

APPENDIX D



Transportation Analysis



DATE: April 28, 2023

TO: Matt Hastie | APG|MIG

FROM: Alex Correa, Garth Appanaitis | DKS Associates

SUBJECT: East Albany Plan – TM #6 TPR Analysis and TSP Amendments Project #21181-000



This memorandum summarizes the impacts to the planned transportation system that result from the preferred East Albany Development Alternative. The planned land use changes would provide additional housing and employment capacity, though full development of all areas are not anticipated to occur within the 20-year planning horizon. Transportation analysis was conducted for the portion of growth assumed to occur within the 20-year horizon. Since the current Albany Transportation System Plan (TSP) has a planning horizon of 2030, more recent transportation **analysis conducted for Albany Area Metropolitan Planning Organization's (AAMPO) Regional Transportation Plan (RTP)** with a planning horizon of 2040 was used to establish the current land use plan baseline. The analysis indicates that the proposed land use changes would not result in additional impacts to the transportation system since the portion of growth assumed to occur over the 20-year planning horizon would not exceed established projections. The recommendations of this work will be incorporated into the next Albany TSP Update, commencing in 2023 or 2024.

PREFERRED DEVELOPMENT ALTERNATIVE OVERVIEW

Three preliminary development scenarios were summarized in prior documentation¹ that included a mix of development types and locations across the approximately 2,800 acres of East Albany. A preferred development alternative was prepared based on the study of the preliminary scenarios. The preferred development alternative map is included as an attachment.

TRANSPORTATION NETWORK

The preferred transportation network includes transportation elements that are both currently planned (in the current City of Albany TSP) and that are not currently included in the TSP.

¹ Memorandum: *East Albany Plan – Development Alternatives (Transportation Evaluation) Summary*, prepared by DKS Associates, August 24, 2022.

Several projects are already included in the Albany TSP and are likely to be funded within the planning horizon based on the 2011 Transportation System Financial Plan². These key elements/projects already included in the Albany TSP in the study area were included in both the Baseline and Preferred Alternative traffic analysis:

- New north-south street east of Goldfish Farm connecting Knox Butte to US 20 (TSP Project ID L15)
- Two new east-west streets connecting Goldfish Farm to Scrael Hill Road (TSP Project IDs L14 and L16)
- Timber Street extension south of US 20 to connect to Three Lakes Road and provide access to areas south of US 20 (TSP Project ID L4)
- Additional connections to neighborhoods north of Knox Butte (Timber Street extension, Santa Maria Avenue extension, and new north/south collector east of Goldfish Farm Road) (TSP Project IDs L18, L15, L20).
- Multimodal improvements to US20 east of I-5 to the Albany urban growth boundary (TSP Project ID L56)
- Widening Knox Butte Road to 5 lanes from I-5 to Clover Ridge Road (TSP Project ID L21)

Additional projects (not currently in the TSP) primarily improve multimodal connectivity and circulation within the East Albany area to support future development. The projects developed as part of the East Albany Plan that are not currently **in the City's TSP** would be added in the upcoming City of Albany TSP update. The preferred development alternative was assumed to include the following major transportation elements to support access, connectivity, and mobility of travel modes in addition to those projects already included in the TSP:

- Closure of Century Drive at Knox Butte Rd (Century Drive traffic routed to Expo Parkway extension via the Dunlap Avenue extension)
- Intersection control improvement (roundabout) at Knox Butte Rd / Scrael Hill Rd
- Timber Street extension north of US 20 to Blue Ox Dr
- Intersection control improvement (roundabout) at Timber / Maple Leaf
- Closure and realignment of Price Rd at US 20

² 2011 Transportation System Financial Plan, May 2011.

https://www.cityofalbany.net/images/stories/publicworks/engineering/tsp/ord5753_may2011tspupdate.pdf

- Revised cross sections for US 20 east of I-5 (currently project L56)
- Miscellaneous Bicycle and Pedestrian infrastructure improvements
 - Includes potential paths and trails in East Albany to improve connectivity for pedestrians and cyclists.
 - A new multimodal bridge structure to connect East Albany and downtown Albany across Interstate 5.

In addition to general circulation and mobility improvements within the East Albany area, these changes would modify (reduce) access near I-5 ramps by incorporating turn restrictions on US 20. One change includes limiting Fescue Street to right in right out at US 20 and routing left turn traffic to Timber Street via Spicer Drive. A second change includes limiting Price Rd to right in right out at US 20 and routing left turn traffic to Timber Street via Blue Ox Drive. These changes would route turning traffic further from US 20 and provide a signalized intersection at Timber Street to improve mobility. These new facilities and connections are intended to improve circulation in the area and to provide access to Price Road in the event of turn restrictions on US 20 near the interchange.

TRANSPORTATION ANALYSIS

The following section summarizes the transportation evaluation that was conducted for the preferred development alternatives.

Land use quantities for the preferred development alternatives, baseline, and the three preliminary scenarios were estimated based on the land use designations. The total estimated household and employment capacity for each scenario is listed in Table 1. The buildout capacity for each scenario is based upon the ultimate development, land designations and densities and is not tied to a specific time period. For 20-year horizon planning purposes, the 2043 growth projection is also provided, which is based on coordinated statewide population projections and would represent the portion of development that is assumed to occur under any of the scenarios. Table 1 indicates that each scenario provides significant household and employment capacity beyond what is assumed to develop over the 20-year planning horizon.

TABLE 1. DEVELOPMENT SCENARIO LAND USE CAPACITY SUMMARY

SCENARIO	HOUSEHOLDS	EMPLOYEES
BASE BUILDOUT	4,850	3,074
PRELIMINARY SCENARIO 1 BUILDOUT	9,136	7,442
PRELIMINARY SCENARIO 2 BUILDOUT	8,753	8,934
PRELIMINARY SCENARIO 3 BUILDOUT	8,159	8,432
PREFERRED DEVELOPMENT ALTERNATIVE BUILDOUT	9,130	8,238
HORIZON YEAR (2043) GROWTH PROJECTION (ALL SCENARIOS) *	4,850	2,529

Note: * While each scenario has varying ultimate buildout capacity, the amount of growth assumed to occur over the 20-year planning horizon was limited to adhere to established statewide population projections. However, the prior scenarios varied by location of growth (where within East Albany) as well as employment types.

As listed in Table 1, the preferred development alternative has similar household and employee capacity to the three preliminary scenarios. These development scenarios each have the potential to add additional housing and employment capacity to East Albany.

20 YEAR PLANNING HORIZON EVALUATION

Regional transportation planning in Albany uses the regional travel demand model to forecast future traffic volumes. The regional Corvallis Albany Lebanon Model (CALM) has a long-range planning horizon of 2043. The future land use assumptions for Albany that are included in the regional travel model are consistent with the statewide coordinated population projections³. The travel model indicates that approximately one third of the overall city-wide household growth (approximately 2,400 units) are assumed to occur in East Albany over the next 21 years.

Since full buildout of the preferred development alternative would exceed the 21-year forecast, an incremental growth scenario was evaluated to maintain the coordinated growth projection. The scenario was capped to include a portion of household and employment growth that was consistent with the regional travel model assumptions and statewide population forecasts. Each scenario included a portion of housing and employment growth consistent with the land use designations.

³ <https://www.pdx.edu/population-research/population-forecasts>

For the incremental 2,400 household unit growth, approximately 1,000 households have been recently approved and were accounted for in the scenario.

The preferred development alternative was evaluated using the CALM travel demand model to determine the additional traffic growth on the transportation system. Due to the incremental growth (limited to a 21-year forecast), relatively similar overall land use assumptions, and spread to an overall large size of the East Albany area, the model run did not vary significantly from the Baseline scenario.

The preferred alternative adds significant additional development capacity that is assumed to occur beyond the 20-year planning horizon. The full development of this area may result in additional growth, impacts, and traffic needs beyond what has been identified in the TSP for the 20-year growth needs. A subsequent section summarizes the type of growth impacts that may occur beyond the 20-year planning horizon.

TPR ANALYSIS

The CALM model run for the preferred scenario was used to establish post-processed intersection turn movement volumes for the 2040 PM peak hour (30 HV). These traffic volumes were used to evaluate intersection operations using the HCM 6 methodology. The RTP (2040 planning horizon) and TSP (2030 planning horizon) previously reported traffic operating conditions in the East Albany study area for the Baseline scenario⁴.

