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Memorandum

September 2, 2022 Project# 27358

To: Sandra Hikari Project Manager
Oregon Department of Transportation (ODOT)
123 NW Flanders St. Portland, OR 97209

From: Nicholas Gross, Alice Root, Ashleigh Ludwig PE, AICP, Hermanus Steyn, PE

CC: Scott Hoelscher

RE: US 26 Rhododendron Design Refinement Plan

TECHNICAL MEMORANDUM #4: SAFETY, OPERATIONS, AND ACTIVE TRANSPORTATION ANALYSIS

Purpose

The purpose of the memorandum is to establish a baseline understanding of the US 26 Rhododendron Design Refinement Plan (Refinement Plan) study area's existing safety, operational, and active transportation conditions. The following scenarios will be analyzed in this memorandum to identify needs to guide the alternatives analysis:

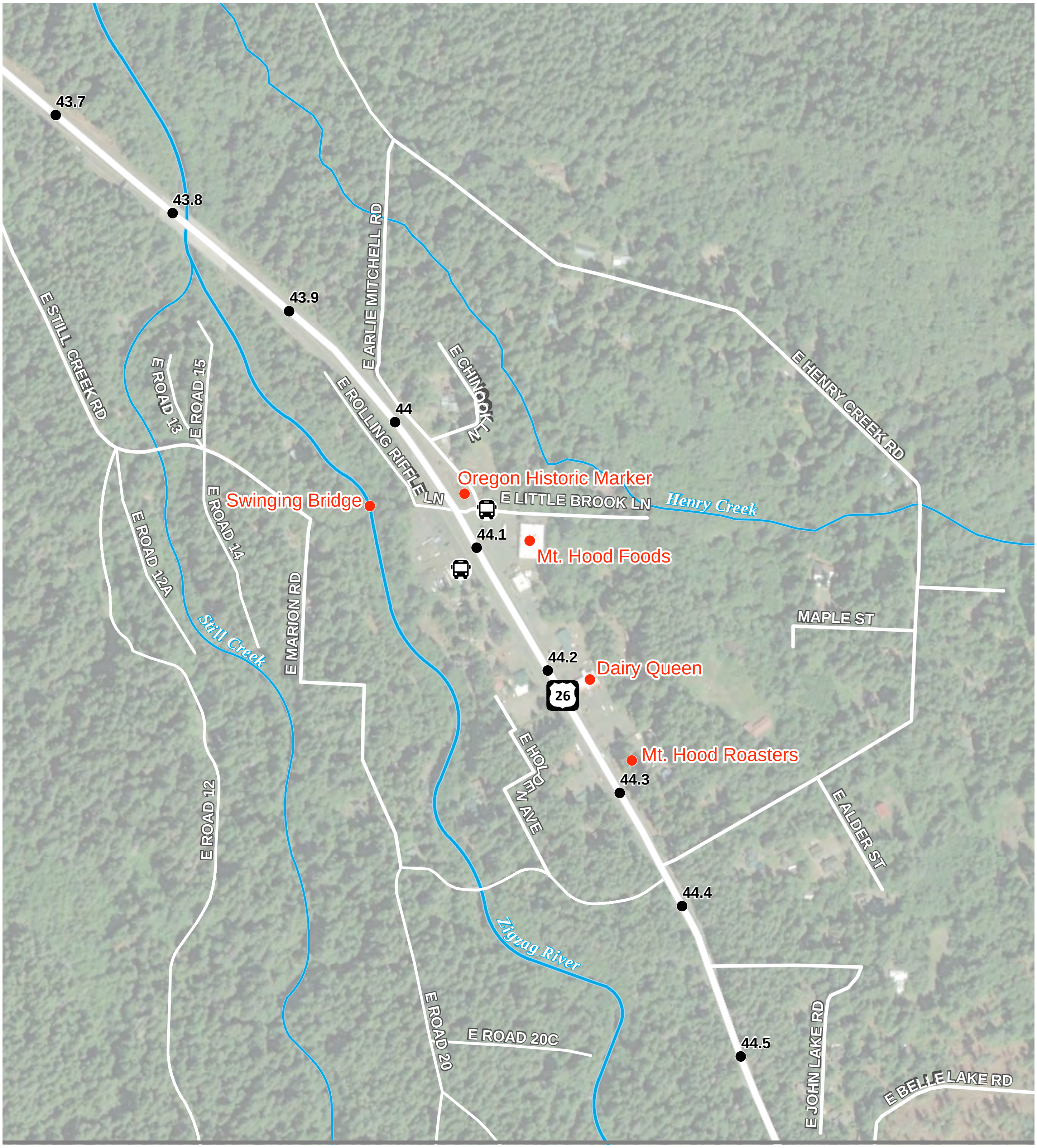
- Existing Conditions (2022)
- Opening Year (2030), No Build
- Future Year (2050), No Build

The Methodology Memorandum, provided in Appendix A, summarizes analysis procedures and assumptions used in this memorandum.

Study Area Characteristics

The Refinement Plan study area is located along US 26 between Mile Point [MP] 44.0 (E Little Brook Lane) and MP 44.4 (E Henry Creek Road) in Rhododendron, Oregon. The study area is located within Rhododendron's core rural commercial zone buffered by rural residential zoning on either side. US 26 is classified as an Oregon Highway Plan (OHP) Statewide Highway, providing critical statewide and regional connectivity, and has a federal functional classification of Rural Principal Arterial.

Within Rhododendron, the highway also serves local access to businesses and residents, many with undefined open accesses along the highway. The highway is designated as an OHP Freight Route and a Reduction Review Route, which requires Oregon Transportation Commission (OTC) review and approval for any changes that reduce the "vehicle-carrying capacity" of the highway per Oregon Revised Statues (ORS) 366.215. Figure 1 illustrates the Refinement Plan study area.



Mile Points

Study Corridor

Landmarks

Transit Stop

0 540 Feet

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Figure 1

Project Study Area
Rhododendron, Oregon

Table 1 summarizes the roadway characteristics of US 26 within the study area. As summarized in Table 1, US 26 is a five-lane roadway consisting of four 12-foot vehicle lanes (two lanes in each direction) and a 14-foot-wide center two-way left turn lane (TWLTL). The five-lane roadway transitions to a two-lane roadway just east of the study area (near MP 44.4).

The posted speed limit is 40 miles per hour (mph) within the study area. Approaching from the west, the speed limit decreases from 50 mph to 40 mph at MP 43.9 and increases from 40 mph to 55 mph at MP 44.4. There are no sidewalks or designated bicycle facilities on US 26 within the study area. The Barlow Trail Oregon Historic Marker, the Swinging Pedestrian Bridge, Mt. Hood Foods, and the Mt. Hood Express transit stops are located on the west end of the study area where the rural commercial zone meets the residential zone. Several additional destinations including restaurants and lodging are located in the study area.

Table 1. US 26 Roadway Characteristics

Roadway	Federal Functional Classification	Number of Lanes	Posted Speed	Lane Width	Shoulder Width (ft)	Bicycle Facility**/ Sidewalk
US 26 (E Little Brook Ln to E Henry Creek Rd)	Rural Principal Arterial	5	40 MPH	12 ft travel lanes, 14 ft TWLTL*	6 ft	None

*TWLTL = Two-Way Left Turn Lane **Bicycles are currently using the 6-foot shoulder.

Traffic Volumes

Segment Traffic Volumes

The project team collected 24-hour tube counts at two locations in Rhododendron: approximately 350 feet west of East Little Brook Lane and approximately 150 feet west of East Henry Creek Road. Counts were collected over a seven-day period between Friday, May 13, 2022, and Thursday, May 19, 2022. The tube count data includes vehicle classification, traffic volume, and vehicle speed. The project team reviewed these counts to understand volume profiles and identify peak days and peak hours. The project team selected two locations to understand if speed differed on each end of the community, but the volume and speeds measured at each location were similar, as discussed below.

Figure 2 and Figure 3 illustrate the hourly traffic volumes for each day of the week on the west and east ends of Rhododendron, respectively. The project team's goal was to evaluate typical weekday conditions and peak conditions. As shown in the figures, the highest traffic volumes occurred on Sunday. For this reason, the project team selected Sunday to represent peak traffic conditions. The US 26 peak hour on Sunday occurred between 3:00 and 4:00 PM. To represent typical weekday peaks, the team considered data from Tuesday to Thursday, excluding Friday, which also showed peaking characteristics associated with recreational traffic, similar to Sunday.

Figure 4 and Figure 5 illustrate the average hourly traffic volumes for the typical midweek day (Tuesday through Thursday) and Sunday on the west and east sides of Rhododendron, respectively. The peak hour between Tuesday and Thursday occurred between 1:45 and 2:45 PM on Thursday. The project team found the 30th highest volume from tube counts occurred on Monday from 2-3pm, when the volume was 638 vehicles. Thursdays peak hour (2-3 pm) volume was 684, and Sunday's peak hour (3-4 pm) volume was 1439. Based on these results, the project team found Thursday to be the most representative day of the week for mid-weekday peak hour volumes.

Figure 2. US 26 Hourly Traffic Volumes by Day of Week (West Side of Rhododendron)

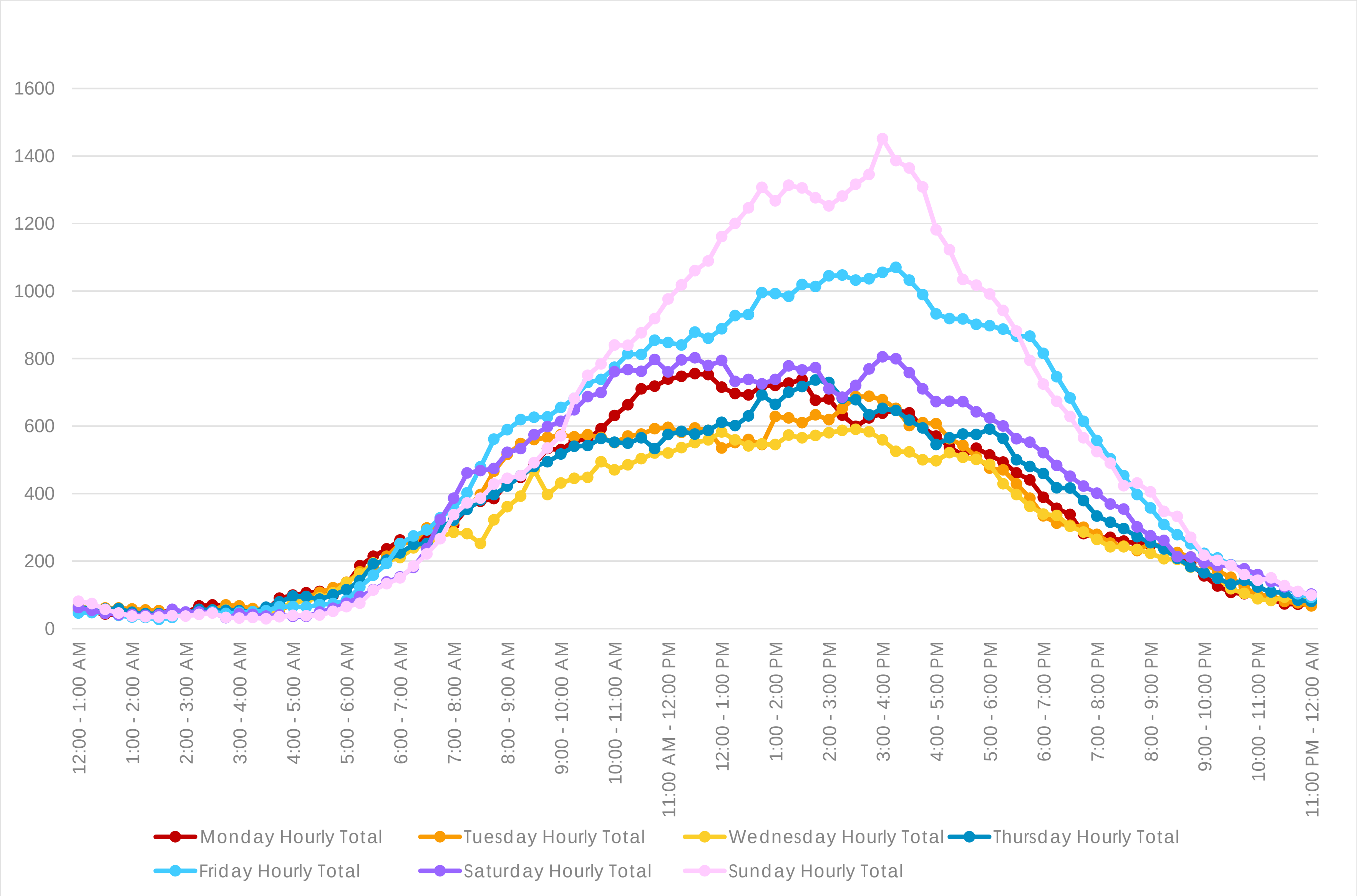


Figure 3. US 26 Hourly Traffic Volumes by Day of Week (East Side of Rhododendron)

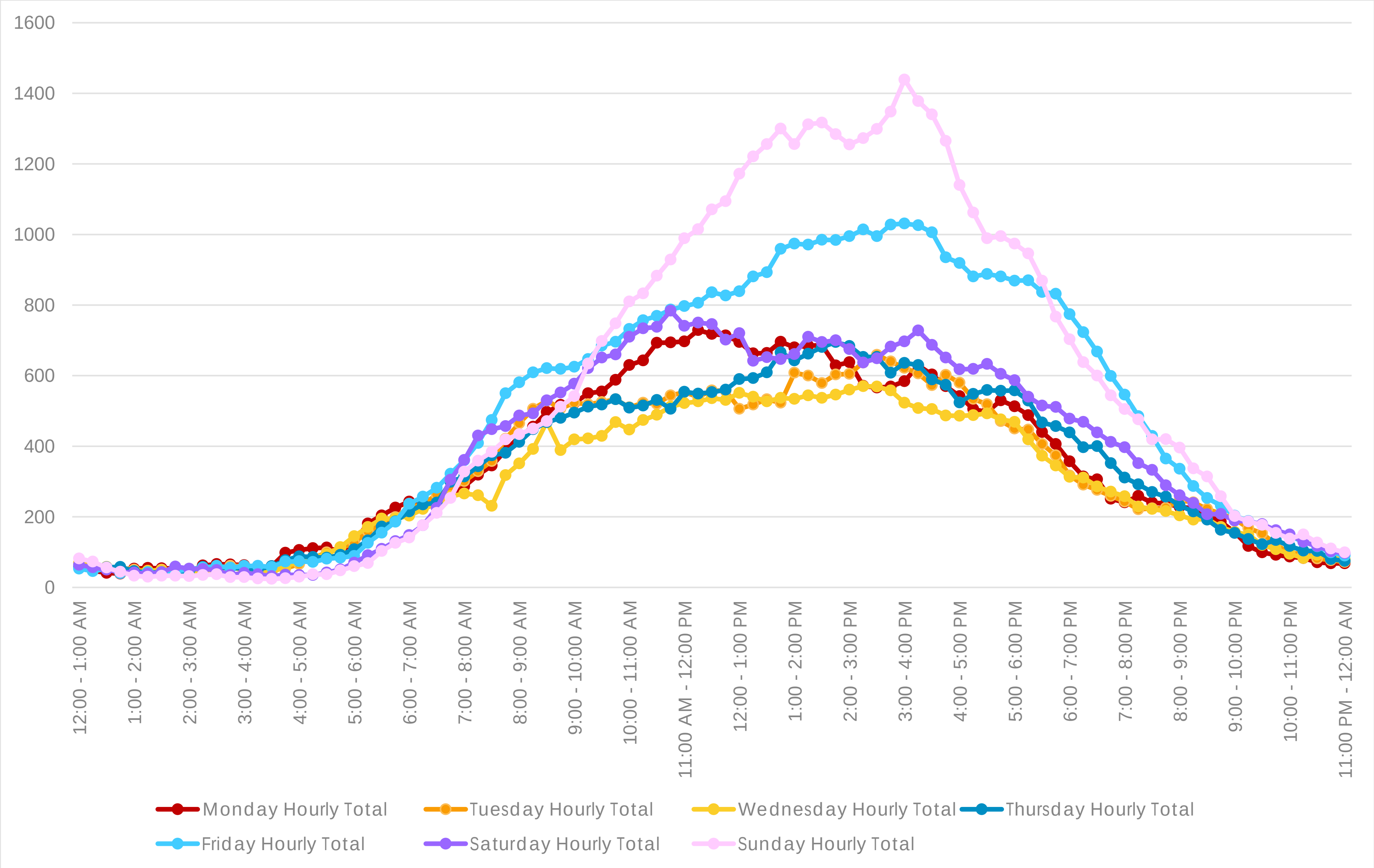


Figure 4. Weekday and Sunday Hourly Traffic Volumes (West Side of Rhododendron)

