

# Traffic Impact Analysis

Port of Chehalis Hydrogen Fueling Facility

Chehalis, Washington

**Prepared For:**

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September 2022



**SCJ ALLIANCE**  
CONSULTING SERVICES

# Traffic Impact Analysis

## **Project Information**

Project: Port of Chehalis Hydrogen Fueling Facility

Prepared for: JSA Civil, LLC

## **Reviewing Agency**

Jurisdiction: Lewis County

## **Project Representative**

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Project Reference: SCJ #22-000582

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## Signature

The technical material and data contained in the Traffic Impact Analysis were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.



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Prepared by Ryan Shea, PTP, Senior Transportation  
Planner



09/27/2022

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Approved by Perry Shea, PE, Principal

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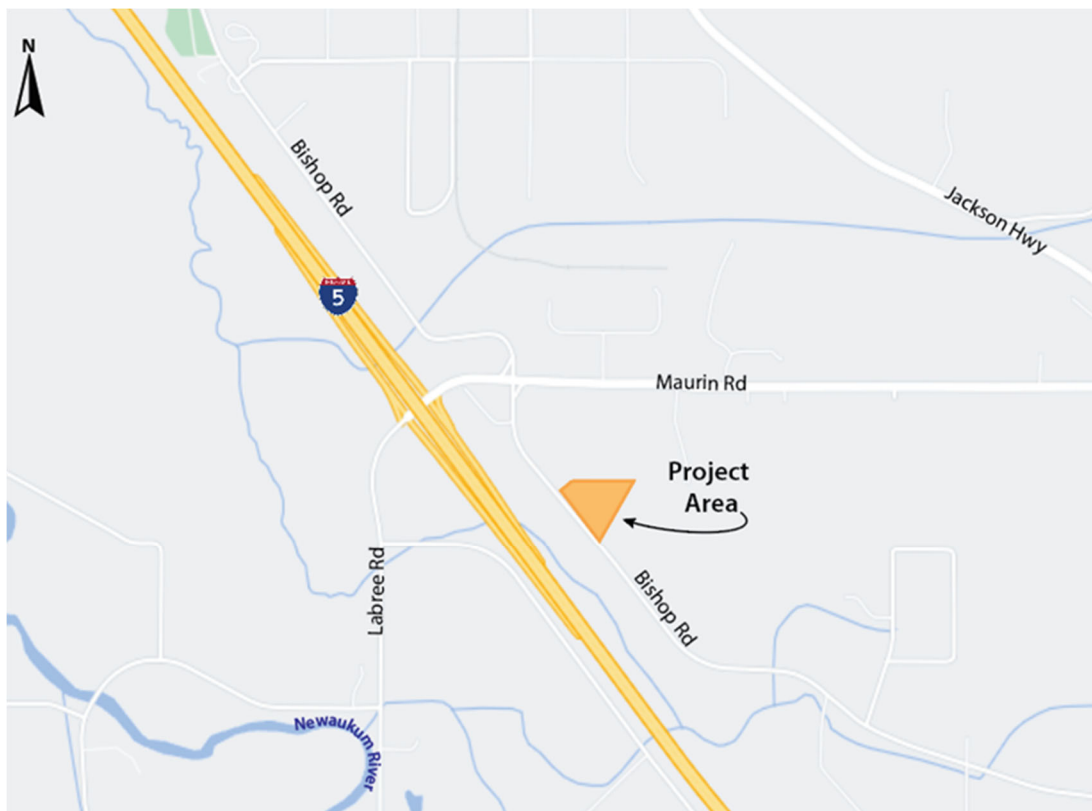
# 1 Introduction

## 1.1 Project Overview

A hydrogen fueling facility is being proposed on an undeveloped parcel located at 1697 Bishop Road in Lewis County near Chehalis, Washington. The proposed project would construct a three-pump hydrogen fueling facility.

**Figure 1** illustrates the site vicinity and the transportation network serving the project area.

**Figure 1.** Site Vicinity Map



## 1.2 Study Context

This report has been prepared to provide the traffic analysis and project information to assist Lewis County in reviewing the development proposal. A Traffic Scoping Letter was prepared and submitted to the County, which documented the trip generation, distribution, and assignment of estimated project trips. The following intersections are included for analysis:

- ◆ Labree Road/Maurin Road at Bishop Road
- ◆ Site Driveway at Bishop Road

Operational analysis has been prepared for existing 2022 PM peak hour conditions and forecasted 2023 PM peak hour conditions with and without completion of the development.

