City of Sandy

Agenda

City Council Meeting

Meeting Date: Monday, December 13, 2021

Meeting Time: 6:00 PM

Page

1. CITY COUNCIL WORK SESSION - 6:00 PM

This meeting will be conducted in a hybrid in-person / online format. The Council will be present in-person in the Council Chambers and members of the public are welcome to attend in-person as well. Members of the public also have the choice to view and participate in the meeting online via Zoom.

To attend the meeting in-person:
Come to Sandy City Hall (lower parking lot entrance).
39250 Pioneer Blvd., Sandy, OR 97055

To attend the meeting online via Zoom:
Please use this link: https://us02web.zoom.us/j/87404718919
Or by phone: (253) 215-8782; Meeting ID: 874 0471 8919

2. TRANSPORTATION SYSTEM PLAN UPDATE AND US26 BYPASS DISCUSSION

2.1. **TSP and Bypass Discussion** 2 - 293

Bypass and TSP Work Session - Pdf

3. CITY COUNCIL EXECUTIVE SESSION (FOLLOWING WORK SESSION ADJOURNMENT)

The City Council will meet in executive session pursuant to ORS 192.660(2)(f) and (2)(h)

4. RESUMPTION OF CITY COUNCIL REGULAR SESSION, IF NECESSARY

If during the executive session the need arises for the Council to make a formal decision or take an action, the Council will do so in a subsequent regular public session.

Staff Report

Meeting Date:	December 13, 2021
From	Kelly O'Neill, Development Services Director
SUBJECT:	Bypass and TSP Work Session

DECISION TO BE MADE:

1. Discuss whether the bypass should be formally included as a project within the TSP
2. Prioritize transportation projects to help determine how to allocate funding for vehicular, transit, pedestrian, and bicycle improvements.

BACKGROUND / CONTEXT:

Bypass Feasibility Study:
On November 3, I sent the Bypass Feasibility Study (attached) to the City Council and the Planning Commission. The study includes, but is not limited to, an analysis of the existing and future transportation system performance, potential benefits and negative impacts to local businesses, safety, hard costs associated with different aspects of the Bypass system, traffic forecasts, and a policy and regulatory considerations memo.

As you will see in the report, the estimate to construct a bypass is approximately $365 million to $390 million in 2021 dollars and $980 million to $1 billion in 2040 dollars. There are also costs associated with the jurisdictional transfer of the existing Highway 26 section (5 miles) that currently runs through Sandy. The evaluation also includes a conceptual design and alignment of the bypass and how it could interact and connect with the existing and planned street and highway network.

If the Council decides to advance the project, the next steps will involve defining the bypass as a project in the revised Transportation System Plan (TSP), meeting with state and local agencies (i.e., DLCD, ODOT, Clackamas County, etc.) to gain support for the bypass as a regional priority, addressing regulatory requirements, getting Clackamas County to add the bypass as a project in the County TSP, and identifying a funding strategy.

Transportation System Plan update:
DKS, ODOT, and City staff are at a decision point in the TSP project. We have identified future needs and forecasted available funding over the 20-year planning horizon. Unfortunately, the identified needs are far greater than the available funding. While some projects are already funded, most projects have no identified funding source.

DKS, ODOT, and City staff need the City Council and Planning Commission to help prioritize transportation projects to determine how to allocate funding for vehicular, transit, pedestrian, and bicycle improvements.

Another consideration to understand is related to adopting alternative mobility standards at select signalized intersections along Highway 26. ODOT has an existing policy (Policy 1G from the Oregon Highway Plan) related to major improvements that requires system efficiency and management prior to adding additional capacity. This has been interpreted to mean that the City of Sandy and ODOT have to first accept the allowance of 'worse' operational standards at select intersections prior to adding additional vehicular lanes or alternative routes (i.e., a bypass facility). The Oregon Traffic Commission (OTC) has approved Alternative Mobility Standards for the following jurisdictions: Albany Area MPO, Gearhart, Lincoln City, Medford, Newberg, Scappoose, Seaside, Warrenton, Lane County, Eugene-Springfield, Oregon City, Newport and Yamhill County.

LIST OF ATTACHMENTS/EXHIBITS:

1. Presentation Slides - 12/13/2021
2. Preliminary Draft - TSP Technical Memo #7
3. Sandy Bypass Feasibility Report

SANDY
TRANSPORTATION SYSTEM PLAN

CITY COUNCIL - PLANNING COMMISSION WORK SESSION

DECEMBER 13, 2021

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AGENDA

1	TSP PROCESS OVERVIEW	5 MINS
2	SANDY BYPASS REPORT SUMMARY	20 MINS
3	COMMUNITY SURVEY #1	10 MINS
4	FUTURE NEEDS AND PROPOSED SOLUTIONS	30 MINS

DKS

1

TSP PROCESS OVERVIEW

WHY UPDATE THE TSP?

Incorporate recent plans - Sandy Transit Master Plan, Sandy Parks and Trails Master Plan and Pleasant Street Master Plan, Downtown Walkability Assessment (in progress)

Extend to Year 2040 Planning Horizon Year

Better definition of safety, walking and biking priorities

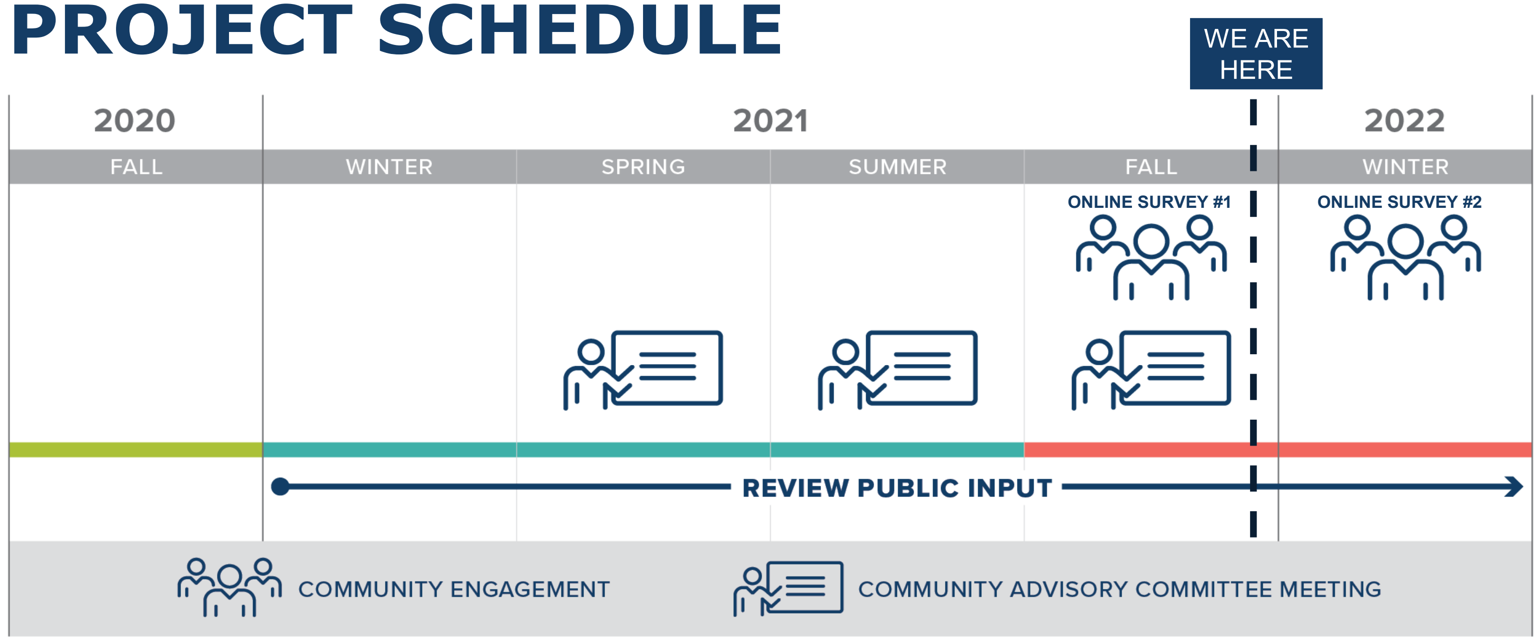
Address US 26 congestion, incorporate US 26 Bypass Feasibility Study recommendations

Evaluate need for alternative mobility targets for US 26 intersections

Provide a strategic investment plan with reasonably funded priority improvements and programs

Development Code consistent with TSP findings

PROJECT SCHEDULE



LEARN & UNDERSTAND
- Evaluate existing conditions and future growth trends.
- Discuss community values and transportation goals.
- Develop performance measures and evaluation criteria.
- Coordinate with state and regional plans.

ANALYZE & EVALUATE
- Determine future conditions.
- Develop alternative solutions for all modes of travel.
- Evaluate and refine draft solutions with the community.

RECOMMEND & ADOPT
- Identify preferred alternatives.
- Develop draft plan for public review.
- Hold public meetings with city boards, commissions and council.
- City Council adopts TSP.

DKS

2

SANDY BYPASS REPORT SUMMARY

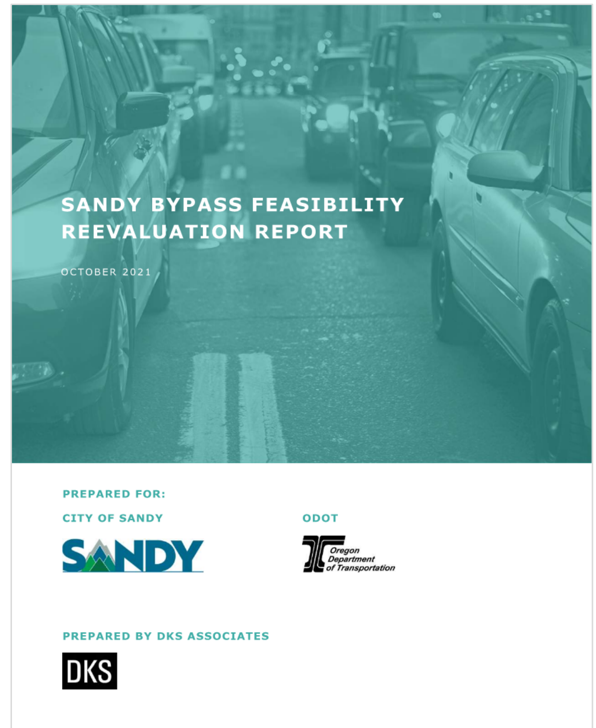
BYPASS FEASIBILITY REEVALUATION STUDY

Objective

Feasibility Reevaluation Study provided a refresh of the 2011 Sandy TSP analysis, expanded measures for high-level benefit cost analysis

Sandy TSP Update will consider findings from the feasibility study with other motor vehicle projects and priorities.

Bypass project is a potential long-term and unfunded TSP solution to address mobility and local growth goals beyond 2040.



BYPASS EVALUATION

Conceptual Alignment

- Bypass would be located south of Sandy UGB and 5.8 miles long
- West end would connect to US 26 west of Orient Drive with new interchange.
- East end would connect to US 26 at Firwood with new interchange.
- Central interchange at OR 211.
- Grade separated overcrossing at 362nd Dr.
- 120-foot-wide right-of-way with 4 vehicle lanes, raised median, shoulder, lighting, trees and utility easement.

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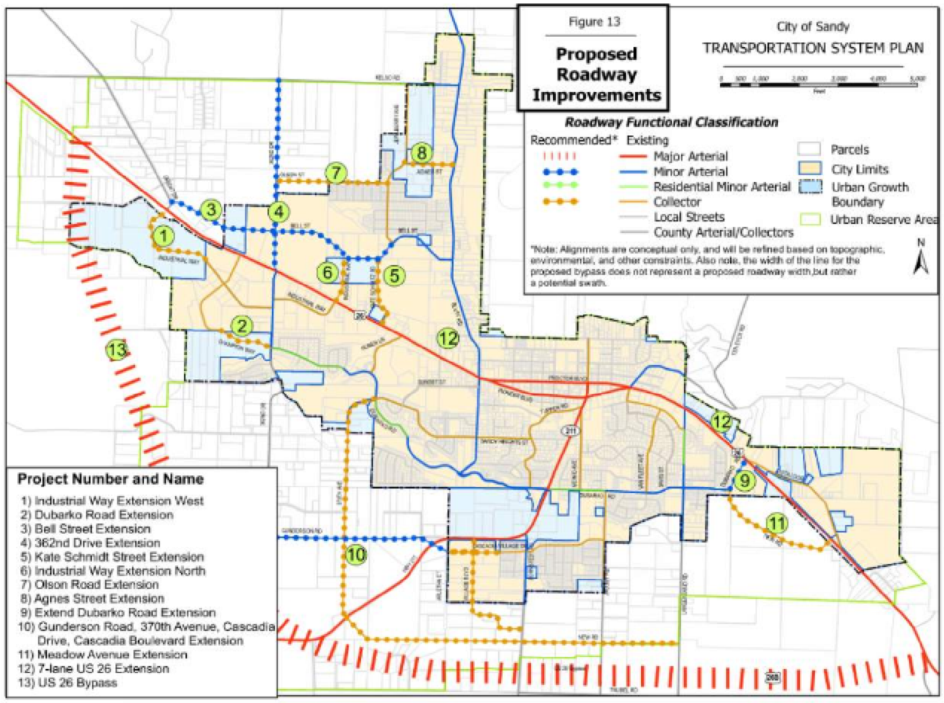
BYPASS EVALUATION

Transportation Analysis

- 2040 No Build: existing + fully funded projects
- 2040 Alternative #1: Local connectivity and intersection capacity projects
- 2040 Alternative #3: Alt #1 + Bypass



BENEFIT COST MEASURES

Measure	Cost/Impact	Benefit
Project Planning and Construction Cost	Bypass would cost $980 million to $1 billion (in 2040 dollars) for construction, right-of-way acquisition, easements, design and construction management	
2040 Future Traffic Demand		Bypass is estimated to serve 1,500 vehicles during future peak hour. Existing US 26 is estimated to serve 2,300 vehicles during future peak hour.
2040 Future Travel Time		Adding the bypass to other Alternative #1 projects would save an additional 4 minutes and 30 seconds travelling eastbound and no savings travelling westbound on existing US 26. Under Alternative #3, the bypass would have shorter travel times compared to existing US 26, saving 1 minute travelling eastbound and 2 minutes 30 seconds travelling westbound.
Travel Time Value		Save $6 million per year, $75 million over 20 years

Measure	Cost/Impact	Benefit
Safety		Overall reduction in crashes on existing US 26 expected with lower volumes and fewer conflicts with pedestrians and cyclists downtown.
Local Businesses	Diverts potential customers from highway-oriented businesses on US 26. Local gas tax revenue would likely be lower.	Reducing traffic volumes in the downtown area could increase walking and biking activity and make fronting businesses more attractive.
Jurisdictional Transfer to City	City would be responsible for US 26 maintenance after construction of the bypass, estimated to cost $5 to 8 million over 20 years. Potential reconstruction of US 26 with reduced vehicle lanes and multimodal improvements could increase congestion and travel times through Sandy.	Potential reconstruction of US 26 with reduced vehicle lanes and multimodal improvements, estimated to cost $55 to $105 million
Policy and Regulation Requirements	Demonstration of compliance with numerous related policies, regulations and ordinances will need to be addressed to gain project approval.	