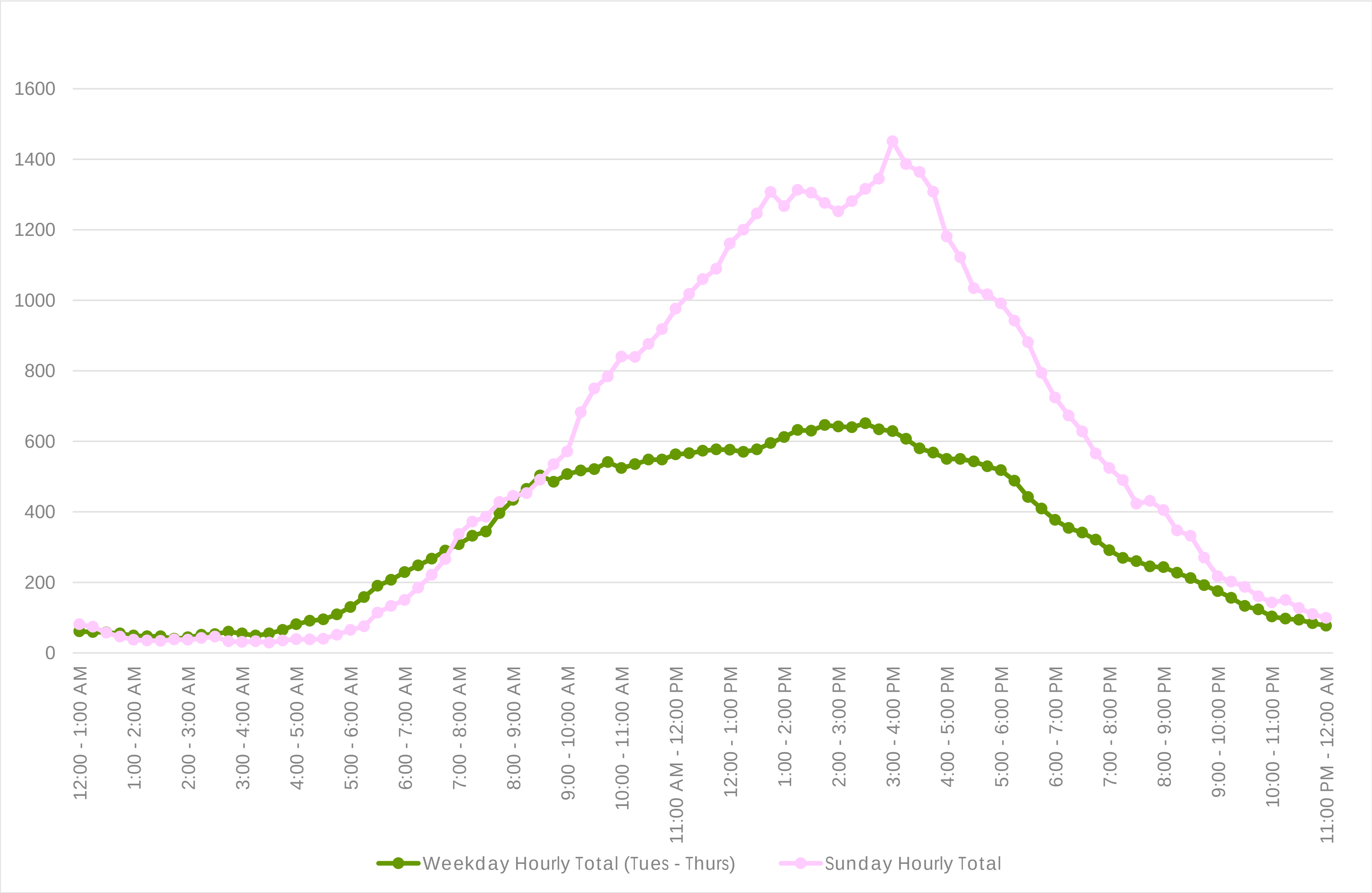
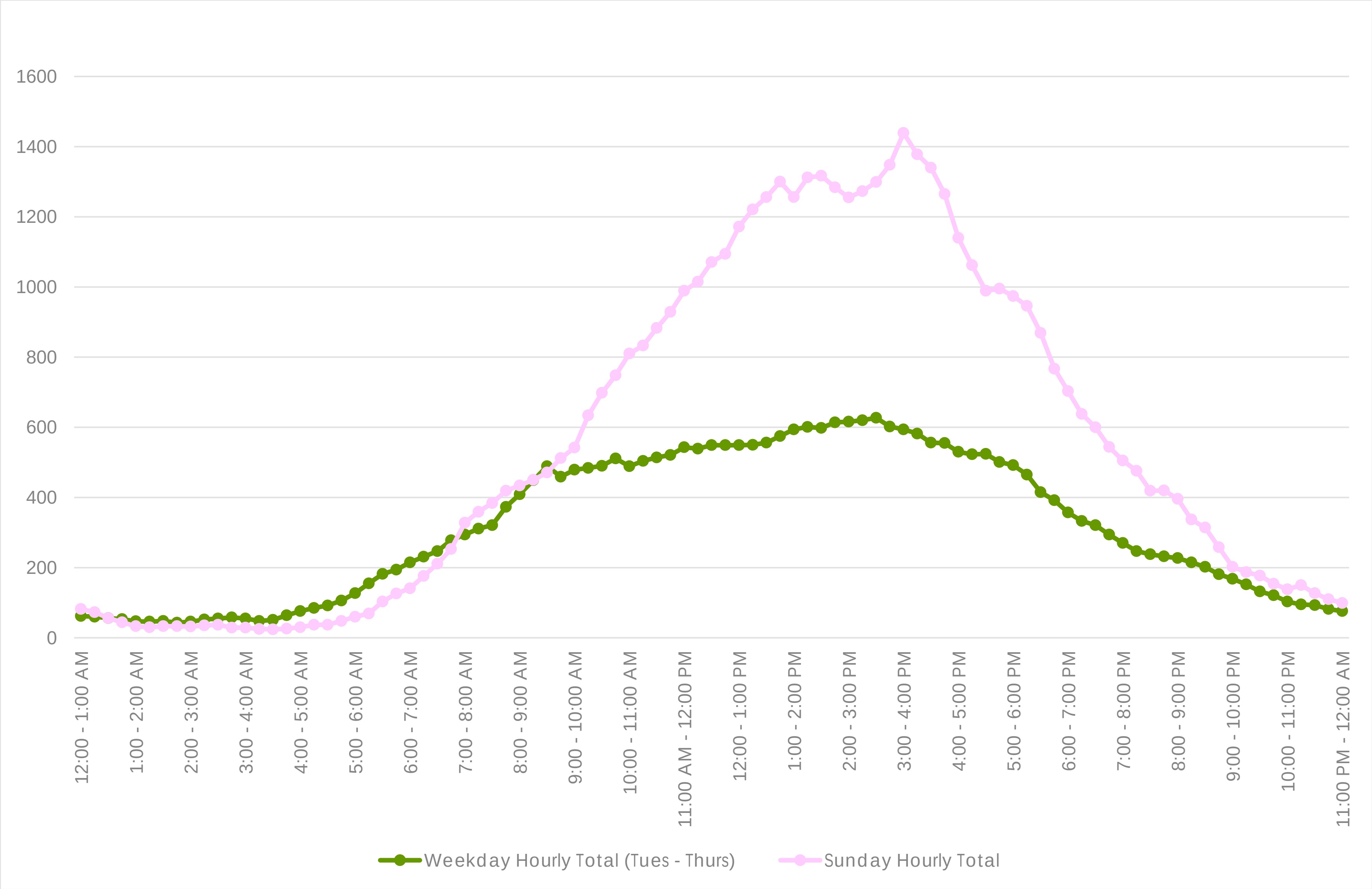


Figure 5. Weekday and Sunday Hourly Traffic Volumes (East Side of Rhododendron)



Heavy Vehicle Percentages

The project team obtained vehicle classification data from the tube counts; these data are summarized in Table 2. As shown in the table, the percentage of vehicles with more than two axles was approximately nine percent during the entire seven-day study period. Tube count volumes showed heavy vehicle percentages 20 to 30 percent higher during the early morning hours between 1:00 am and 5:00 am than the rest of the day; there were no significant differences in heavy vehicle percentages during weekend (Friday through Sunday) or midweek (Tuesday through Thursday) data. Vehicle classification data is provided in Appendix B.

Table 2. Vehicle Classification Summary (Shown in Percentages)

Location	Time Period	Motorcycles	Cars & Trailer	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Double	5 Axle Double	>6 Axle Double	<6 Axle Multi	6 Axle Multi	>6 Axle Multi	Not Classified	Total Over 2 Axles
Vehicle Classification		1	2	3	4	5	6	7	8	9	10	11	12	13	-	-
West End	Total 7-day	0.60	56.50	20.00	1.70	10.10	0.50	0.10	3.80	2.50	0.80	0.30	0.20	0.90	1.90	9.10
	Thursday Peak Hour	0.95	52.85	22.28	2.72	9.92	0.95	0.14	4.35	1.09	0.41	0.14	0.00	0.54	3.67	7.61
	Sunday Peak Hour	0.90	62.10	18.33	0.41	10.75	0.07	0.14	4.62	0.62	0.28	0.34	0.34	0.14	0.96	6.55
East End	Total 7-day*	0.60	46.20	19.20	2.00	12.60	0.30	0.00	5.10	1.40	0.40	0.70	0.10	0.70	10.70*	8.70*
	Thursday Peak Hour	0.29	51.51	23.31	2.5	11.94	1.44	0.14	4.60	1.29	0.43	0.14	0.00	0.58	1.73	8.63
	Sunday Peak Hour*	0.35	40.38	15.71	0.28	9.87	0.21	0.14	5.00	0.21	0.21	0.07	0.14	0.14	27.31*	6.12*

Source: Federal Highway Administration

*Tubes on the east end were temporarily unable to collect vehicle classification data in the eastbound direction from 10:30 am to 8:45 pm on Sunday. Therefore, classification data from the west end of town will be used to inform heavy vehicle percentages during the Sunday study period and for the overall 7-day time period. Totals for these rows do not sum to 100 percent.

Vehicle Speeds

The project team collected vehicle speed data as part of the tube count data on the ends of Rhododendron near the transitions to adjacent highway segments with higher posted speed limits. Table 3 summarizes the collected 85th and 50th percentile vehicle speeds on both ends of Rhododendron near the transitions. The 85th percentile speeds on both ends of Rhododendron is 58 mph: 18 mph greater than the posted speed limit of 40 mph. The 50th percentile speeds for the west and east end are 49 mph and 50 mph respectively: nine to ten mph greater than the posted speed limit. In general, vehicles entering the community were traveling one to two mph greater than those exiting town. Vehicle speed data is provided in Appendix C.

Table 3. Vehicle Speed Summary

Percentile Speed	West/East End of Town	Vehicle Speed	Entering/Exiting	Vehicle Speed
85th Percentile	West End	58 mph	Entering	59 mph
			Exiting	57 mph
	East End	58 mph	Entering	59 mph
			Exiting	57 mph
50th Percentile	West End	49 mph	Entering	48 mph
			Exiting	49 mph
	East End	50 mph	Entering	50 mph
			Exiting	46 mph

Intersection Turning Movement Volumes

Development of Existing Volumes (2022)

The Methodology Memorandum in Appendix A documents the methodology and key assumptions used in the existing and future conditions analyses. This memorandum relies on the foundation that was established in the Methodology Memorandum.

The project team collected turning movement counts (TMCs) at the study intersections on Thursday, May 12, 2022, from 2:00 – 4:00 PM[1] as well as Sunday, May 15, 2022, from 1:00 – 3:00 PM. Traffic volume from Thursday reflects typical weekday conditions, and the traffic volume from Sunday reflects peak weekend volume conditions. There were no morning TMCs collected due to relatively low volumes during that time period. The peak hour factors (PHF) for the study area intersections ranged between 0.85 to 0.89 for the weekday peak period and 0.85 to 0.91 for the weekend peak period.

[1] Although the tube counts showed a peak hour on US 26 mainline traffic from 1:45 to 2:45 PM on Thursday, the difference in traffic volumes on US 26 between 1:45 – 2:45 PM and 2:00 – 3:00 PM was less than one percent on the west end of town. Therefore, it was determined that the difference in traffic volumes was negligible and that the Thursday turning movement counts captured the peak hour for that day.