## 2 Project Description

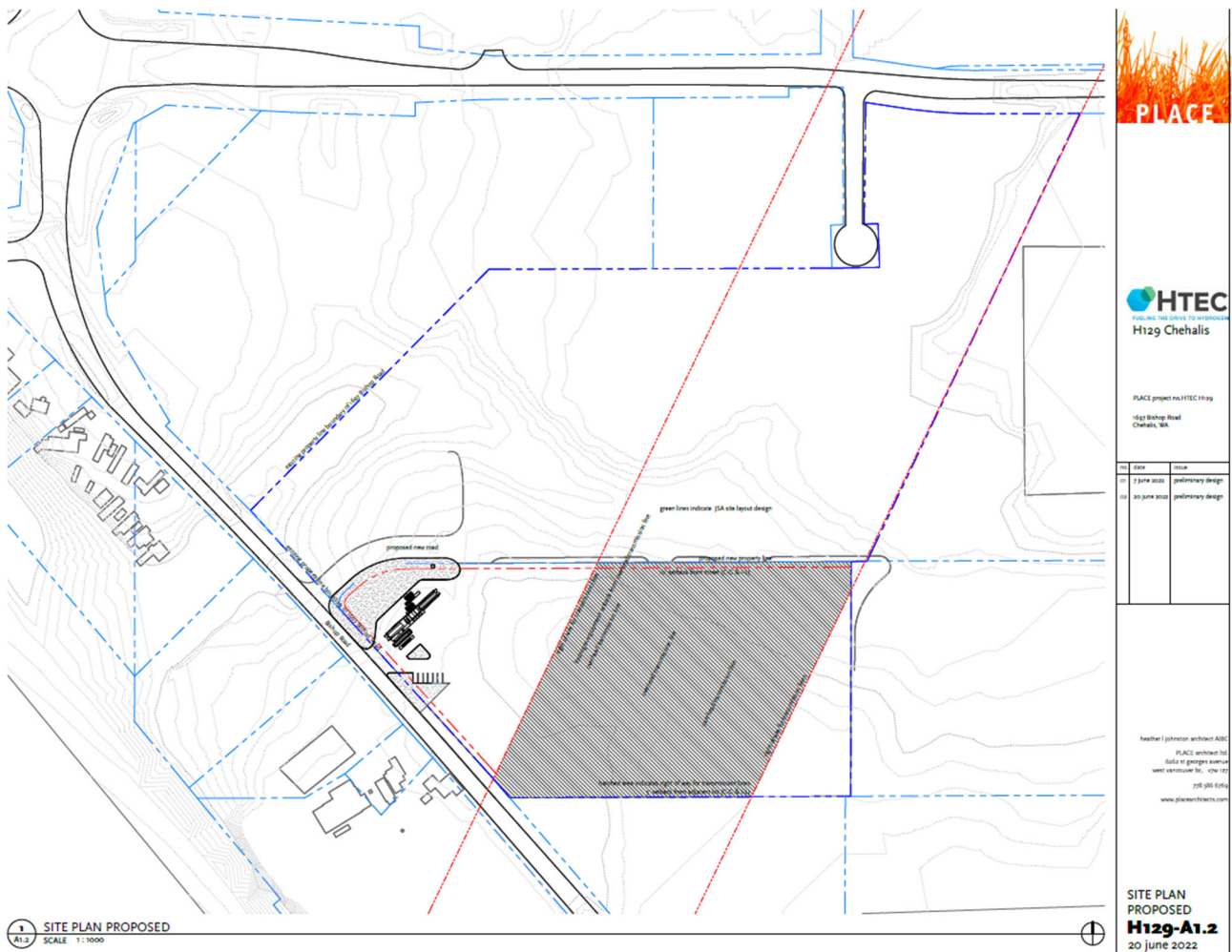
### 2.1 Development Proposal

The proposed project would construct a three-pump hydrogen fueling facility. The facility will initially serve the Twin Transit bus fleet but will be available for all vehicles. While this fuel source is not expected to draw the same consistent volume of traffic today as more established fuels like gasoline or even electricity, this analysis assumes eventual use at similar levels to current gasoline fueling stations.

Access to the project will be provided by a driveway along Bishop Road. A new east-west road is being proposed along the northern project frontage with the potential of an access point to the project site. For this analysis, all project trips have been assigned to the proposed driveway on Bishop Road. The project is anticipated to open in 2023.

The preliminary site plan is provided on **Figure 2**.

**Figure 2. Preliminary Site Plan**



## 3 Existing Conditions

### 3.1 Area Land Uses

The proposed project will be located on undeveloped land located at 1697 Bishop Road in Lewis County. The site is located within the City of Chehalis's Urban Growth Boundary but outside of the city limits. The site is under the land use jurisdiction of Lewis County. The adjacent land uses are industrial.

### 3.2 Roadway Inventory

#### 3.2.1 Bishop Road

Bishop Road is minor arterial roadway that runs north-south along the western property frontage. This roadway has a single travel lane in each direction with paved shoulders and a posted speed limit is 35 mph. The Lewis County Comprehensive Plan Transportation element identifies Bishop Road as a T-3 freight route.

#### 3.2.2 Interstate 5

Interstate 5 (I-5) is a north-south divided highway with posted speed limit of 70 mph, north of the project site the speed limit drops to 60 mph. In the project area the roadway provides three lanes in each direction. Interstate 5 is classified an Urban Interstate and is a highway of statewide significance (HSS).

#### 3.2.3 Labree Road

Labree Road, within the project vicinity, is an east-west minor arterial with a posted speed limit of 35 mph. Labree Road provides connections to and from I-5. This roadway provides 6 to 8 travel lanes through the I-5 interchange. East and west of the interchange, Labree Road provides one travel lane in each direction. The Lewis County Comprehensive Plan Transportation element identifies Labree Road (within the project vicinity) as a T-3 freight route.

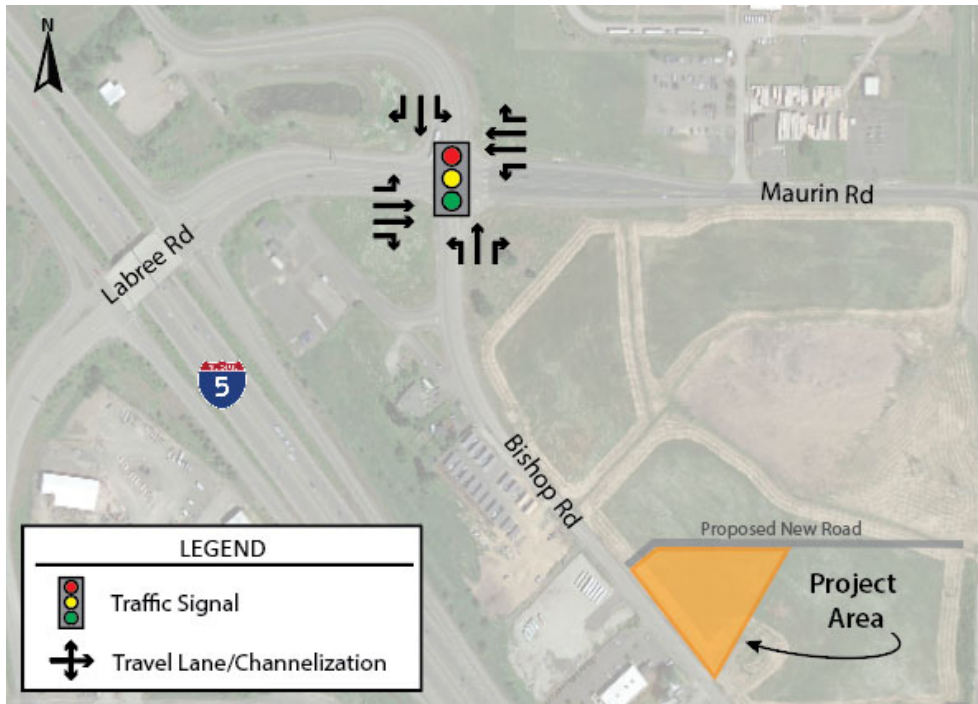
#### 3.2.4 Maurin Road

Maurin Road is major collector roadway that runs east-west north of the project site. This roadway has a single travel lane in each direction with paved shoulders and a posted speed limit is 35 mph. The Lewis County Comprehensive Plan Transportation element identifies Maurin Road as a T-3 freight route.

A summary of the existing intersection channelization and control type for each of the study intersections is provided in **Figure 3**.



Figure 3. Existing Channelization and Intersection Control



### 3.3 Traffic Volume Data

Traffic Count Consultants, TC2, a transportation data collection service, provided evening peak period turning movement counts for the Labree Road/Maurin Road at Bishop Road intersection.