The RTP provides the following overview of the intersection operations documented in the RTP:

Intersection operations were analyzed based on the 2000 Highway Capacity Manual⁵ for signalized intersections and 2010 Highway Capacity Manual⁶ for unsignalized intersections. Level of service and v/c ratios are two commonly used performance measures that provide **a gauge of intersection operations. Level of service is a “report card” rating (A through F)** based on the average delay experienced by vehicles at the intersection. LOS A, B, and C indicate conditions where traffic moves without significant delays over periods of peak hour travel demand. LOS D and E are progressively worse operating conditions. LOS F represents conditions where average vehicle delay has become excessive and demand has exceeded capacity. This condition is typically evident in long queues and delays.

A v/c ratio is decimal representation (between 0.00 and 1.00) of the proportion of capacity that is being used (i.e., the saturation) at a turn movement, approach leg, or intersection. A

⁴ Memorandum: East Albany Plan – Gap Analysis Memorandum, prepared by DKS Associates, January 20, 2022.

⁵ *2000 Highway Capacity Manual*, Transportation Research Board, Washington DC, 2000.

⁶ *2010 Highway Capacity Manual*, Transportation Research Board, Washington DC, 2010.

lower ratio indicates smooth operations and minimal delays. As the ratio approaches 1.00, congestion increases and performance is reduced. If the ratio is greater than 1.00, the turn movement, approach leg, or intersection is oversaturated and usually results in excessive queues and long delays.

All non-state roadways within the study area are under the jurisdiction of the local or county agency. The City of Albany requires a Level of Service (LOS) D or better to be maintained for all signalized or all-way stop intersections. For uncontrolled and two-way stop controlled intersections the volume-to-capacity ratio should not exceed 0.85, for the worst movement.

ODOT intersections have mobility targets based on the Oregon Highway Plan (OHP). The volume-to-capacity target for interchanges is 0.85. Following the adoption of the AAMPO RTP, an alternate mobility target⁷ was adopted for US 20 and OR99E (non-interchange locations), which is a volume-to-capacity ratio of 1.0 during the 30HV (peak season) condition and using a peak hour factor of 1.0.

Table 3 lists the intersection operations for the 2040 PM Peak hour conditions for both the Baseline condition and the Preferred Alternative condition. The 2040 Baseline condition results were previously reported in the Albany Area MPO RTP. The intersection of Airport Road / Albany Avenue / OR 99E has a lane configuration improvement that is set to finish this spring and is assumed in the analysis for both the Baseline and Preferred Alternative⁸.

Three intersections were previously identified to not meet mobility targets for the 2040 Baseline condition. The operations for the Airport Road/Albany Avenue/OR 99E intersection and the Knox Butte Road/Clover Ridge Road intersections would improve and meet the mobility target for the Preferred Alternative condition. The intersection of I-5 Northbound / Knox Butte Road would not meet mobility targets under the Preferred Alternative but would improve relative to the Baseline condition. Therefore, the preferred alternative would not have a significant effect on the transportation system at year 2040, and additional improvements to the TSP beyond those identified in this memo would not be required.

⁷ https://www.oregon.gov/odot/Planning/OHP%20Registry/Consent_16_Attach_06_AAMPO.pdf

⁸ The lane configuration for the northbound movement is being converted to an exclusive left and through-right, which will improve intersection operations.

TABLE 3. STUDY AREA INTERSECTION OPERATIONS (FUTURE 2040 - 30 HV PEAK HOUR)

INTERSECTION	INTERSECTION CONTROL	MOBILITY TARGET	BASELINE		PREFERRED ALT	
			LOS	V/C	LOS	V/C
AIRPORT RD/ALBANY AVE / OR99E	Signalized	v/c < 1.0	E	1.11	D	0.92
I-5 NB / KNOX BUTTE RD	TWSC ⁹	v/c <0.85	B/F	0.66/>2.0	A/F	N/A/1.95
KNOX BUTTE RD / CLOVER RIDGE RD	TWSC (Baseline)	LOS D, v/c < 0.85	B/F	0.76/1.97	C	0.47
	Signalized (Preferred Alt)					
KNOX BUTTE RD / SCRAVEL HILL RD	TWSC (Baseline)	LOS D	A/B	0.13/0.25	A	0.18
	Roundabout (Preferred Alt)					
I-5 SB / US20	Signalized	v/c <0.85	D	0.78	D	0.83
I-5 NB / US20	Signalized	v/c <0.85	C	0.85	B	0.65
US20 / GOLDFISH FARM RD	Signalized	v/c<1.0	B*	0.68*	C	0.67
US20 / SCRAVEL HILL RD	TWSC	v/c<1.0	A/C	0.38/0.22	A/E	0.34/0.42
7 MILE LN / THREE LAKES RD	TWSC	LOS D	A/B	0.12/0.12	A/B	0.11/0.13
US20 / TIMBER ST	Signalized	v/c<1.0	C*	0.83*	C	0.82

*Information gathered from City of Albany TSP, which has a horizon year of 2030 rather than 2040 and base year of 2008.

⁹ TSP Project I10 identifies installing an interim traffic signal at the intersection of Knox Butte/Century Drive, if warranted. This project is not currently identified as a funded project in the TSP. Initial coordination between the City and ODOT has identified that site context related to curvature and sight distance may limit opportunities to provide a traffic signal at this location without significant modification of the surrounding system, which could be temporary and change as part of the long-term I-5 improvements. Additional sensitivity analysis was conducted that determined that under the preferred alternative, the intersection would operate with a V/C ratio of 0.51 and would meet the mobility target (v/c < 0.85) with the traffic signal and two eastbound through lanes. Due to the funding status currently documented in the TSP, the TWSC operations are reported.

POTENTIAL NEEDS BEYOND PLANNING HORIZON (BUILDOUT SENSITIVITY TESTS)

Due to the limitations of the planning horizon evaluation, additional sensitivity tests were conducted that estimated the relative differences of full buildout for the land use designation. Based on statewide population projections, full buildout of the scenarios would not be anticipated to occur within the next 20 years.

The travel model was used to conduct a preliminary sensitivity comparison between the three scenarios to determine potential differences of full buildout. This simplified sensitivity analysis scaled model trips within the East Albany area and did not control to growth in other areas of the City beyond the 20 year planning horizon or at regional gateways (including I-5) traveling into and out of the region. The analysis indicated that there would not be significant difference between the three scenarios (generally within ten percent) but that each of the scenarios at full buildout have the potential to add significant traffic growth beyond the 20-year horizon.

The preliminary analysis indicates that these future traffic growth estimates (relative to year 2043) could include:

- Knox Butte east of I-5 - Approximately double traffic and require a five-lane section along with strategies to maintain mobility.
- US 20 east of I-5 – Approximately double traffic, strategies to maintain mobility, and capacity upgrades at major intersections.
- Timber south of US 20 – Approximately double traffic. Would likely operate as a three lane facility but would require additional turn lanes near US 20.
- Goldfish Farm north of US 20 – Significant increase in traffic would require widening at US 20 and improved connectivity to reduce reliance on the corridor and provide alternative connections to US 20

SAMPLE ROADWAY CROSS SECTIONS

Sample DRAFT cross sections for two locations were prepared to illustrate how the future roads may transform. Each of these sample sections are attached.

Note: These draft cross sections are preliminary, are provided for discussion, and will be updated based on feedback from project stakeholders. Elements that may change include lane width and ped/bike/parking treatments.

US Highway 20: **This is based on ODOT's Highway Design Manual Commercial Corridor and** reflects a primarily commercial context and recognizes that this is an important state route. New, wide sidewalks are provided on both sides of the street to connect employment and commercial

areas, buffered from cars by street trees and a new raised and protected bike lane. Two lanes of traffic are maintained in both directions and a continuous center turn lane provides access to numerous commercial and employment access points and side streets along the length of Highway 20. **Options for this section to better align with the Urban Mix context in ODOT’s Blueprint for Urban Design** could include narrower travel lanes. However, the corridor designation as a reduction review route (priority freight corridor) could restrict ability to narrow travel lanes.

East Albany Connections: These street sections would be applied to new streets through Village Center and Neighborhood Village land use areas, reflecting a more urban, mixed-use walkable context, with wide sidewalks and furnishing zones with street trees in tree wells adjacent to ground floor commercial uses. On-street parking would be provided on both sides of the street to help slow traffic and support adjacent businesses. Bikes could share the narrower travel lanes, as slower speeds are assumed, with more regular intersections. Regular bike lanes could be provided on parallel routes and along natural corridors as shown on the proposed trail system map.

TRANSPORTATION SYSTEM PLAN AMENDMENTS

The following section summarizes the TSP changes that would be needed to incorporate the East Albany Plan into the TSP.