The project team completed the following adjustments to obtain analyses volumes for Existing Conditions:

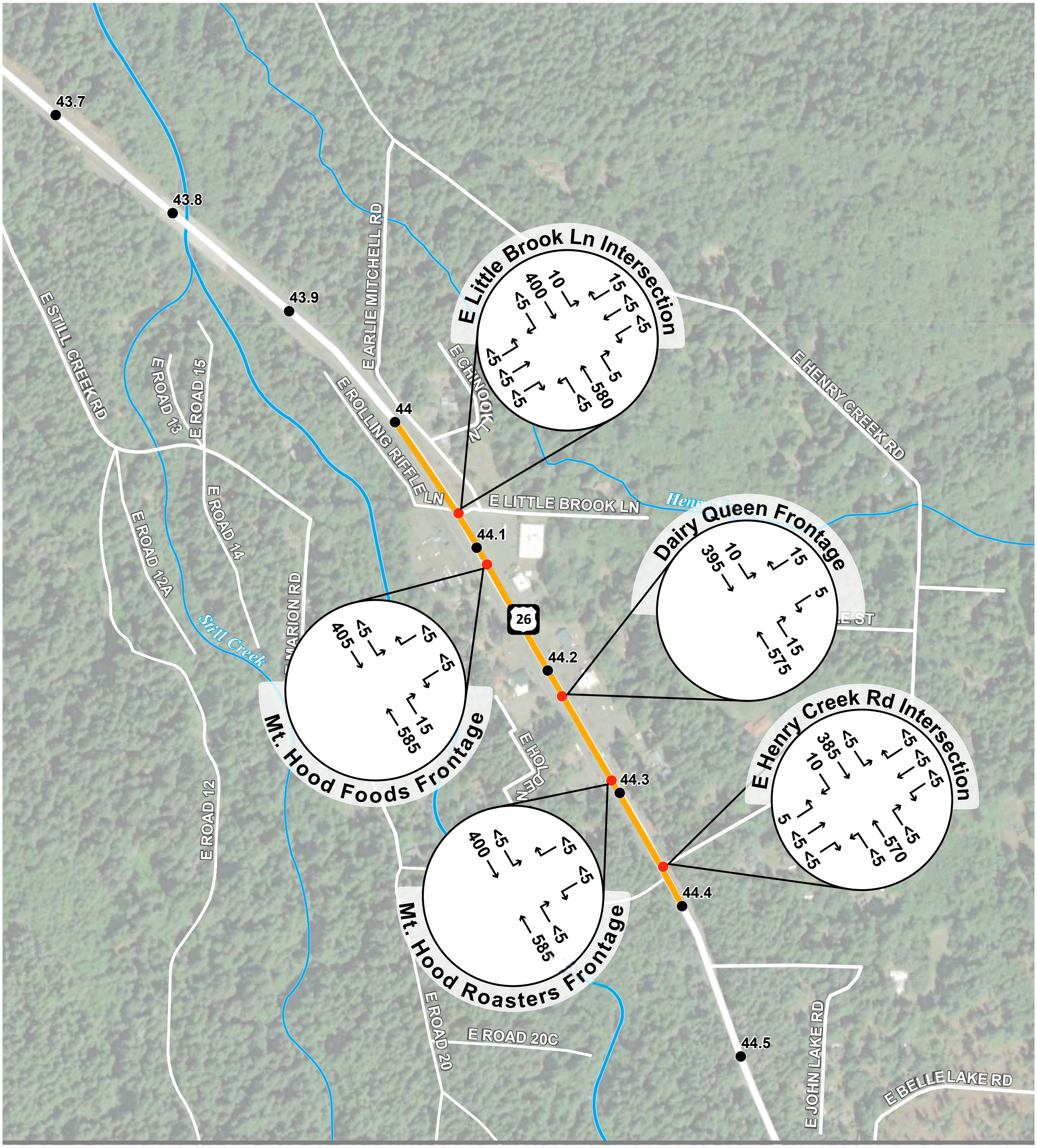
- Using the On-Site ATR method, a calculated seasonal adjustment factor of 1.42 was used to adjust the traffic volumes from the count month of May to the peak month of July.
  The project team increased Sunday traffic volumes by 10 percent, because the tube counts show traffic volumes to be approximately 10 percent higher between 3:00 and 4:00 PM on Sunday, compared to the peak hour of the TMCs (2:00 – 3:00 PM), which were only conducted between 1:00 and 3:00 PM on Sunday.

Figure 6 and Figure 7 summarize the existing, seasonally adjusted, weekday and weekend peak hour TMCs at the study intersections.

Traffic data is provided as part of the Methodology Memorandum in Appendix A.

Opening Year (2030) and Future Year (2050) No-Build Volumes

The project team used the historical trends method to develop future year no-build volumes, as documented in the Methodology Memorandum in Appendix A. The project team applied an annual simple growth rate of 1.82 percent to existing volumes to develop the opening year 2030 and future year 2050 no-build volumes. Figure 8, Figure 9, Figure 10, and Figure 11summarize the opening year 2030 and future year 2050 no-build weekday and weekend volumes that were used in the analysis.



- Mile Points
- Study Corridor
- Study Area Intersections

0 540 Feet

Figure 6

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Existing (2022) Weekday (Thursday) PM Traffic Volumes Rhododendron, Oregon

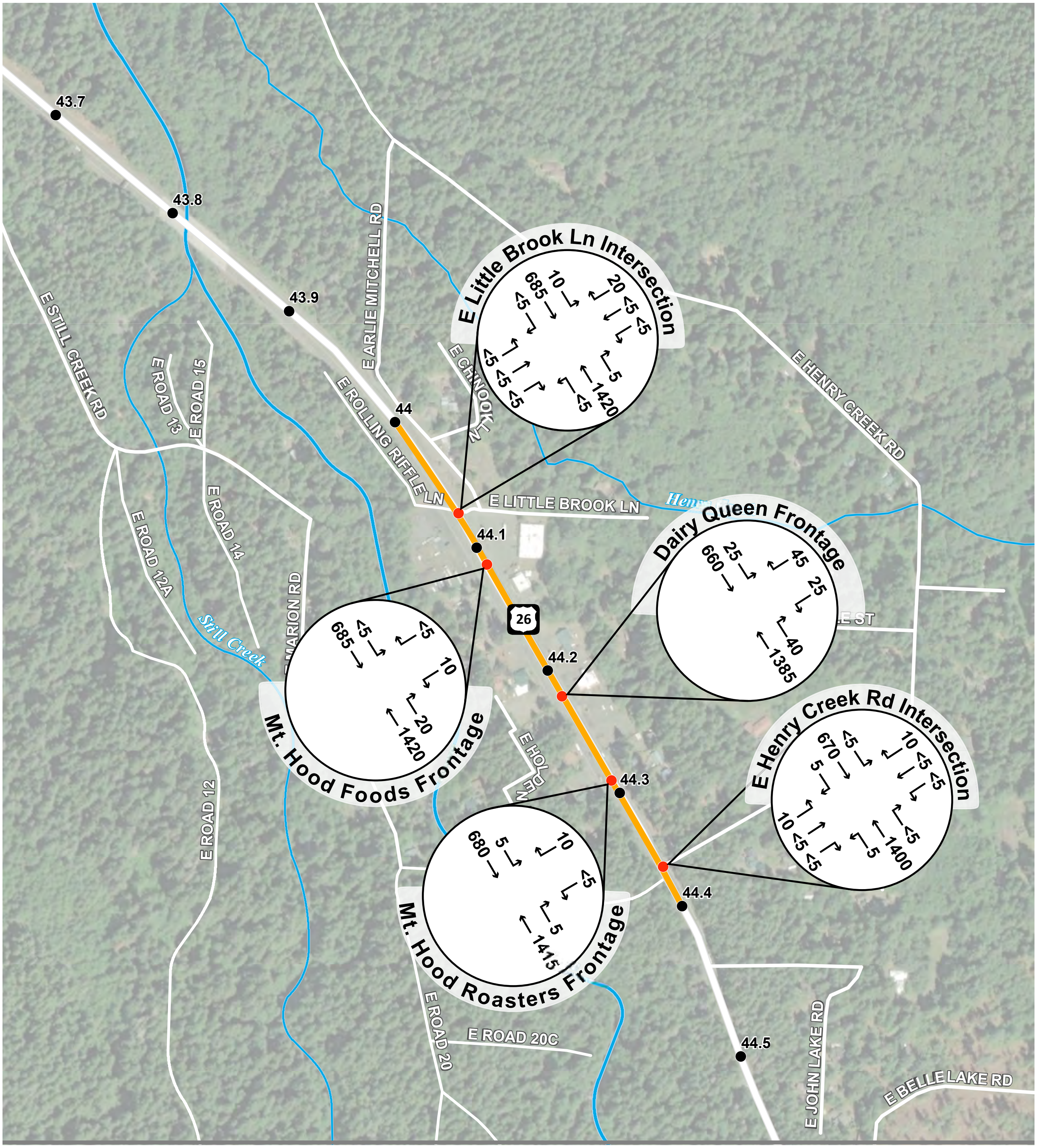

Figure 7

Existing (2022) Weekend (Sunday) Afternoon Traffic Volumes Rhododendron, Oregon

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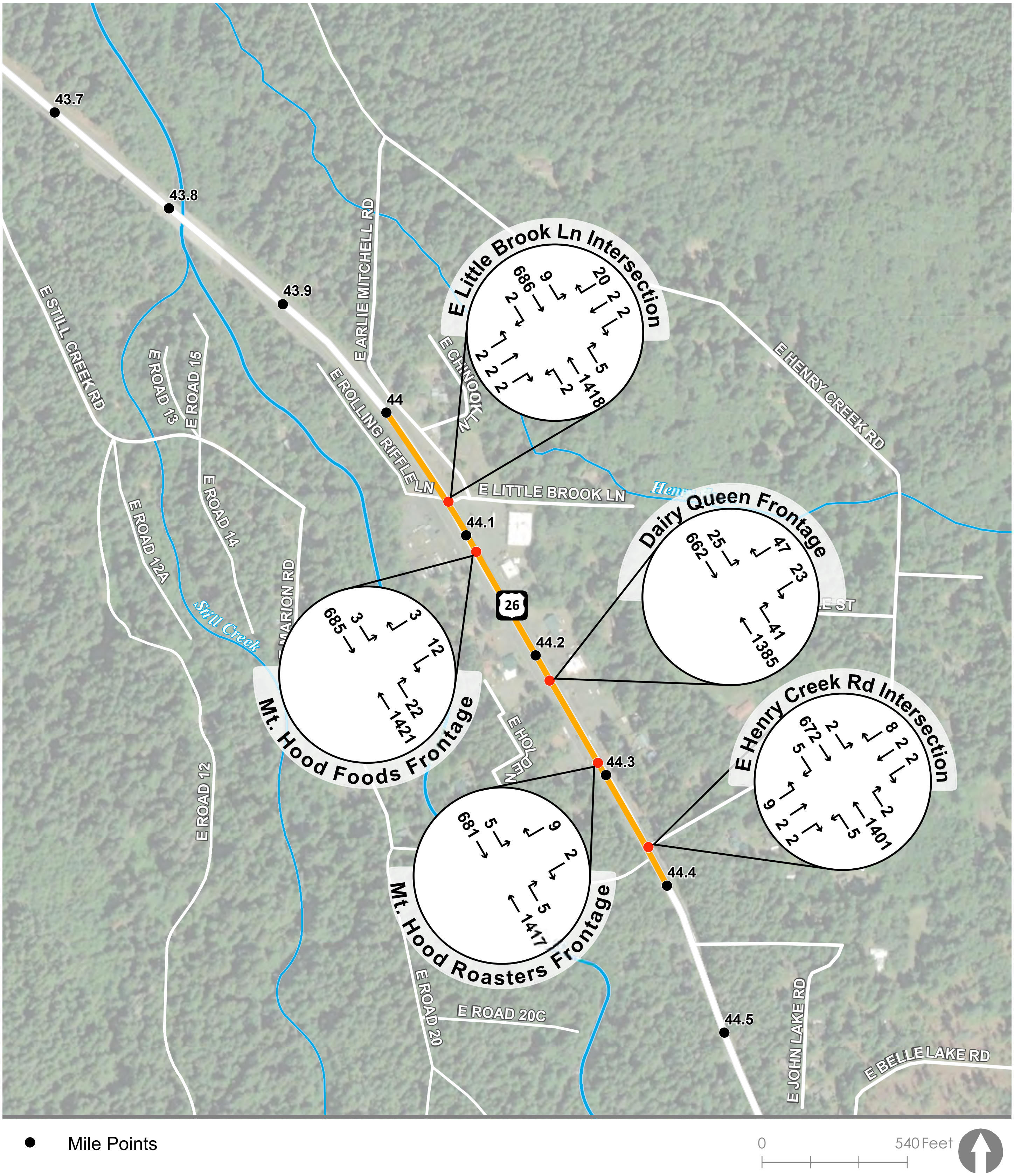