The counts were conducted on September 8, 2022 between 4:00 and 6:00 PM for the PM peak hour.

**Figure 4** shows the existing, 2022 PM peak hour traffic volumes for the study intersections.

The turning movement count diagrams are provided in **Appendix A**

Figure 4. Existing 2022 PM Peak Hour Traffic Volumes



### 3.4 Crash History

The Washington Department of Transportation provides crash data for study area roadways. The data was collected over the five-year span between January 1, 2017 and December 31, 2021. We have summarized the crash data in **Table 1**.

**Table 1. Existing Crash Severity**

Intersection	Fatal	Serious Injury	Minor Injury	Possible Injury	Property Damage Only	Total
Labree Road/Maurin Road at Bishop Road	0	0	0	1	4	5

Overall, 80% of all the reported crashes were classified as property damage only (no apparent injury). There were no fatal or serious injury crashes reported.

### 3.5 Transit and Non-Motorized Facilities

Twin Transit currently serves Chehalis and Centralia with transit services and also provides express service to Grand Mound, Tumwater, Olympia, and Castle Rock. The closest transit stop is located approximately 0.50 miles northeast of the project site along Maurin Road.

In the project vicinity, there are currently no sidewalks or bike lanes provided along any of the study area roadways.

## 4 Project Traffic Characteristics

The project-related characteristics having the most effect on area traffic conditions are peak hour trip generation and the directional distribution of traffic volumes on the surrounding roadway network. The PM peak hour was selected as the traffic analysis period as it represents the highest potential traffic condition on area roadways.

### 4.1 Site-Generated Traffic Volumes

Vehicle trip generation was calculated using the trip generation rates contained in the 11<sup>th</sup> edition of the *Trip Generation Manual* by the *Institute of Transportation Engineers (ITE)*. Gasoline/Service Station (land use code 944) land use category best matches the proposed development and has been used to calculate the trip generation.

#### *Pass-By*

Typically, a gas station would be expected to attract some traffic from people already driving on adjacent roadways. These trips are not new trips added to the local roadway system (primary trips) but represent “pass-by” trips according to the following definition:

*Pass-by trips:* Pass-by trips are trips made as an intermediate stop from an origin to a primary destination (i.e., stopping to shop on the way home from work) by vehicles passing directly by the project driveway.

The established pass-by percentage for Gasoline/Service Station (land use code 944) is 58% for the AM peak period and 42% for the PM peak period, which is provided in the 3<sup>rd</sup> edition of the *Trip Generation Handbook* by ITE. However, given the specific nature of the proposed fueling station and the initial intended use by the Twin Transit Fleet, it is assumed that this site will not draw vehicles from the existing volumes on Bishop Road. Rather, this analysis assumes all traffic will be primary trips from the surrounding area.

The trip generation rates used for the PM peak hour are shown in **Table 2**.

**Table 2. PM Peak Hour Trip Generation Rates**

Peak Period	Variable	Trip Rate	Enter %	Exit %
AM peak hour of Adjacent Street	Fueling Positions	10.28	50%	50%
PM peak hour of Adjacent Street	Fueling Positions	13.91	50%	50%

The total trip generation expected from this project is calculated by applying the unit measure for the land use category to the appropriate trip generation rate. The trip generation calculations for the proposed *Port of Chehalis Hydrogen Fueling Facility* project are shown in **Table 3** and provided in **Appendix B**.

**Table 3. PM Peak Hour Project Trip Generation**

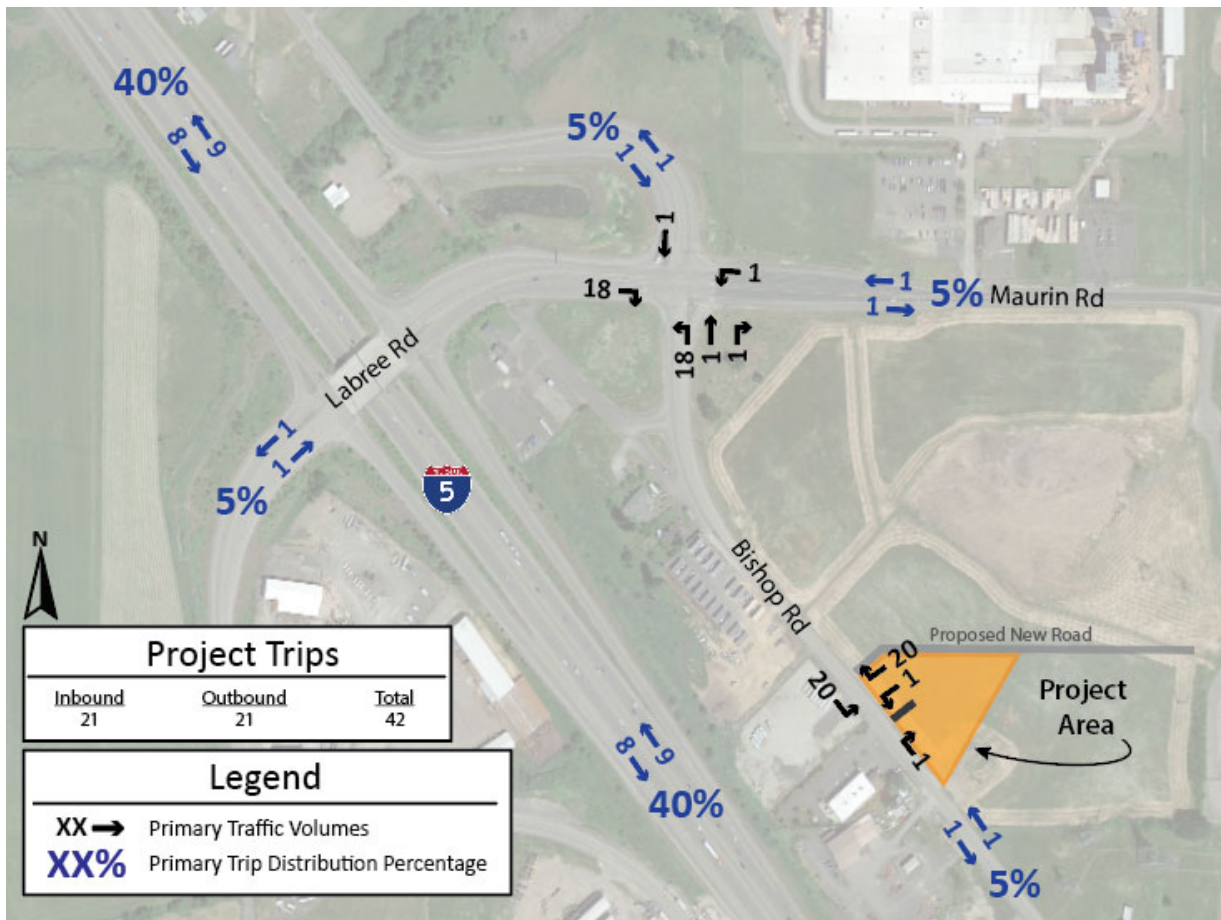
Peak Period	Size	Total Trips	Enter	Exit
AM peak hour of Adjacent Street	3	31	15	16
PM peak hour of Adjacent Street	3	42	21	21

## 4.2 Site Traffic Distribution and Assignment

For this study, the regional distribution of traffic to and from the proposed project was estimated based on locations and densities of the potential customer base, as well as the proximity of the nearby Labree Road interchange with I-5.