DKS

FURTHER CONSIDERATIONS

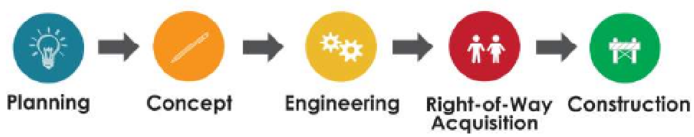
Regulations

- Demonstrate compliance with several State policies and regulations required if bypass is pursued and further developed. The bypass would require the Oregon Transportation Commission to adopt a facility plan and an Oregon Highway Plan amendment.
- OHP Policy 1G and 1H: existing facilities should be maintained and enhanced to improve performance and safety before adding capacity. A bypass is categorized under the lowest level of priority. Planning process must show other improvements cannot adequately support safety, growth management and other livability and economic goals.
- Sandy and Clackamas County need to work together on necessary amendments to local plans to support bypass project.
- Bypass would likely impact land designated for forest use, County would need to support adoption of Goal 5 resource exception findings.

FURTHER CONSIDERATIONS

Schedule and Funding

- Due to project magnitude, construction in 2040 is the earliest reasonable schedule



- Major infrastructure projects use a wide variety of revenue and funding, multiple sources for each phase, compete with other state priorities.

DKS

3 COMMUNITY SURVEY #1

PUBLIC INPUT

Focused on sharing information and gathering input on the needs and issues of the stakeholders, local residents, businesses and key communities.

- Sandy Speaks website
- Public Surveys
- Community Advisory Committee
- Public Open House
- Public Hearings

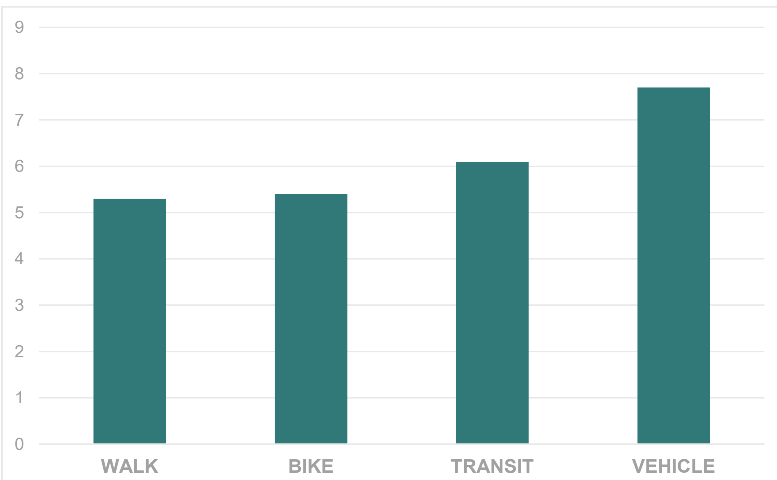
We invite everyone to provide feedback. We are committed to engaging community members of all incomes and backgrounds, including those who need transportation assistance or who speak other languages.

For project information and engagement opportunities, visit *sandy-speaks.org*

COMMUNITY SURVEY #1

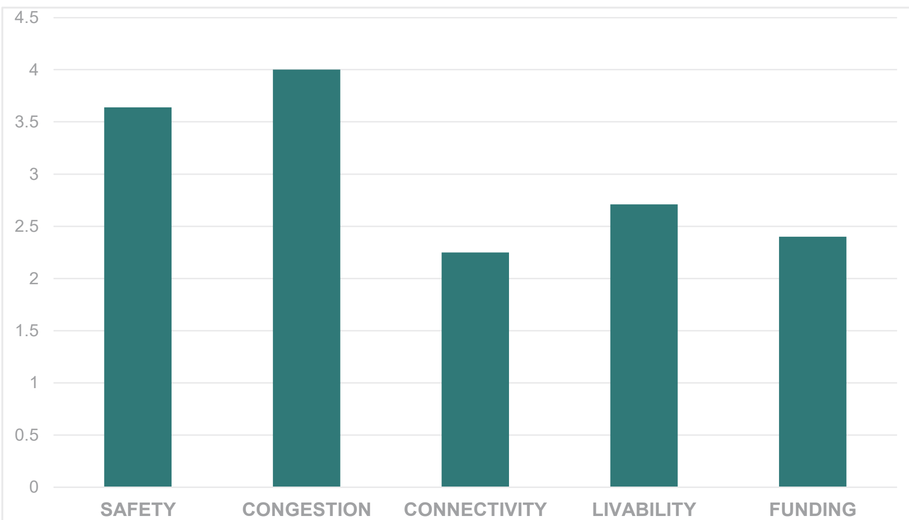
Conducted online survey with over 400 responses

Q1 to Q4: How easy is it to walk, bike, ride transit and drive in Sandy?
(0 not easy, 5 moderately easy, 10 extremely easy)



COMMUNITY SURVEY #1

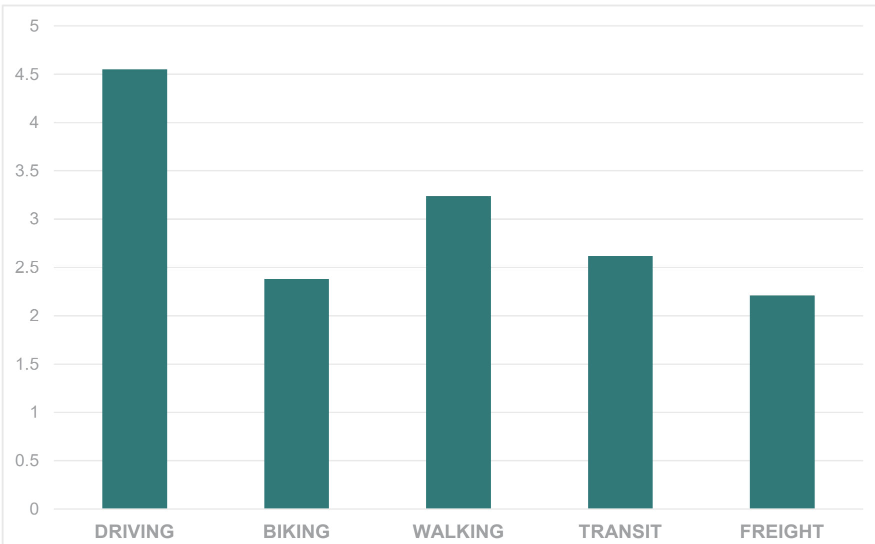
Q5: What type of issue is most important to address in the TSP?
(Rank 1 to 5)



DKS

COMMUNITY SURVEY #1

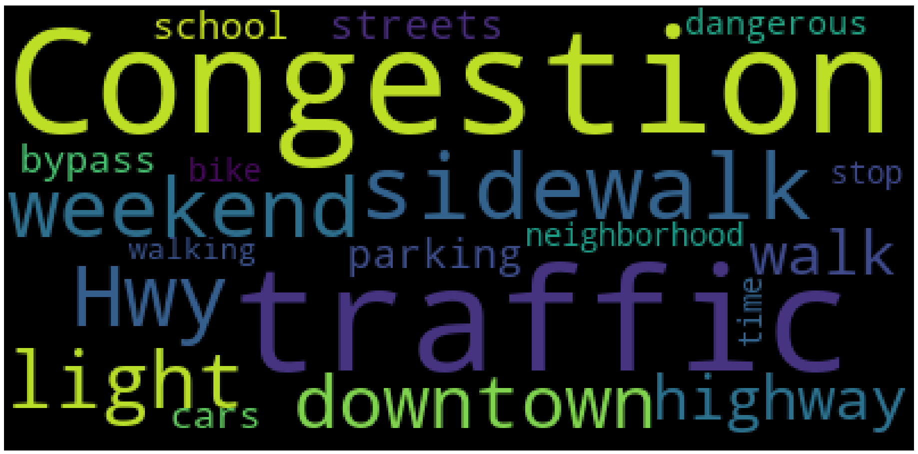
Q6: What modes of travel are most important to address? (Rank 1 to 5)



COMMUNITY SURVEY #1

Q7: What transportation challenges have you experienced in Sandy?

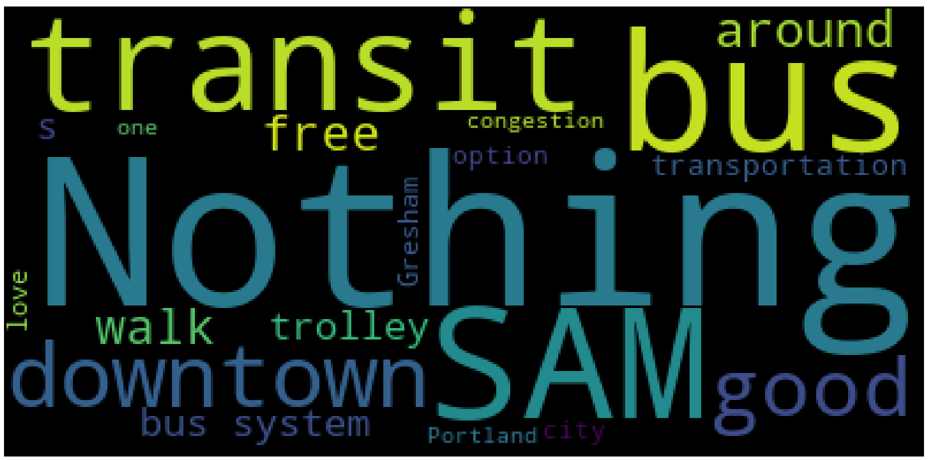
Below is a visual representation of words in survey responses, the size of each word indicates its frequency or importance.



COMMUNITY SURVEY #1

Q8: What do you value most in the existing transportation system?

Below is a visual representation of words in survey responses, the size of each word indicates its frequency or importance.



COMMUNITY SURVEY #1

Q9: How would you rank each approach to prioritizing transportation projects?

#1	Add vehicle capacity by widening, constructing major improvements to existing roadways, or extending existing roadways to create parallel routes to congested corridors.
#2	Improve existing facilities with minor enhancements, such as upgrading roads to standards, filling in important system gaps, and safety improvements to intersections and corridors.
#3	Add cost-effective improvements such as better traffic signal operations, encouraging walking, biking and transit, and applying new policies and standards.
#4	Add vehicle capacity to the system by constructing new facilities.

4

FUTURE NEEDS AND PROPOSED SOLUTIONS

NEEDS AND SOLUTIONS EVALUATION PROCESS

Step 1: Inventory of existing and future system needs, identify gaps and deficiencies

Step 2: Review 2011 TSP projects, remove competed projects, confirm, revise or add new projects

Step 3: Apply evaluation criteria to determine preliminary priorities

Vision → **Goals** → **Evaluation Criteria** → **Priority Solutions**

GOALS

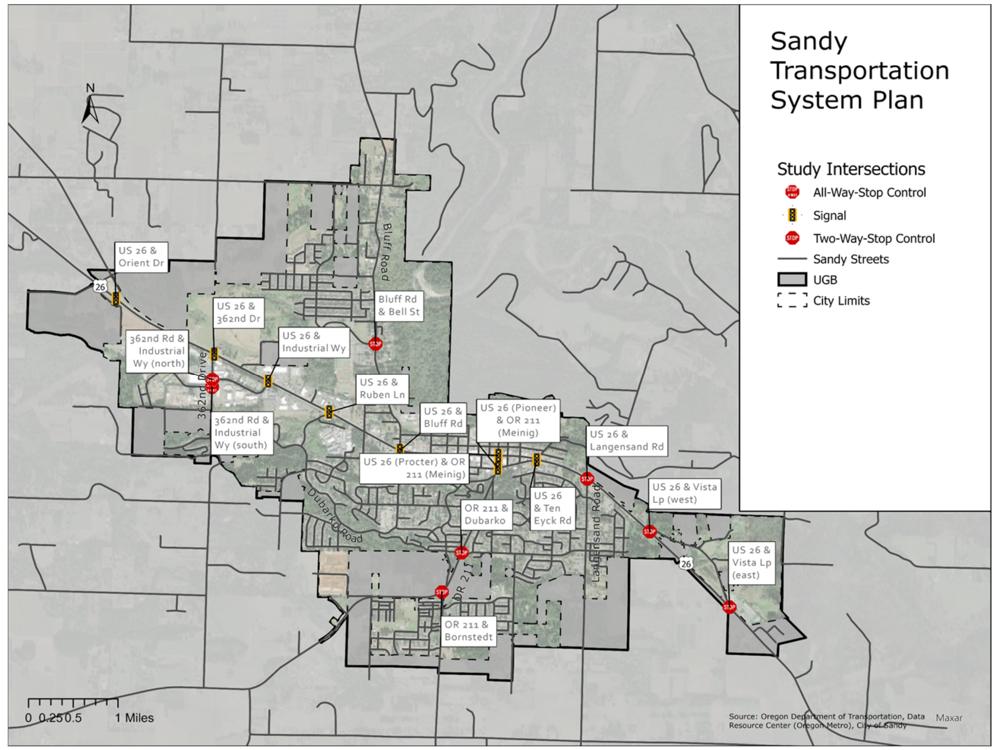
#	Goal	Description
1	MOBILITY & CONNECTIVITY	Provide a transportation system that prioritizes mobility and connectivity for all users.
2	CAPITAL INVESTMENTS AND FUNDING	Promote cost effective investments to the transportation system.
3	COMMUNITY	Provide a transportation system that supports specific community needs.
4	SYSTEM MANAGEMENT	Promote traffic management to achieve the efficient use of transportation infrastructure.
5	ENVIRONMENTAL	Minimize environmental impacts on natural resources and encourage carbon-neutral or efficient transportation alternatives.
6	TRANSIT	Provide safe, efficient, high-quality transit service that gives Sandy residents, employees, employers, and visitors more freedom to meet their needs.
7	SAFETY	Promote a safe transportation system for all users.
8	EQUITY	Support an equitable transportation system and provide transportation choices to all users.
9	HEALTH	Support options for exercise and healthy lifestyles to enhance the quality of life.