Figure 7

Existing (2022) Weekend (Sunday) Afternoon Traffic Volumes
Rhododendron, Oregon

KITTELSON & ASSOCIATES

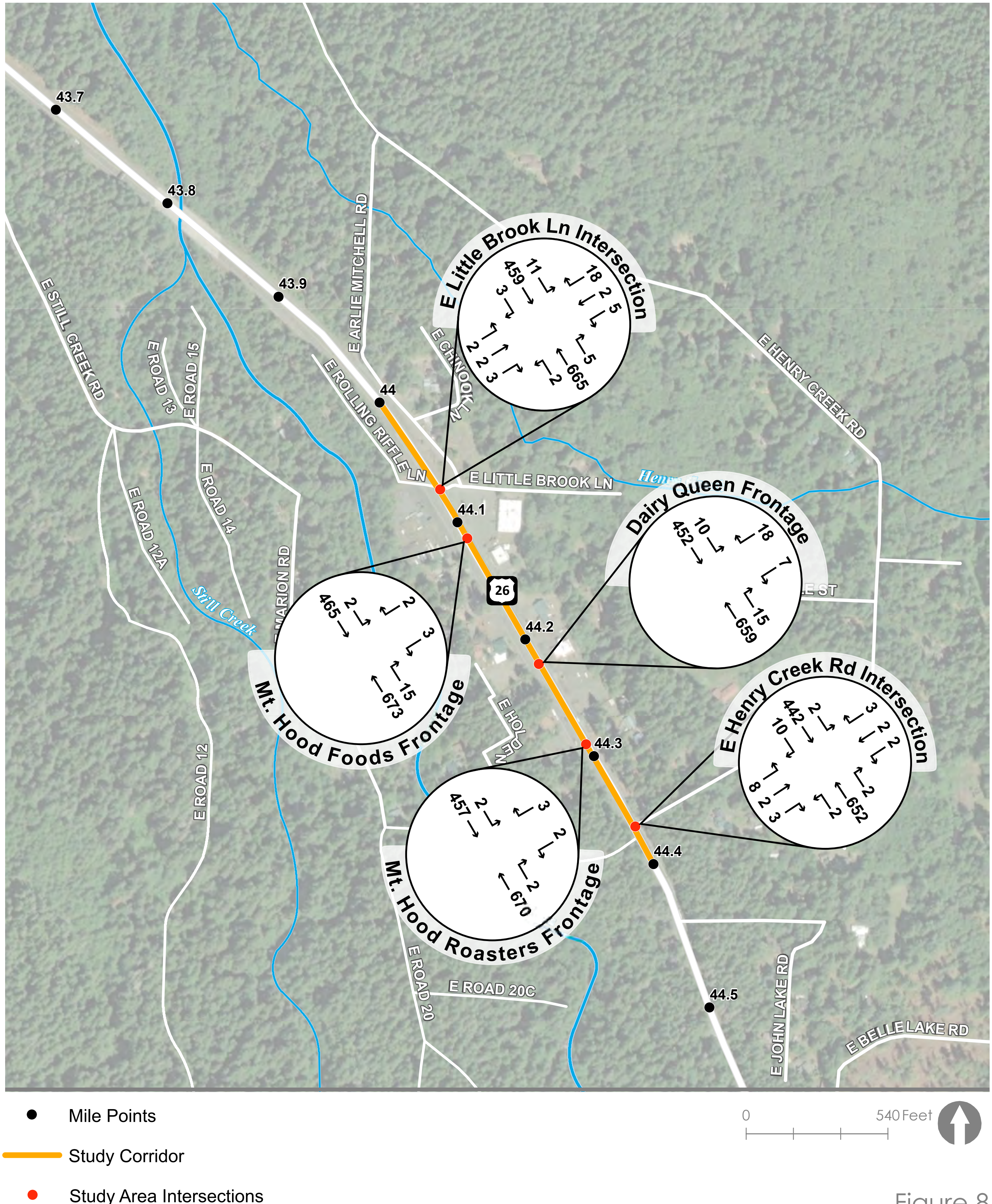

Figure 8

KITTELSON & ASSOCIATES

Opening Year (2030) Weekday (Thursday) PM Traffic Volumes Rhododendron, Oregon

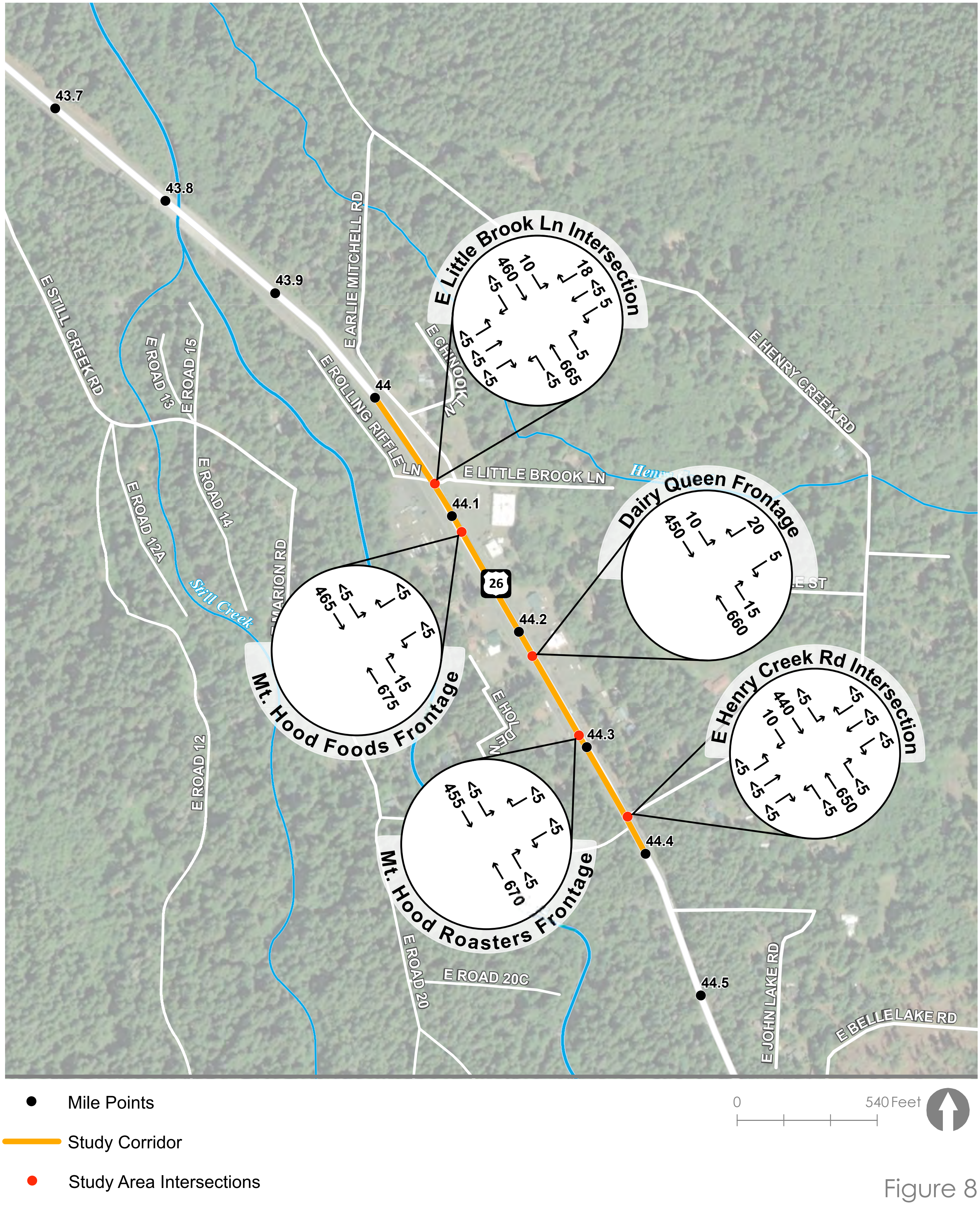

Figure 8

Opening Year (2030) Weekday (Thursday) PM Traffic Volumes Rhododendron, Oregon

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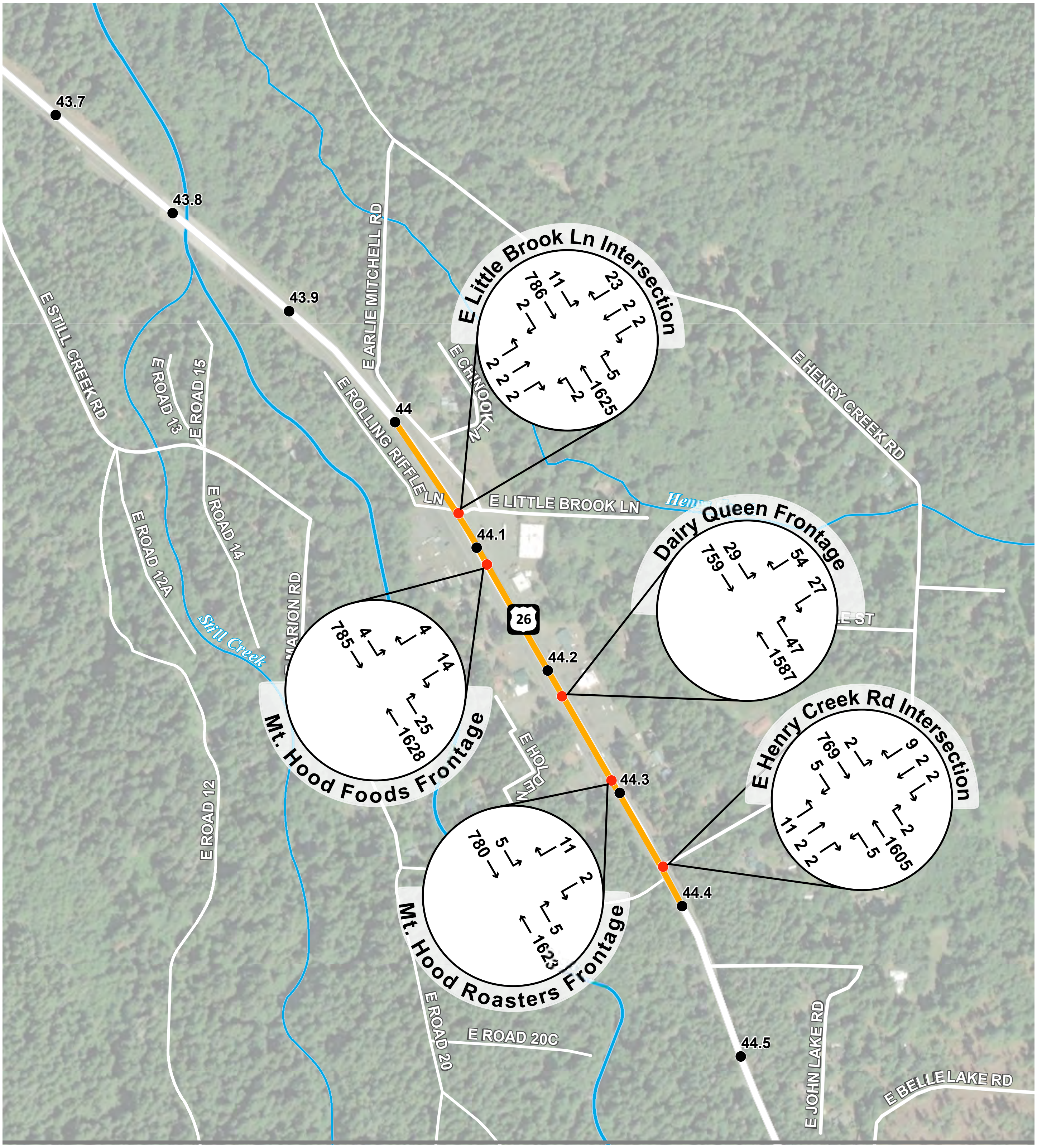

Figure 9

Opening Year (2030) Weekend (Sunday)
Afternoon Traffic Volumes
Rhododendron, Oregon

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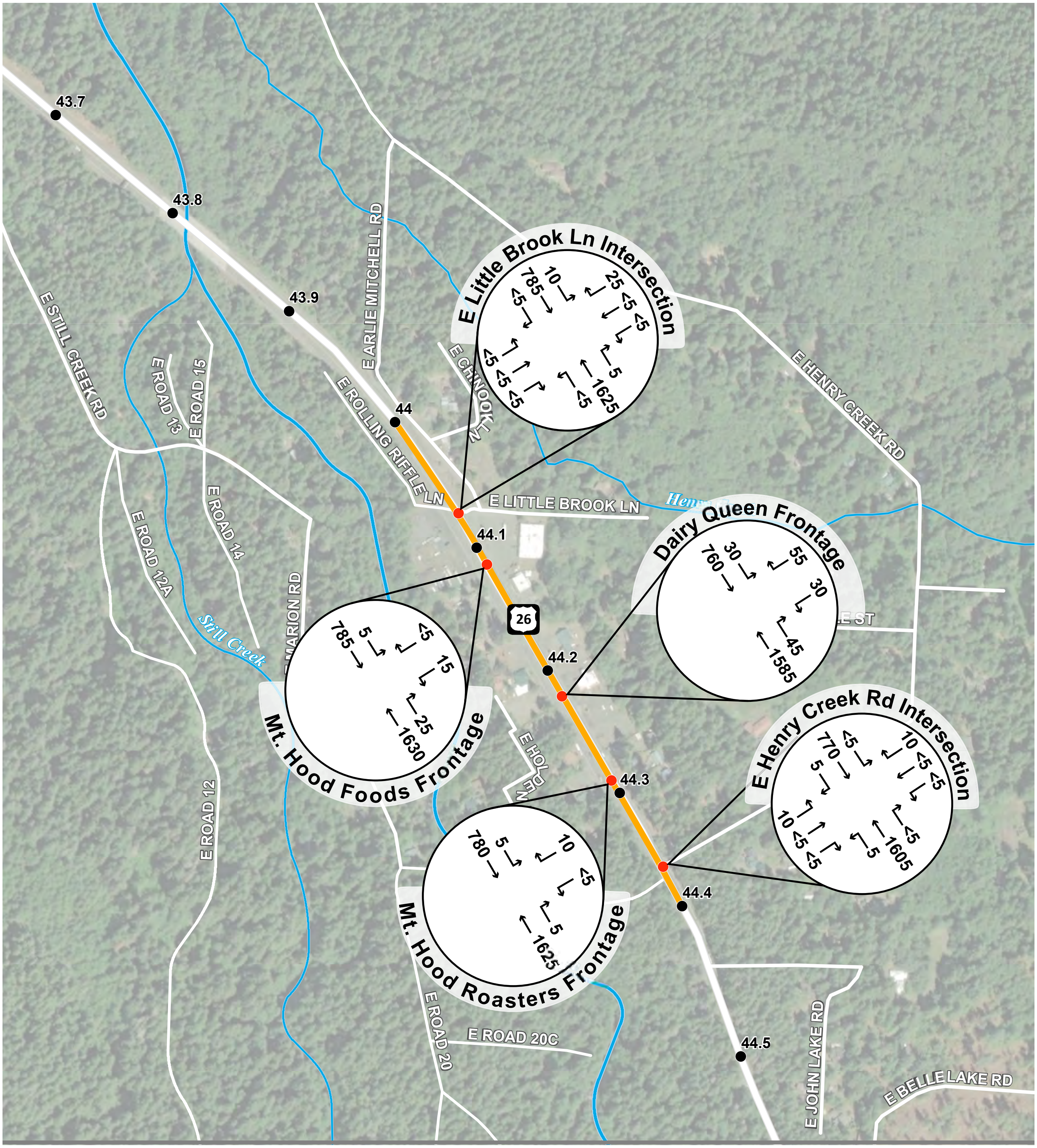

Mile Points

Study Corridor

Study Area Intersections

0 540 Feet

Figure 9

Opening Year (2030) Weekend (Sunday) Afternoon Traffic Volumes Rhododendron, Oregon

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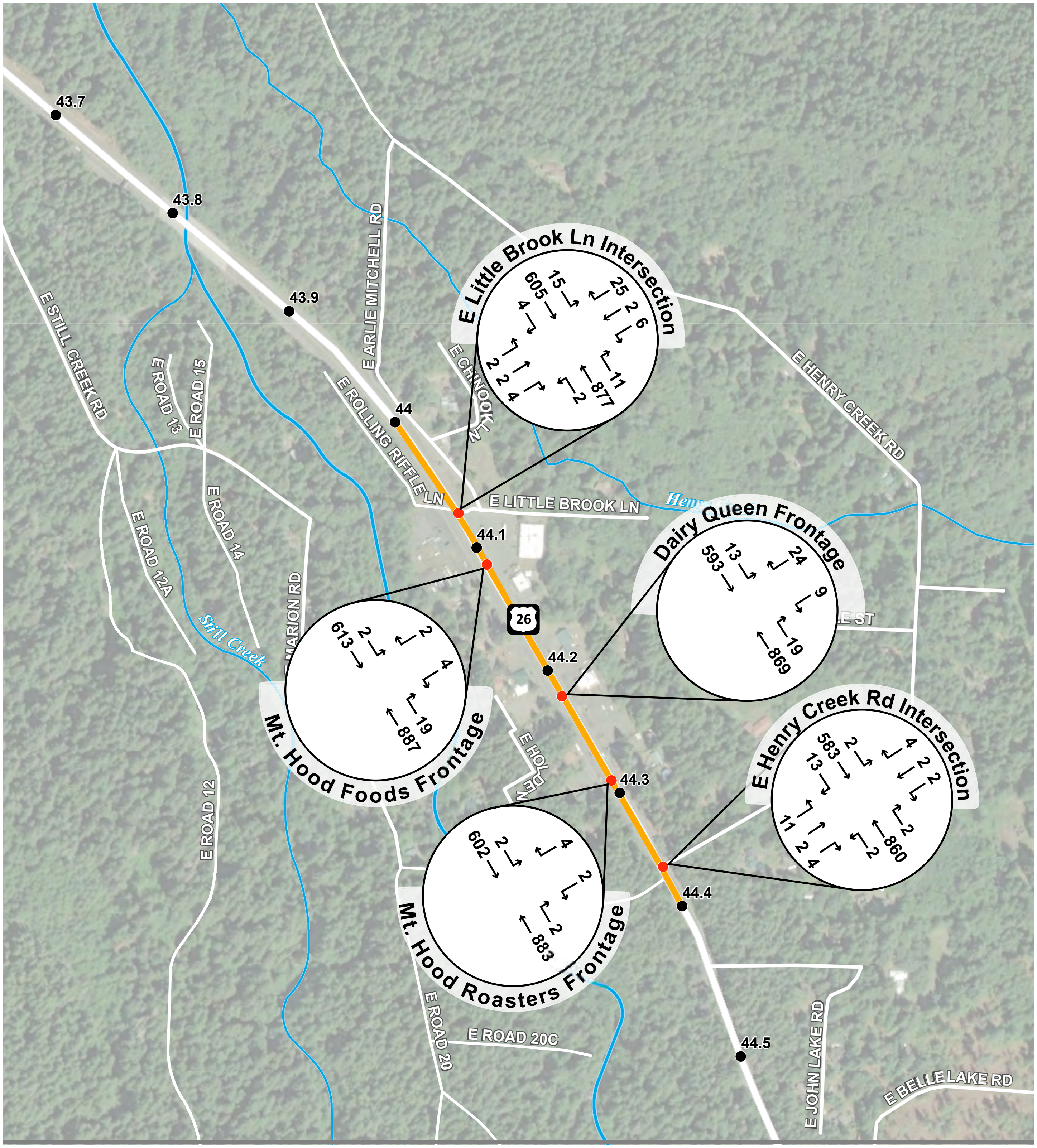