The resultant traffic distribution percentages and traffic assignments are shown on **Figure 5** for the PM peak hour.

**Figure 5. Site-Generated PM Peak Hour Volumes**





## 5 Future Traffic Conditions

### 5.1 Roadway Network Improvements

The Lewis County 2021-2026 6-year Transportation Improvement Program (TIP) does not include an identified project that could affect the study area. The Lewis County Comprehensive Plan Transportation element was reviewed, and no projects were identified in the project area.

### 5.2 Future Traffic Volumes

Traffic volume forecasts were prepared for PM peak hour conditions for the 2023 opening year. The future traffic volume forecast includes non-specific background traffic growth and estimated traffic generated by the proposed project.

It is anticipated that background growth will occur within the study area and affect traffic volumes. To calculate a background growth rate historic traffic counts on the I-5/Labree Road interchange for 2010 and 2018 were identified. An annualized growth rate between the two data points was determined which equates to 9 percent per year. This rate was applied to existing traffic volumes at the study area intersections to obtain future 2023 turning movement projections.

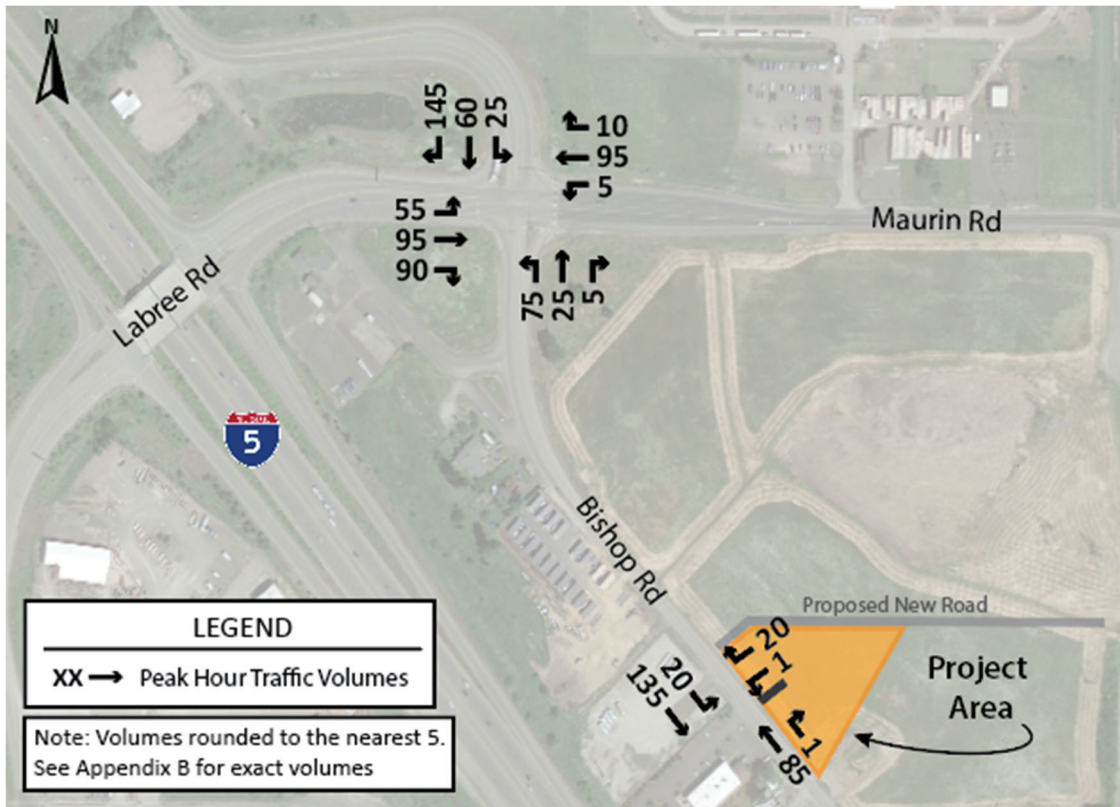
The projected 2023 traffic volumes without the project are shown on **Figure 6**. The projected 2023 traffic volumes with project are shown on **Figure 7**.

The traffic volume calculations for the study intersections are included in **Appendix B**.

Figure 6. Projected 2023 PM Peak Hour Traffic Volumes without Project



Figure 7. Projected 2023 PM Peak Hour Traffic Volumes with Project



## 6 Traffic Operations Analysis

Traffic analyses were conducted to identify any deficiencies within the study area for the PM peak hour in the 2022 base year and the 2023 project opening year. The PM peak hour was selected as the traffic analysis period as it represents the highest potential traffic condition on area roadways.

### 6.1 Level of Service

The acknowledged source for determining overall capacity for arterial segments and independent intersections is the current edition of the *Highway Capacity Manual* (HCM). Intersection analysis was performed using the Synchro software package. This software implements the methods of the 6<sup>th</sup> edition HCM.

Capacity analysis results are described in terms of Level of Service (LOS). LOS is a qualitative term describing operating conditions a driver will experience while traveling on a particular street or highway during a specific time interval. It ranges from A (very little delay) to F (long delays and congestion).

The Lewis County Comprehensive Plan transportation element identifies a mobility target of LOS D or better for county roads and intersections.

#### 6.1.1 Intersection Operations

For signalized intersections, the overall LOS grade represents the weighted average of all movements at the intersection. For intersections under minor street stop-sign control, the LOS of the most difficult movement (typically the minor street left turn) represents the intersection level of service. The LOS/delay criteria for stop sign-controlled intersections are different than for signalized intersections

because driver expectation is that a signalized intersection is designed to carry higher traffic volumes and experience greater delay.