FUTURE NEEDS – STREET NETWORK

Exceed mobility targets in 2040

- US 26 and Orient Drive
- US 26 and 362nd Drive
- US 26 and Industrial Way
- US 26 and Ruben Lane
- US 26 and Bluff Road
- 362nd Drive and Industrial Way (north)
- 362nd Drive and Industrial Way (south)
- OR 211 and Bornstedt Road

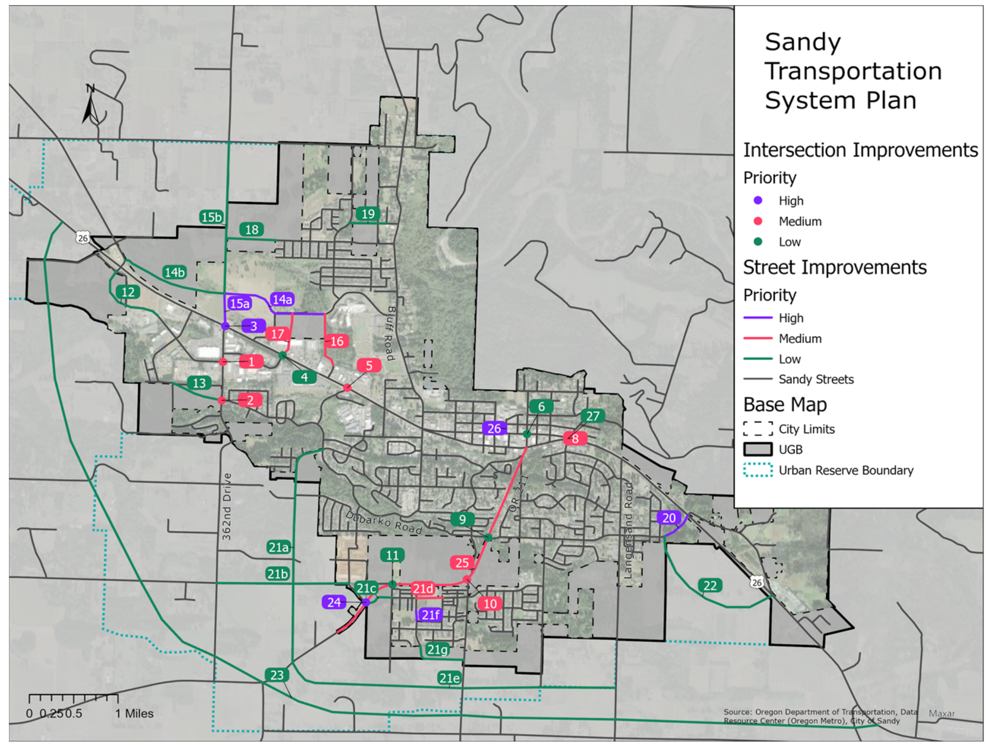
Lack of arterial and collector connections



SOLUTIONS – STREET NETWORK

High Priority Driving Projects

PROJECT ID	NAME	DESCRIPTION
D14A	Extend Bell St. to 362nd Dr	Extend Bell Street to 362nd Drive Extension 1 at Minor Arterial cross section standards
D15A	Extend 362nd Dr to Bell Street	Extend 362nd Drive to Bell Street Extension 1 at Minor Arterial cross section standards
D20	Extend Dubarko Rd. to US 26 opposite Vista Loop Dr. (West)	Extend Dubarko Road to US 26/Vista Loop Road (west) at Minor Arterial cross section standards. Coordinate with D9 and C17.
D21F	Village Blvd Ext 1	Connect Village Boulevard at Collector standards between Cascadia Village Drive and Juniper Street
D24	OR 211 Turn Lane to Gunderson	Reconstruct Alt Avenue from Proctor Blvd to Pleasant St to improve walkability and access to the Sandy Library



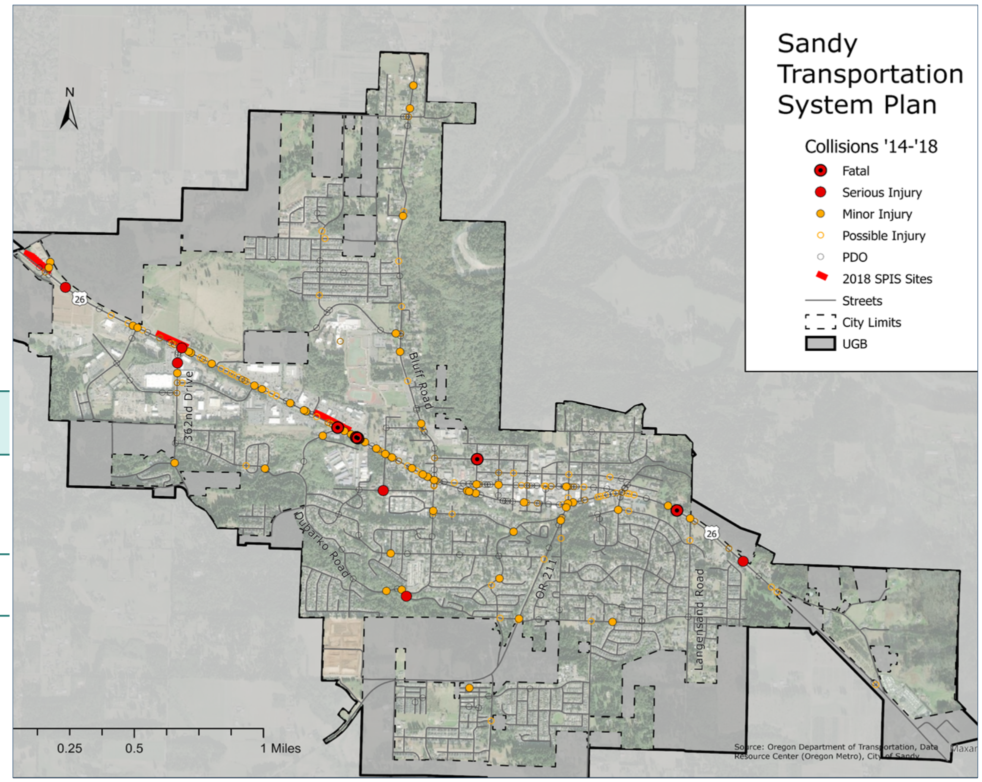
SOLUTIONS - SAFETY

Crash and Safety Deficiencies

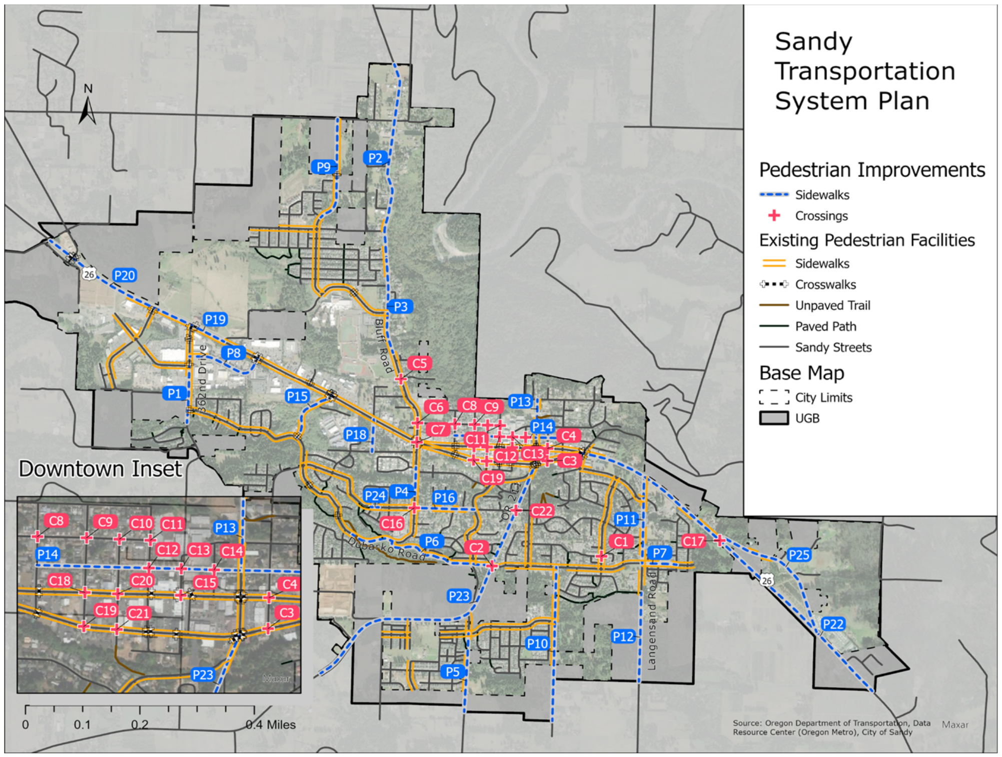
- US 26 at 362nd Drive, Ruben Lane and Orient Drive: rear end and turning crashes caused by high traffic volumes and urban traffic conditions
- OR 211 and Dubarko Road – Turning collisions caused by a driver not yielding.

High Priority Safety Projects

PROJECT ID	PROJECT	DESCRIPTION
S1	US 26 Adaptive Signal System	Install an adaptive signal control system on US 26 between Orient Drive and Bluff Road
D8	OR 211/Dubarko Road	Install a traffic signal



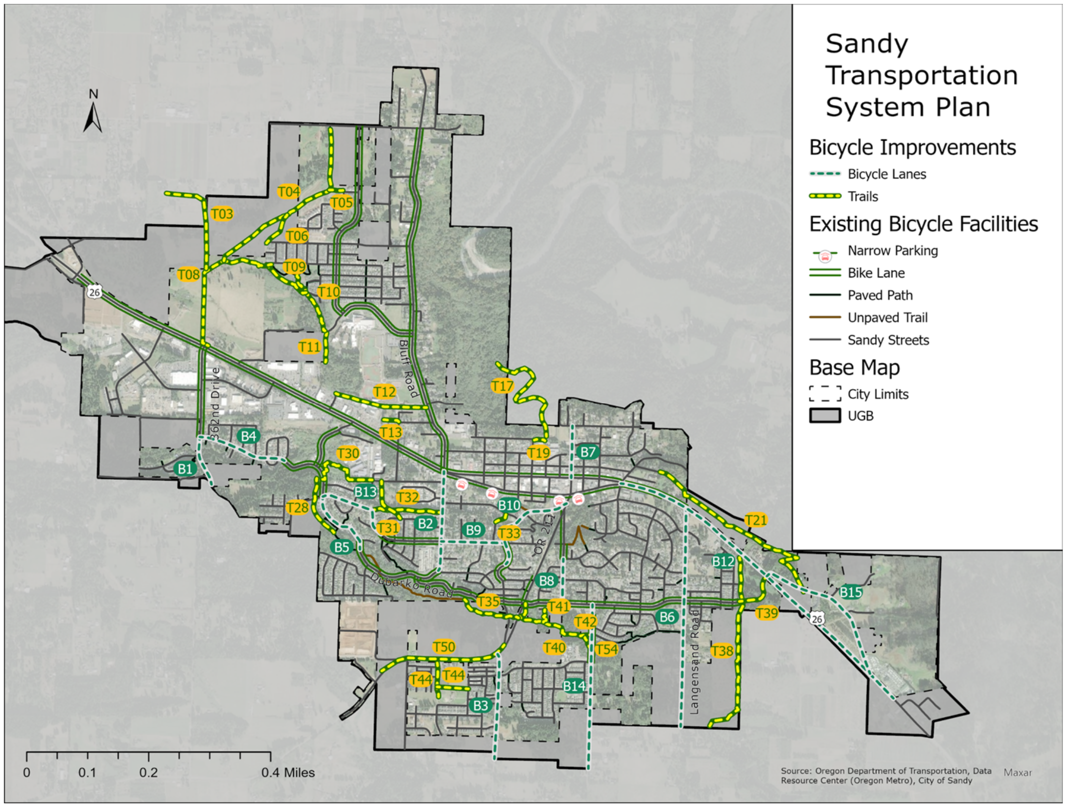
SOLUTIONS - WALKING



High Priority Pedestrian Projects

PROJECT ID	NAME	DESCRIPTION
P1	362nd Dr.	Sidewalk infill Chinook Dr. to Industrial Wy.
P7	Dubarko Rd.	Sidewalk infill Langensand Rd. to Antler Ave.
P11	Langensand Rd.	Sidewalk infill Dubarko Rd. to US 26
P14	Pleasant St.	Sidewalk infill Beers Ave. to Revenue Ave.
P16	Sandy Heights St.	Sidewalk infill Bluff Rd. to Tupper Rd.
P17	Downtown Core Pedestrian	Sidewalk infill side streets perpendicular to US 26
P22	US 26	Sidewalk infill Ten Eyck Rd. to Vista Loop Dr. West
C1	Sandy Shopper Crossing - Evans	Pedestrian crossing advisory signage, curb extensions, and marked crosswalks.
C2	OR 211 Dubarko Crossing	Pedestrian crossing advisory signage, curb extensions, marked crosswalks, and installation of RRFB
C5	CRMS - Bluff Road at Marcy	Rectangular Rapid Flashing Beacon (RRFB) and high visibility crosswalks
C6	CRMS - Bluff Road at Hood	Install a curb extension including perpendicular curb ramps and tactile domes
C7	CRMS - Bluff Road at US 26	Increase pedestrian signal crossing time, reconfigure crossing. Add pedestrian-scale lighting.
C11	SGS - Hood/Strauss	Install a curb ramp, add tactile domes and a stop bar associated with the crosswalk across the west leg of the intersection.
C12	SGS - Pleasant/Strauss	Mark stop bars in advance of crosswalks.
C13	SGS - Pleasant/Alt	Mark stop bars in advance of crosswalks. Install perpendicular curb ramps. Construct a raised intersection at Pleasant St at Alt Ave.
C15	SGS - Alt/US 26	Increase pedestrian signal crossing time. Consolidate the two existing crosswalks across US 26, with bulbouts, curb ramps, and pedestrian scale lighting.
C18	Scales/Proctor	marked crosswalks on all four legs
C19	Scales/Pioneer	marked crosswalks on all four legs
C20	Bruns/Proctor	marked crosswalks on all four legs
C21	Bruns/Pioneer	marked crosswalks on all four legs

SOLUTIONS - BIKING



High Priority Bicycle Projects

PROJECT ID	NAME	DESCRIPTION
B1	362nd Dr.	Widen shoulder to 6 feet minimum for bike access from Dubarko Rd. to UGB
B2	Bluff Rd.	Re-stripe roadway to provide bike lanes from US 26 to Miller Rd.
B3	Bornstedt Rd.	Widen roadway to provide bike lanes from OR 211 to UGB
B4	Dubarko Rd.	Re-stripe roadway to provide bike lanes from 362nd Dr. to Eldridge Dr.
B5	Dubarko Rd.	Re-stripe roadway to provide bike lanes from Sandy Heights St. to Melissa Ave.
B6	Langensand Rd.	Re-stripe roadway to provide bike lanes from US 26 to UGB
B7	Meinig Ave.	Re-stripe roadway to provide bike lanes from Scenic St. to US 26
B8	Meinig Ave.	Re-stripe roadway to provide bike lanes from Barker Ct. to Dubarko Rd.
B9	Sandy Heights	Re-stripe roadway to provide bike lanes from Bluff Rd. to Tupper Rd.
B10	Tupper Rd.	Widen roadway to provide bike lanes from Long Circle to OR 211
B12	US 26	Widen shoulder to 6 feet from Ten Eyck Rd. to UGB

SOLUTIONS - TRANSIT

PROJECT	DESCRIPTION
Local service improvements - Fixed routes	Add Saturday service, lengthen service hours, add an additional shuttle route that reaches the Vista Apartments.
Local service improvements - Flexible services	Add a bus and driver.
Local service improvements - Electric buses	Purchase one or more electric buses, a charging station, and the required maintenance equipment.
Additions to regional service - Gresham Express	Higher frequencies on Saturdays or Sundays, more night and morning service on Saturdays or Sundays, Occasional additional trips that go directly to important destinations.
Additions to regional service - New Clackamas Express	Coordinate with Clackamas County, the City of Boring and TriMet to plan and fund a route connecting these communities.
Additions to regional service - Improved bus stops	Coordinate with the City of Gresham and TriMet to invest in better stop amenities at the Gresham Transit Center.
Pedestrian Improvements - Transit Center	Improve access to the transit center by providing crossing treatments from every direction specifically at Proctor and Pioneer Blvd at Hoffman Ave. TSP projects include C3 & C4 – Hoffman Ave at Proctor and at Pioneer Crossing Improvement, these projects require coordination with ODOT.
Pedestrian Improvements - Evans St Crossing	Construct a crosswalk or traffic calming treatment on Evans St. TSP projects include C1 – Van Fleet Ave/Evans St Crossing Improvement, this project would be led by SAM.