- Mile Points
- Study Corridor
- Study Area Intersections

Figure 10

![Kittelson & Associates]

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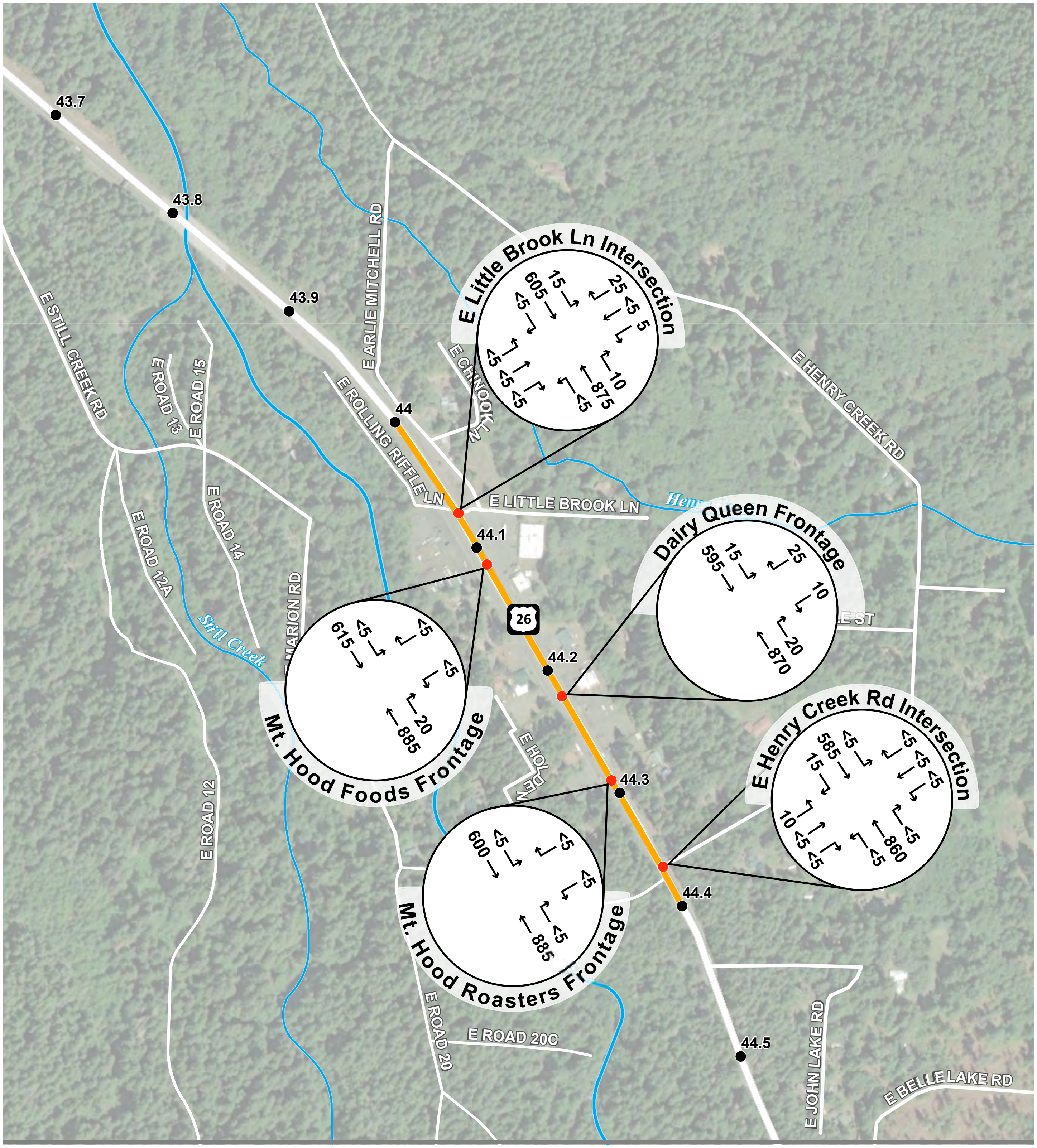
Future Year (2050) Weekday (Thursday)
PM Traffic Volumes
Rhododendron, Oregon



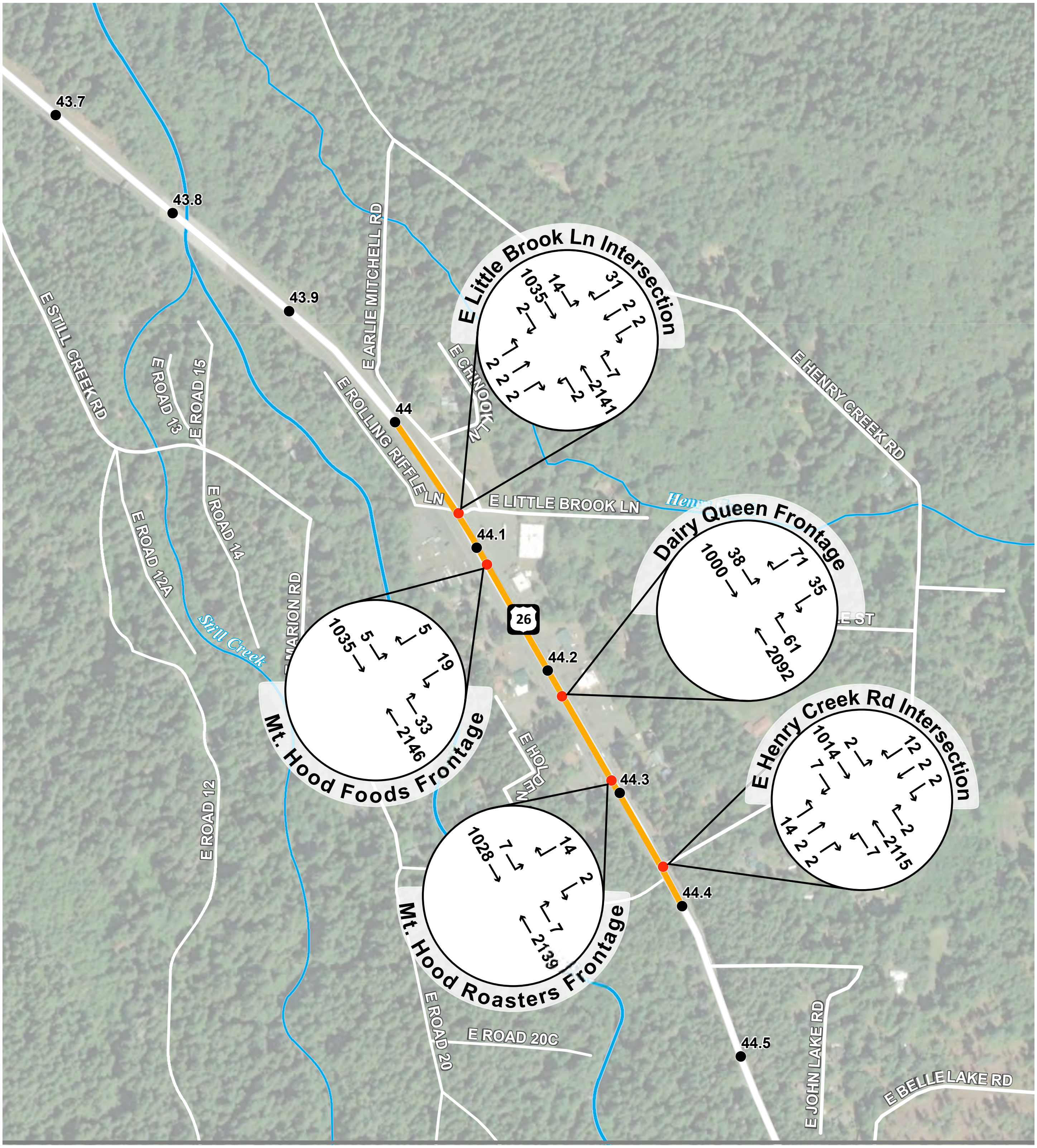
- Mile Points
- Study Corridor
- Study Area Intersections

0 540 Feet

Figure 10

KITTELSON & ASSOCIATES

Future Year (2050) Weekday (Thursday) PM Traffic Volumes
Rhododendron, Oregon



Mile Points

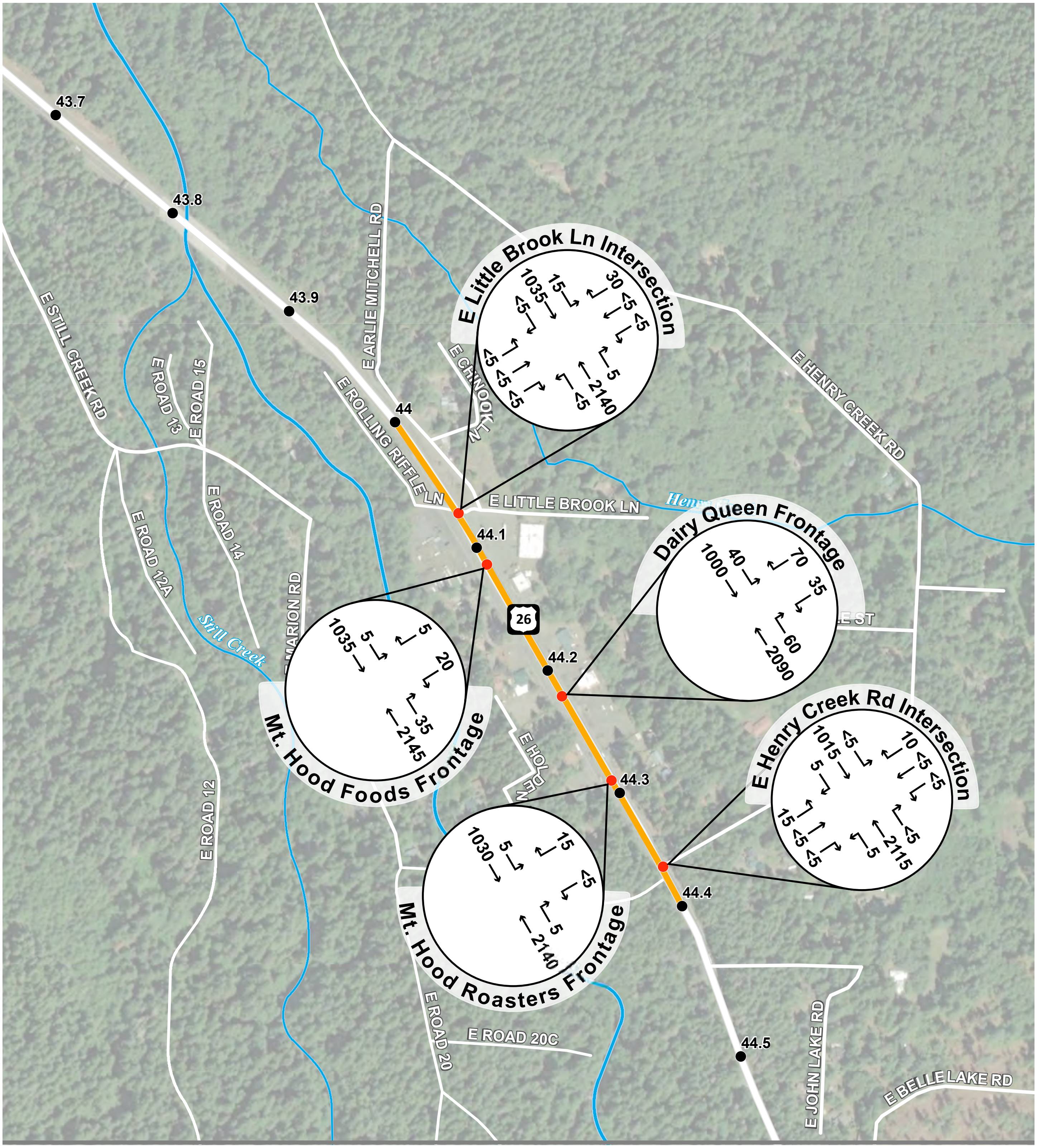
Study Corridor

Study Area Intersections

Figure 11

Future Year (2050) Weekend (Sunday) Afternoon Traffic Volumes
Rhododendron, Oregon

KITTELSON & ASSOCIATES



Mile Points

Study Corridor

Study Area Intersections

0 540 Feet

Figure 11

KITTELSON & ASSOCIATES

Future Year (2050) Weekend (Sunday) Afternoon Traffic Volumes
Rhododendron, Oregon

Safety Analysis

The project team reviewed the reported crash history in the study area to identify potential safety issues. ODOT provided crash records along the study area roadway for the five-year period from January 1, 2016, through December 31, 2020, the most complete five-year period at the time of analysis. Preliminary data for 2021 was not available at the time of analysis.

