements, a potential improvement may be to restrict turns (e.g. right-in and right-out movements only). However, a complete engineering investigation considering the impacts of such an improvement and the availability of alternate routes for the restricted movements should be conducted first.

Another option may to offset the east and west approaches. This type of improvement does not mitigate the left turn movements, but would convert the through movements to right turns, which typically require fewer gaps on the highway and can often operate more safely. To convert through movements to right turns, the west approach must be located to the north of the east approach. In this case, Cinder Butte may

make moving Pershall Way to the north infeasible and the proximity to the proposed interchange may make moving O'Neil Highway to the south undesirable.

Maple Avenue at 9th Street

The intersection on Maple Avenue at 9th Street operated well under existing conditions, but degraded significantly by 2025, operating at a level of service F and failing to meet the City's performance standard. The failing future operations are largely due to the increased volumes on Maple Avenue resulting from the street extension from Negus Way to 19th Street.

The City of Redmond CIP includes a project at this intersection for "capacity improvements" with estimated funding at approximately $35,000. Further analysis revealed that the installation of a traffic signal would be required to restore operating conditions to meet performance standards. New traffic signal installations typically cost around $175,000. The installation of a roundabout may be another option for improving this intersection, but was not investigated due to the limited right-of-way available in this area.

US 97 at Kingwood Avenue

This intersection operated very poorly under existing conditions, but has been shown to improve in 2025 due to decreased traffic volumes on US 97 and the addition of separate left turn lanes on the east and west approaches. However, it will not meet the City's preferred performance standard requiring operation of level of service "E" or better, but may meet the lesser standard allowing low volume minor street approaches to operate at v/c ratios less than 0.90 with 95th percentile vehicle queues less than four vehicles during the peak hour.

A traffic signal, which has been identified in the City CIP as a future improvement at this intersection, could restore operations such that City performance standards are be met, but the traffic volumes on the east and west approaches may be too low to meet signal warrants. Therefore, finding a suitable solution will require further study. As future development patterns surrounding this intersection may differ from those assumed in the City-wide demand model used, creating localized impacts to side-street volumes, this intersection should be monitored to note if side-street volumes increase enough to warrant signalization.

Figure 4.10: IAMP Area Intersection Failing to Meeting Adopted Performance Measures – 2025 DHV

Access / Intersection Spacing

In Chapter 3, the existing access spacing on the area street network was compared to adopted access management spacing standards. It was found that on US 97, the number of approaches to the highway is far greater than would be allowed under ODOT's spacing standards, with access density increasing to the south. Access spacing on City streets generally met standards with some deficiencies noted to be related to public street intersection spacing on arterials. County roads were not assessed, as the County does not maintain access management spacing standards.

The changes to the state highway system resulting from the construction of the US 97 Reroute and interchange will require additional access management spacing standards to be applied to this area that specifically address interchange areas. Figure 4.11 displays US 97, the US 97 Reroute, and the new interchange (the primary routes of interests regarding access management), over an aerial photograph showing existing5 land development and associated access points and identifies different zones where access management spacing standards change. These zones are described below.

Zone 1: This zone includes the segment of US 97/US 97 Reroute bounded by the interchange, the interchange ramps, and the crossroad between the ramp terminals. According to OAR 734-051-0070(4)(a), "The Department shall not accept an application for an approach to a freeway, a freeway ramp, or an expressway ramp, or where an approach would be aligned opposite a freeway or expressway ramp terminal."

Recommendation: Within Zone 1, all access rights should be purchased and no access to the highway system should be allowed.

Zone 2: Zone 2 includes the interchange crossroads of US 97 and Canal Boulevard to the north and south of the interchange ramp terminals for a minimum distance of 1,320 feet. The southern section of this zone along US 97 (Zone 2A) covers an urban, multi-lane highway, with applicable access management spacing standards coming from Table 8 and Figure 4, as referenced in OAR 734-051-0125(2).

Recommendation: Within Zone 2A, a distance of at least 1,320 feet should be maintained between the interchange ramp terminal and the first right-in/right-out approach or first intersection allowing left turns and the last right-in/right-out approach and the start of the taper for the on-ramp.
The northern section along Canal Boulevard (Zone 2B) covers an urban, two-lane facility owned by the City of Redmond. While ODOT does maintain interchange area spacing standards for interchange crossroads, they are not directly applicable to facilities under the jurisdiction of other agencies. To maintain consistency with the treatment of access on the south side of the interchange, it is recommended that the City adopt ODOT's access management spacing standards for an area extending 1,320 feet from the US 97 northbound interchange ramp terminal. ODOT's access management spacing standards for two-lane crossroads in interchange areas are slightly different than those for multi-lane crossroads. As shown in Table 7 and Figure 3 of OAR 734-051, a distance of at least 1,320 feet should be maintained between the interchange ramp terminal and the first right-in/right-out approach or first intersection allowing left turns, but a shorter distance of 990 feet is allowed between the last right-in/right-out approach and the start of the taper for the on-ramp.