GENERAL TSP CONTENT UPDATES

The following items would need to be updated in the TSP to incorporate the projects identified for the East Albany Plan area:

- Table 7-1: Link and Intersection Improvement Projects
 - Add in the projects outlined in E Albany Plan
 - > Intersection control improvement (roundabout) at Knox Butte Rd / Scrael Hill Rd
 - > Timber Street extension north of US 20 to Blue Ox Dr
 - > Intersection control improvement (roundabout) at Timber / Maple Leaf
 - > Miscellaneous pedestrian and bicycle infrastructure improvements including a series of paths and potential pedestrian bridge crossing I5
- Figure 7-1: Roadway and Intersection Improvement Map
 - Modify to be consistent with changes made in Table 7-1
- Figure 7-2: Preferred Network PM Peak Hour Volume
 - Modify to be consistent with project changes made in Table 7-1.
- Figure 7-3: Preferred Network D/C Ratios
 - Update map and data to include Timber Street extension

- Figure 7-4: Roadway Functional Classification Map
 - Show Timber Street Extension as Major Collector
- Table 8-1: TSP Improvements Total Costs
 - Update list of projects (consistent with items above)

NEW PROJECT DESCRIPTIONS

Table 4 summarizes the projects that would need to be added to the TSP to accommodate the East Albany Plan.

TABLE 4. NEW PROJECT DESCRIPTIONS

PROJECT NAME	PROJECT DESCRIPTION
KNOX BUTTE ROAD/ SCRAVEL HILL ROAD TRAFFIC CONTROL IMPROVEMENTS	Construct a single lane roundabout
TIMBER STREET EXTENSION	Extend Timber Street north of US 20 to Blue Ox Drive as a two-lane roadway.
TIMBER STREET / MAPLE LEAVE AVENUE TRAFFIC CONTROL IMPROVEMENT	Construct a single lane roundabout
PRICE ROAD/US 20 CLOSURE AND REALIGNMENT	Following completion of roadway connection between Spicer Drive and Timber Street to US 20, modify the intersection of Price Road/ US 20 to restrict turn movements.
US 20 URBAN UPGRADE	This project replaces TSP project L56 and would include upgrading US 20 from I-5 to Scrael Hill Road.
PEDESTRIAN AND BICYCLE IMPROVEMENTS	Incorporate a series of pedestrian and bicycle improvements including multiuse paths and trails to enhance connectivity and a potential pedestrian bridge to cross I5.

Note:

FINDINGS

The transportation evaluation of the preferred development alternative provided the following findings:

- The preferred development alternative has the potential to provide significant additional capacity for housing and employment uses. However, growth within the long-range planning horizon (2043) would not reach full buildout based on statewide coordinated population projections. Due to this constraint, significant differences do not exist between the 2040 Baseline condition and the 2040 Preferred Alternative condition.
- The 2040 PM Peak hour traffic analysis indicates that the preferred alternative would not have a significant impact on the transportation system and that additional motor vehicle capacity projects are not required in the Transportation System Plan to accommodate this growth. Therefore the TPR requirements are met.
- The following strategies should be considered through future development of the preferred alternative:
 - The identified additional transportation system will provide relief to existing streets
 - A mix of housing and employment uses in close proximity allows opportunities for shorter, multimodal trips
 - Higher intensity uses should be located along existing transit routes
 - Larger employment areas that may require regional travel are best suited near east-west roads that provide access to I-5 (e.g., US 20)
- The ultimate buildout for the preferred development alternative has the potential to significantly increase trips and traffic in the East Albany area. While this buildout would likely occur beyond 2043 (and should be considered in future TSP updates), sensitivity tests indicate that traffic could further double on some key roadway segments within East Albany if the full buildout potential is realized.

ATTACHMENTS

The following items are included as attachments:

- 1) Preferred Scenario Map
- 2) Sample Cross Sections
- 3) Airport Rd / Albany Ave / OR99E No Build Scenario HCM Worksheet
- 4) Preferred Scenario HCM Worksheets
- 5) I-5 NB / Knox Butte Rd Interim Signal HCM Worksheets