**Table 4** shows the Level of Service criteria for stop-controlled intersections and signalized intersections.

**Table 4. Level of Service Criteria for Intersections**

Level of Service	Signalized/Roundabout Intersection Average Control Delay (seconds/vehicle)	Stop-Controlled Intersection Average Control Delay (seconds/vehicle)
A	≤ 10	≤ 10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-50
F	> 80	> 50

## 6.2 Volume to Capacity Ratio

Another measure of the performance of an intersection is the “degree of saturation” which is typically presented as the “volume to capacity” (v/c) ratio. Many factors affect the volume of traffic an intersection can accommodate during a specific time interval. These factors include the number of lanes, lane widths, the type of signal phasing, the number of parking maneuvers on the adjacent street, etc. Based on these factors, the intersection (or individual lane group) is determined to have a total theoretical vehicle carrying capacity “c” for the analysis period. The analysis period volume “v” is compared to the calculated carrying capacity and presented as a ratio. If the v/c ratio is below 1.0, the demand volume is less than the maximum capacity. If the v/c ratio is over 1.0, the demand volume is exceeding the available capacity.

## 6.3 Intersection Analysis

The analysis was conducted for the following scenarios:

- Existing 2022 traffic volumes
- Projected 2023 traffic volumes without the Project
- Projected 2023 traffic volumes with the Project

The intersection control and channelization are documented earlier in this report in Figure 3. The LOS analysis worksheets are included in **Appendix C**. Following is a description of the Level of Service analysis results for the study intersections with the scenarios listed above.

### 6.3.1.1 Labree Road/Maurin Road at Bishop Road

This is a four-legged intersection under traffic signal control. In PM peak hour, the intersection currently operates at a LOS A. In the projected 2023 horizon, this intersection is expected to operate at LOS B with and without project traffic.



### 6.3.1.2 Site Driveway at Bishop Road

This will be a three-legged intersection under stop-sign control for the westbound approach. In the PM peak hour, this intersection is projected to operate at LOS A in the 2023 horizon year with project traffic.

The intersection operational results for the PM peak hour are presented in **Table 5**.

**Table 5. PM Peak Hour Intersection Operating Conditions**

Intersection	Control	Base Year 2022		Projected 2023 Without Project		Projected 2023 With Project	
		LOS (Delay)	Worst V/C Ratio	LOS (Delay)	Worst V/C Ratio	LOS (Delay)	Worst V/C Ratio
Labree Road/Maurin Road at Bishop Road	Signal	A (8.9)	0.22	B (15.6)	0.64	B (16.1)	0.65
Site Driveway at Bishop Road	TWSC <sup>2</sup>	-	-	-	-	A (9.2)	0.03

1. Two-Way Stop-Control

## 6.4 Site Driveway Analysis

The project proposes to construct a driveway on Bishop Road that will serve as the primary access to the project. A left-turn warrant analysis and sight distance analysis have been performed for the proposed driveway and are discussed below.

### 6.4.1 Left-Turn Warrant Analysis

A left-turn warrant analysis has been performed for the proposed site driveway on Bishop Road based on forecasted 2023 PM peak hour traffic volumes. Using the WSDOT guidelines for left turn lanes (exhibit 1310-7a) a left turn lane is not warranted at the driveway. The warrant graphic is included in **Appendix D**.

### 6.4.2 Sight Distance Analysis

The proposed site driveway is located on a long, straight, and flat stretch of Bishop Road. With a posted speed of 35 MPH, the driveway would need to provide 390 feet of sight distance to meet full intersection entering sight distance. The proposed driveway location provides over 600 feet of visibility in each travel direction, more than meeting the recommended intersection sight distance for entering vehicles.

## 7 Summary and Conclusions

A hydrogen fueling facility is being proposed on an undeveloped parcel located at 1697 Bishop Road in Lewis County near Chehalis, Washington. The proposed project would construct a three-pump hydrogen fueling facility. The facility will initially serve the Twin Transit bus fleet but will be available for all vehicles. Access to the project will be provided by a driveway along Bishop Road. A new east-west road is being proposed along the northern project frontage with the potential of an additional access point to the project site.

At full occupancy and operation, the project is estimated to generate approximately 42 new-to-network trip ends during the PM peak hour. An evaluation of the existing 2022 and project opening year (2023) with and without the project traffic was performed. All of the study area intersections are projected to operate at LOS B or better.