Recommendation: Within Zone 2B, a distance of at least 1,320 feet should be maintained between the interchange ramp terminal and the first right-in/right-out approach or first intersection allowing left turns.

[5] Photo taken in 2004.

A minimum distance of 990 feet should be maintained between the last right-in/right-out approach and the start of the taper for the on-ramp.

Zone 3: Zone 3 includes the remainder of US 97 south of the new interchange that is outside of Zone 2A. It is anticipated that the jurisdiction of this segment of US 97 will be transferred to the City of Redmond following the construction of the Reroute. This area maintains a lesser access spacing requirement than Zone 2A, but, as a major arterial[6], still demands a significant degree of protection. Assuming the current 45 mph speed zone is extended to cover this entire area, the City's adopted access management spacing guidelines from Table 15-2 in the City of Redmond Transportation System Plan (January 2000) require a separation of at least 800 feet between adjacent driveways and/or streets on the same side of the roadway and ½ mile between adjacent intersections.

Recommendation: Within Zone 3, a distance of at least 800 feet should be maintained between adjacent driveways and/or streets on the same side of the roadway. A minimum distance of ½ mile should be maintained between adjacent intersections.

Zone 4: Zone 4 includes the remainder of Canal Boulevard north of the new interchange that is outside of Zone 2B. With the exception of a small 200-foot segment at the southern end, which is City-owned, this section of Canal Boulevard is under the jurisdiction of Deschutes County, who does not maintain any access management spacing standards. However, since the land surrounding this roadway is included within the urban reserve area, it is recommended that the County adopt the current City of Redmond access management guidelines for major collector streets, requiring a minimum of 165 feet between driveways and/or streets and 330 feet between intersections. Implementing these guidelines will provide further protection for the interchange area and will ensure access spacing has been planned in accordance with City requirements prior to the roadway's future incorporation into the City.

Recommendation: Within Zone 4, it is recommended that the City continue to implement their adopted access management guidelines for major collector streets, requiring a minimum of 165 feet between driveways and/or streets and 330 feet between intersections. It is further recommended that the County adopt the same access management spacing guidelines for implementation on Canal Boulevard within this zone.

Zone 5: This zone includes US 97 to the north of the new interchange. While this section will continue to maintain the current alignment, the inclusion of the interchange will have a significant impact on access management needs. As a rural, Statewide Freight Route on the National Highway System and expressway with a posted speed of 55 mph, Table 2 from OAR 734-051 requires a separation of at least 5,280 feet (1-mile) between adjacent approaches on the same side of the highway. However, the construction of the new interchange will result in the application of spacing standards for interchange areas, which are more restrictive. According to Table 8 in OAR 734-051, these new spacing standards would require a minimum distance of 2 miles between the start of the ramp tapers and the nearest at-grade intersection (extending well beyond the IAMP area to nearly Davidson Way).

Recommendation: Within Zone 5, no direct access to the highway should be permitted. From Spruce Avenue north to O'Neil Highway, the City of Redmond and Deschutes County TSPs should be amended to show a frontage/backage road on both sides of US 97. At the time of development of redevelopment of properties adjacent to the highway, the City of Redmond and Deschutes County should require that a frontage/backage road be incorporated into the design of the development and should not allow any direct access to US 97. Where property adjacent to US 97 has access to a local street, through the application of

[6] As shown in the City of Redmond Urban Area Transportation Plan map (January 13, 2005).

local development regulations and OAR 734-051, the City, County, and State should require all new development to take access to the local street and not permit direct access to the highway.

Zone 6: Zone 6 includes the US 97 Reroute south of the new interchange. This zone is similar to Zone 5 in that the spacing standards for interchange areas from Table 8 in OAR 734-051 will apply, with the difference being that this area is entirely within the urban growth boundary. Therefore, the spacing standard from this table will require a minimum distance of 1 mile between the start of the ramp tapers and the nearest at-grade intersection (nearly reaching Hemlock Avenue). However, in the design of the US 97 Reroute, a right-in/right-out approach at Larch Avenue for southbound traffic has been included within this 1-mile envelope. To accommodate this element into the design, ODOT needs to approve a deviation to the access management spacing standards in Table 8 of OAR 734-051 prior to construction.

Recommendation: Within Zone 6, ODOT needs to approve a deviation to the access management spacing standards in Table 8 of OAR 734-051 for the US 97 right-in/right-out at Larch Avenue prior to construction.