Projects include service and access to transit improvements. Reflects recommendations from the 2020 Sandy Transit Master Plan.

FINANCIAL FORECAST THROUGH 2040

REVENUES	AVERAGE ANNUAL AMOUNT	ESTIMATED AMOUNT THROUGH 2040
STATE HIGHWAY TRUST FUND	$720,000	$18,300,000
LOCAL GAS TAX	$307,000	$6,390,578
CLACKAMAS COUNTY VEHICLE REGISTRATION FEE	$200,000	$4,163,243
SYSTEM DEVELOPMENT CHARGES	$445,000	$9,263,216
GRANTS	$40,000	$600,000
INTEREST	$62,000	$1,290,605
MISCELLANEOUS	$96,000	$1,998,357
SALE OF CAPITAL ASSETS	$600	$12,490
TOTAL REVENUES	**$1,870,600**	**$42,018,489**

EXPENDITURES	AVERAGE ANNUAL AMOUNT	ESTIMATED AMOUNT THROUGH 2040
PERSONAL SERVICES	$250,000	$5,204,054
MATERIALS & SERVICES	$443,000	$9,221,583
CAPITAL OUTLAY	$327,000	$6,806,902
DEBT SERVICE	$450,000	$9,367,297
TRANSFERS OUT	$58,000	$1,207,340
TOTAL EXPENDITURES	**$1,528,000**	**$31,807,177**
20 YEAR FUNDING FORECAST		**$10,211,312**

Total Estimated Cost of High Priority Projects = $34M

Which projects are the highest priority to fund next 20 years?

THANK YOU

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TM #7: TSP SOLUTIONS

DATE: December 10, 2021

TO: Project Management Team

FROM: Reah Flisakowski, Dock Rosenthal | DKS Associates

SUBJECT: Sandy Transportation System Plan Project #20020-001

This memo summarizes the preliminary transportation solutions identified for the Sandy Transportation System Plan (TSP) update. The recommended solutions respond to system performance needs identified through the prior technical analysis by the consultant team, and on-going feedback and reviews by the Project Management Team and the Project Advisory Committee. The system solutions identified include pedestrian and bicycle enhancements, safety improvements, and a review of the transit projects, along with minor roadway capacity improvements for motor vehicles. In addition, a more in-depth evaluation was made regarding a US 26 bypass to help understand the trade-offs, expected benefits and potential risks of implementation.

The projects documented in this memo are needed to develop a future, multimodal transportation system for Sandy with an understanding that adequate funding will not be available to construct all recommended capital improvements. Evaluation criteria were used to provide an initial prioritization of transportation improvements. These criteria are based on the project's goals and objectives that were identified in Technical Memorandum 2. The project scores, from the evaluation criteria, and project cost estimates will be used to develop a high priority, financially constrained project list as part of Technical Memorandum 8: Planned and Financially Constrained Transportation System. The projects presented in this memo are still preliminary and will be refined through public engagement prior to adoption of the TSP update. Furthermore, inclusion of a project in this memo does not commit the City of Sandy to its ultimate construction.

APPROACH TO DEVELOPING NETWORK IMPROVEMENTS

Sandy's proposed approach to developing transportation projects is based on four tiers of priorities that includes:

1. **Highest Priority** – add cost-effective improvements such as better traffic signal operations, encouraging walking, biking and transit, and applying new policies and standards.
2. **High Priority** – improve existing facilities with minor enhancements, such as upgrading roads to cross section standards, filling in important system gaps, and completing safety improvements to intersections and corridors.
3. **Moderate Priority** – add vehicle capacity by widening roads, constructing major improvements to existing roadways, or extending existing roadways to create parallel routes to congested corridors.
4. **Lowest Priority** – add vehicle capacity to the system by constructing new facilities.

This approach could allow the City to maximize use of available funds, minimize impacts to the natural and built environments, and balance investments across all modes of travel.

Measurable evaluation criteria were developed from the City's specific transportation goals and objectives (see Technical Memorandum #2: Goals and Objectives). These evaluation criteria were used to screen and prioritize potential transportation solutions in the next phase of the evaluation process, see graphic below. The prioritized solutions, consequently, will be consistent with the goals and objectives. The recommended evaluation criteria for each goal are summarized below in Table 1.

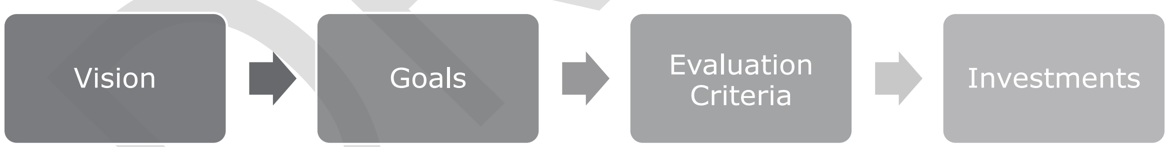


TABLE 1: RECOMMENDED EVALUATION CRITERIA

#	GOAL	DESCRIPTION	EVALUATION CRITERIA
1	**MOBILITY & CONNECTIVITY**	Provide a transportation system that prioritizes mobility and connectivity for all users.	(1) Project improves an existing facility or provides a new connection to existing local facilities. (2) Project addresses a critical system capacity need.
2	**CAPITAL INVESTMENTS AND FUNDING**	Promote cost effective investments to the transportation system.	(1) Project serves the needs of multiple system users. (2) Project extends the useful life of existing facilities.
3	**COMMUNITY NEEDS**	Provide a transportation system that supports specific community needs.	(1) Project improves access to natural features. (2) Project improves the human scale of US 26 and OR 211.
4	**SYSTEM MANAGEMENT**	Promote traffic management to achieve the efficient use of transportation infrastructure.	(1) Project reduces the local vehicle demand on US 26.
5	**ENVIRONMENTAL**	Minimize environmental impacts on natural resources and encourage carbon-neutral or efficient transportation alternatives.	(1) Project minimizes impact on natural resources. (2) Project reduces single occupant vehicle trips.
6	**TRANSIT**	Provide safe, efficient, high-quality transit service that gives Sandy residents, employees, employers, and visitors more freedom to meet their needs within the city, region, and state. Create a transit system that offers an alternative to private automobile use, supports efficient use of roadways, and reduces air pollution and energy use.	(1) Project improves the comfort and safety of existing transportation users. (2) Project improves the accessibility to transit for residents and visitors to Sandy.
7	**SAFETY**	Promote a safe transportation system for all users.	(1) Project addresses an identified safety need.
8	**EQUITY**	Support an equitable transportation system and provide transportation choices to all users.	(1) Project addresses the needs of a disadvantaged community.
9	**HEALTH**	Support options for exercise and healthy lifestyles to enhance the quality of life.	(1) Project promotes a healthy community.

TRANSPORTATION SOLUTIONS

The following sections summarize the evaluation of multimodal improvement options to provide early direction in developing recommended solutions. Sandy's high priority transportation solutions are generally cost-effective minor roadway improvements which include spot motor vehicle improvements, minor roadway extensions, enhancements to the pedestrian and bicycle network, and other programmatic improvements. The options consider the available right-of-way and environmental constraints to ease implementation. These identified solutions are preliminary and are subject to change. Community input and further technical analysis will ultimately lead to recommended solutions to be included in the TSP update.

UPDATE TO TSP PEDESTRIAN IMPROVEMENTS

Pedestrian enhancements throughout the city will be important to meet pedestrian mobility needs and to adequately connect to community destinations. The pedestrian projects in the 2011 TSP were reviewed and updated to identify future solutions. The recommended pedestrian system improvements are shown in Figure 1.

The existing sidewalk gaps were inventoried to identify priority corridors for sidewalk infill or shared use path projects. Beyond the evaluation criteria, priority corridors were identified based on their:

- Proximity to schools
- Proximity to major destinations
- The extent of existing gaps on a segment
- Lack of topographical constraints

Enhanced crossing locations were also identified, as needed, to facilitate safe crossing opportunities for US 26 and OR 211 based on the future sidewalk conditions for adjacent roadways. Several pedestrian crossing projects were carried forward from the Sandy Transit Master Plan[1] and local Safe Routes to School plans. Specific pedestrian improvements are identified in Tables 2 and 3.

[1] Sandy Transit Master Plan, April 2020.

FIGURE 1: PEDESTRIAN SYSTEM IMPROVEMENT

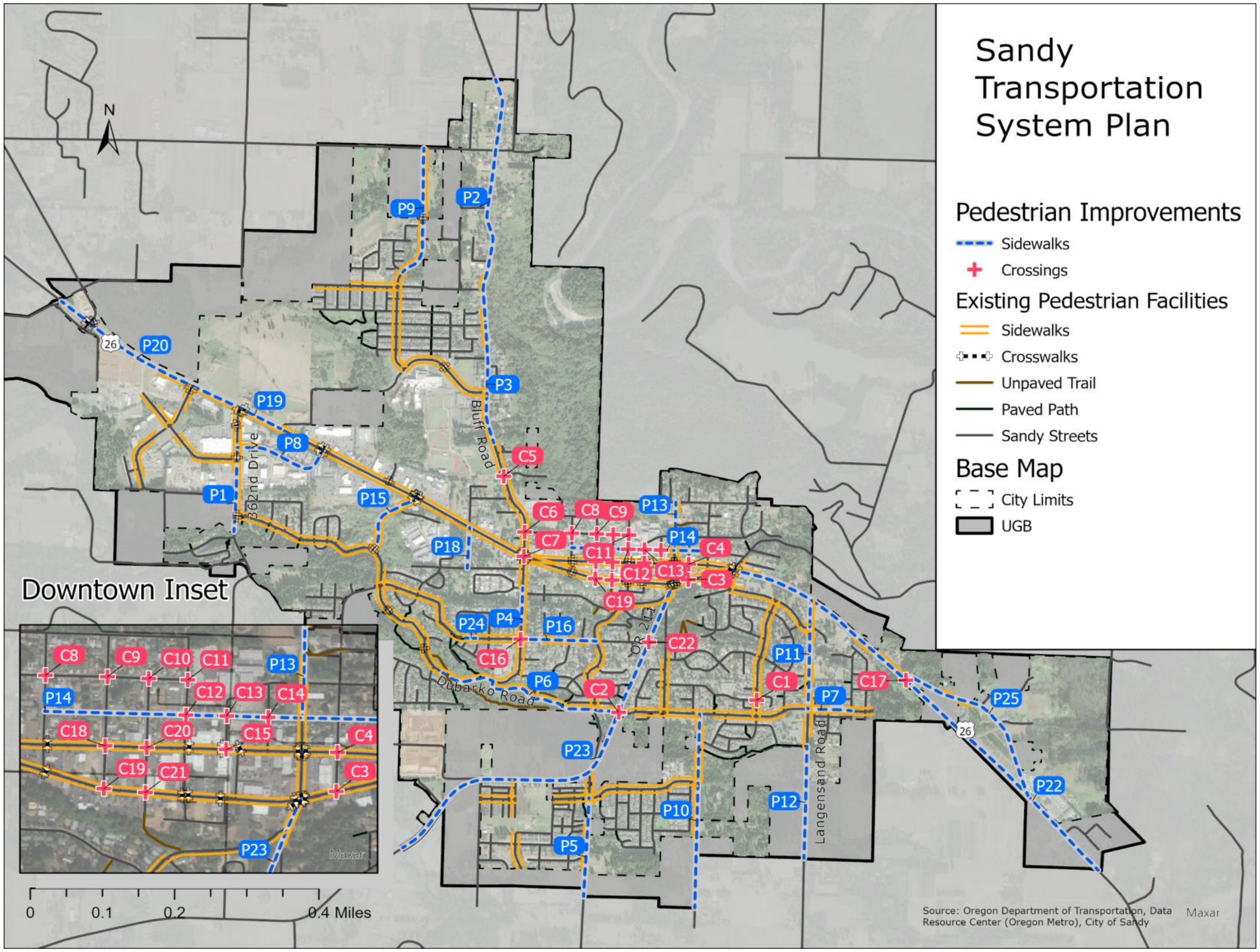


TABLE 2: PEDESTRIAN SYSTEM IMPROVEMENTS

ID	PROJECT	SEGMENT	DESCRIPTION	COST	PRIORITY
P1	362nd Drive	Chinook Dr. to Industrial Way	Infill sidewalk gaps	$1,500,600	High
P2	Bluff Rd.	Green Mountain St. to Northern UGB	Infill sidewalk gaps	$873,500	Medium
P3	Bluff Rd	200 feet north of Marcella Ct. to Green Mountain St.	Infill sidewalk gaps	$634,400	Medium
P4	Bluff Rd	Strawbridge Pkwy to Nettie Connett Dr.	Infill sidewalk gaps	$616,100	Medium
P5	Bornstedt Rd.	Cascadia Village Dr to UGB	Infill sidewalk gaps	$1,732,400	Medium
P6	Dubarko Rd.	300 feet east of Melissa Ave. to 200 feet east OR 211	Infill sidewalk gaps	$3,952,800	Medium
P7	Dubarko Rd.	Langensand Rd. to Antler Ave.	Infill sidewalk gaps	$47,600	High
P8	Industrial Way	362nd Dr. to US 26	Infill sidewalk gaps	$2,183,800	Medium
P9	Jewelberry Rd.	Penny Ave. to Kelso Rd.	Infill sidewalk gaps	$236,700	Medium
P10	Jacoby Rd.	Dubarko Rd. to southern UGB	Infill sidewalk gaps/construct sidewalk	Included in B14	Medium
P11	Langensand Rd	Dubarko Rd. to US 26	Infill sidewalk gaps	$100,000	High
P12	Langensand Rd.	630 feet south of Dubarko Rd. to UGB	Infill sidewalk gaps	$1,150,000	Medium
P13	Meinig Avenue	Scenic St. to US 26	Infill sidewalk gaps	$115,900	Medium
P14	Pleasant St	Beers Ave. to Revenue Ave.	Infill sidewalk gaps	$211,000	High
P15	Ruben Ln	US 26 to Dubarko Rd.	Infill sidewalk gaps	$62,200	Medium
P16	Sandy Heights St	Bluff Rd. to Tupper Rd.	Infill sidewalk gaps	$214,700	High
P17	Downtown Core Pedestrian Improvements	Sidewalk infill side streets perpendicular to US 26	Infill sidewalk gaps	$350,150	High
P18	University Ave	Sunset St. to US 26	Construct sidewalk	$130,500	Medium
P19	US 26	Royal Ln to 362nd Dr.	Infill sidewalk gaps	$536,800	Medium

ID	PROJECT	SEGMENT	DESCRIPTION	COST	PRIORITY
P20	US 26	362nd Dr. to West UGB	Infill sidewalk gaps	$1,207,800	Medium
P22	US 26[A]	Ten Eyck Rd. to Vista Loop Dr. West	Infill sidewalk gaps	$3,977,200	High
P23	OR 211	South UGB to US 26 – coordinate with D25	Construct sidewalk	Included in D25	Medium
P24	Sandy Heights St.	Nettie Connett Drive to Balken Ave	Construct sidewalk on northside	$123,000	Medium
P25	Vista Loop	Full extent	Construct sidewalk	Included in B15	Medium

A. A project completing the gap on the northern side of US 26 is currently funded.

Many of the crossing improvements in Table 3 come from the Cedar Ridge Middle School and Sandy Grade School Safe Routes to School Plan (2020). The low cost of many of these improvements makes it likely that they would be grouped together and funded simultaneously. The cost of all improvements for each school is:

- Cedar Ridge Middle School (CRMS) – Improvements C5 through C10, $292,500.
- Sandy Grade School (SGS) Improvements C11 through C15, $848,250.