The reported crash data showed eight reported crashes within the study area, with five of the reported crashes occurring at study area intersections. There were no fatal or severe injury crashes reported; five crashes involved a non-severe injury. All four sideswipe collision types occurred under wet (2), snowy (1), or icy (1) roadway conditions. Three of the sideswipe collisions occurred on the east end of Rhododendron where the five-lane roadway transitions to a two-lane roadway. Although no speed-related crashes were reported, observed vehicle speeds were found to be higher than posted speeds throughout the corridor. Other crash patterns findings include:

- 4 crashes (50 percent) occurred during dark, dawn, or dusk conditions
- 0 crashes included pedestrians or bicyclists
- 2 crashes (25 percent) occurred on wet roadway conditions
- 2 crashes (25 percent) occurred on snow or ice roadway conditions
- 0 crashes reported drugs or alcohol involved
- 0 crashes reported excess speed as a factor

Table 4 summarizes the calculated segment crash data including comparisons to the average crash rates for similar state highway segments. The highway segment crash rates come from the Oregon State Highway Crash Rates Tables which is annually published by the ODOT Crash Analysis and Reporting (CAR) Unit. The calculated segment crash rate is 1.12 crashes per million vehicle miles, which exceeds the average crash rate for rural principal arterials in Oregon between 2016 and 2020.

Table 4. Segment Crash Rate

US 26 Study Area Segment Crash Rate 2016-2020	ODOT CARS Crash Rate Table Summary: Rural Areas – Other Principal Arterials				
	2016 Rate	2017 Rate	2018 Rate	2019 Rate	2020 Rate
1.12	0.81	0.78	0.79	0.92	0.88

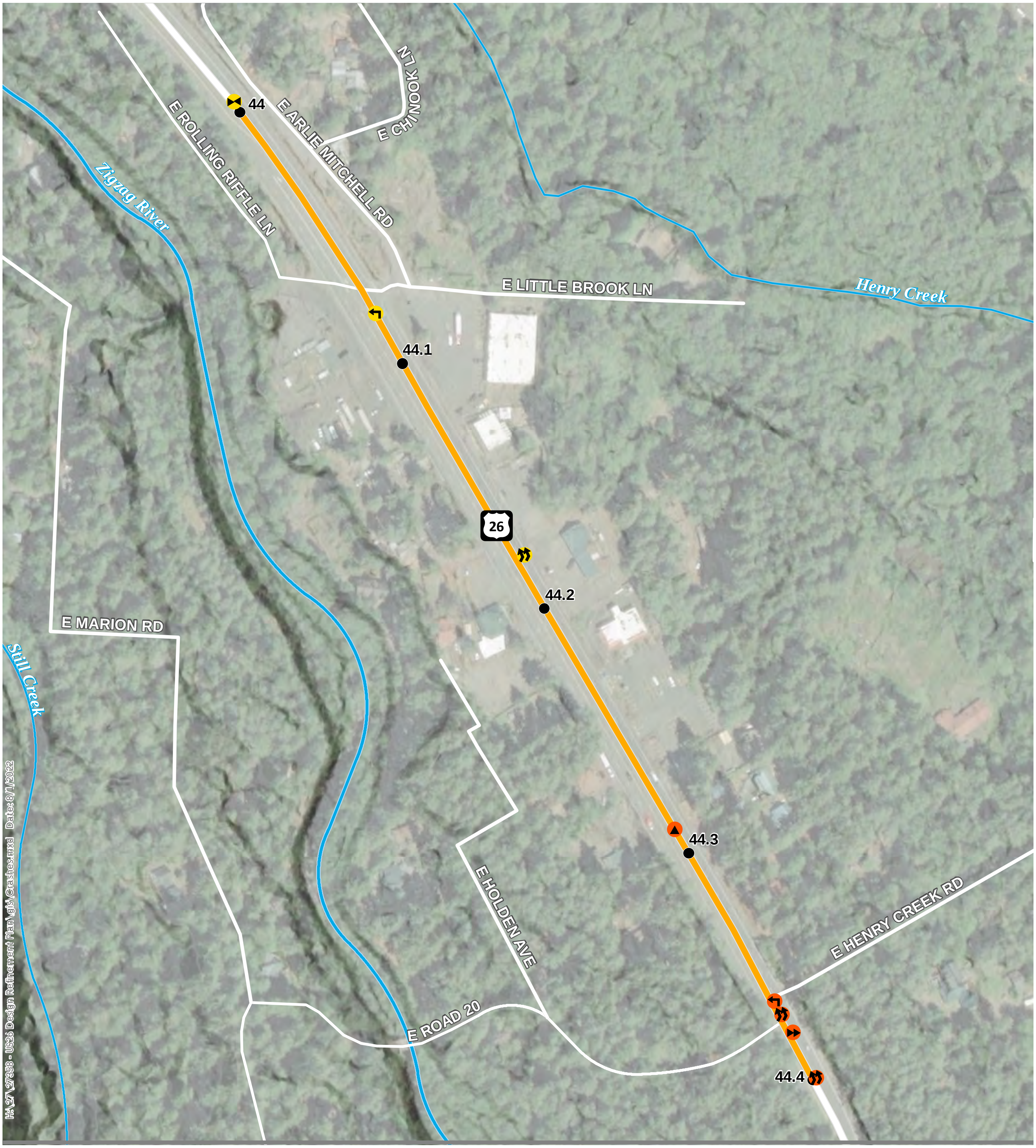
Table 5 summarizes the reported crash data and intersection crash rates including comparisons to the published statewide 90th-percentile crash rates as provided in ODOT's Analysis Procedures Manual (APM) Exhibit 4-1. The 90th-percentile crash rates are categorized by land use type (rural/urban) and traffic control and provide a benchmark for comparing intersections to similar facilities. The study area crash analysis assumes rural land use type (rural/urban) with three-leg or four-leg stop-controlled intersections. None of the study area intersection crash rates exceeded the 90th percentile values. Figure 12 illustrates the locations of reported crashes and collision types along the study area roadway.

Appendix D contains the crash data obtained from ODOT.

Table 5. Study Area Reported Crash History (January 1, 2016-December 31, 2020)

Study Area	Collision Type				Severity			Total Crashes	Crash Rate (per MEV[2])	90th Percentile Crash Rate
	Rear-End	Turning	Side-swipe	Fixed-Object or Other-Object Collision Type	PDO[1]	Non-Severe Injury	Fatal /Severe			
East Little Brook Lane/US 26	0	1	0	0	1	0	0	1	0.04	1.08
Mount Hood Food Frontage/US 26	0	0	0	0	0	0	0	0	0.00	0.48
Non-Intersection Crash: Between Dairy Queen and Mount Hood Foods	0	0	1	0	1	0	0	1	N/A	N/A
Dairy Queen Driveway/US 26	0	0	0	0	0	0	0	0	0.00	0.48
Mount Hood Roasters Driveway Access/US 26	0	0	0	1	0	1	0	1	0.04	0.48
East Henry Creek Road/Rd. 20/US 26	1	1	1	0	0	3	0	3	0.13	1.08
Non-Intersection Crash: East End Approach on US 26	0	0	2	0	1	1	0	2	N/A	N/A
Study Area Total	1	2	4	1	3	5	0	8	N/A	N/A

[1] PDO = Property Damage Only
[2] MEV = Million Entering Vehicles, calculated using average daily volumes from the 7-day tube counts, supplemented with side street volumes from peak-hour turning movement counts to estimate total entering vehicles at each intersection.



- Fixed-Object or Other-Object Collision Type
- Rear-End Collision Type
- Sideswipe-meeting Collision Type
- Sideswipe-overtaking Collision Type
- Turning Movement Collision Type
- Minor Injury
- Property Damage Only
- Study Corridor

0 270 Feet

Figure 12

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Reported Crashes 2016 - 2020
Rhododendron, Oregon

Risk Assessment

In addition to reviewing reported crash data, the project team considered the roadway characteristics as they relate to safety risk. Many agencies take a proactive approach to reducing crash frequency and severity by identifying locations with risk factors, which are roadway, traffic, land use, user type, or other characteristics that are associated with an increased frequency or severity of crashes throughout an area. This proactive approach allows for systemically addressing high risk locations before crashes occur, rather than chasing crash locations.

The Oregon Bicycle and Pedestrian Safety Implementation Plan assigned state highways a bike and pedestrian crash risk score based on the presence of risk factors associated with each crash type; the higher the score, the more risk factors present. The study area scored in the highest category for both the bike and pedestrian crash risk scores throughout Oregon. The Refinement Plan study area includes several factors that may be associated with higher crash risk:

- Five-lane cross-section:
  - Results in a higher number of potential conflict points between vehicles at intersections;
  - Associated with higher speeds when compared to three-lane cross-sections; and
  - Requires pedestrians and bicyclists to cross longer distances and more lanes of traffic.
- Posted Speed ≥ 35 mph
  - Posted speed is linked to an increase in crash severity and frequency
- Lack of dedicated sidewalks and bicycle lanes:
  - The lack of dedicated facilities results in pedestrians and bicyclists sharing the roadway or shoulder with vehicles. This increases the risk of a conflict between a vehicle and a person walking or biking.
- Lack of defined driveways at many businesses:
  - With a wide-open access area, more areas of potential conflict are available. In addition, drivers are not looking for potential slowing, turning, or entering vehicles at a specific location.

Roadway design choices must balance multiple needs. In many situations, the presence of these risk factors are difficult to avoid and is appropriate for the context. The alternatives analysis for this project will further evaluate scenarios that look to reduce crash risk by implementation safety countermeasures and proven crash reduction factors (CRFs).

Operational Analysis

The project team conducted intersection and roadway segment operation analyses for the Refinement Plan study area for three analysis years: 2022 existing conditions, 2030 (opening year) no-build conditions, and 2050 (future year) no-build conditions. The volume-to-capacity (v/c) ratios for the intersections were used to evaluate the performance of each intersection. The OHP mobility target (v/c ratio) for the study area's two-way stop-controlled intersections is 0.80 for the side street approach.

The project team used a combination of analysis methods. For the two-way stop-controlled (TWSC) intersections, the project team used a combination of SIDRA 9 and the *Highway Capacity Manual (HCM)* procedure as implemented in HCS, for reasons that are discussed below. For the roadway segments, the project team used the *Highway Capacity Manual* procedure for multilane highways as implemented in HCS. Observed peak hour factors (PHF) were used for existing conditions analyses, and a PHF of 1.0 was used for 2030 and 2050 analyses.

The Methodology Memorandum, provided in Appendix A, summarizes analyses procedures and assumptions used in this memorandum.

Calibration to Field Conditions

Although the project scope and Methodology Memorandum request the use of SIDRA 9 to complete intersection analyses, the team found that initial SIDRA analyses did not adequately represent observed conditions. Review of video footage from the traffic counts showed the following:

- The side streets were operating with abundant excess capacity and relatively low delays, even during the Sunday peak period. By contrast, results from SIDRA showed conditions operating well over capacity with large delays. Although the video footage does not account for the seasonally adjusted volume, this observation indicated that the SIDRA analysis without further calibration may be overly conservative, and that the analysis is not reflective of true conditions. Field observations during the August 2022 site visit was used to confirm summer conditions. Field observations during a Thursday afternoon in August 2022 revealed average side street delay of nine seconds, with a maximum observed delay of 20 seconds.

To better replicate field conditions, the team conducted an analysis using the HCM as implemented in McTrans Highway Capacity Software (HCS) for scenarios with and without two-stage left turns. The analysis used the default values for gap acceptance (critical headway and follow-up headway) based on national averages in the United States. The project team selected the East Henry Creek Road/US 26 intersection for this comparison because it had the highest side street v/c ratio based on the initial SIDRA 9 analysis.

Table 6 compares the intersection operations analysis results for the three scenarios. As shown, HCS with national default values for gap acceptance generally reports conditions that are closer to those observed in video footage on the side street approach compared to SIDRA without further calibration.

Appendix E provides the detailed results of the HCS & SIDRA 9 analyses reports.

Appendix F, G, and H provide the initial detailed results of all scenarios under SIDRA 9 analyses.

Table 6. US 26/E Henry Creek Road Intersection HCS to SIDRA v/c Comparison

SIDRA/ HCS	Critical Movement of Side Street	v/c	Meets ODOT v/c Target	Delay (sec)	LOS
Existing Weekday (Thursday) Peak Hour					
SIDRA	NBL	0.10	Yes	44.6	LOS E
HCS – one-stage operation	NBL	0.04	Yes	16.6	LOS C
HCS – two-stage operation	NBL	0.03	Yes	13.9	LOS B
Existing Weekend (Sunday) Peak Hour					
SIDRA	NBL	>1	No	>50.0	LOS F
HCS – one-stage operation	NBL	0.25	Yes	>50.0	LOS F
HCS – two-stage operation	NBL	0.14	Yes	43.9	LOS E
2050 Weekday (Thursday) Peak Hour					
SIDRA	NBL	0.24	Yes	>50.0	LOS F
HCS – one-stage operation	NBL	0.08	Yes	23.4	LOS C
HCS – two-stage operation	NBL	0.06	Yes	17.6	LOS C
2050 Weekend (Sunday) Peak Hour					
SIDRA	NBL	>1	No	>50.0	LOS F
HCS – one-stage operation	NBL	0.79	Yes	>50.0	LOS F
HCS – two-stage operation	NBL	0.32	Yes	>50.0	LOS F

*Analyzes the intersection without using the two-way left turn lane settings.
Note: Bold text indicates intersections that do not meet mobility targets.

The team recommends that HCS with HCM default values for gap acceptance be used for intersection analyses for the study area because HCS provides full implementation of the HCM methodology, HCS produced results that more closely matched field observations without additional calibration effort that would be required of SIDRA, and the analysis results will be adequate to inform trade-offs of alternatives for this planning-level study.

Intersection Operations Analysis

The team completed the intersection analyses using SIDRA 9, as called for in the scope of work. However, because the team determined the SIDRA results to be unrepresentative of observed conditions, these results are not presented in the body of this memorandum. The Existing 2022, 2030 No-Build, and 2050 No-Build intersection analyses using SIDRA 9 can be found in Appendices F, G, and H, respectively.

The team reevaluated the 2030 and 2050 No-Build Conditions for Thursday and Sunday conditions using HCS assuming two-stage operation (drivers using the TWLTL to complete minor-street left turns). Queue lengths were calculated using ODOT's Queue Length Estimation for Two-Way Stop-Controlled Intersections Worksheet, per ODOT's Analysis Procedures Manual (APM). As shown in Table 7 and Table 8, all study intersections are anticipated to meet ODOT mobility targets under the 2030 and 2050 No-Build Conditions. Based on these findings during the future scenarios, the team concludes that the two existing scenarios would result in intersection operations that meet ODOT v/c targets.

Analysis reports for the 2030 and 2050 No-Build HCS analyses are provided in Appendix I.