# Appendix A

## Traffic Volume Counts



Prepared for: **SCJ Alliance**

**Traffic Count Consultants, Inc.**

Phone: (253) 770-1407 FAX: (253) 770-1411 E-Mail: Team@TC2inc.com

WBE/DBE

**Intersection:** Bishop Rd & Maurin Rd/Labree Rd

**Date of Count:** Thu 09/08/2022

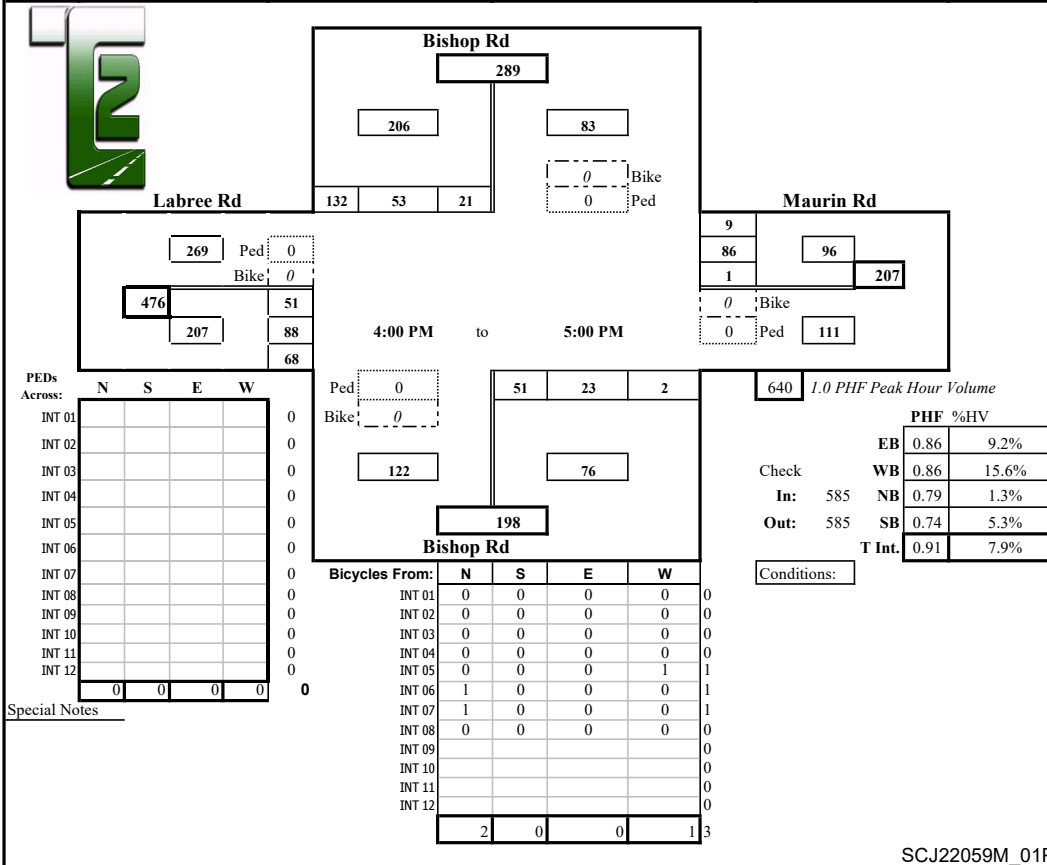
**Location:** Chehalis, Washington

**Checked By:** Jen

Time Interval	From North on (SB) Bishop Rd				From South on (NB) Bishop Rd				From East on (WB) Maurin Rd				From West on (EB) Labree Rd				Interval Total
	T	L	S	R	T	L	S	R	T	L	S	R	T	L	S	R	
4:15 P	4	5	17	48	0	7	5	0	6	0	21	2	6	15	14	16	150
4:30 P	3	4	14	20	0	17	6	1	2	0	19	3	7	11	17	23	135
4:45 P	2	8	10	41	1	14	7	1	1	1	23	4	1	11	23	17	160
5:00 P	2	4	12	23	0	13	5	0	6	0	23	0	5	14	34	12	140
5:15 P	2	1	6	25	0	12	4	0	1	0	17	5	2	10	35	18	133
5:30 P	2	7	12	12	0	10	5	0	3	0	32	2	3	5	32	20	137
5:45 P	1	2	8	14	0	10	4	0	1	0	48	7	5	18	27	22	160
6:00 P	1	3	4	11	0	9	3	1	2	0	28	1	4	11	21	10	102
6:15 P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Total Survey	17	34	83	194	1	92	39	3	22	1	211	24	33	95	203	138	1117
Peak Hour: 4:00 PM to 5:00 PM																	

Total	11	21	53	132	1	51	23	2	15	1	86	9	19	51	88	68	585
Approach	206				76				96				207				585
%HV	5.3%				1.3%				15.6%				9.2%				7.9%
PHF	0.74				0.79				0.86				0.86				0.91



# Appendix B

## Traffic Volume Calculation Worksheets





# Port of Chehalis Hydrogen Fueling Facility

PM Peak Hour Volumes

Growth Rate: 9%

Intersection	Movement		Existing	Background	Baseline	Site	Projected
			2022	2023	2023	Generated	2023
			Counts	Growth	Volumes	Volumes	Volumes
<b>1</b> <b>Labree Rd/Maurin Rd</b> <b>Bishop Rd</b>  TMC Date: 09/08/2022  4:00 - 5:00 PM PHF: 0.91		L	51	5	56	0	56
	EB	T	88	8	96	0	96
		R	68	6	74	18	92
		L	1	0	1	1	2
	WB	T	86	8	94	0	94
		R	9	1	10	0	10
		L	51	5	56	18	74
	NB	T	23	2	25	1	26
		R	2	0	2	1	3
		L	21	2	23	0	23
	SB	T	53	5	58	1	59
		R	132	12	144	0	144
				<b>585</b>		<b>40</b>	<b>678</b>
<b>2</b> <b>Site Driveway</b> <b>Bishop Rd</b>		L	0	0	0	0	0
	EB	T	0	0	0	0	0
		R	0	0	0	0	0
		L	0	0	0	1	1
	WB	T	0	0	0	0	0
		R	0	0	0	20	20
		L	0	0	0	0	0
	NB	T	76	7	83	0	83
		R	0	0	0	1	1
		L	0	0	0	20	20
	SB	T	122	11	133	0	133
	R	0	0	0	0	0	
			<b>198</b>		<b>42</b>	<b>258</b>	

# Appendix C

## Capacity Analysis Worksheets



Lanes, Volumes, Timings  
3: Bishop Rd & Labree Rd/Maurin Rd

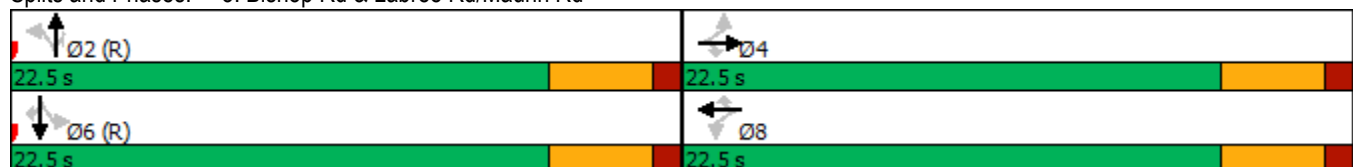
Existing 2022  
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	90	70	5	85	10	50	25	5	20	55	130
Future Volume (vph)	50	90	70	5	85	10	50	25	5	20	55	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		300	350		350	225		225	450		400
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		511			582			807			560	
Travel Time (s)		11.6			13.2			18.3			12.7	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2		2	6		6
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Maximum Green (s)	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0

Intersection Summary

























Area Type: Other  
 Cycle Length: 45  
 Actuated Cycle Length: 45  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green  
 Natural Cycle: 45  
 Control Type: Pretimed