FIGURE 1. PREFERRED SCENARIO LAND USE AND TRANSPORTATION SYSTEM

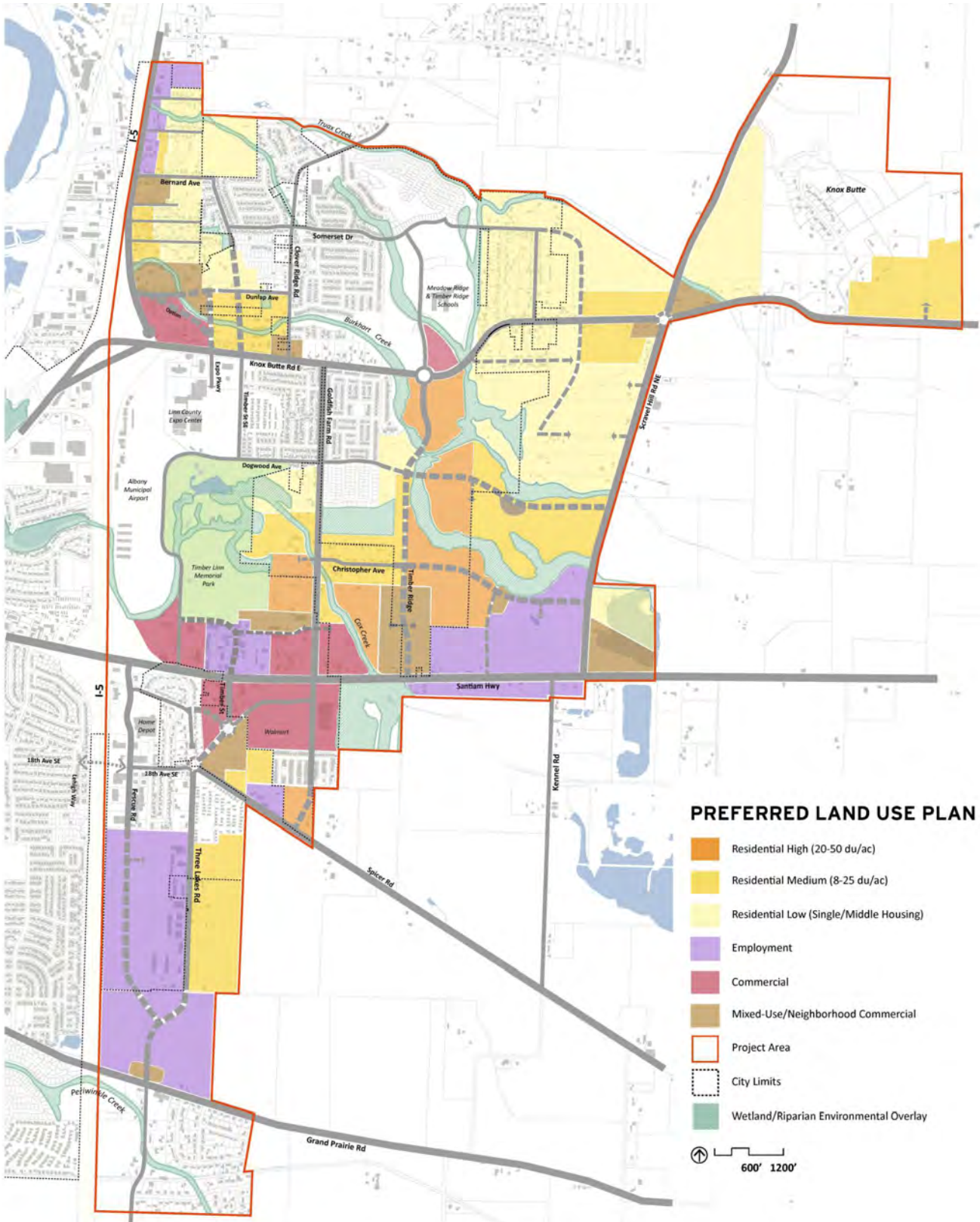


FIGURE 2. US 20 SAMPLE CROSS SECTION

US Highway 20 Proposed Section

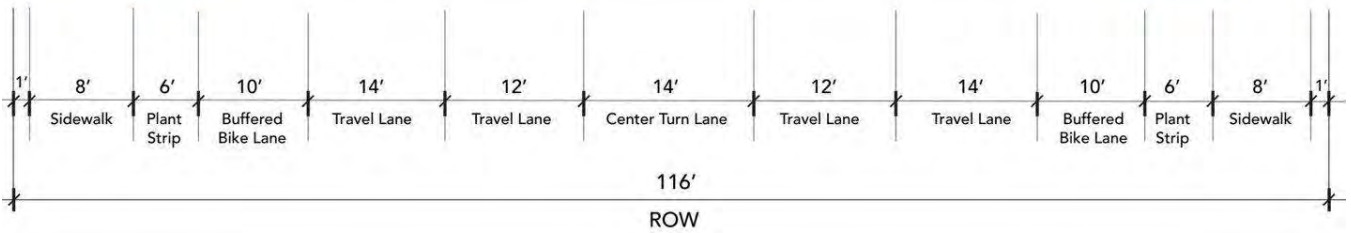


FIGURE 3. EAST ALBANY CONNECTIONS - TIMBER RIDGE EXTENSION

Timber Ridge Extension Proposed Section

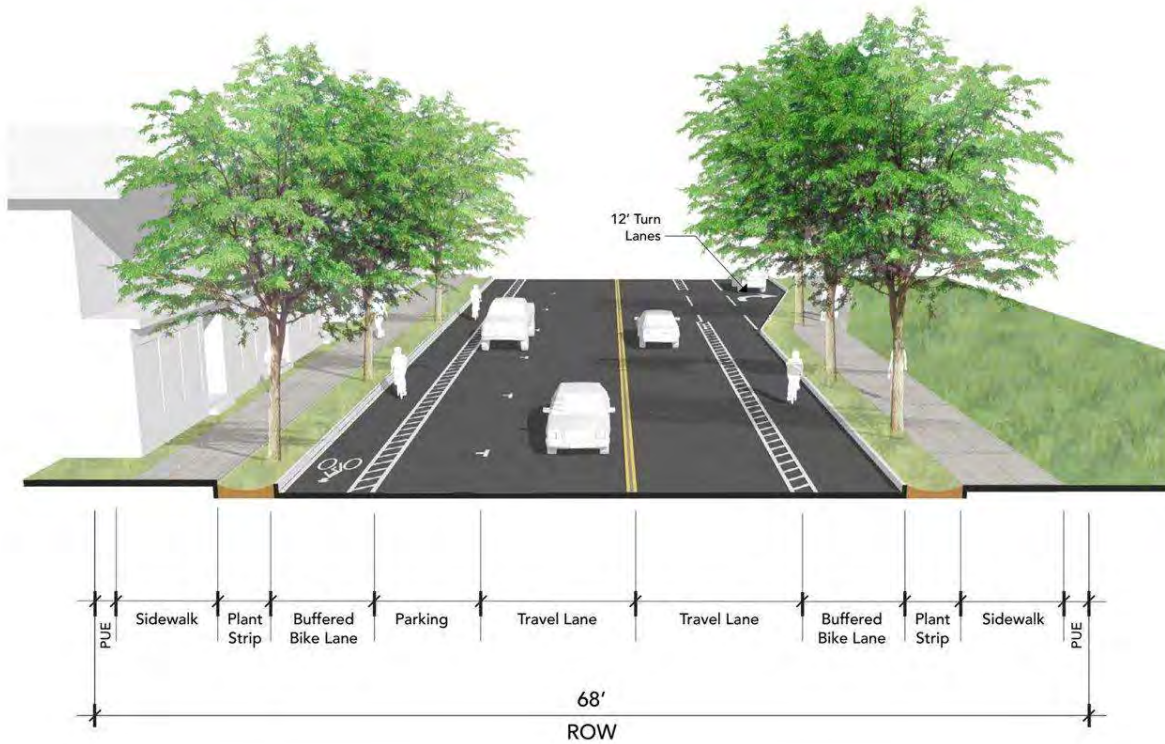


FIGURE 4. EAST ALBANY CONNECTIONS – E/W CONNECTOR LOW TRAFFIC

East-West Connector (Low Traffic Volume) Proposed Section

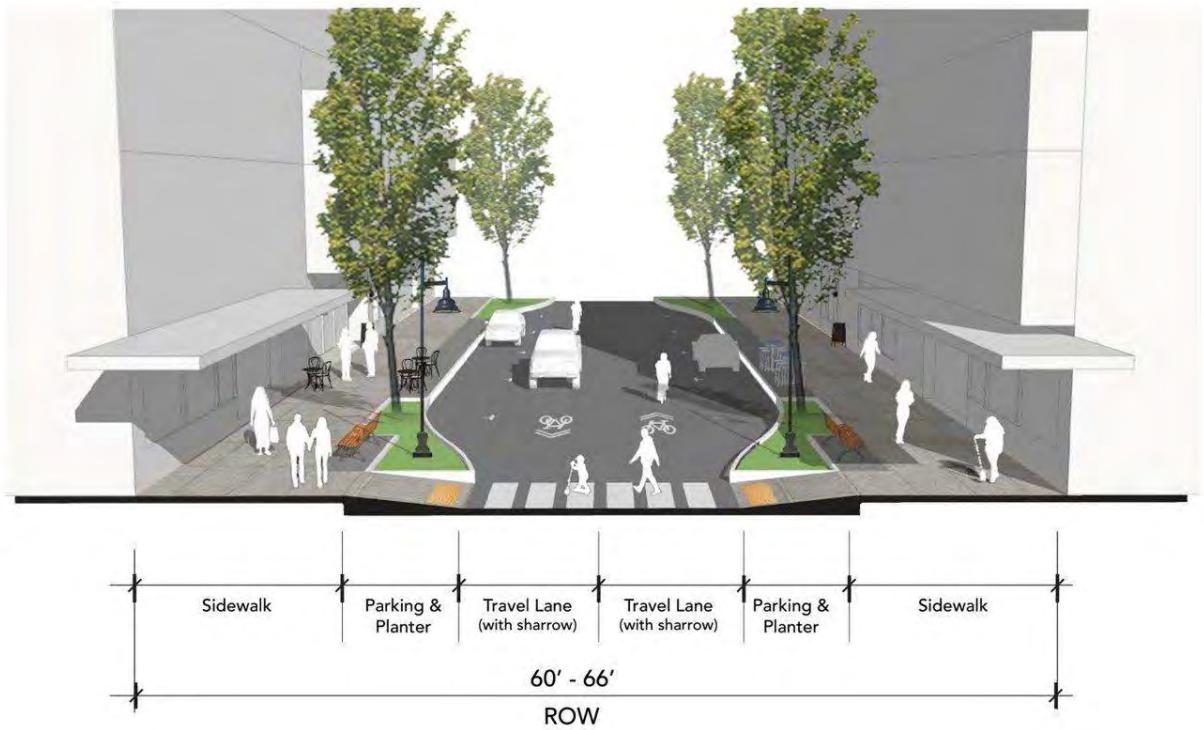


FIGURE 5. EAST ALBANY CONNECTIONS – E/W CONNECTOR LOW TRAFFIC OPEN SPACE

East-West Connector (Low Traffic Volume: Open Space Edge) Proposed Section

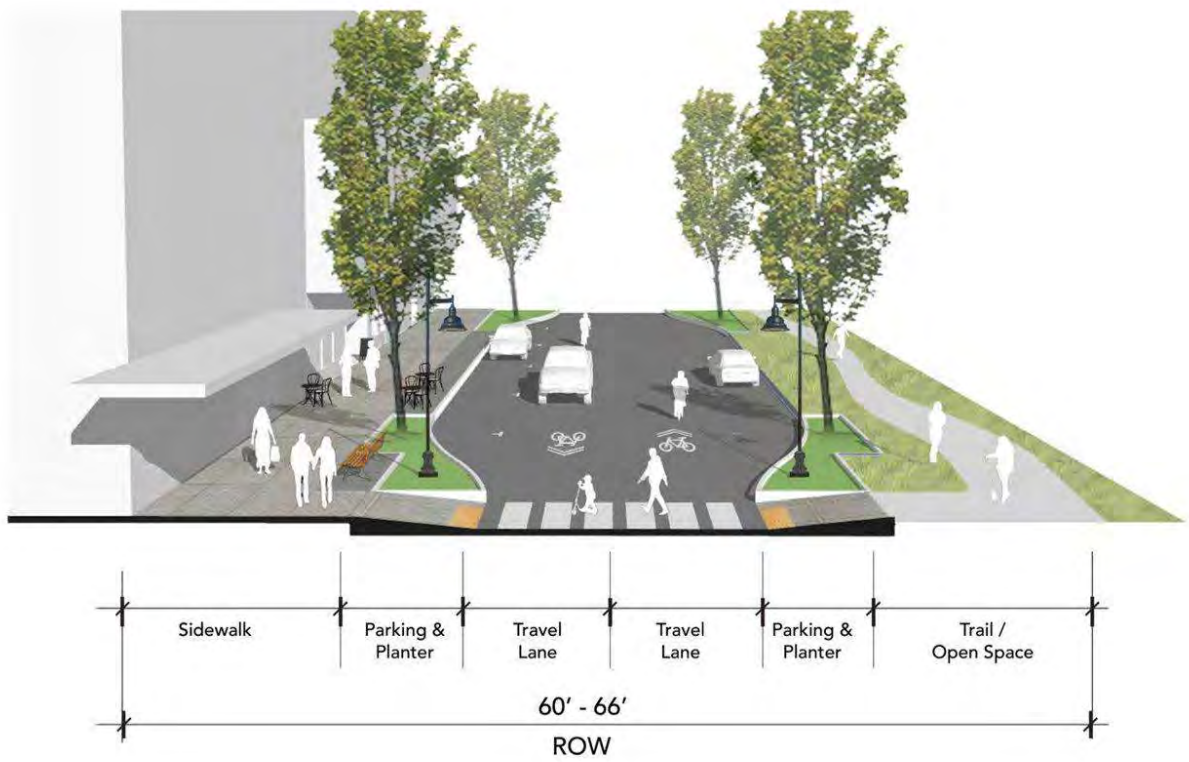
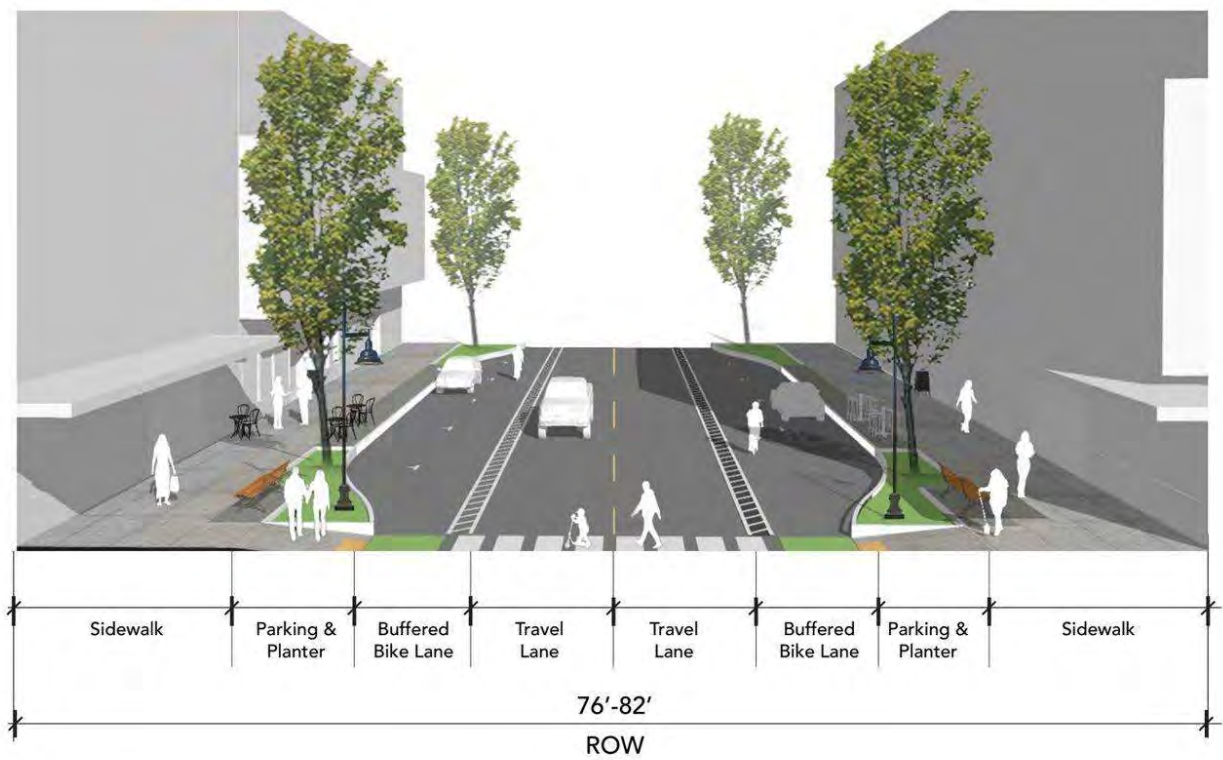


FIGURE 6. EAST ALBANY CONNECTIONS – HIGH TRAFFIC VOLUME

East-West Connector (High Traffic Volume) Proposed Section



HCM 6th Signalized Intersection Summary
 38: Airport Rd SE/Albany Ave SE & Hwy 99E

04/21/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (veh/h)	120	1280	170	190	1070	220	150	240	70	305	205	120
Future Volume (veh/h)	120	1280	170	190	1070	220	150	240	70	305	205	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.98	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	1709	1709	1709	1709	1709	1709	1709	1709	1709	1695	1695	1695
Adj Flow Rate, veh/h	126	1347	179	200	1126	0	158	253	74	321	216	126
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	4	4	4
Cap, veh/h	316	1266	552	301	1288		211	290	85	236	250	146
Arrive On Green	0.13	0.39	0.39	0.14	0.40	0.00	0.06	0.23	0.23	0.08	0.25	0.25
Sat Flow, veh/h	1628	3247	1416	1628	3247	1448	1628	1265	370	1615	1003	585
Grp Volume(v), veh/h	126	1347	179	200	1126	0	158	0	327	321	0	342