Table 7. 2030 No-Build Intersection Operations

Intersection	Critical Movement of Side Street	v/c	Meets ODOT v/c Targets?	Delay (sec)	LOS	Queue Length (ft)*
2030 (Thursday) Peak Hour - HCS						
East Little Brook Lane/US 26	SBL	0.05	Yes	13.0	B	25
Mount Hood Food Frontage/US 26	SBL	0.01	Yes	13.8	B	25
Dairy Queen Driveway/US 26	SBR	0.03	Yes	10.6	B	50
Mount Hood Roasters Driveway Access/US 26	SBL	0.01	Yes	12.6	B	25
East Henry Creek Road/Rd. 20/US 26	NBL	0.03	Yes	14.5	B	25
2030 (Sunday) Peak Hour - HCS						
East Little Brook Lane/US 26	SBL	0.16	Yes	30.0	D	50
Mount Hood Food Frontage/US 26	SBL	0.14	Yes	37.7	E	75
Dairy Queen Driveway/US 26	SBL	0.25	Yes	48.1	E	75
Mount Hood Roasters Driveway Access/US 26	SBL	0.05	Yes	20.1	C	75
East Henry Creek Road/Rd. 20/US 26	NBL	0.12	Yes	38.5	E	50

*Queue lengths are provided from ODOT's Queue Length Estimation for Two-Way Stop-Controlled Intersections Worksheet, per the APM. Worksheets are provided in Appendix J.

Table 8. 2050 No-Build Intersection Operations

Intersection	Critical Movement of Side Street	v/c	Meets ODOT v/c Targets?	Delay (sec/veh)	LOS	Queue Length (ft)*
2050 (Thursday) Peak Hour - HCS						
East Little Brook Lane/US 26	SBL	0.08	Yes	15.4 s	C	50
Mount Hood Food Frontage/US 26	SBL	0.02	Yes	17.1 s	C	50
Dairy Queen Driveway/US 26	SBL	0.04	Yes	20.0 s	C	50
Mount Hood Roasters Driveway Access/US 26	SBL	0.01	Yes	14.1 s	B	50
East Henry Creek Road/Rd. 20/US 26	NBL	0.06	Yes	19.1 s	C	25
2050 (Sunday) Peak Hour – HCS						
East Little Brook Lane/US 26	SBL	0.40	Yes	>50 s	F	75
Mount Hood Food Frontage/US 26	SBL	0.35	Yes	>50 s	F	100
Dairy Queen Driveway/US 26	SBL	0.62	Yes	>50 s	F	100
Mount Hood Roasters Driveway Access/US 26	SBL	0.10	Yes	29.3 s	D	100
East Henry Creek Road/Rd. 20/US 26	NBL	0.32	Yes	>50 s	F	75

*Queue lengths are provided from ODOT's Queue Length Estimation for Two-Way Stop-Controlled Intersections Worksheet, per the APM. Worksheets are provided in Appendix J.

Segment Analysis

The project team used the HCM methodology for multilane highways as implemented in HCS to conduct the segment analysis for the study area roadway. The team analyzed the five-lane multilane highway facility using the weekday and Sunday peak hours from the seven-day 24-hour tube counts. The segment analysis used the following inputs obtained from the tube count data to determine the v/c ratios and LOS:

- Eastbound (EB)/Westbound (WB) Volumes
- EB/WB Truck %
- EB/WB PHF
- 85th Percentile Speed

The weekday analysis used the 1:45PM-2:45PM Thursday peak hour volumes, and the weekend analysis used the 3:00PM-4:00PM Sunday peak hour volumes. Since the tube counts were not collected during the Sunday Peak hour time for eastbound heavy vehicles at the east end of the town, the eastbound heavy vehicle percentage from the west end of town was used in its place. As shown in Table 9, all study area segments are anticipated to operate with v/c ratios under 0.25 in 2050 No-Build conditions.

Segment analysis reports are provided in Appendix K.

Table 9. HCS Segment Analysis

West/East End of Town	Thursday/ Sunday Peak Hour	Westbound/ Eastbound	HCS v/c
2022 Existing Conditions			
West End of Town	Thursday	WB	0.21
		EB	0.17
	Sunday	WB	0.55
		EB	0.20
East End of Town	Thursday	WB	0.19
		EB	0.16
	Sunday	WB	0.54
		EB	0.20
2030 Opening Year Conditions			
West End of Town	Thursday	WB	0.21
		EB	0.17
	Sunday	WB	0.56
		EB	0.20
East End of Town	Thursday	WB	0.20
		EB	0.17
	Sunday	WB	0.61
		EB	0.20
2050 Future Year Conditions			
West End of Town	Thursday	WB	0.28
		EB	0.23
	Sunday	WB	0.74
		EB	0.26
East End of Town	Thursday	WB	0.26
		EB	0.22
	Sunday	WB	0.74
		EB	0.25

Active Transportation Analysis

Currently, no sidewalks or bicycle lanes exist along either side of US 26 or along any of the minor streets within the study area. There are no marked crosswalks crossing US 26 within the study area. The 6-ft shoulders along both sides of US 26 exists throughout the entire study area and serve as unmarked bicycle facilities.

Transit

The Mount Hood Express transit line provides eastbound and westbound transit stops within the study area. The transit stop for people traveling in the westbound direction is located at the intersection of Little Brook Lane and the frontage road parallel to US 26, East Arlie Michelle Road. The transit stop is designated by a small wooden shelter and is set back approximately 75-ft north from US 26. The transit stop for people traveling in the eastbound direction is located on the south side of US 26 approximately 200 feet east from the aforementioned transit stop. There are no transit signs or shelters that designate this stop.

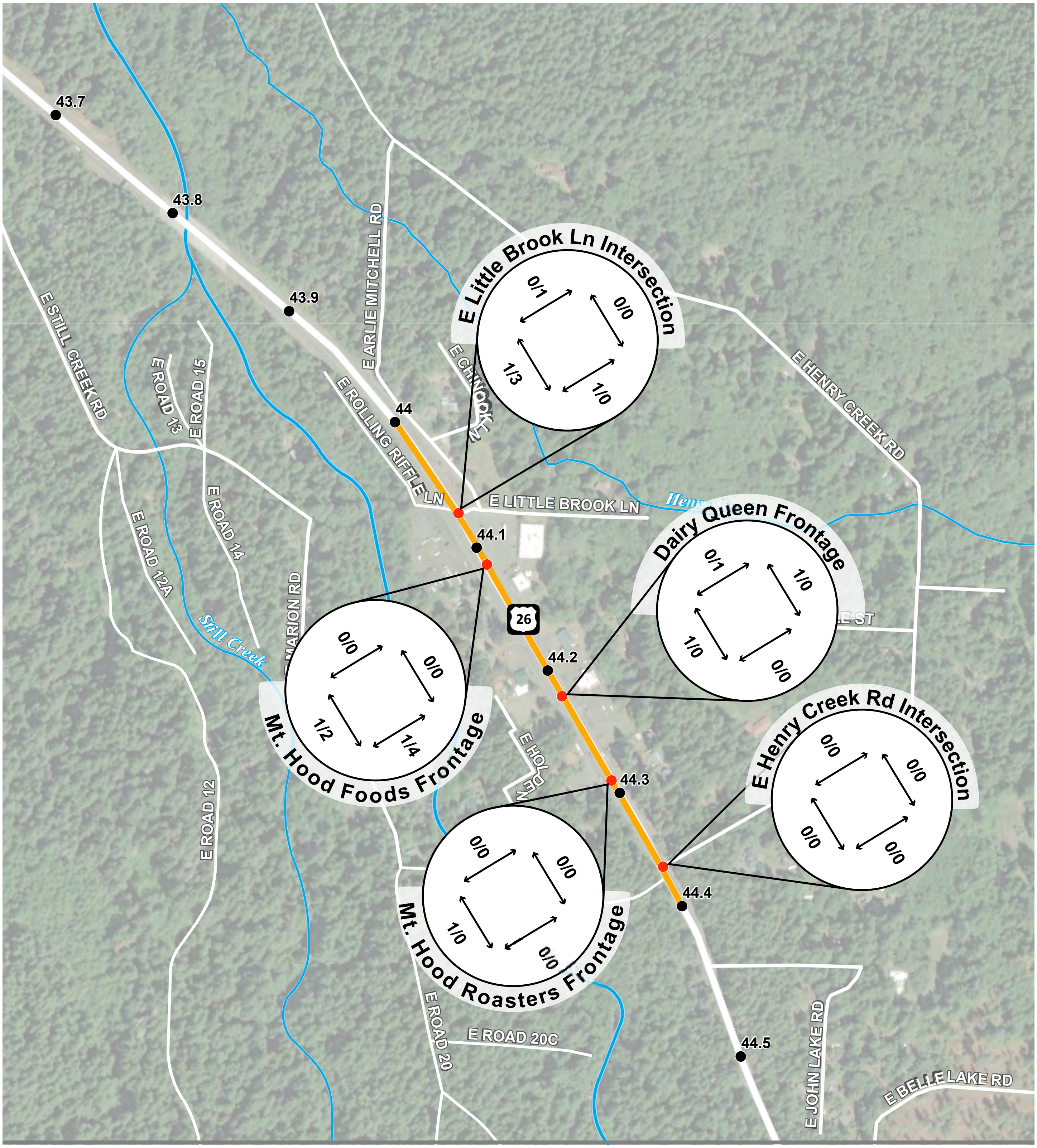
Pedestrian and Bicycle Volumes

Weekday pedestrian and bicycle volumes collected in May 2022 as part of the intersection turning movement counts. The observed pedestrian volumes during the study hours are shown in Figure 13. An increase in pedestrians was observed on Sunday, with five pedestrians at the E little Brook Lane intersection and six pedestrians at the Mt Hood Foods intersection.

24-hour pedestrian and bicycle count volumes were collected at the US 26 and Little Brook Lane intersection on Tuesday, August 9, 2022. A total of eight cyclists and twenty pedestrians were counted at the study intersection. Seven pedestrians were counted between 5:45 am and 9:45 am, and the remaining thirteen pedestrians were counted between 1:30 pm and 7:30 pm. Cyclists were active throughout the second half of the day between 12:45pm and 8:15pm. Of the twenty pedestrians counts, sixteen were counted crossing US 26, eight in each direction. Table 10 summarizes the results of the 24-hr count data.

Table 10. 24-Hr Pedestrian and Bicycle Count

Ped/ Bike	Direction of travel	12AM -2AM	2AM - 4AM	4AM - 6AM	6AM - 8AM	8AM - 10AM	10AM - 12PM	12PM - 2PM	2PM - 4PM	4PM - 6PM	6PM - 8PM	8PM - 10PM	10PM - 12AM
Ped	Northbound crossing US-26	0	0	1	0	2	0	0	4	1	0	0	0
	Southbound crossing US-26	0	0	0	3	0	0	1	0	2	2	0	0
	Westbound along US-26	0	0	0	0	0	0	1	2	0	0	0	0
	Eastbound along US-26	0	0	0	1	0	0	0	0	0	0	0	0
Bike	Westbound along US-26	0	0	0	0	0	0	1	0	2	0	0	0
	Eastbound along US-26	0	0	0	0	0	0	0	1	1	0	3	0



Mile Points

Study Corridor

Study Area Intersections

0 540 Feet

Figure 13

Pedestrian Traffic Volumes
Thursday/Sunday Volumes
Rhododendron, Oregon

KITTELSON & ASSOCIATES

Pedestrian Crossing Analysis

The study area does not provide any existing marked crossings which can make it challenging for pedestrians or cyclists to cross the five-lane highway. With key destinations located on both sides of US 26, a crosswalk or enhanced crossing would increase visibility and awareness of pedestrians or cyclists traveling across the highway. ODOT's Uncontrolled Marked Crosswalk Treatments Chart from the 2022 Traffic Manual is shown in Table 11 and was used to determine the most appropriate crossing treatments for the study area roadway. The annual average daily traffic (AADT), posted speed, presence of refuge island and number of lanes crossed were all the parameters included in the analysis. 2030 and 2050 AADT volumes were also developed to determine if any additional treatments would need to be implemented in the future under the existing roadway (no-build) configuration. A 1.82 percent annual growth rate was applied to 2020 ATR AADT data to develop the future volumes.

- 2022 AADT: 9,800 veh/day (per TransGIS ATR data)
- 2030 AADT: 11,100 veh/day
- 2050 AADT: 14,600 veh/day
- Posted Speed (mph): 40 mph

Although a state-traffic-roadway engineer (STRE) approval is required for crossings on roadways with more than four vehicle lanes, an analysis on four lanes was completed to determine an initial reference/threshold for recommended and optional treatments.

With the assumption of a four-lane roadway, the primary recommended treatment for all existing and future conditions is a Rectangular Rapid-Flashing Beacon (RRFB) when a pedestrian refuge island is provided or a traffic signal/pedestrian hybrid beacon (PHB) when a pedestrian refuge island is not provided. Supplementary recommended and optional treatments are listed in Table 12.

Table 11. Uncontrolled Marked Crosswalk Treatments Chart

Table 310.3-A: Uncontrolled marked crosswalk treatments

Lanes Crossed**	Refuge Island	AADT & Posted Speed***														
		<3000 veh/day			3000-9000 veh/day			9000-12,000 veh/day			12,000-15,000 veh/day			>15,000 veh/day		
		≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
1	N/A	A* B C E	🅐 C E G I	Ⓐ C E 🅖 I	🅐 B C E	🅐 C E G I	Ⓐ C E 🅖 I	🅐 C E G I	🅐 C E G I	Ⓐ C E 🅖 I	🅐 C E G I	🅐 C E G I	Ⓐ C E 🅖 I	🅐 C E G I	Ⓐ C E G I	Ⓐ C E 🅖 I
2	Yes	A* B C D E	🅐 C E G I	Ⓐ C E 🅖 I	🅐 B C D E	🅐 C E G I	Ⓐ C E 🅖 I	🅐 C D E G I	🅐 C E G I	Ⓐ C E 🅖 I	🅐 C D E G I	🅐 C E G I	Ⓐ C E 🅖 I	🅐 C D E G I	Ⓐ C E G I	Ⓐ C E 🅖 I
2	No	A* B C D E F	🅐 🅒 E F G I	Ⓐ 🅒 E F 🅖 I	🅐 B 🅒 D E F	🅐 🅒 E F G I	Ⓐ 🅒 E F 🅖 I	🅐 🅒 D E F G I	🅐 🅒 E F G I	Ⓐ 🅒 E F 🅖 I	🅐 🅒 D E F 🅖 I	🅐 🅒 E F 🅖 I	Ⓐ 🅒 E F 🅖 I	🅐 🅒 D E F 🅖 I	Ⓐ 🅒 E F 🅖 I	Ⓐ 🅒 E F 🅘
3	Yes	🅐 B 🅒 D E G I	🅐 🅒 E G I	Ⓐ 🅒 E 🅖 I	🅐 B 🅒 D E G I	🅐 🅒 E G I	Ⓐ 🅒 E 🅖 I	Ⓐ 🅒 D E G I	Ⓐ 🅒 E 🅖 I	Ⓐ 🅒 E 🅖 I	Ⓐ 🅒 D E G I	Ⓐ 🅒 E 🅖 I	Ⓐ 🅒 E 🅖 I	Ⓐ 🅒 D E 🅖 I	Ⓐ 🅒 E 🅖 I	Ⓐ 🅒 E 🅖 I
3	No	🅐 B 🅒 D E F G I	🅐 🅒 E F G I	Ⓐ 🅒 E 🅕 🅖 I	🅐 B 🅒 D E F G I	🅐 🅒 E F G I	Ⓐ 🅒 E 🅕 🅖 I	Ⓐ 🅒 D E 🅕 🅖 I	Ⓐ 🅒 E 🅕 🅖 I	Ⓐ 🅒 E 🅕 🅘	Ⓐ 🅒 D E 🅕 🅖 I	Ⓐ 🅒 E 🅕 🅖 I	Ⓐ 🅒 E 🅕 🅘	Ⓐ 🅒 D E 🅕 🅖 I	Ⓐ 🅒 E 🅕 🅘	Ⓐ 🅒 E 🅕 🅘
4	Yes	🅐 🅒 D E G 🅗 I	🅐 🅒 E G 🅗 I	Ⓐ 🅒 E 🅖 🅗 I	🅐 🅒 D E G 🅗 I	🅐 🅒 E G 🅗 I	Ⓐ 🅒 E 🅖 🅗 I	Ⓐ 🅒 D E G H I	Ⓐ 🅒 E 🅖 H I	Ⓐ 🅒 E 🅖 H I	Ⓐ 🅒 D E G H I	Ⓐ 🅒 E 🅖 H I	Ⓐ 🅒 E 🅖 H I	Ⓐ 🅒 D E 🅖 H I	Ⓐ 🅒 E 🅖 H I	Ⓐ 🅒 E H 🅘
4	No	🅐 🅒 E F G 🅗 I	Ⓐ 🅒 E 🅕 G 🅗 I	Ⓐ 🅒 E 🅕 🅖 🅗 I	🅐 🅒 E F 🅖 🅗 I	Ⓐ 🅒 E 🅕 🅖 🅗 I	Ⓐ 🅒 E 🅕 🅖 🅗 I	Ⓐ 🅒 E 🅕 🅖 H I	Ⓐ 🅒 E 🅕 🅖 H I	Ⓐ 🅒 E 🅕 H 🅘	Ⓐ 🅒 E 🅕 🅖 H I	Ⓐ 🅒 E 🅕 H 🅘	Ⓐ 🅒 E 🅕 H 🅘	Ⓐ 🅒 E 🅕 H 🅘	Ⓐ 🅒 E 🅕 H 🅘	Ⓐ 🅒 E 🅕 H 🅘