TABLE 3: ROADWAY CROSSING IMPROVEMENTS

ID	PROJECT	DESCRIPTION	COST	PRIORITY
C1	Sandy Shopper Crossing - Evans	Evans Street Senior Apartments, traffic calming, and other crossing improvements are needed. Project may include pedestrian crossing advisory signage, curb extensions, and marked crosswalks.	$17,550	High
C2	OR 211 Dubarko Crossing	Project may include pedestrian crossing advisory signage, curb extensions, marked crosswalks, and installation of RRFB. Coordinate with D9 and D20.	$111,150	High
C3	Sandy Transit Center - Pioneer	Project may include pedestrian crossing advisory signage, curb extensions, and marked crosswalks.	$17,550	Medium
C4	Sandy Transit Center - Proctor	Project may include pedestrian crossing advisory signage, curb extensions, and marked crosswalks.	$17,550	Medium
C5	CRMS - Bluff Road at Marcy	Install Rectangular Rapid Flashing Beacon (RRFB) with School Crossing Assembly (S1-1 and W16-7P), and high visibility crosswalks across the north and east sides of the intersection.	$111,150	High
C6	CRMS - Bluff Road at Hood	Install a curb extension including perpendicular curb ramps and tactile domes at northeast corner of Hood St. Install a curb extension to provide clearance from existing pole, including	$17,550	High

ID	PROJECT	DESCRIPTION	COST	PRIORITY
		perpendicular curb ramps and tactile domes, at southeast corner. Mark crosswalk and stop bar across the east leg of intersection.		
C7	CRMS - Bluff Road at US 26	Increase pedestrian signal crossing time. Reconfigure crossing to provide perpendicular curb ramps with tactile domes and reduce curb radius at all corners. Add pedestrian-scale lighting. Reallocate existing roadway space to provide buffered bike lanes along Highway 26 and consider the use of green pavement markings near Bluff Rd. Consider installing vertical delineators with buffered bike lanes contingent on city maintenance agreement or construct a fully grade-separated bicycle facility.	$111,150	High
C8	CRMS - Hood Street at Beers	At Beers Ave, repaint stop bars on west and east sides of intersection. Consider installation of a 4 way stop at Beers Ave.	$17,550	Medium
C9	CRMS - Hood Street at Scales	Install perpendicular curb ramps with tactile domes at northwest and southwest corners of the intersection of Hood St and Scales Ave. Install tactile domes at the northeast and southeast corners. Repaint stop bars.	$17,550	Medium
C10	CRMS -Hood Street at Bruns	Install tactile dome at southwest corner of Bruns Ave and Hood St.	$17,550	Medium
C11	SGS - Hood/Strauss	Relocate southbound school advance crossing assembly (S1-1 & W16-9P) and school speed limit assembly (S4-3P & R2-1) along Strauss Ave to approximately 100 ft and 175 ft north of intersection, respectively. Repair approximately 150 LF of degraded sidewalk along the east side of Strauss Ave at the intersection with Hood St and widen sidewalk at encroaching utility pole. Install a curb ramp on the east side of the south leg of the intersection of Strauss Ave at Hood St. Add tactile domes and a stop bar associated with the crosswalk across the west leg of the intersection.	$350,000	High
C12	SGS - Pleasant/Strauss	Mark stop bars in advance of crosswalks. Consider revising the intersection of Pleasant St and Strauss Ave to be a four-way stop (currently STOP control north- and southbound only).	$17,550	High
C13	SGS - Pleasant/Alt	Mark stop bars in advance of crosswalks. Replace existing diagonal curb ramps at all four corners with perpendicular curb ramps with tactile domes. Construct a raised intersection at Pleasant St at Alt Ave.	$350,000	High
C14	SGS - Smith/Pleasant	Mark stop bars in advance of crosswalks. Relocate southbound school advance crossing assembly (S1-1 & W16-9P) and school speed limit assembly (S4-	$17,550	Medium

ID	PROJECT	DESCRIPTION	COST	PRIORITY
		3P & R2-1) along Smith Ave to approximately 100 ft and 175 ft north of intersection, respectively.		
C15	SGS - Alt/US 26	Increase pedestrian signal crossing time. Upgrade pedestrian pushbuttons to meet current standards with audible indications. Consolidate the two existing crosswalks across Highway 26 at Alt Ave with one high visibility continental crosswalk on the east side of the intersection including advance stop bar, bulb outs, curb ramps, and pedestrian scale lighting.	$111,150	High
C16	Bluff/Sandy Heights	Install marked crosswalks on all four legs with tactile domes on the ramps.	$17,550	Medium
C17	Dubarko/US26	Install marked crosswalks on all four legs with tactile domes on the ramps, coordinate with D20, this project is not needed until the Dubarko Extension is complete.	$17,550	Medium
C18	Scales/Proctor	Install marked crosswalks on all four legs with tactile domes on the ramps.	$17,550	High
C19	Scales/Pioneer	Install marked crosswalks on all four legs with tactile domes on the ramps.	$17,550	High
C20	Bruns/Proctor	Install marked crosswalks on all four legs with tactile domes on the ramps.	$17,550	High
C21	Bruns/Pioneer	Install marked crosswalks on all four legs with tactile domes on the ramps.	$17,550	High
C22	OR 211	Pedestrian Overcrossing for Sandy Heights Street.	$5,978,000	Medium

Note: CRMS – Cedar Ridge Middle School and SGS – Sandy Grade School

UPDATE TO TSP BICYCLE IMPROVEMENTS

Sandy's existing bicycle facilities were inventoried and used as a starting point to develop future bicycle solutions. Bicycle enhancements throughout the city will be important to meet bicycle needs and provide an alternative to driving. The bicycle projects in the 2011 TSP were reviewed and updated to identify future solutions. The recommended bicycle system improvements are shown in Figure 2.

Beyond the evaluation criteria, corridors were included in the priority bicycle network based on:

- A comparison of the relative increase in the area accessible with the project
- Proximity to schools
- Proximity to major destinations
- Directness of route

- Ability to provide an off-highway connection

Recommended treatments included:

- Separated bike facilities – treatments could include a shared use path, separated bicycle lanes, or buffered bicycle lanes
- Bicycle lanes – treatments could include on-street bicycle lanes without a buffer

Specific bicycle improvements are identified below. The specific locations where system improvements were identified is shown in Table 3.

The proposed bicycle system enhancements are shown in Figure 2 and Table 4. The proposed off-road trail system improvements from the Sandy Parks and Trails Master Plan are shown in Table 5.

FIGURE 2: PROPOSED BICYCLE SYSTEM IMPROVEMENTS

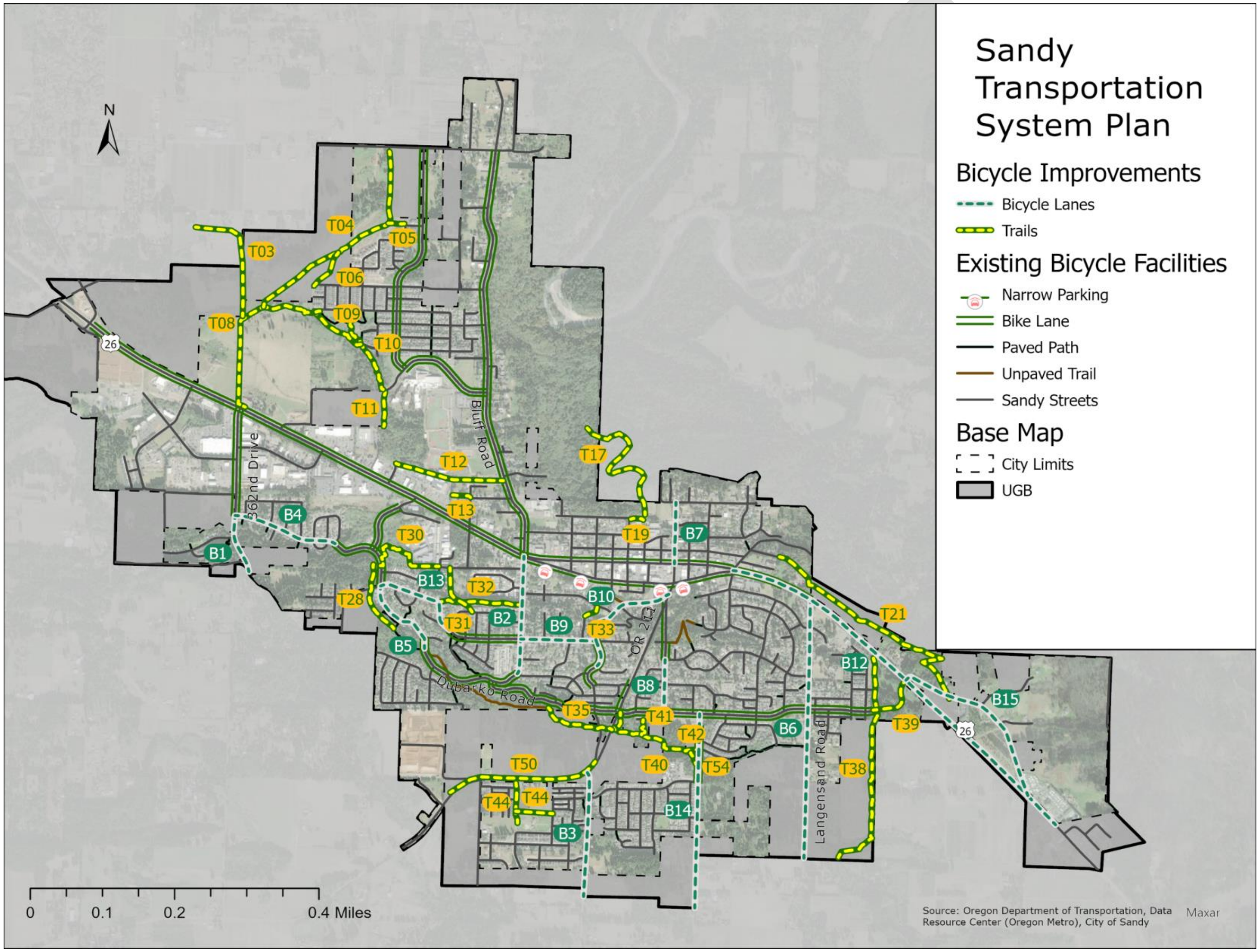


TABLE 4: BICYCLE SYSTEM IMPROVEMENTS

ID	PROJECT	SEGMENT	DESCRIPTION	COST	PRIORITY
B1	362nd Dr.	Dubarko Rd. to UGB	Widen shoulder to 6 feet minimum for bike access	$1,500,600	High
B2	Bluff Rd.*	US 26 to Miller Rd.	Re-stripe roadway to provide bike lanes	$48,800	High
B3	Bornstedt Rd	OR 211 to UGB	Widen roadway to provide bike lanes	$2,533,050	High
B4	Dubarko Rd.*	362nd Dr. to Eldridge Dr.	Re-stripe roadway to provide bike lanes	$43,920	High
B5	Dubarko Rd.*	Sandy Heights St. to Melissa Ave.	Re-stripe roadway to provide bike lanes	$43,920	High
B6	Langensand Rd.*	US 26 to UGB	Re-stripe roadway to provide bike lanes	$74,660	High
B7	Meinig Ave*	Scenic St. to US 26	Re-stripe roadway to provide bike lanes	$74,420	High
B8	Meinig Ave*	Barker Ct. to Dubarko Rd.	Re-stripe roadway to provide bike lanes	$20,740	High
B9	Sandy Heights St*	Bluff Rd. To Tupper Rd.	Re-stripe roadway to provide bike lanes	$48,800	High
B10	Tupper Rd.	Long Circle to OR 211	Widen roadway to provide bike lanes	$2,990,000	High
B12	US 26	Ten Eyck Road to UGB	Widen shoulder to 6 feet	$3,977,200	High
B13	Sandy Heights St	Dubarko Rd to Nettie Connett Dr	Re-stripe/widen Roadway to provide bike lanes	$2,269,800	High
B14	Jacoby Rd	Dubarko Rd to southern UGB	Re-stripe/widen Roadway to provide bike lanes and construct sidewalk	$3,920,000	High
B15	Vista Loop	Full extent	Re-stripe/widen Roadway to provide bike lanes and construct sidewalk	$2,060,200	High

*NOTE: REQUIRES THE ELMINATION OF ON STREET PARKING

TABLE 5: PROPOSED OFF-ROAD TRAIL IMPROVEMENTS (FROM SANDY PARKS AND TRAILS MASTER PLAN)[A]