Grp Sat Flow(s),veh/h/ln	1628	1624	1416	1628	1624	1448	1628	0	1635	1615	0	1588
Q Serve(g_s), s	0.8	39.0	6.4	7.0	32.0	0.0	6.0	0.0	19.3	8.0	0.0	20.6
Cycle Q Clear(g_c), s	0.8	39.0	6.4	7.0	32.0	0.0	6.0	0.0	19.3	8.0	0.0	20.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.23	1.00		0.37
Lane Grp Cap(c), veh/h	316	1266	552	301	1288		211	0	375	236	0	396
V/C Ratio(X)	0.40	1.06	0.32	0.66	0.87		0.75	0.00	0.87	1.36	0.00	0.86
Avail Cap(c_a), veh/h	316	1266	552	301	1299		211	0	507	236	0	524
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	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	37.0	30.5	11.2	38.7	27.9	0.0	33.4	0.0	37.1	35.0	0.0	35.9
Incr Delay (d2), s/veh	0.6	44.1	1.6	5.4	8.4	0.0	13.9	0.0	11.1	187.0	0.0	10.3
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	2.7	22.1	3.0	4.8	12.9	0.0	2.0	0.0	8.7	14.5	0.0	9.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	37.6	74.6	12.7	44.1	36.3	0.0	47.3	0.0	48.2	221.9	0.0	46.2
LnGrp LOS	D	F	B	D	D		D	A	D	F	A	D
Approach Vol, veh/h		1652			1326			485				663
Approach Delay, s/veh		65.1			37.5			47.9				131.3
Approach LOS		E			D			D				F
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	17.4	43.7	12.0	26.9	18.1	43.0	10.0	28.9				
Change Period (Y+Rc), s	* 4	5.4	4.0	4.0	* 4	5.4	4.0	4.0				
Max Green Setting (Gmax), s	* 5	38.6	8.0	31.0	* 6	37.6	6.0	33.0				
Max Q Clear Time (g_c+I1), s	2.8	34.0	10.0	21.3	9.0	41.0	8.0	22.6				
Green Ext Time (p_c), s	0.1	4.2	0.0	0.9	0.0	0.0	0.0	1.1				

Intersection Summary

HCM 6th Ctrl Delay	64.8
HCM 6th LOS	E

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.
 Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
 1: Airport Rd SE/Albany Ave SE & Hwy 99E