Splits and Phases: 3: Bishop Rd & Labree Rd/Maurin Rd



HCM 6th Signalized Intersection Summary  
3: Bishop Rd & Labree Rd/Maurin Rd

Existing 2022  
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	90	70	5	85	10	50	25	5	20	55	130
Future Volume (veh/h)	50	90	70	5	85	10	50	25	5	20	55	130
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	54	98	76	5	92	11	54	27	5	22	60	141
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	656	1421	634	624	1421	634	609	748	634	699	748	634
Arrive On Green	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Sat Flow, veh/h	1291	3554	1585	1211	3554	1585	1181	1870	1585	1377	1870	1585
Grp Volume(v), veh/h	54	98	76	5	92	11	54	27	5	22	60	141
Grp Sat Flow(s),veh/h/ln	1291	1777	1585	1211	1777	1585	1181	1870	1585	1377	1870	1585
Q Serve(g_s), s	1.2	0.8	1.4	0.1	0.7	0.2	1.3	0.4	0.1	0.4	0.9	2.6
Cycle Q Clear(g_c), s	1.9	0.8	1.4	0.9	0.7	0.2	2.2	0.4	0.1	0.8	0.9	2.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	656	1421	634	624	1421	634	609	748	634	699	748	634
V/C Ratio(X)	0.08	0.07	0.12	0.01	0.06	0.02	0.09	0.04	0.01	0.03	0.08	0.22
Avail Cap(c_a), veh/h	656	1421	634	624	1421	634	609	748	634	699	748	634
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	8.9	8.3	8.5	8.6	8.3	8.2	9.1	8.2	8.1	8.5	8.4	8.9
Incr Delay (d2), s/veh	0.2	0.1	0.4	0.0	0.1	0.1	0.3	0.1	0.0	0.1	0.2	0.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.2	0.4	0.0	0.2	0.1	0.3	0.1	0.0	0.1	0.3	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	9.2	8.4	8.9	8.6	8.4	8.2	9.3	8.3	8.1	8.6	8.6	9.7
LnGrp LOS	A	A	A	A	A	A	A	A	A	A	A	A
Approach Vol, veh/h		228			108			86			223	
Approach Delay, s/veh		8.8			8.4			9.0			9.3	
Approach LOS		A			A			A			A	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		22.5		22.5		22.5		22.5				
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5				
Max Green Setting (Gmax), s		18.0		18.0		18.0		18.0				
Max Q Clear Time (g_c+I1), s		4.2		3.9		4.6		2.9				
Green Ext Time (p_c), s		0.2		0.8		0.7		0.4				
<b>Intersection Summary</b>												
HCM 6th Ctrl Delay				8.9								
HCM 6th LOS				A								

Lanes, Volumes, Timings  
1: Bishop Rd & Labree Rd/Maurin Rd

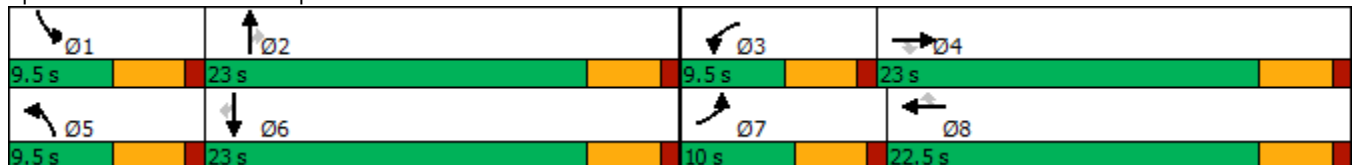
Projected 2023 Without Project  
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	95	75	5	95	10	55	25	5	25	60	145
Future Volume (vph)	55	95	75	5	95	10	55	25	5	25	60	145
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		300	350		350	225		225	450		400
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		511			582			807			560	
Travel Time (s)		10.0			11.3			15.7			10.9	
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	9.5	22.5	22.5	9.5	22.5	22.5	9.5	22.5	22.5	9.5	22.5	22.5
Total Split (s)	10.0	23.0	23.0	9.5	22.5	22.5	9.5	23.0	23.0	9.5	23.0	23.0
Total Split (%)	15.4%	35.4%	35.4%	14.6%	34.6%	34.6%	14.6%	35.4%	35.4%	14.6%	35.4%	35.4%
Maximum Green (s)	5.5	18.5	18.5	5.0	18.0	18.0	5.0	18.5	18.5	5.0	18.5	18.5
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	Min	Min	Min	Min	Min	Min	None	None	None	None	None	None
Walk Time (s)					7.0	7.0		7.0	7.0			
Flash Dont Walk (s)					11.0	11.0		11.0	11.0			
Pedestrian Calls (#/hr)					0	0		0	0			

Intersection Summary

























Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 34.6  
 Natural Cycle: 65  
 Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Bishop Rd & Labree Rd/Maurin Rd



HCM 6th Signalized Intersection Summary  
 1: Bishop Rd & Labree Rd/Maurin Rd

Projected 2023 Without Project  
 PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	55	95	75	5	95	10	55	25	5	25	60	145
Future Volume (veh/h)	55	95	75	5	95	10	55	25	5	25	60	145
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1767	1767	1767	1663	1663	1663	1885	1885	1885	1826	1826	1826
Adj Flow Rate, veh/h	60	104	82	5	104	11	60	27	5	27	66	159
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	9	9	9	16	16	16	1	1	1	5	5	5
Cap, veh/h	234	466	208	220	439	196	112	358	303	57	292	248
Arrive On Green	0.14	0.14	0.14	0.14	0.14	0.14	0.06	0.19	0.19	0.03	0.16	0.16
Sat Flow, veh/h	1682	3357	1497	1584	3159	1409	1795	1885	1598	1739	1826	1547
Grp Volume(v), veh/h	60	104	82	5	104	11	60	27	5	27	66	159
Grp Sat Flow(s),veh/h/ln	1682	1678	1497	1584	1580	1409	1795	1885	1598	1739	1826	1547
Q Serve(g_s), s	1.1	1.0	1.8	0.1	1.1	0.2	1.2	0.4	0.1	0.5	1.1	3.5
Cycle Q Clear(g_c), s	1.1	1.0	1.8	0.1	1.1	0.2	1.2	0.4	0.1	0.5	1.1	3.5
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	234	466	208	220	439	196	112	358	303	57	292	248
V/C Ratio(X)	0.26	0.22	0.39	0.02	0.24	0.06	0.53	0.08	0.02	0.47	0.23	0.64
Avail Cap(c_a), veh/h	257	1724	769	220	1579	704	249	968	821	241	938	795
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	13.9	13.8	14.1	13.4	13.8	13.5	16.4	12.0	11.9	17.1	13.2	14.2
Incr Delay (d2), s/veh	0.6	0.2	1.2	0.0	0.3	0.1	3.9	0.1	0.0	5.9	0.4	2.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.3	0.5	0.0	0.3	0.1	0.5	0.1	0.0	0.3	0.4	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	14.4	14.0	15.3	13.4	14.1	13.6	20.3	12.1	11.9	23.1	13.6	16.9
LnGrp LOS	B	B	B	B	B	B	C	B	B	C	B	B
Approach Vol, veh/h		246			120			92			252	
Approach Delay, s/veh		14.6			14.0			17.4			16.7	
Approach LOS		B			B			B			B	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	5.7	11.3	9.5	9.5	6.8	10.3	9.5	9.5				
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5				
Max Green Setting (Gmax), s	5.0	18.5	5.0	18.5	5.0	18.5	5.5	18.0				
Max Q Clear Time (g_c+I1), s	2.5	2.4	2.1	3.8	3.2	5.5	3.1	3.1				
Green Ext Time (p_c), s	0.0	0.1	0.0	0.7	0.0	0.7	0.0	0.4				
<b>Intersection Summary</b>												
HCM 6th Ctrl Delay			15.6									
HCM 6th LOS			B									