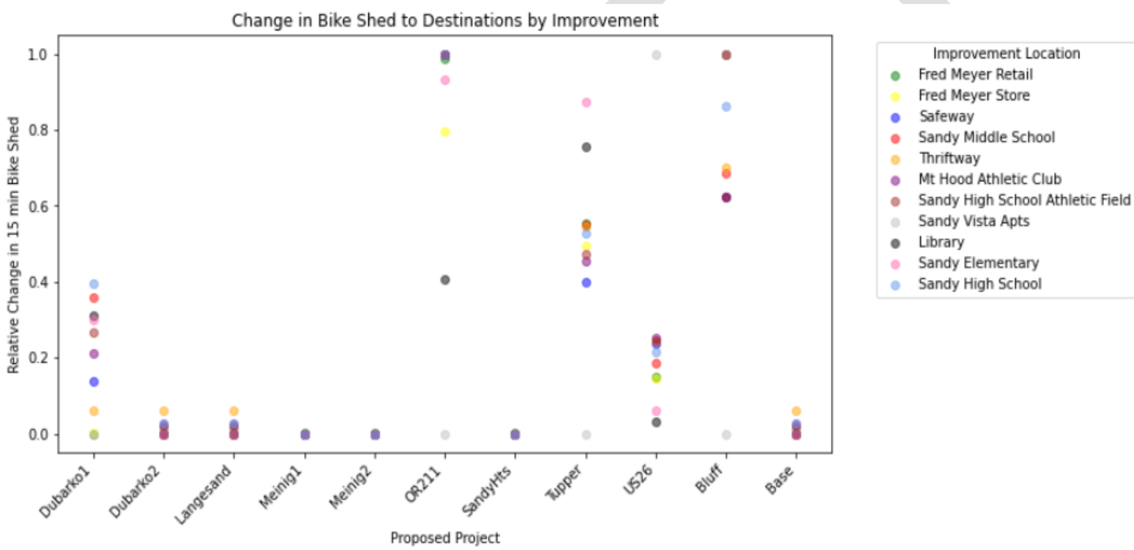
ID	PROJECT	DESCRIPTION	COST	PRIORIRTY
T03	362nd	6' - 8' wide gravel trail	$104,500	Medium
T04	Kelso to Powerline	6' - 8' wide gravel trail	$184,500	Medium
T05	Powerline	5' concrete path	$30,600	Medium
T06	Olson to Powerline	5' concrete path	$81,700	Medium
T08	Sandy Bluff Park to 362nd 3	6' - 8' wide gravel trail	146,300	Medium
T09	Sandy Bluff Park Pond Loop Trail 3	6' - 8' wide gravel trail	$48,400	Medium
T10	Bell Street to Sandy Bluff Park 3	6' - 8' wide gravel trail	$63,900	Medium
T11	Kate Schmidt to Bell Street 3	3' wide natural surface trail	$28,500	Medium
T12	SHS Trail Easement 1 3	3' wide natural surface trail	$88,400	Medium
T13	Meeker to MH Athletic Club	5' concrete path	$34,800	Medium
T17	Community Campus to Sandy River Trail	3' wide natural surface trail	$23,900	Medium
T19	Park Street to Community Campus	3' wide natural surface trail	$1,800	Medium
T21	Vista Loop to Hood Street	6' - 8' wide gravel trail	$37,100	Medium
T28	Tickle Creek Reroutes 3	6' - 8' wide gravel trail	$61,200	Medium
T30	Sunset Street to Tickle Creek	3' wide natural surface trail	$13,000	Medium
T31	Sunset Street to Nettie Connett Drive	5' wide concrete path	101,600	Medium
T32	Bluff Road to Sandy Heights	3' wide natural surface trail	$11,600	Medium
T33	Tupper Park to Gerilyn Court	5' concrete path	$30,800	Medium
T35	Tickle Creek Extension East to Dubarko Underpass	6' - 8' wide gravel trail	$59,900	Medium
T38	Tickle Creek to Deer Point Park	5' concrete path	432,000	Medium
T39	Dubarko Extension Road	8' wide asphalt trail	127,800	Medium
T40	Tickle Creek Extension Dubarko East to Jacoby	3 6' - 8' wide gravel trail	$98,700	Medium
T41	Alleyway to Tickle Creek Trail Connector	5' concrete path	$37,500	Medium
T42	Jacoby Road to Tickle Creek Connector	5' concrete path	$27,900	Medium

ID	PROJECT	DESCRIPTION	COST	PRIORIRTY
T44	Bornstedt Park	5' concrete path	$78,000	Medium
T50	Highway 211 Parkway		$389,500	Medium
T54	Cascadia to Tickle Creek	6' - 8' wide gravel trail	$30,200	Medium

A. The trail component of the existing Parks SDC is expected to fund these projects

The potential benefit of these bicycle projects on system connectivity was evaluated using a service area analysis tool in ArcGIS. This analysis measured the area accessible to people biking in 15 minutes from the key destinations in the city, including the commercial, educational, and cultural locations. The relative service area improvement of each bicycling system project was evaluated against the existing bicycle network. The results of this analysis are shown in Figure 3.

FIGURE 3: RELATIVE BENEFIT OF BICYCLE SYSTEM IMPROVEMENTS FOR KEY DESTINATIONS



Improvements to OR 211, Tupper Road, and Bluff Road show the highest relative benefit to bicycle connectivity to most key destinations. The US 26 improvement (B12) is the only project that improves accessibility to the Sandy Vista Apartments.

TRANSIT SYSTEM IMPROVEMENTS

The projects in Table 6 were recommendations obtained from the Sandy Transit Master Plan[2] that can be referenced for more information about these specific projects. Most transit projects will be led by Sandy Area Metro and may require coordination with TriMet and the City of Gresham. TSP projects in other sections that were created to meet the needs of the transit improvements are noted.

TABLE 6: TRANSIT SYSTEM IMPROVEMENTS

PROJECT	DESCRIPTION
Local service improvements - Fixed routes	Add Saturday service, lengthening the service hours, adding an additional shuttle route that reaches the Vista Apartments.
Local service improvements - Flexible services	Add a bus and driver.
Local service improvements - Electric buses	Purchase one or more electric buses, a charging station, and the required maintenance equipment.
Additions to regional service - Gresham Express	Higher frequencies on Saturdays or Sundays, more night and morning service on Saturdays or Sundays, Occasional additional trips that go directly to important destinations.
Additions to regional service - New Clackamas Express	Coordinate with Clackamas County, the City of Boring and TriMet to plan and fund a route connecting these communities.
Additions to regional service - Improved bus stops	Coordinate with the City of Gresham and TriMet to invest in better stop amenities at the Gresham Transit Center.
Pedestrian Improvements - Transit Center	Improve access to the transit center by providing crossing treatments from every direction specifically at Proctor and Pioneer Blvd at Hoffman Ave. TSP projects include C3 & C4 – Hoffman Ave at Proctor and at Pioneer Crossing Improvement, these projects require coordination with ODOT.
Pedestrian Improvements - Evans St Crossing	Construct a crosswalk or traffic calming treatment on Evans St. TSP projects include C1 – Van Fleet Ave/Evans St Crossing Improvement, this project would be lead by SAM.

[2] Sandy Transit Master Plan, April 2020.

SAFETY IMPROVEMENTS

There are four locations where the historic crash analysis demonstrated a need for safety related improvements. The three locations on US 26 (362^{nd} Drive, Ruben Lane, and Orient Drive) demonstrated crash causes that are attributable to high traffic volumes and urban traffic conditions. Implementing an adaptive traffic signal control plan along US 26 may reduce the frequency of these collisions because those systems typically reduce congestion and delay along a corridor. The turning collisions at OR 211 and Dubarko Road will likely be reduced with the installation of a traffic signal at that intersection, project D8. That improvement also serves driving needs and is included in Table 8. Potential safety improvements are shown in Table 7.

TABLE 7: SAFETY SYSTEM IMPROVEMENTS

PROJECT ID	NAME	DESCRIPTION	COST	PRIORITY
S1	US 26 Adaptive Signal System[A]	Install an adaptive signal control system on US 26 between Orient Drive and Bluff Road	$200,000	High
S2	US 26 at Ten Eyck Road	Study improvements to business access at Ten Eyck Road and US 26	$50,000	Low

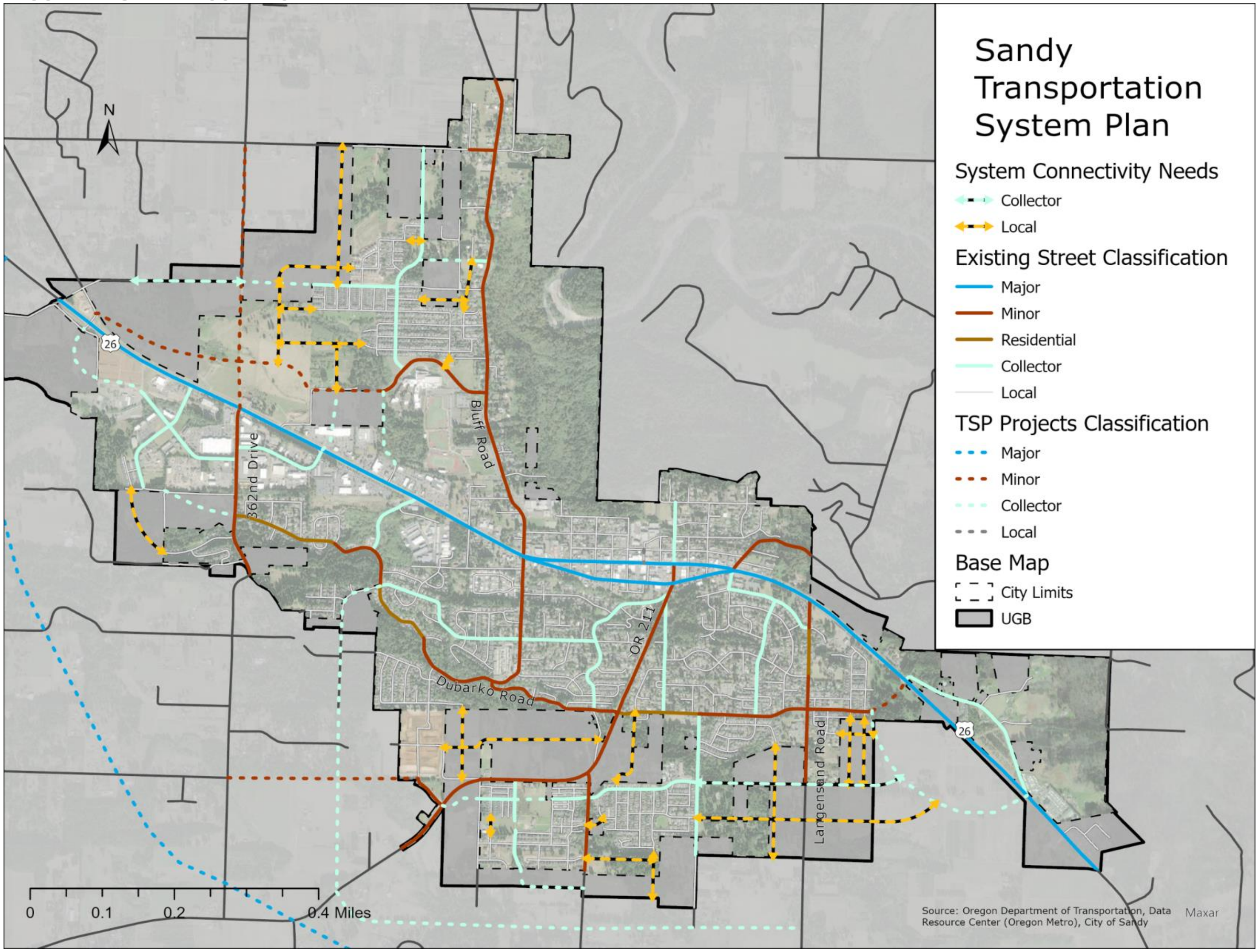
A. An adaptive signal system is currently in place between Bluff Road and Ten Eyck Road

UPDATE TO TSP SYSTEM CONNECTIVITY IMPROVEMENTS

By providing connectivity between neighborhoods, out-of-direction travel and vehicle miles traveled (VMT) can be reduced, the attractiveness of various travel modes enhanced, traffic levels can be balanced between various streets, and public safety response time is reduced. In the City of Sandy, several important new roadway connections will be needed within developed areas to reduce out of direction travel for vehicles, pedestrians, bicyclists, and transit services. New connections will be most critical in areas where a significant amount of new development is possible.

Figure 4 shows the Street Connectivity Plan for Sandy. In most cases, the connector alignments are not specific and are aimed at reducing potential neighborhood traffic impacts by balancing traffic flows on local streets. The arrows shown in the figures represent potential connections and the general direction for the placement of the connection. In each case, the specific alignments and design should be determined as part of development review, with consideration being given to the built environment, topography, and environmental conditions.

FIGURE 4: STREET CONNECTIVITY PLAN



Should new cul-de-sacs be created, bicycle and pedestrian accessways to provide a connection to the surrounding transportation system from the cul-de-sac shall be required per Section 17.100.120(D) of the SMC.

To protect existing neighborhoods from the potential traffic impacts caused by extending stub end streets, the City may require that appropriate traffic calming measures are incorporated into the design and construction of new street extensions. In addition, when a development constructs stub streets, the City may require the installation of signs indicating the potential for future connectivity to increase residents' awareness. Additionally, new developments that construct new streets or street extensions are required by Section 17.100.100(F) of the SMC to provide a proposed street map that:

- Provides full street connections with spacing of no more than 400 feet between connections except where prevented by barriers or access management standards on higher classified facilities.
- Provides bike and pedestrian accessways through the middle of the block when block lengths exceed 600 feet.
- Limits use of cul-de-sacs and other closed-end street systems to situations where existing barriers prevent full street connections.
- Includes no cul-de-sacs or close-end street longer than 400 feet. Those street segments longer than 400 feet, or developments with only one access point, may be required to provide an alternative access for emergency vehicle use only.
- Includes street cross-sections showing dimensions of right-of-way improvements, with streets designed for posted or expected speed limits which meet City design standards (or ODOT standards for state highways).

VEHICLE CAPACITY IMPROVEMENTS

Future improvement alternatives were previously developed and evaluated as part of the 2011 Sandy TSP[3] to enhance connectivity, provide access to developing lands, and address congestion in the US 26 corridor. The objective for each improvement alternative ranged from relying mainly on management and enhancement of the existing transportation system to large investments in new facilities to increase corridor capacity.

Two of the alternatives were carried forward into this plan. One alternative contains improvements to the street network that improve local connectivity for highway travel (Alternative #1) while the other alternative contains all the local connectivity projects in Alternative #1 and a US 26 bypass (Alternative #3). The phasing of projects based on the alternative is shown in Figure 5. Project descriptions can be found in Table 8.

[3] Sandy TSP Update, Technical Memo #2: Transportation Alternatives and Improvement Strategies, DKS Associates, February 25, 2011.

ALTERNATIVE #1

The improvements included in Alternative 1 were analyzed to assess operation benefits at the study intersections resulting from new system network and added capacity. Two intersections that did not meet mobility targets will do so with the improvements in Alternative #1.