04/21/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗		↖	↗	
Traffic Volume (veh/h)	285	1095	170	195	920	315	285	95	70	410	210	120
Future Volume (veh/h)	285	1095	170	195	920	315	285	95	70	410	210	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.98	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	1856	1856	1856	1856	1856	1856	1856	1856	1856	1841	1841	1841
Adj Flow Rate, veh/h	285	1095	170	195	920	0	285	95	70	410	210	120
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	4	4	4
Cap, veh/h	433	1328	579	308	1108		314	241	177	426	235	134
Arrive On Green	0.19	0.38	0.38	0.13	0.31	0.00	0.12	0.24	0.24	0.09	0.21	0.21
Sat Flow, veh/h	1767	3526	1537	1767	3526	1572	1767	985	726	1753	1098	627
Grp Volume(v), veh/h	285	1095	170	195	920	0	285	0	165	410	0	330
Grp Sat Flow(s),veh/h/ln	1767	1763	1537	1767	1763	1572	1767	0	1711	1753	0	1725
Q Serve(g_s), s	9.1	28.1	4.9	5.7	24.2	0.0	12.0	0.0	8.1	9.0	0.0	18.6
Cycle Q Clear(g_c), s	9.1	28.1	4.9	5.7	24.2	0.0	12.0	0.0	8.1	9.0	0.0	18.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.42	1.00		0.36
Lane Grp Cap(c), veh/h	433	1328	579	308	1108		314	0	418	426	0	370
V/C Ratio(X)	0.66	0.82	0.29	0.63	0.83		0.91	0.00	0.39	0.96	0.00	0.89
Avail Cap(c_a), veh/h	433	1340	584	308	1128		314	0	530	426	0	483
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	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	34.7	28.2	8.8	39.2	31.8	0.0	28.7	0.0	31.6	36.1	0.0	38.2
Incr Delay (d2), s/veh	3.3	5.9	1.3	4.2	7.2	0.0	28.7	0.0	0.4	33.9	0.0	14.5
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	6.5	12.4	2.8	4.6	10.8	0.0	7.7	0.0	3.4	9.8	0.0	9.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	38.1	34.1	10.1	43.4	39.1	0.0	57.4	0.0	32.0	70.0	0.0	52.7
LnGrp LOS	D	C	B	D	D		E	A	C	E	A	D
Approach Vol, veh/h		1550			1115			450			740	
Approach Delay, s/veh		32.2			39.8			48.1			62.3	
Approach LOS		C			D			D			E	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	23.1	35.4	13.0	28.4	16.9	41.7	16.0	25.4				
Change Period (Y+Rc), s	* 4	5.4	4.0	4.0	* 4	5.4	4.0	4.0				
Max Green Setting (Gmax), s	* 12	30.6	9.0	31.0	* 6	36.6	12.0	28.0				
Max Q Clear Time (g_c+I1), s	11.1	26.2	11.0	10.1	7.7	30.1	14.0	20.6				
Green Ext Time (p_c), s	0.1	3.8	0.0	0.6	0.0	6.2	0.0	0.9				

Intersection Summary

HCM 6th Ctrl Delay	42.0
HCM 6th LOS	D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.
 Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
 2: I-5 NB Off-Ramp & Knox Butte Rd/Knox Butte Rd E

04/21/2023



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↘	↗
Traffic Volume (veh/h)	1463	0	0	738	70	216
Future Volume (veh/h)	1463	0	0	738	70	216
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	0	0	1870	1826	1826
Adj Flow Rate, veh/h	1626	0	0	820	78	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	0	0	2	5	5
Cap, veh/h	3037	0	0	3037	100	
Arrive On Green	0.85	0.00	0.00	0.85	0.06	0.00
Sat Flow, veh/h	3741	0	0	3741	1739	1547
Grp Volume(v), veh/h	1626	0	0	820	78	0
Grp Sat Flow(s),veh/h/ln	1777	0	0	1777	1739	1547
Q Serve(g_s), s	11.2	0.0	0.0	4.0	4.0	0.0
Cycle Q Clear(g_c), s	11.2	0.0	0.0	4.0	4.0	0.0
Prop In Lane		0.00	0.00		1.00	1.00
Lane Grp Cap(c), veh/h	3037	0	0	3037	100	
V/C Ratio(X)	0.54	0.00	0.00	0.27	0.78	
Avail Cap(c_a), veh/h	3037	0	0	3037	267	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	1.8	0.0	0.0	1.3	42.4	0.0
Incr Delay (d2), s/veh	0.7	0.0	0.0	0.2	12.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.0	0.0	0.3	2.0	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	2.5	0.0	0.0	1.5	54.5	0.0
LnGrp LOS	A	A	A	A	D	
Approach Vol, veh/h	1626			820	78	
Approach Delay, s/veh	2.5			1.5	54.5	
Approach LOS	A			A	D	
Timer - Assigned Phs		2		4		6
Phs Duration (G+Y+Rc), s		82.0		9.3		82.0
Change Period (Y+Rc), s		4.0		4.0		4.0
Max Green Setting (Gmax), s		78.0		14.0		78.0
Max Q Clear Time (g_c+I1), s		0.0		6.0		0.0
Green Ext Time (p_c), s		0.0		0.1		0.0
Intersection Summary						
HCM 6th Ctrl Delay			3.7			
HCM 6th LOS			A			
Notes						
Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.						

Intersection

Int Delay, s/veh 47.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑			↑↑			↘	↗	↘		↗
Traffic Vol, veh/h	0	1463	0	0	738	0	70	0	216	0	0	0
Future Vol, veh/h	0	1463	0	0	738	0	70	0	216	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	110	-	-	-	-	-	-	-	-	0	-	20
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	5	5	5	10	10	10
Mvmt Flow	0	1626	0	0	820	0	78	0	240	0	0	0

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	820	0	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.13	-	-	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.219	-	-	-
Pot Cap-1 Maneuver	807	-	0	0
Stage 1	-	-	0	0
Stage 2	-	-	0	0
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	807	-	-	-
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0	\$ 415.7	0
HCM LOS			F	A

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	103	123	807	-	-	-	-	-
HCM Lane V/C Ratio	0.755	1.951	-	-	-	-	-	-
HCM Control Delay (s)	107	\$ 515.7	0	-	-	-	0	0
HCM Lane LOS	F	F	A	-	-	-	A	A
HCM 95th %tile Q(veh)	4	19.3	0	-	-	-	-	-

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

HCM 6th TWSC

2: I-5 NB Off-Ramp/Century Dr NE & Knox Butte Rd/Knox Butte Rd E

01/19/2023

Intersection												
Int Delay, s/veh	47.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↑		↖	↑	↖		↖	↑	↖	↑	↖
Traffic Vol, veh/h	0	1463	0	0	738	0	70	0	216	0	0	0
Future Vol, veh/h	0	1463	0	0	738	0	70	0	216	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	110	-	-	-	-	-	-	-	-	0	-	20
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	5	5	5	10	10	10
Mvmt Flow	0	1626	0	0	820	0	78	0	240	0	0	0

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	820	0	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.13	-	-	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.219	-	-	-
Pot Cap-1 Maneuver	807	-	0	0
Stage 1	-	-	0	0
Stage 2	-	-	0	0
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	807	-	-	-
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0	\$ 415.7	0
HCM LOS			F	A

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	103	123	807	-	-	-	-	-
HCM Lane V/C Ratio	0.755	1.951	-	-	-	-	-	-
HCM Control Delay (s)	107	\$ 515.7	0	-	-	-	0	0
HCM Lane LOS	F	F	A	-	-	-	A	A
HCM 95th %tile Q(veh)	4	19.3	0	-	-	-	-	-

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

HCM 6th Signalized Intersection Summary

4: Knox Butte Rd E & Clover Ridge Rd

01/19/2023



Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations	↙	↕↕	↕	↗	↙	↗	
Traffic Volume (veh/h)	335	625	370	45	45	195	
Future Volume (veh/h)	335	625	370	45	45	195	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00			0.97	1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach		No	No		No		
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	
Adj Flow Rate, veh/h	353	658	389	47	47	0	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	
Percent Heavy Veh, %	2	2	2	2	2	2	
Cap, veh/h	530	2250	326	267	79		
Arrive On Green	0.30	0.63	0.17	0.17	0.04	0.00	
Sat Flow, veh/h	1781	3647	1870	1532	1781	1585	
Grp Volume(v), veh/h	353	658	389	47	47	0	
Grp Sat Flow(s),veh/h/ln	1781	1777	1870	1532	1781	1585	
Q Serve(g_s), s	4.3	2.1	4.3	0.6	0.6	0.0	
Cycle Q Clear(g_c), s	4.3	2.1	4.3	0.6	0.6	0.0	
Prop In Lane	1.00			1.00	1.00	1.00	
Lane Grp Cap(c), veh/h	530	2250	326	267	79		
V/C Ratio(X)	0.67	0.29	1.19	0.18	0.59		
Avail Cap(c_a), veh/h	2440	10307	2562	2099	1292		
HCM Platoon Ratio	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	0.00	
Uniform Delay (d), s/veh	7.6	2.1	10.2	8.7	11.6	0.0	
Incr Delay (d2), s/veh	1.5	0.1	93.1	0.3	6.8	0.0	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	0.9	0.0	9.4	0.1	0.3	0.0	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	9.1	2.1	103.3	9.0	18.5	0.0	
LnGrp LOS	A	A	F	A	B		
Approach Vol, veh/h		1011	436		47		
Approach Delay, s/veh		4.6	93.2		18.5		
Approach LOS		A	F		B		
Timer - Assigned Phs				4	6	7	8
Phs Duration (G+Y+Rc), s				19.7	5.1	11.4	8.3
Change Period (Y+Rc), s				4.0	4.0	4.0	4.0
Max Green Setting (Gmax), s				72.0	18.0	34.0	34.0
Max Q Clear Time (g_c+I1), s				0.0	2.6	6.3	2.6
Green Ext Time (p_c), s				0.0	0.1	1.8	0.1
Intersection Summary							
HCM 6th Ctrl Delay			30.9				
HCM 6th LOS			C				
Notes							
Unsignalized Delay for [SBR] is excluded from calculations of the approach delay and intersection delay.							