* Treatment "A" recommended for school crossings and midblock crosswalks.
** Total motor vehicle lanes crossed to complete the crossing, including TWLTL and left/right turn lanes. Bicycle lanes and refuge islands at least 6 feet wide are not lanes crossed. STRE approval required for uncontrolled marked crosswalks across 5+ lanes.
*** See Speed discussion in the Special Considerations subsection. 85th percentile speed may be used instead of the posted speed.

Installation of a treatment(s) at any location is subject to an engineering study that accounts for factors such as sight distance, safety, operations, other field conditions, and local land use.

This table does not apply to temporary marked crosswalks. See the TCP Manual (4) for temporary uncontrolled marked crosswalks.

X = Treatment optional
🅧 = Treatment recommended
Ⓧ = Treatment recommended and should be installed with other identified treatments.

The absence of a letter means the treatment is generally not appropriate, but exceptions may be considered through the engineering study and STRE approval process.

A = Continental-style crosswalk markings, parking restrictions on crosswalk approach (see Table 310.3-B), lighting according to the ODOT Traffic Lighting Design Manual. Crossing warning sign(s) for school crosswalks, midblock crosswalks, or speed ≥30 mph.
B = Raised crosswalk, except on freight routes, emergency response routes, arterial roadways, and snowplow routes.
C = If 2+ lanes in one direction, wide advance stop bar and STOP HERE FOR Pedestrians sign.
D = In-street pedestrian crossing sign (R1-6a). If refuge island present, install on the refuge island.
E = Curb extension
F = Pedestrian refuge island (at least 6 feet wide)
G = Rectangular rapid flashing beacon (RRFB)
H = Reduce number of motor vehicle lanes
I = Traffic signal or pedestrian hybrid beacon (PHB)

Blue = All treatments shown in category optional. Treatment "A" recommended for school and midblock crossings.
Green = Visibility enhancements recommended
Yellow = RRFB treatment recommended
Red = Traffic signal or PHB recommended

Table 12 Crossing Treatments[2]

Analysis Scenarios	AADT (veh/day)	# Vehicle Lanes Crossed	Refuge Island	Treatment Recommended	Optional Treatments
2022 Existing	9,800	4	No	1. Traffic Signal or PHB 2. If 2+ lanes in one direction, wide advance stop bar and STOP HERE FOR Pedestrians sign. 3. Pedestrian refuge island (at least 6 feet wide) 4. Continental-style crosswalk marking, parking restrictions on crosswalk approach, lighting according to ODOT Traffic Lighting Design Manual. Crosswalk warning sign(s) for speed ≥ 30 mph.	1. Curb extensions 2. Reduce number of motor vehicle lanes
2030 No-Build	11,100				
2050 No-Build	14,600				
2022 Existing	9,800	4	Yes	1. RRFB 2. If 2+ lanes in one direction, wide advance stop bar and STOP HERE FOR Pedestrians sign. 3. Continental-style crosswalk marking, parking restrictions on crosswalk approach, lighting according to ODOT Traffic Lighting Design Manual. Crosswalk warning sign(s) for speed ≥ 30 mph.	1. Curb extensions 2. Reduce number of motor vehicle lanes 3. Traffic signal or PHB
2030 No-Build	11,100				
2050 No-Build	14,600				

Bicycle Facility Analysis

US 26's six-foot shoulders serve as the study area's bicycle facilities connecting to bicycle trails at both ends of Rhododendron. The Mt. Hood Express bus comes equipped with a bike trailer that can be used to shuttle cyclists up and down the mountain (including a stop in Rhododendron). HCS software was used to calculate the bicycle level of service (BLOS) at both ends of the project area. The BLOS for all existing and future year Thursday scenarios is D for all Sunday scenarios is C. Results are summarized in Table 13

The Blueprint for Urban Design (BUD) was used to determine the appropriate treatments for bicycle facilities within the study area. Using the BUD's Bicycle Facility Tier Identification Matrix as seen in Figure 14, the recommended bicycle facility treatments for existing and future year conditions are separated bikeways. Results are summarized in Table 14.

[2] The study area was analyzed as a four-lane instead of a five-lane roadway due to the limitations of the parameters in the traffic manual spreadsheet. STRE approval will be required for any crossing of a five-lane roadway.

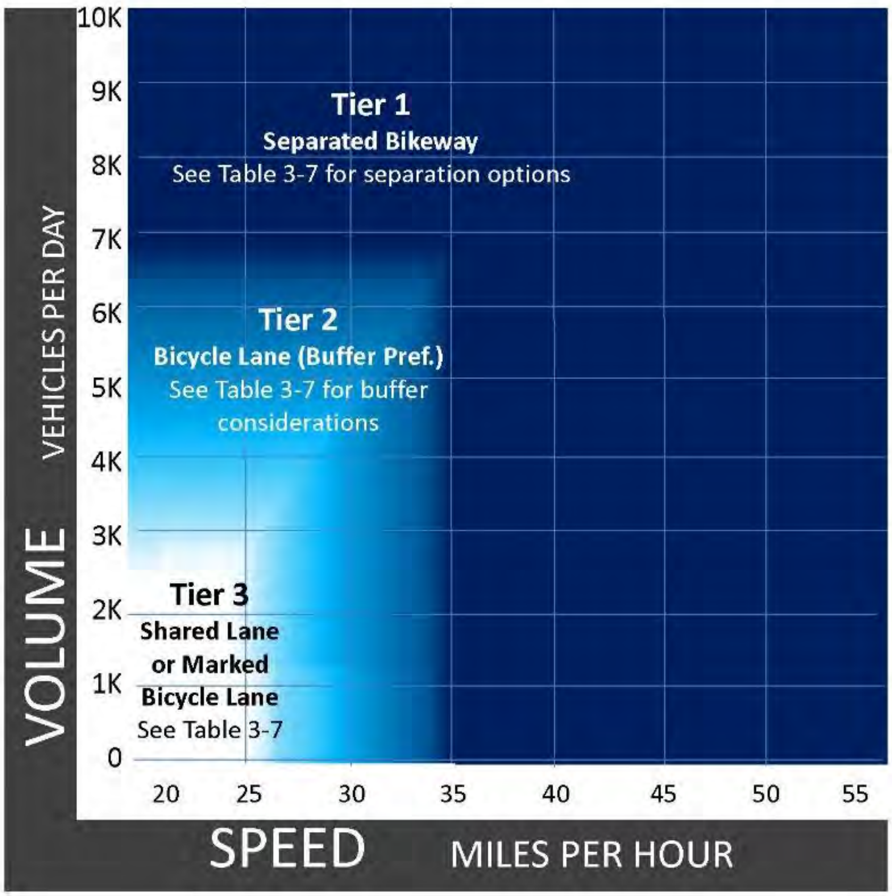
Table 13. HCS Bicycle Level of Service (BLOS)

Thursday/Sunday	West End/East End	WB/EB	LOS
2022 Peak Hour - HCS			
Thursday	West End	WB	D
		EB	D
	East End	WB	D
		EB	D
Sunday	West End	WB	C
		EB	C
	East End	WB	C
		EB	C
2030 Peak Hour – HCS			
Thursday	West End	WB	D
		EB	D
	East End	WB	D
		EB	D
Sunday	West End	WB	C
		EB	C
	East End	WB	C
		EB	C
2050 Peak Hour – HCS			
Thursday	West End	WB	D
		EB	D
	East End	WB	D
		EB	D
Sunday	West End	WB	C
		EB	C
	East End	WB	C
		EB	C

Table 14. Bicycle Facility Recommendation

Analysis Year	AADT (veh/day)	Posted Speed (mph)	Recommended Treatment
2022 Existing	9,400	40	Separated Bikeway
2030 No Build	10,800	40	Separated Bikeway
2050 No Build	14,200	40	Separated Bikeway

Figure 14. Bicycle Facility Tier Identification Matrix



Separation Options

As referenced in Figure 14, Table 3-7 in the BUD provides guidance for the type of separation options for bikeways based on the urban context. Based on the urban context "Rural Community" as identified in the Corridor Vision Statement and agreed upon by the project management team (PMT), the recommendation separation options include:

- Parking, raised island, flexible delineator posts, planters, concrete barrier, guardrail, bioswale, ditch.

Findings

This section summarizes the findings of the existing and future Safety, Operations, and Active Transportation Analysis for the study area. These findings will be used to inform the Alternatives Analysis, which will consider a No-Build Scenario, a three-lane Scenario, and a five-lane Scenario for the study area.

Roadway Characteristics Findings

- Within the study area, US 26 has a five-lane cross-section (two lanes in each direction with a center two-way left-turn lane), with a posted speed limit of 40 mph. US 26 travels through the center of a rural commercial zone buffered by rural residential zoning on the east and west ends of the community.
- Observed speed data showed 85th percentile speeds of 58 mph on both ends of the study area, substantially higher than the posted speed of 40 mph.
- Key destinations are located on both sides of US 26 with no connecting sidewalk and bicycle facilities and no marked pedestrian crossings of US 26.

Safety Findings

- Between 2016 and 2020, eight total crashes were reported within the study area with none resulting in fatalities or serious injuries.
- Reported crash types included sideswipe-overtaking (three crashes), turning movement (two crashes), sideswipe-meeting (one crash), rear-end (one crash), and fixed-object (one crash).
- Half of all crashes occurred during dark, dawn, or dusk conditions.
- None of the study area crash rates exceeded the 90th percentile crash rates for similar facilities.
- The study area ranked among the highest category for Pedestrian and Bicyclist risk factor scoring across the entire state of Oregon as identified within the ODOT Bicycle and Pedestrian Safety Implementation Plan.
- The segment crash rate exceeded the average crash rates for rural principal arterials in Oregon between 2016 and 2020.
- Several roadway characteristics contributing to high pedestrian and bicycle risk include number of lanes, speed, lack of dedicated pedestrian and bicycle facilities, and undefined accesses to businesses along the highway.

Traffic Operations Findings

- Traffic volumes peak on Sunday and Friday, likely due to recreational traffic. Thursday was analyzed to represent a typical weekday condition.

- The project team selected HCS using HCM default values for this project as the most appropriate tool to use for intersection and segment operations analyses for the study area based on field observations and sensitivity analyses.
- All study intersection met ODOT v/c ratios targets under existing and future weekday conditions.
- The segment analysis showed the US 26 highway corridor is anticipated to continue to operate acceptably under 2050 No-Build scenarios.

Active Transportation Findings

- The study area has six-foot paved shoulders but lacks dedicated pedestrian and bicycle facilities including sidewalks, marked crosswalks, and bicycle lanes.
- Under existing, 2030 No-Build, and 2050 No-Build conditions, STRE approval would be required for any pedestrian crossing of the highway without a median because it is a five-lane roadway.
- Based on existing and projected highway volumes and speeds, Table 310.3-A of the 2022 ODOT Traffic Manual recommends a traffic signal or PHB if a pedestrian refuge is not provided or an RRFB if a pedestrian refuge island is provided.
- Additional supporting features for an enhanced crossing should include pedestrian refuge island (at least six feet wide); wide advance stop bar and STOP HERE FOR PEDESTRIANS sign (if 2+ lanes in one direction); continental-style crosswalk marking; parking restrictions on crosswalk approach; lighting according to ODOT Traffic Lighting Design Manual; and crosswalk warning sign(s) for speed ≥ 30 mph. Optional treatments include curb extensions and reducing the number of motor vehicle lanes.
- Under existing, 2030 No-Build, and 2050 No-Build conditions, application of the BUD's Bicycle Facility Tier Identification Matrix results in a recommended separated bikeway for US 26 in the study area.
- Separation options include Parking, raised island, flexible delineator posts, planters, concrete barrier, guardrail, bioswale, ditch.

Appendices

Appendix A: Methodology Memorandum

Appendix B: Vehicle Classification Data

Appendix C: Speed Data

Appendix D: ODOT Crash Data

Appendix E: HCS & SIDRA 2022/2050 Comparison Analyses Reports

Appendix F: SIDRA Existing 2022 Intersection and Network Analyses

Appendix G: SIDRA 2030 No-Build Intersection and Network Analyses

Appendix H: SIDRA 2050 No-Build Intersection and Network Analyses

Appendix I: HCS 2030 and 2050 No-Build Intersection Analyses

Appendix J: Queue Analysis Worksheets

Appendix K: HCS Segment Analyses Results

Appendix A : Methodology Memorandum

Appendix B : Vehicle Classification

Appendix C : Speed Data

Appendix D : ODOT Crash Data

Appendix E : HCS & SIDRA 2022/2050 Comparison Analyses Reports

Appendix F : SIDRA Existing 2022 No-Build Intersection and Average Network Speed Analysis

Appendix G SIDRA 2030 No-Build Intersection and Average Network Speed Analysis

Appendix H : SIDRA 2050 No-Build Intersection and Average Network Speed Analysis

Appendix I HCS 2030 and 2050 Intersection Analyses Results

Appendix J Queue Analysis Worksheets

Appendix K HCS Segment Anal Results