- The intersection of US 26 and Industrial Way meets mobility targets with a reduction in demand at the eastbound, westbound, and northbound approaches.
- The intersection of OR 211 and Bornstedt Road meets mobility targets with the prohibition of the northbound left turn movement.

With the new local network connections north of US 26, particularly the Bell Street extension to Orient Drive, through volumes along US 26 are reduced in Alternative #1 which results in improvements to the operation of intersections along the highway.

Six intersections still fail to meet mobility targets under Alternative #1.

- **US 26 and Orient Drive** – There is a higher eastbound left traffic volume and lower eastbound through volume relative to the No Build condition however this reduction does not improve conditions enough for this intersection to meet mobility targets.
- **US 26 and 362nd Drive** – Lower traffic volumes for the eastbound and westbound approaches improve conditions at this intersection but it still fails to meet mobility targets.
- **362nd Drive and Industrial Way (north)** – With an additional southbound through lane that widens this intersection and increased traffic volumes, conditions remain LOS F for the Industrial Way approach.
- **362nd Drive and Industrial Way (south)** – The eastbound left turn lane improves conditions for that approach, but higher northbound and southbound volumes degrade conditions for the major approaches.
- **US 26 and Ruben Lane** – Lower traffic volumes for the eastbound and westbound approaches improve conditions at this intersection but it still fails to meet mobility targets.
- **US 26 and Bluff Road** – Lower traffic volumes for the eastbound left and through and westbound through movements improve conditions at this intersection but it still fails to meet mobility targets.

ALTERNATIVE #3 (US 26 BYPASS)

The improvements included in Alternative 1, combined with the bypass of the existing US 26 corridor, were analyzed to assess operation benefits at the study intersections. Because the impacts on the city street network will vary significantly with the locations and types of access allowed to the bypass, only the US 26 corridor intersections were evaluated to see how much the bypass could relieve congestion.

With the addition of a US 26 bypass only the intersection of US 26 and Orient Drive would exceed mobility targets. The eastbound through and southbound left movements at this intersection continue to compete for available green time in the cycle even with the addition of the bypass.

FIGURE 5: FUTURE STREET PROJECT IMPROVEMENTS

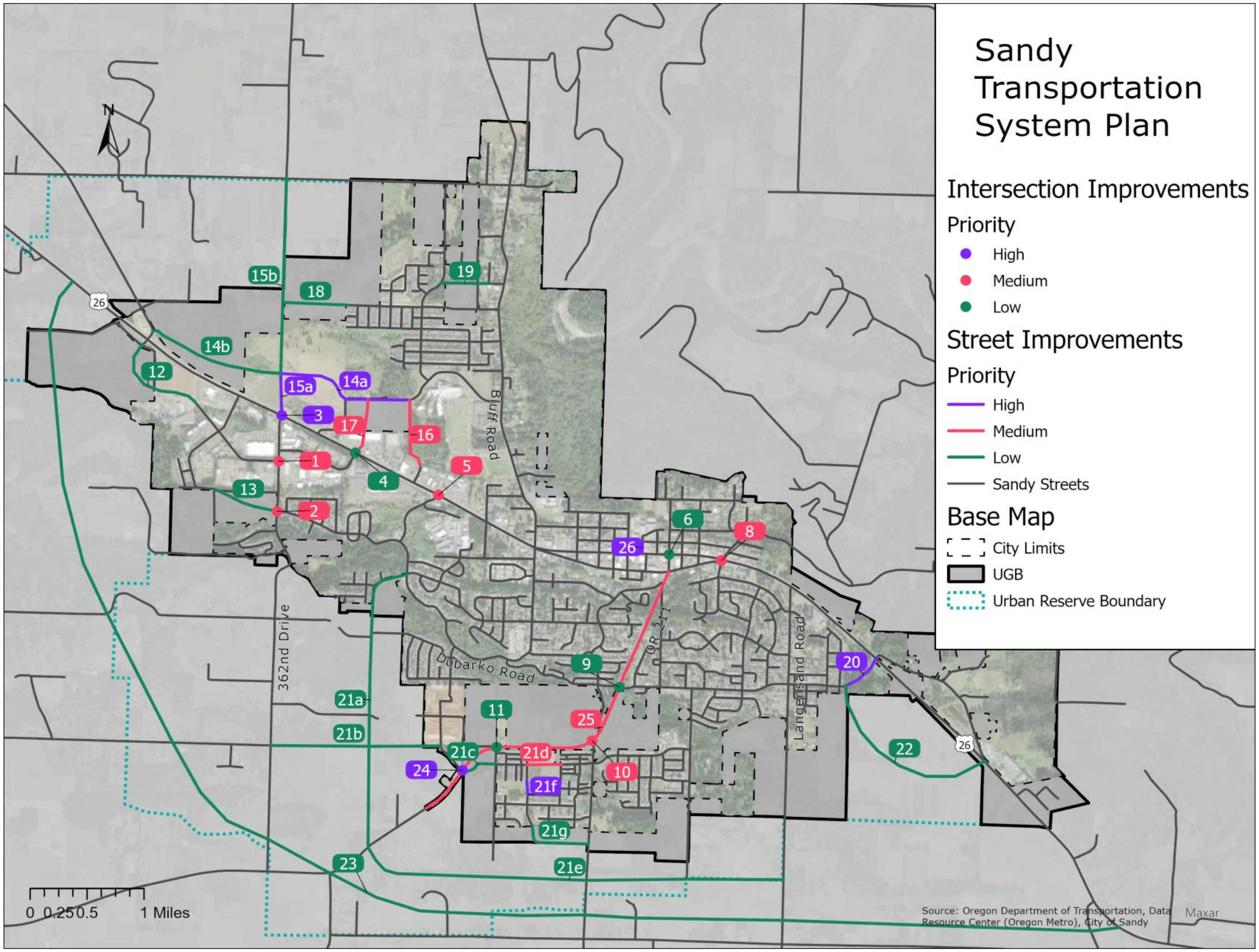


TABLE 8: STREET SYSTEM IMPROVEMENTS

PROJECT ID	NAME	DESCRIPTION	COST	PRIORITY
D1	362nd Drive & Industrial Way (south) Intersection Improvement	Reduce eastbound congestion. Project may include restriping to include an exclusive eastbound left turn lane and exclusive right turn lane.	$140,300	Medium
D2	362nd Drive & Dubarko Road Intersection Improvement	Reduce intersection congestion. Project may construct a traffic signal or roundabout.	$1,421,300	Medium
D3	US 26 & 362nd Drive Intersection Improvement	Reduce congestion for the westbound left turn and accommodate the 362nd Drive Extension 1. Project may include minor widening to accommodate a second westbound left turn lane and receiving lane on 362nd Drive, minor widening to accommodate a northbound through lane, construction of a three-lane southbound approach with a right turn lane, through lane, and left turn lane, and an eastbound left turn lane.	$6,527,000	High
D4	US 26 & Industrial Way Intersection Improvement	Improve egress from commercial area and reduce northbound congestion. Project may include minor widening to accommodate a northbound left turn lane and restriping on the southbound approach to dual left turn lanes and a shared through/right turn lane.	$951,600	Low
D5	US 26 & Ruben Lane Intersection Improvement	Improve egress from commercial area and reduce northbound congestion. Project may include restriping southbound approach to dual left turns and a shared through/right lane and restriping the northbound approach to a left turn lane and shared through/right lane.	$939,400	Medium
D6	OR 211 & Proctor Boulevard Intersection Improvement	Reduce northbound congestion. Project may include restriping northbound approach to include an exclusive left turn lane and through/right lane.	$6,100	Low
D7	US 26 Adaptive Signal Timing	Implement ASCT along US 26 through Sandy. ASCT can improve the operation of individual signals and corridor wide to reduce travel time and delay for drivers	$488,000	Medium
D8	US 26 & Ten Eyck Road/Wolf Drive Intersection Improvement	Improve northbound and southbound approaches. Project may include striping left turn lanes on both minor street approaches.	$1,488,400	Low

PROJECT ID	NAME	DESCRIPTION	COST	PRIORITY
D9	OR 211 & Dubarko Road Intersection Improvement	Reduce intersection congestion and improve safety. Project may include constructing a turn signal or roundabout. A traffic signal improvement may include minor widening for a northbound right turn lane, northbound left turn lane, and southbound left turn lane. Coordinate with C2 and D20.	$12,383,000	Medium
D10	OR 211 & Bornstedt Road Intersection Improvement	Reduce northbound congestion. Project may include signage and approach modifications to prohibit left turns from the minor street approach.	$19,520	Low
D11	OR 211 & Arletha Court Intersection Improvement	Reduce northbound congestion. Project may include signage and approach modifications to prohibit left turns from the minor street approach.	$3,135,400	Low
D12	Industrial Way Extension 1	Extend Industrial Way to Jarl Road/US 26 at Collector standards	$13,176,000	Low
D13	Dubarko Road Extension	Extend Dubarko Road to Champion Way at Collector standards	$7,448,100	Low
D14A	Bell Street Extension 1[A]	Extend Bell Street to 362nd Drive Extension 1 at Minor Arterial standards	$9,945,000	High
D14B	Bell Street Extension 2	Extend Bell Street from 362ND Drive Extension 1 to Orient Drive at Minor Arterial standards	$9,885,000	Low
D15A	362nd Drive Extension 1[A]	Extend 362nd Drive to Bell Street Extension 1 at Minor Arterial standards	$2,985,000	High
D15B	362nd Drive Extension 2	Extend 362nd Drive from Bell Street Extension 1 to Kelso Road at Minor Arterial standards	$14,020,000	Low
D16	Kate Schmidt Street Extension	Extend Kate Schmidt Street to Bell Street Extension 1 at Collector standards	$8,960,900	Medium
D17	Industrial Way Extension 2	Extend Industrial Way to Bell Street Extension 1 at Collector standards	$4,660,400	Medium
D18	Olson Road Extension	Extend Olson Road to 362nd Drive Extension 2 at Collector standards	$5,246,000	Low
D19	Agnes Street Extension	Extend Agnes Street to Bluff Road at Collector standards	$5,941,400	Low
D20	Dubarko Road Extension	Extend Dubarko Road to US 26/Vista Loop Road (west) at Minor Arterial standards, coordinate with D9 and C17	$3,904,000	High

PROJECT ID	NAME	DESCRIPTION	COST	PRIORITY
D21A	Sandy Heights Street/370th Avenue Extension	Extend Sandy Heights Street/370th Avenue to OR 211 at Collector standards	$24,341,850	Low
D21B	Gunderson Road Extension	Extend Gunderson Road from existing terminus near OR 211 to 362nd Drive at Collector standards	$13,735,800	Low
D21C	Cascadia Village Extension 1	Extend Cascadia Village from OR 211 to Arletha Court at Collector standards	$2,024,100	Low
D21D	Cascadia Village Extension 2	Extend Cascadia Village Drive from Village Boulevard to Pine Street at Collector standards	$2,170,350	Medium
D21E	New southern collector	Construct new a new road at Collector standards from OR 211 at the intersection with the Sandy Heights Street/370th Avenue Extension to Langensand Road	$33,532,200	Low
D21F	Village Boulevard Extension 1	Connect Village Boulevard at Collector standards between Cascadia Village Drive and Juniper Street	$865,800	High
D21G	Village Boulevard Extension 2	Extend Village Boulevard at Collector standards from existing terminus south of Juniper Street to Bornstedt Road	$3,980,000	Low
D22	New eastern collector	Construct new a new road at Collector standards from Dubarko Road at the intersection with the Dubarko Road Extension to US 26/ Vista Loop Road (east)	$19,995,800	Low
D23	US 26 Bypass	Construct bypass from east of Orient Drive to Shorty's Corner (Firwood Road)	$970,000,000	Low
D24	OR 211 & Gunderson Road Intersection Improvement	Intersection improvement project includes a northbound left turn lane from OR 211 to Gunderson Road	$1,700,000	High
D25	OR 211	Upgrade OR 211 to Minor Arterial standards from UGB to US 26, coordinate with P23	$22,057,600	Medium
D26	Alt Avenue	Reconstruct Alt Avenue from Proctor Blvd to Pleasant St to improve walkability and access to the Sandy Library	$10,941,750	High

A. This project is currently funded

FUNCTIONAL CLASSIFICATION

The motor vehicle classifications for streets help support the movement of vehicles by indicating the street's intended level of mobility, access, and use for vehicles. A city's street functional classification system is an important tool for managing the transportation system. It is based on a hierarchical system of roads in which streets of a higher classification, such as arterials, are designed for a higher level of mobility for through movements, while streets of a lower classification are designed to facilitate access to adjacent land uses. From highest to lowest intended use, the recommended classifications are Major Arterial, Minor Arterial, Neighborhood Arterial, Collector, and Local Streets. Streets with higher intended usage generally limit access to adjacent property in favor of more efficient motor vehicle traffic movement (i.e., mobility). Local roadways with lower intended usage have more driveway access and intersections, and generally accommodate shorter trips to nearby destinations.

The only change in functional classification from the 2011 Sandy Transportation System Plan is OR 211 which is classified as a Minor Arterial due to the jurisdictional transfer from ODOT.

Major Arterial

Major arterials are typically three to five-lane highways that operate as two-way streets or as a one-way couplet. These roads are intended to handle high volumes of traffic, typically 16,000 ADT (Average Daily Traffic) or more. Major arterials provide greater regional mobility, are managed to favor through traffic capacity and safety over direct access and should generally be spaced approximately one mile apart. Private driveway access, on-street parking, and traffic calming measures are typically discouraged along major arterial routes and the provision of bike lanes or shoulders is required.

Minor Arterial

Minor arterials are high-volume, intra-city streets providing connectivity and parallel features, and should generally be spaced approximately one mile apart. These roads have a typical capacity between 8,000 and 16,000 ADT. Minor arterials are generally the most critical classification for circulation in the urban areas of Sandy and are intended to serve longer local trips. Private driveway access is discouraged where access to facilities of lower classification is available, and traffic calming measures and on-street parking should be avoided. The provision of bike lanes is required.

Residential Minor Arterial

Residential minor arterials are a hybrid between minor arterial and collector type streets that allows for moderate to high traffic volumes on streets where over 90% of the fronting lots are residential. These roads have similar typical capacity to minor arterials, 6,000 to 10,000 ADT. They are intended to provide some relief to the strained arterial system while ensuring a safe residential environment. Residential minor arterials may include on-street parking and traffic calming measures may be applied. Direct access to properties is managed in a manner like collector streets. The provision of bike lanes is required.

Collector

Collector streets provide both access and circulation within and between residential and commercial areas. These roads have a typical capacity between 2,000 and 6,000 ADT. Collectors differ from arterials in that they provide more of a citywide circulation function, do not require as extensive control of access (compared to arterials), and penetrate residential neighborhoods, distributing trips from the local street system to minor and major arterials. Collectors may provide on-street parking, may incorporate traffic calming measures, and should be spaced approximately one-half mile apart. The provision of bike lanes is required.