HCM 6th Roundabout

5: Scrael Hill Rd SE/Scrael Hill Rd & Knox Butte Rd E

01/19/2023

Intersection

Intersection Delay, s/veh 4.4

Intersection LOS A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	222	145	123	84
Demand Flow Rate, veh/h	230	155	129	88
Vehicles Circulating, veh/h	88	192	237	143
Vehicles Exiting, veh/h	143	174	81	204
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	4.5	4.6	4.5	3.8
Approach LOS	A	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	230	155	129	88
Cap Entry Lane, veh/h	1261	1134	1084	1193
Entry HV Adj Factor	0.965	0.936	0.955	0.951
Flow Entry, veh/h	222	145	123	84
Cap Entry, veh/h	1218	1062	1034	1134
V/C Ratio	0.182	0.137	0.119	0.074
Control Delay, s/veh	4.5	4.6	4.5	3.8
LOS	A	A	A	A
95th %tile Queue, veh	1	0	0	0

HCM 6th Signalized Intersection Summary

6: I-5 SB On Ramp/I-5 SB Off Ramp

01/19/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (veh/h)	75	1465	125	140	920	250	70	110	105	160	150	240
Future Volume (veh/h)	75	1465	125	140	920	250	70	110	105	160	150	240
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	75	1465	0	140	920	250	70	110	0	160	150	240
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	125	1528		160	1243	337	285	299		285	299	254
Arrive On Green	0.07	0.43	0.00	0.09	0.45	0.45	0.16	0.16	0.00	0.16	0.16	0.16
Sat Flow, veh/h	1781	3554	1585	1781	2763	749	1781	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	75	1465	0	140	591	579	70	110	0	160	150	240
Grp Sat Flow(s),veh/h/ln	1781	1777	1585	1781	1777	1735	1781	1870	1585	1781	1870	1585
Q Serve(g_s), s	4.1	40.0	0.0	7.8	27.4	27.5	3.4	5.2	0.0	8.3	7.3	15.0
Cycle Q Clear(g_c), s	4.1	40.0	0.0	7.8	27.4	27.5	3.4	5.2	0.0	8.3	7.3	15.0
Prop In Lane	1.00		1.00	1.00		0.43	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	125	1528		160	800	781	285	299		285	299	254
V/C Ratio(X)	0.60	0.96		0.87	0.74	0.74	0.25	0.37		0.56	0.50	0.95
Avail Cap(c_a), veh/h	125	1528		160	800	781	285	299		285	299	254
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	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	45.1	27.6	0.0	44.9	22.7	22.7	36.7	37.5	0.0	38.8	38.4	41.6
Incr Delay (d2), s/veh	19.6	15.1	0.0	43.8	6.1	6.3	2.0	3.5	0.0	7.8	5.9	44.2
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	2.5	19.3	0.0	5.3	12.1	11.9	1.7	2.7	0.0	4.2	3.8	8.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	64.8	42.7	0.0	88.7	28.7	29.0	38.8	40.9	0.0	46.5	44.2	85.8
LnGrp LOS	E	D		F	C	C	D	D		D	D	F
Approach Vol, veh/h	1540		1310				180		550			
Approach Delay, s/veh	43.8		35.2				40.1		63.0			
Approach LOS	D		D				D		E			
Timer - Assigned Phs	2		3		4		6		7		8	
Phs Duration (G+Y+Rc), s	20.0		13.0		47.0		20.0		11.0		49.0	
Change Period (Y+Rc), s	4.0		4.0		4.0		4.0		4.0		4.0	
Max Green Setting (Gmax), s	16.0		9.0		43.0		16.0		7.0		45.0	
Max Q Clear Time (g_c+I1), s	5.4		9.8		0.0		17.0		6.1		0.0	
Green Ext Time (p_c), s	0.1		0.0		0.0		0.0		0.0		0.0	

Intersection Summary

HCM 6th Ctrl Delay	43.4
HCM 6th LOS	D

Notes

User approved volume balancing among the lanes for turning movement.
 Unsignalized Delay for [NBR, EBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary

7: Fescue St/I-5 NB Off Ramp

01/19/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	425	965	475	0	720	295	0	0	50	70	0	65
Future Volume (veh/h)	425	965	475	0	720	295	0	0	50	70	0	65
Initial Q (Qb), veh	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
Parking Bus, Adj	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	
Adj Sat Flow, veh/h/ln	1870	1870	1870	0	1870	1870				1870	0	1870
Adj Flow Rate, veh/h	425	965	475	0	720	295				70	0	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Percent Heavy Veh, %	2	2	2	0	2	2				2	0	2
Cap, veh/h	474	2965	1322	0	1244	510				144	0	
Arrive On Green	0.27	0.83	0.83	0.00	0.51	0.51				0.04	0.00	0.00
Sat Flow, veh/h	1781	3554	1585	0	2552	1007				3456	0	1585
Grp Volume(v), veh/h	425	965	475	0	520	495				70	0	0
Grp Sat Flow(s),veh/h/ln	1781	1777	1585	0	1777	1689				1728	0	1585
Q Serve(g_s), s	16.7	4.5	5.1	0.0	14.8	14.8				1.4	0.0	0.0
Cycle Q Clear(g_c), s	16.7	4.5	5.1	0.0	14.8	14.8				1.4	0.0	0.0
Prop In Lane	1.00		1.00	0.00		0.60				1.00		1.00
Lane Grp Cap(c), veh/h	474	2965	1322	0	899	855				144	0	
V/C Ratio(X)	0.90	0.33	0.36	0.00	0.58	0.58				0.49	0.00	
Avail Cap(c_a), veh/h	528	2965	1322	0	899	855				977	0	
HCM Platoon Ratio	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	0.00	1.00	1.00				1.00	0.00	0.00
Uniform Delay (d), s/veh	25.6	1.4	1.4	0.0	12.5	12.5				34.0	0.0	0.0
Incr Delay (d2), s/veh	16.8	0.3	0.8	0.0	2.7	2.9				2.5	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.7	0.3	0.4	0.0	5.4	5.1				0.6	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	42.4	1.7	2.2	0.0	15.2	15.4				36.5	0.0	0.0
LnGrp LOS	D	A	A	A	B	B				D	A	
Approach Vol, veh/h	1865				1015						70	
Approach Delay, s/veh	11.1				15.3						36.5	
Approach LOS	B				B						D	
Timer - Assigned Phs	2		4		5		6					
Phs Duration (G+Y+Rc), s	65.0		7.5		23.8		41.2					
Change Period (Y+Rc), s	4.5		4.5		4.5		4.5					
Max Green Setting (Gmax), s	60.5		20.5		21.5		34.5					
Max Q Clear Time (g_c+I1), s	7.1		3.4		18.7		16.8					
Green Ext Time (p_c), s	13.3		0.2		0.6		4.3					
Intersection Summary												
HCM 6th Ctrl Delay			13.1									
HCM 6th LOS			B									
Notes												
Unsignalized Delay for [NBR, SBR] is excluded from calculations of the approach delay and intersection delay.												