Beyond the area bounded by the IAMP, it should also be acknowledged that ODOT maintains spacing standards for the separation of interchanges as well. For rural areas, these standards require 3 miles of separation between adjacent interchanges. For urban areas, a shorter distance of 1.9 miles is required. Therefore, with the proposed interchange in place, the construction of adjacent interchanges on US 97 would be restricted within an envelope ranging from approximately 11th Street in Terrebonne to the north and Highland Avenue to the south.

By looking at the number of access points per zone, the deficiency analysis (Chapter 3) an be refined to account for the future roadway system. Figure 4.12 displays the locations of existing access points along US 97 and the future crossroads over the new interchange and Table 4.F compares the number of existing access points in each access management zone to the number of access points that would be allowed to remain under the spacing standards applied in the description of each zone.

From Table 4.F, it can be seen that there are a significant number of access points that will require closure if compliance with spacing standards is to be attained. Options to explore for moving in the direction of the applicable access management spacing standards that should be considered during the development of preliminary improvement alternatives should include:

- The construction of new local roads to provide alternate access;
- The establishment of shared access points by creating easements; and
- The purchase of access rights for long-range protection.

Table 4.F: Access Deficiencies by Zone*

Access Management Zone	Existing Number of Access Points	Allowed Number of Access Points
1	7	0
2A	10	0
2B	10	1
3	41	10
4	15	30
5	22	0
6	N/A	0

* Includes existing access points only.

Figure 4.11: Access Management Zones

Figure 4.12: Existing Access Points

Signal Spacing

ODOT's desired traffic signal spacing is ½-mile. While there are no traffic signals in the study area under existing conditions, there are several signals on US 97 planned for in the City of Redmond CIP that could be constructed in the future. These include signals at the intersections with Quince Avenue, a new public street to be constructed with the Wal-Mart development, Maple Avenue, and Kingwood Avenue. In addition, while it is currently unknown whether signals will be constructed at the interchange ramp terminals, it should be assumed that at some point in the future they will be needed there so as not to preclude their ability to function properly by locating another signal in close proximity.

On the City street system, another traffic signal is planned for in the City CIP at the intersection on Maple Avenue with 19th Street. In addition, while not currently planned for, the operations analysis of future conditions found that a traffic signal may be needed at the intersection on Maple Avenue at 9th Street as well.

It should be noted that signals spaced at least ½-mile (2,640 feet) apart generally do not impact each other and can operate without need for coordination. When closer than ½-mile, coordination of adjacent signals is typically recommended, especially on the state system, but the ability of the signals to operate well together is usually very good if spacing of at least ¼-mile (1,320 feet) is maintained. Under ¼-mile, coordination of adjacent signals is strongly recommended, with the ability of these signals to function without impacting each other degrading as spacing decreases.

Figure 4.13 illustrates the study area and identifies the locations of these potential future signals. As shown, with the exception of the signals at the interchange ramp terminals, the signals on US 97 would maintain spacing of at least 1,000 feet, with most signals being close to ¼-mile apart. On Maple Avenue, the signal at 9th Street would be approximately 1,000 feet from the signal on US 97. Therefore, the future signals on US 97 will all require coordination and the signal on Maple Avenue at 9th Street should be coordinated with the signal on Maple Avenue at US 97. Given the resulting signal spacing on US 97 from these planned signals, it is recommended that no additional signals be constructed south of the interchange on US 97 in the IAMP area.

Recommendation: Within the study area, with the exception of US 97 at the interchange ramp terminals, Quince Avenue, the proposed street to be constructed by Wal-Mart, Maple Avenue, and Kingwood Avenue, no additional signals should be approved on US 97 south of the interchange.

Figure 4.13: Potential Locations of Future Traffic Signals in IAMP Area

Local Connectivity

When planning for future streets to enhance local connectivity in the IAMP area, consideration should be given to the following deficiencies.

- **Improving East-West Connectivity**: Within the IAMP study area, there are several north-south routes of significant length, but very few east-west routes due to a limited number of crossings at US 97, the canal, the railroad, and Dry Canyon (see Figure 3.3). This could result in increased demand at the available crossings, putting pressure on areas like Maple Avenue, O'Neil Highway/Pershall Way, and specifically at the intersections on US 97 at Maple Avenue, Quince Avenue, the northbound and southbound interchange ramp terminals, and O'Neil Highway/Pershall Way.
- **Providing Access to Lands Surrounding the US 97 Interchange**: The land surrounding the proposed interchange is predominantly vacant or underdeveloped (see Figure 3.1 and Figure 4.11). It should be anticipated that these lands would develop at urban densities with types of developments consistent with the commercial zoning. To ensure adequate access can be provided to these developments while maintaining the desired access management spacing standards on US 97 and the interchange crossroad, a local street plan should be adopted that will provide access to lands surrounding the interchange with connections to the interchange crossroad (US 97 and Canal Boulevard) located 1,320 feet from the interchange ramp terminals. This would result in all access provided through a future signal at Quince Avenue to the south and a new public street intersection on Canal Boulevard near the current urban growth boundary to the north. This plan should also include a new alignment of King Way to the north to improve the substandard spacing currently planned.
- **Reducing Access Points to US 97 to the North of the Interchange**: Much of the land to the north of the proposed interchange is currently outside of the urban growth boundary, with no public street intersections on US 97 prior to the intersection at O'Neil Highway/Pershall Way (see Figure 4.11). While some properties abutting US 97 can be accessed via 10th Street, Pershall Way, O'Neil Highway, or Canal Boulevard, there are several that can be accessed only from US 97. In recognition of the access management spacing standards and proximity to the new interchange that would prohibit direct access to US 97 in this area, a system of frontage roads or other local streets should be planned for to serve this area without creating access points to US 97 between the interchange and the intersection at Pershall Way/O'Neil Highway.