Lanes, Volumes, Timings  
1: Bishop Rd & Labree Rd/Maurin Rd

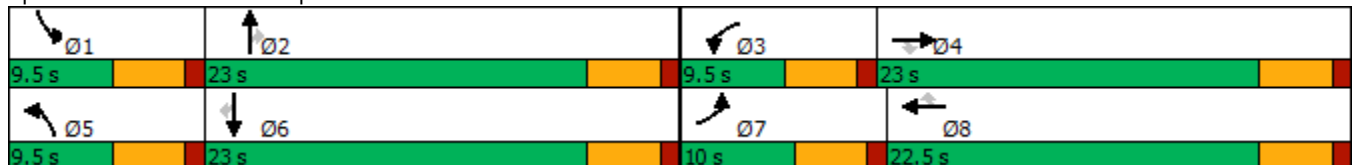
Projected 2023 With Project  
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	95	90	5	95	10	75	25	5	25	60	145
Future Volume (vph)	55	95	90	5	95	10	75	25	5	25	60	145
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		300	350		350	225		225	450		400
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		511			582			1427			560	
Travel Time (s)		10.0			11.3			27.8			10.9	
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	9.5	22.5	22.5	9.5	22.5	22.5	9.5	22.5	22.5	9.5	22.5	22.5
Total Split (s)	10.0	23.0	23.0	9.5	22.5	22.5	9.5	23.0	23.0	9.5	23.0	23.0
Total Split (%)	15.4%	35.4%	35.4%	14.6%	34.6%	34.6%	14.6%	35.4%	35.4%	14.6%	35.4%	35.4%
Maximum Green (s)	5.5	18.5	18.5	5.0	18.0	18.0	5.0	18.5	18.5	5.0	18.5	18.5
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	Min	Min	Min	Min	Min	Min	None	None	None	None	None	None
Walk Time (s)					7.0	7.0		7.0	7.0			
Flash Dont Walk (s)					11.0	11.0		11.0	11.0			
Pedestrian Calls (#/hr)					0	0		0	0			

Intersection Summary

























Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 36.6  
 Natural Cycle: 65  
 Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Bishop Rd & Labree Rd/Maurin Rd



HCM 6th Signalized Intersection Summary  
1: Bishop Rd & Labree Rd/Maurin Rd

Projected 2023 With Project  
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	55	95	90	5	95	10	75	25	5	25	60	145
Future Volume (veh/h)	55	95	90	5	95	10	75	25	5	25	60	145
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1767	1767	1767	1663	1663	1663	1885	1885	1885	1826	1826	1826
Adj Flow Rate, veh/h	60	104	99	5	104	11	82	27	5	27	66	159
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	9	9	9	16	16	16	1	1	1	5	5	5
Cap, veh/h	229	458	204	216	431	192	139	384	325	57	291	246
Arrive On Green	0.14	0.14	0.14	0.14	0.14	0.14	0.08	0.20	0.20	0.03	0.16	0.16
Sat Flow, veh/h	1682	3357	1497	1584	3159	1409	1795	1885	1598	1739	1826	1547
Grp Volume(v), veh/h	60	104	99	5	104	11	82	27	5	27	66	159
Grp Sat Flow(s),veh/h/ln	1682	1678	1497	1584	1580	1409	1795	1885	1598	1739	1826	1547
Q Serve(g_s), s	1.2	1.0	2.2	0.1	1.1	0.2	1.6	0.4	0.1	0.6	1.2	3.5
Cycle Q Clear(g_c), s	1.2	1.0	2.2	0.1	1.1	0.2	1.6	0.4	0.1	0.6	1.2	3.5
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	229	458	204	216	431	192	139	384	325	57	291	246
V/C Ratio(X)	0.26	0.23	0.49	0.02	0.24	0.06	0.59	0.07	0.02	0.47	0.23	0.65
Avail Cap(c_a), veh/h	252	1693	755	216	1551	692	245	951	806	237	921	781
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	14.2	14.1	14.6	13.7	14.1	13.8	16.4	11.8	11.7	17.4	13.4	14.4
Incr Delay (d2), s/veh	0.6	0.2	1.8	0.0	0.3	0.1	4.0	0.1	0.0	6.0	0.4	2.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.3	0.7	0.0	0.3	0.1	0.7	0.1	0.0	0.3	0.4	1.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	14.8	14.4	16.4	13.8	14.4	13.9	20.3	11.9	11.7	23.4	13.8	17.3
LnGrp LOS	B	B	B	B	B	B	C	B	B	C	B	B
Approach Vol, veh/h		263			120			114			252	
Approach Delay, s/veh		15.2			14.4			18.0			17.0	
Approach LOS		B			B			B			B	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	5.7	12.0	9.5	9.5	7.3	10.3	9.5	9.5				
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5				
Max Green Setting (Gmax), s	5.0	18.5	5.0	18.5	5.0	18.5	5.5	18.0				
Max Q Clear Time (g_c+I1), s	2.6	2.4	2.1	4.2	3.6	5.5	3.2	3.1				
Green Ext Time (p_c), s	0.0	0.1	0.0	0.7	0.0	0.7	0.0	0.4				
<b>Intersection Summary</b>												
HCM 6th Ctrl Delay			16.1									
HCM 6th LOS			B									

Intersection						
Int Delay, s/veh	1.4					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations		↶	↷		↶	↷
Traffic Vol, veh/h	20	135	85	5	5	20
Future Vol, veh/h	20	135	85	5	5	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	147	92	5	5	22

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	97	0	-	0	286 95
Stage 1	-	-	-	-	95 -
Stage 2	-	-	-	-	191 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1496	-	-	-	704 962
Stage 1	-	-	-	-	929 -
Stage 2	-	-	-	-	841 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1496	-	-	-	693 962
Mov Cap-2 Maneuver	-	-	-	-	693 -
Stage 1	-	-	-	-	914 -
Stage 2	-	-	-	-	841 -

Approach	SE	NW	SW
HCM Control Delay, s	1	0	9.2
HCM LOS			A

Minor Lane/Major Mvmt	NWT	NWR	SEL	SETSWLn1
Capacity (veh/h)	-	-	1496	- 893
HCM Lane V/C Ratio	-	-	0.015	- 0.03
HCM Control Delay (s)	-	-	7.4	0 9.2
HCM Lane LOS	-	-	A	A A
HCM 95th %tile Q(veh)	-	-	0	- 0.1

# Appendix D

## Left-Turn Warrant