HCM 6th Signalized Intersection Summary
 8: Goldfish Farms Rd & Santiam Hwy SE (US 20)

01/19/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↖↗	↗	↖	↖↗		↖↗	↗		↖	↗	
Traffic Volume (veh/h)	420	530	230	15	470	10	165	95	25	5	75	280
Future Volume (veh/h)	420	530	230	15	470	10	165	95	25	5	75	280
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	420	530	230	15	470	10	165	95	25	5	75	280
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	373	1405	627	27	714	15	610	482	127	521	117	437
Arrive On Green	0.21	0.40	0.40	0.02	0.20	0.20	0.34	0.34	0.34	0.34	0.34	0.34
Sat Flow, veh/h	1781	3554	1585	1781	3558	76	1991	1427	376	1272	346	1292
Grp Volume(v), veh/h	420	530	230	15	234	246	165	0	120	5	0	355
Grp Sat Flow(s),veh/h/ln	1781	1777	1585	1781	1777	1857	995	0	1803	1272	0	1638
Q Serve(g_s), s	10.0	5.1	4.9	0.4	5.8	5.8	3.6	0.0	2.3	0.1	0.0	8.7
Cycle Q Clear(g_c), s	10.0	5.1	4.9	0.4	5.8	5.8	12.4	0.0	2.3	2.4	0.0	8.7
Prop In Lane	1.00		1.00	1.00		0.04	1.00		0.21	1.00		0.79
Lane Grp Cap(c), veh/h	373	1405	627	27	357	373	610	0	609	521	0	554
V/C Ratio(X)	1.12	0.38	0.37	0.56	0.66	0.66	0.27	0.00	0.20	0.01	0.00	0.64
Avail Cap(c_a), veh/h	373	2235	997	373	1117	1168	1523	0	1436	1104	0	1305
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	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	18.9	10.3	10.2	23.3	17.6	17.6	18.6	0.0	11.2	12.0	0.0	13.3
Incr Delay (d2), s/veh	84.9	0.2	0.4	16.8	2.1	2.0	0.2	0.0	0.2	0.0	0.0	1.2
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/ft	2.1	1.4	1.3	0.3	2.1	2.2	0.8	0.0	0.8	0.0	0.0	2.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	103.7	10.4	10.6	40.1	19.6	19.5	18.8	0.0	11.4	12.0	0.0	14.6
LnGrp LOS	F	B	B	D	B	B	B	A	B	B	A	B
Approach Vol, veh/h	1180			495			285			360		
Approach Delay, s/veh	43.7			20.2			15.7			14.6		
Approach LOS	D			C			B			B		
Timer - Assigned Phs	2		3	4		6		7	8			
Phs Duration (G+Y+Rc), s	20.1		4.7	22.9		20.1		14.0	13.6			
Change Period (Y+Rc), s	4.0		4.0	4.0		4.0		4.0	4.0			
Max Green Setting (Gmax), s	38.0		10.0	30.0		38.0		10.0	30.0			
Max Q Clear Time (g_c+I1), s	14.4		2.4	7.1		10.7		12.0	7.8			
Green Ext Time (p_c), s	1.7		0.0	4.3		1.8		0.0	1.8			
Intersection Summary												
HCM 6th Ctrl Delay	30.7											
HCM 6th LOS	C											

HCM 6th TWSC

9: Santiam Hwy SE (US 20) & Scrael Hill Rd SE

01/19/2023

Intersection

Int Delay, s/veh	2.8					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	55	585	485	5	80	0
Future Vol, veh/h	55	585	485	5	80	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	140	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	7	7	9	9	11	11
Mvmt Flow	55	585	485	5	80	0

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	490	0	-	0	1183 488
Stage 1	-	-	-	-	488 -
Stage 2	-	-	-	-	695 -
Critical Hdwy	4.17	-	-	-	6.51 6.31
Critical Hdwy Stg 1	-	-	-	-	5.51 -
Critical Hdwy Stg 2	-	-	-	-	5.51 -
Follow-up Hdwy	2.263	-	-	-	3.599 3.399
Pot Cap-1 Maneuver	1048	-	-	-	201 562
Stage 1	-	-	-	-	599 -
Stage 2	-	-	-	-	479 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1048	-	-	-	191 562
Mov Cap-2 Maneuver	-	-	-	-	191 -
Stage 1	-	-	-	-	568 -
Stage 2	-	-	-	-	479 -

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	36.8
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1048	-	-	-	191
HCM Lane V/C Ratio	0.052	-	-	-	0.419
HCM Control Delay (s)	8.6	-	-	-	36.8
HCM Lane LOS	A	-	-	-	E
HCM 95th %tile Q(veh)	0.2	-	-	-	1.9

HCM 6th TWSC

11: Grand Prairie Rd & Three Lakes Rd

01/19/2023

Intersection

Int Delay, s/veh 2.3

Movement

	EBL	EBT	WBT	WBR	SBL	SBR
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Lane Configurations		↕	↕		↕	↕
Traffic Vol, veh/h	25	135	155	60	30	50
Future Vol, veh/h	25	135	155	60	30	50
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	90	90	90	90	90	90
Heavy Vehicles, %	7	7	7	7	10	10
Mvmt Flow	28	150	172	67	33	56

Major/Minor

	Major1	Major2	Minor2
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Conflicting Flow All	239	0	0	412	206
Stage 1	-	-	-	206	-
Stage 2	-	-	-	206	-
Critical Hdwy	4.17	-	-	6.5	6.3
Critical Hdwy Stg 1	-	-	-	5.5	-
Critical Hdwy Stg 2	-	-	-	5.5	-
Follow-up Hdwy	2.263	-	-	3.59	3.39
Pot Cap-1 Maneuver	1299	-	-	581	815
Stage 1	-	-	-	810	-
Stage 2	-	-	-	810	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	1299	-	-	567	815
Mov Cap-2 Maneuver	-	-	-	567	-
Stage 1	-	-	-	791	-
Stage 2	-	-	-	810	-

Approach

	EB	WB	SB
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HCM Control Delay, s	1.2	0	10.9
HCM LOS			B

Minor Lane/Major Mvmt

	EBL	EBT	WBT	WBR	SBLn1
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Capacity (veh/h)	1299	-	-	-	700
HCM Lane V/C Ratio	0.021	-	-	-	0.127
HCM Control Delay (s)	7.8	0	-	-	10.9
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.4

HCM 6th Signalized Intersection Summary

12: Timber Street & Santiam Highway (US 20)/Santiam Highway (US 20)

02/03/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↑↑↑	↗	↖	↑↑		↖↗	↖			↕	
Traffic Volume (veh/h)	70	1894	84	115	946	20	644	84	139	20	27	78
Future Volume (veh/h)	70	1894	84	115	946	20	644	84	139	20	27	78
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	70	1894	84	115	946	20	644	84	139	20	27	78
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	90	2400	745	120	1731	37	663	208	345	56	43	98
Arrive On Green	0.05	0.47	0.47	0.07	0.49	0.49	0.19	0.33	0.33	0.10	0.10	0.10
Sat Flow, veh/h	1781	5106	1585	1781	3558	75	3456	633	1048	161	438	994
Grp Volume(v), veh/h	70	1894	84	115	472	494	644	0	223	125	0	0
Grp Sat Flow(s),veh/h/ln	1781	1702	1585	1781	1777	1857	1728	0	1682	1592	0	0
Q Serve(g_s), s	4.1	32.6	3.1	6.7	19.4	19.4	19.3	0.0	10.7	4.3	0.0	0.0
Cycle Q Clear(g_c), s	4.1	32.6	3.1	6.7	19.4	19.4	19.3	0.0	10.7	7.9	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.04	1.00		0.62	0.16		0.62
Lane Grp Cap(c), veh/h	90	2400	745	120	864	903	663	0	553	197	0	0
V/C Ratio(X)	0.78	0.79	0.11	0.96	0.55	0.55	0.97	0.00	0.40	0.63	0.00	0.00
Avail Cap(c_a), veh/h	171	2790	866	120	920	961	663	0	677	311	0	0
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	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	48.9	23.3	15.5	48.5	18.7	18.7	41.9	0.0	27.1	45.9	0.0	0.0
Incr Delay (d2), s/veh	13.2	1.4	0.1	70.2	0.6	0.6	28.0	0.0	0.5	3.4	0.0	0.0
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	2.1	12.1	1.1	5.2	7.4	7.7	10.7	0.0	4.3	3.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	62.1	24.7	15.5	118.8	19.3	19.3	69.9	0.0	27.6	49.2	0.0	0.0
LnGrp LOS	E	C	B	F	B	B	E	A	C	D	A	A
Approach Vol, veh/h		2048			1081			867			125	
Approach Delay, s/veh		25.6			29.9			59.0			49.2	
Approach LOS		C			C			E			D	
Timer - Assigned Phs		2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s		39.3	11.0	54.0	24.0	15.3	9.3	55.7				
Change Period (Y+Rc), s		5.0	4.0	5.0	4.0	5.0	4.0	5.0				
Max Green Setting (Gmax), s		42.0	7.0	57.0	20.0	18.0	10.0	54.0				
Max Q Clear Time (g_c+I1), s		12.7	8.7	34.6	21.3	9.9	6.1	21.4				
Green Ext Time (p_c), s		1.4	0.0	14.4	0.0	0.4	0.0	6.3				
Intersection Summary												
HCM 6th Ctrl Delay			34.5									
HCM 6th LOS			C									