Freight Mobility

As noted in Chapter 3, the current land use zoning in the IAMP area includes commercial zoning down the middle surrounding US 97 and Canal Boulevard, with residential zoning of various densities to the east and west. While only a small amount of industrial land is located within the IAMP area, there is a significant amount to the southeast, including much of the lands within the City to the east of the railroad tracks.

There is a significant amount of truck traffic on US 97 moving freight through and within the City. While the US 97 Reroute should remove the through truck trips from the local system, other trips associated with origins or destinations within the City will remain. Considering the zoning surrounding this area, most local truck trips are anticipated to be traveling to and from the commercial and industrial developments along the highway and to the east of the US 97 Reroute. Therefore, the routes most heavily relied upon for freight movement in the IAMP area would include US 97, Canal Boulevard, Negus Way, NE 9th Street, and Quince Avenue within the commercially zoned area.

Of these routes, US 97 and NE 9th Street are currently constructed to accommodate truck traffic. The future projects to construct the US 97/US 97 Reroute interchange, the extensions of Quince Avenue and Negus Way, and the reconstruction of Canal Boulevard will need to consider freight movement requirements during the design process and should comply with the Highway Design Manual[7] for State facilities and the City of Redmond Standards and Specifications[8] for City streets. In addition, the design of future local streets planned to serve lands surrounding US 97 and the new interchange for the purpose of consolidating access (see "Local Connectivity" discussion above) should accommodate freight needs and should also be designed in accordance with the City's standards and specifications.

Bicycle and Pedestrian Facilities

While some bicycle and pedestrian facilities exist on the IAMP area streets, most of the arterial and collector routes studied maintain only partial improvements with many gaps needing to be filled (see Figure 4.14). The City of Redmond Transportation CIP contains several projects including bike lane construction, sidewalk construction, and complete street modernization/reconstruction that when completed will provide continuous bicycle and pedestrian facilities throughout most of the area's arterials and collectors, with some small gaps remaining to be filled by land development. The approximate locations of these planned projects are illustrated in Figure 4.14.

Multi-modal Constraints

The major modes of transportation existing within the IAMP area include motor vehicles (passenger cars and trucks), freight trains, bicycles, and pedestrians. With the construction of planned improvements listed in the City's Transportation CIP, the area street network will provide for adequate facilities for motor vehicle, bicycle, and pedestrian travel. As noted previously, the ability to facilitate these modes in the east-west direction is somewhat limited by the presence of Dry Canyon, US 97, the canal, and the Burlington Northern Santa Fe (BNSF) railway. These features may also have a significant impact on the development of future local street networks and frontage roads.

Potential Mode Conflicts

With the completion of the planned improvement projects in the City's Transportation CIP, most of the arterial and collector streets within the IAMP area will maintain separate bicycle lanes and sidewalks to minimize motor vehicle, bicycle, and pedestrian conflicts.
No new conflicts are anticipated to occur between rail movement along the BNSF railway and other transportation modes following the US 97 Reroute and interchange construction, as no new at-grade crossings are proposed and one existing at-grade crossing will be replaced by a grade-separated crossing. As future local streets are planned to enhance connectivity, the creation of additional at-grade crossings should be avoided.

Potential Right of Way Constraints

While much vacant or underdeveloped land remains in the IAMP area, there are a number of potential constraints to the purchase of additional right of way for future roadway alignments. In addition to existing developments, other features impacting potential roadway alignments include Dry Creek, the BNSF railway, the canal, lands zoned for park use, and lands zoned for exclusive farm use outside of the urban growth boundary.

[7] *Highway Design Manual*, Oregon Department of Transportation, 2003
[8] *Standards and Specifications*, City of Redmond Public Works Department, April 2003.

Figure 4.14: Existing Bicycle and Sidewalk Conditions & Redmond CIP Projects