Local Street

Local streets have the sole function of providing immediate access to adjacent land. These streets have a typical capacity not exceeding 1,000 ADT. Service for through traffic movements on local streets is deliberately discouraged by design. All other City streets in the City of Sandy that are not designated as arterial streets or collector streets are local streets. Local streets may allow on-street parking and may incorporate traffic calming measures. Bike lanes are not required.

STREET CROSS SECTION STANDARDS

The design characteristics of Sandy's streets are defined in Section 17.100.110 of the SMC and were developed by the City to meet the function and demand for each facility type. Two updates to the design standards in the 2011 Sandy Transportation System Plan have been included in the design standards below. They are:

- A minimum bike lane width for Minor Arterials and Collectors of six feet.
- A minimum sidewalk width for Local streets of six feet. This makes sidewalk width consistent between functional class levels.
- Specific applications of the Blueprint for Urban Design along US 26 have been included for reference. The Blueprint for Urban Design controls the design of US 26 and the land use contexts below summarize conditions applicable to the City.

The actual design of a roadway can vary from segment to segment due to adjacent land uses, traffic demand, topography and/or resources. Some elements of a particular cross section design are necessary to provide for the unique needs of a class, but flexibility is also needed so that standards can be applied in a variety of circumstances. Minimum cross section dimensions are shown in Table 9.

Design standards for Major Arterials in Sandy (US 26) are controlled by the Blueprint for Urban Design in the Oregon Highway Design Manual and are not completely duplicated in the TSP. For reference, three land use contexts and highway design options are included in this discussion. Those contexts are:

- **Special Transportation Area (STA)** along Proctor Boulevard and Pioneer Boulevard between Bluff Road and Ten Eyck Road (Figure 6). In this urban context speeds are low, at or below 25 miles per hour, there are regular transit stops, and ample bicycle and pedestrian facilities to serve the expected higher volume of these users.

- **Commercial Corridor** west of Bluff Road (Figure 7). In this context speeds are moderate, typically between 30 and 35 miles per hour, there are regular transit stops and pedestrian and bicycle facilities should be buffered from the travel lanes.
- **Suburban Fringe** east of Ten Eyck Road (Figure 8). In this context speeds are higher, between 35 and 40 miles per hour. Pedestrian and bicycle facilities should be separated with a buffer and future uses of the surrounding land should be considered

TABLE 9: STREET DIRECTIONAL CROSS SECTION DIMENTIONS[E]

CROSS SECTION	TOTAL ROW	SIDEWALK	PLANTER STRIP	PARKING	BIKE LANE	TRAVEL LANE	CENTER LANE[A]
MAJOR ARTERIAL - STA	58	7[CD]	-	8	6[A]	11	-
MAJOR ARTERIAL – COMMERCIAL CORRIDOR	102	6.5[C]	6.5[D]	-	7	12	14
MAJOR ARTERIAL – SUBURBAN FRINGE	94	10.5[CF]	8.5[D]	-	-	12	8
MINOR ARTERIAL – STANDARD	86	6.5[C]	5.5[D]	8	6	11	12
MINOR ARTERIAL – MINIMUM[B]	66	6.5[C]	5.5[D]	-	6	11	8
COLLECTOR - STANDARD	82	6.5[C]	5.5[D]	8	6	11	8
COLLECTOR – MINIMUM[B]	58	6.5[C]	5.5[D]	-	6	11	-
LOCAL	52	6.5[C]	5.5[D]	7	-	14[A]	-

A. Not directional, this element only appears once in the cross section

B. Minimum cross section designs can be applied per Section 17.66.00 SMC

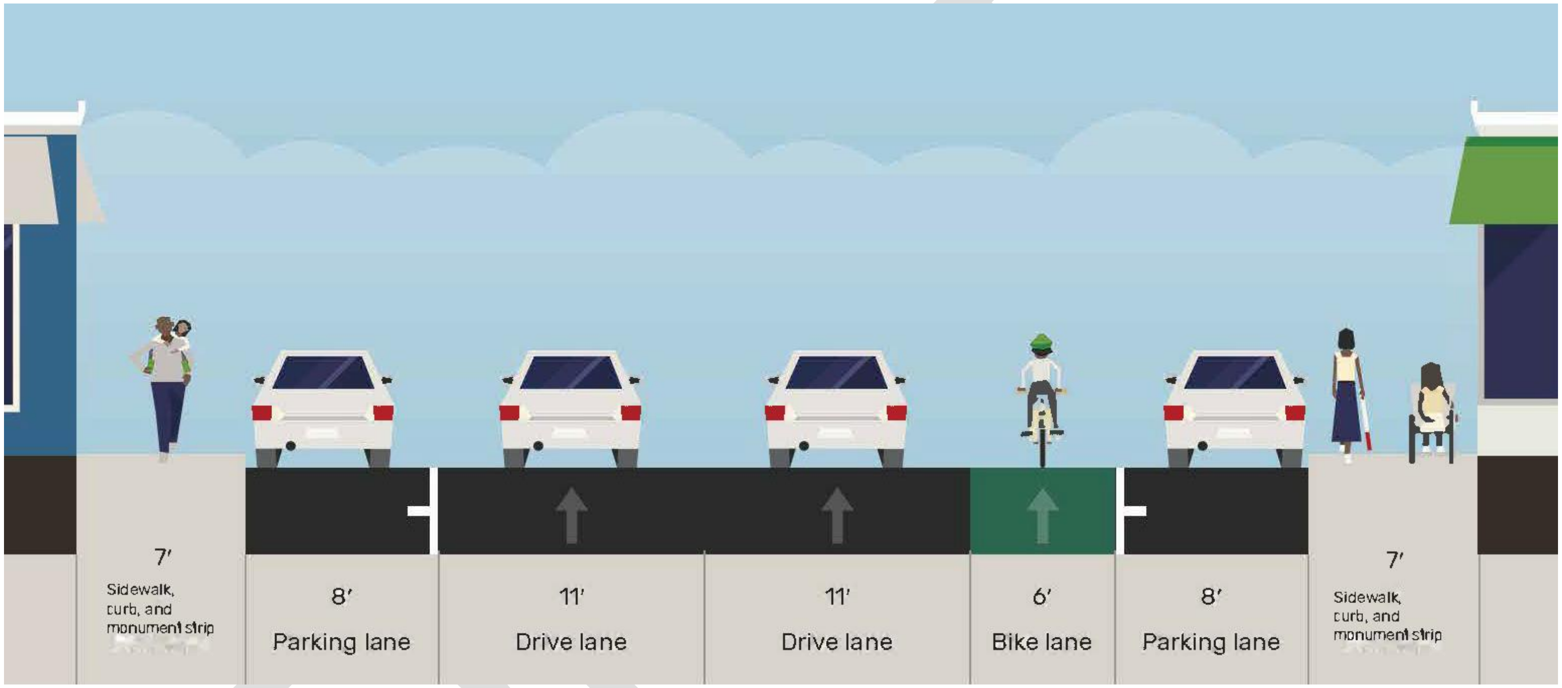
C. Includes 0.5’ monument strip

D. Includes 0.5’ curb

E. All dimensions in feet

F. As shared use path

FIGURE 6: US 26 SPECIAL TRANSPORTATION AREA[4]



[4] Streetmix.net accessed 12/03/2021

FIGURE 7: US 26 COMMERCIAL CORRIDOR[5]

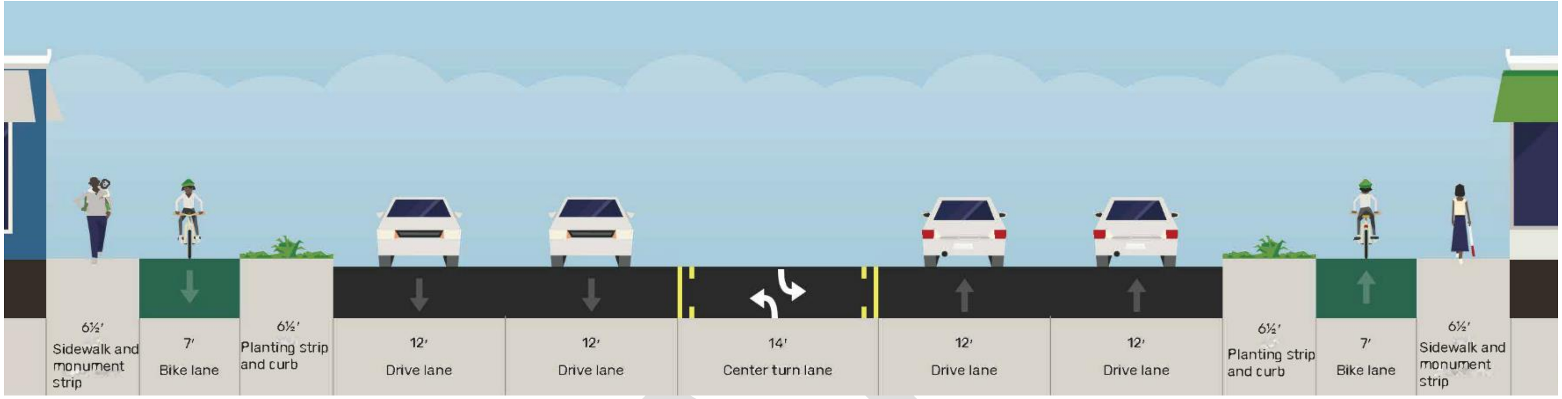
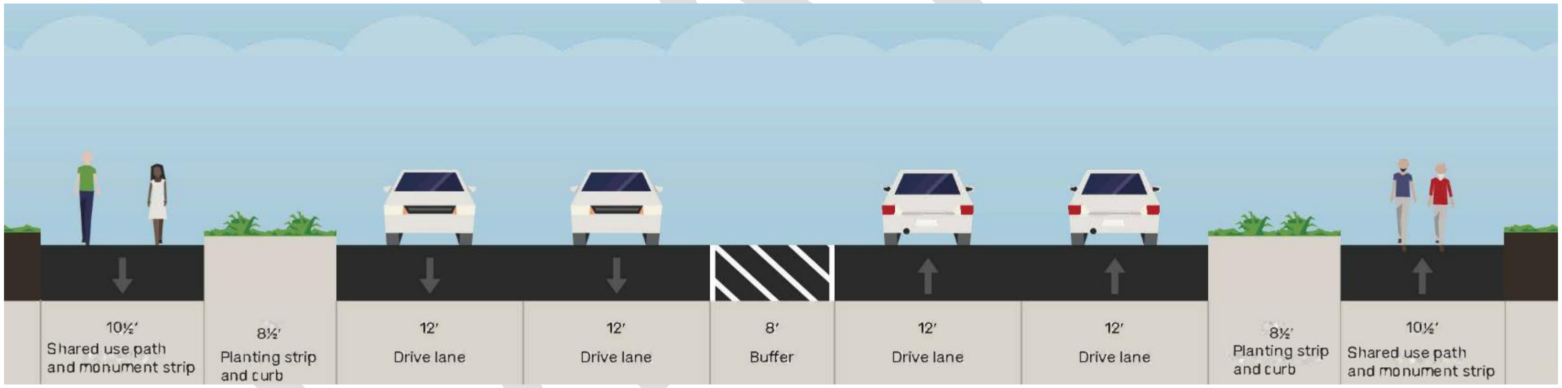


FIGURE 8: US 26 SUBURBAN FRINGE[6]



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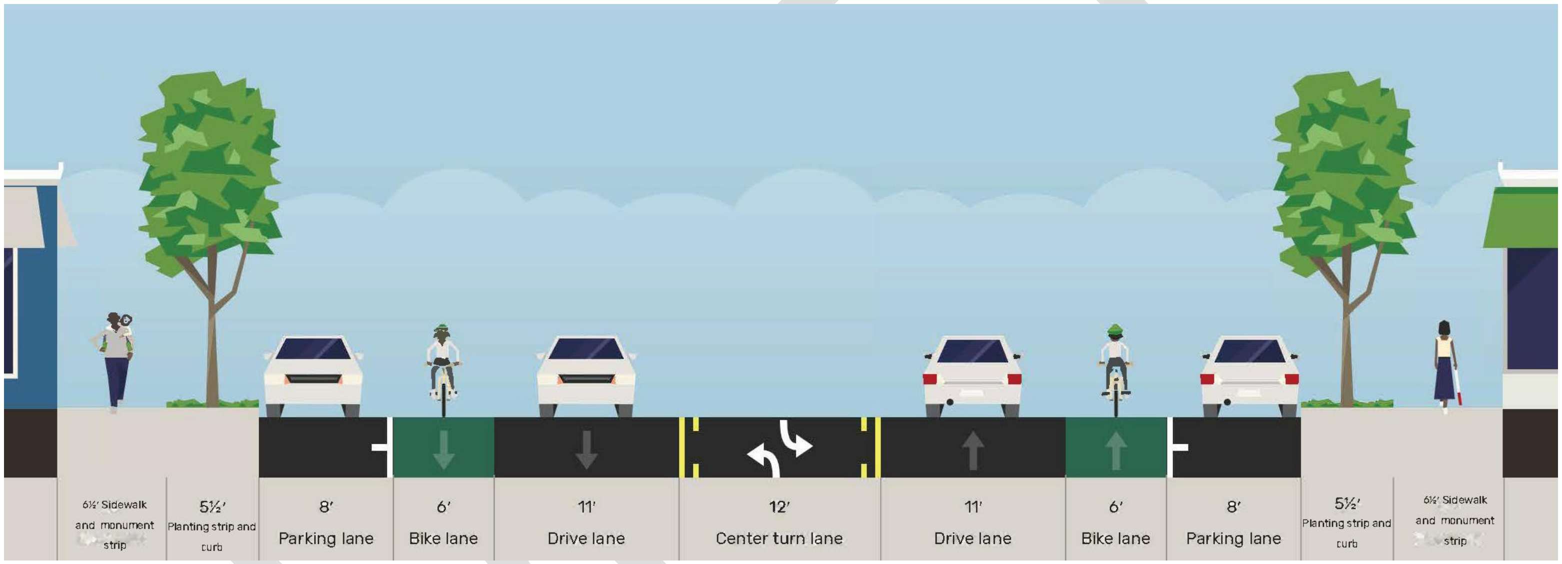
[5] Streetmix.net accessed 12/03/2021

[6] Streetmix.net accessed 12/03/2021

Minor Arterials/Residential Minor Arterials

Some Minor arterials within Sandy include: 362nd Drive, Bluff Road, and OR 211. This street class should be spaced at 1-mile intervals which is approximately the distance between 362nd Drive and Bluff Road. The east-west and north-south spacing between most other minor arterials in Sandy is less than one mile. Residential Minor Arterials are a subset of Minor Arterials where the abutting land use is 90 percent residential. Design standards are shown in Figure 9.

FIGURE 9: MINOR ARTERIAL CROSS SECTION[7]



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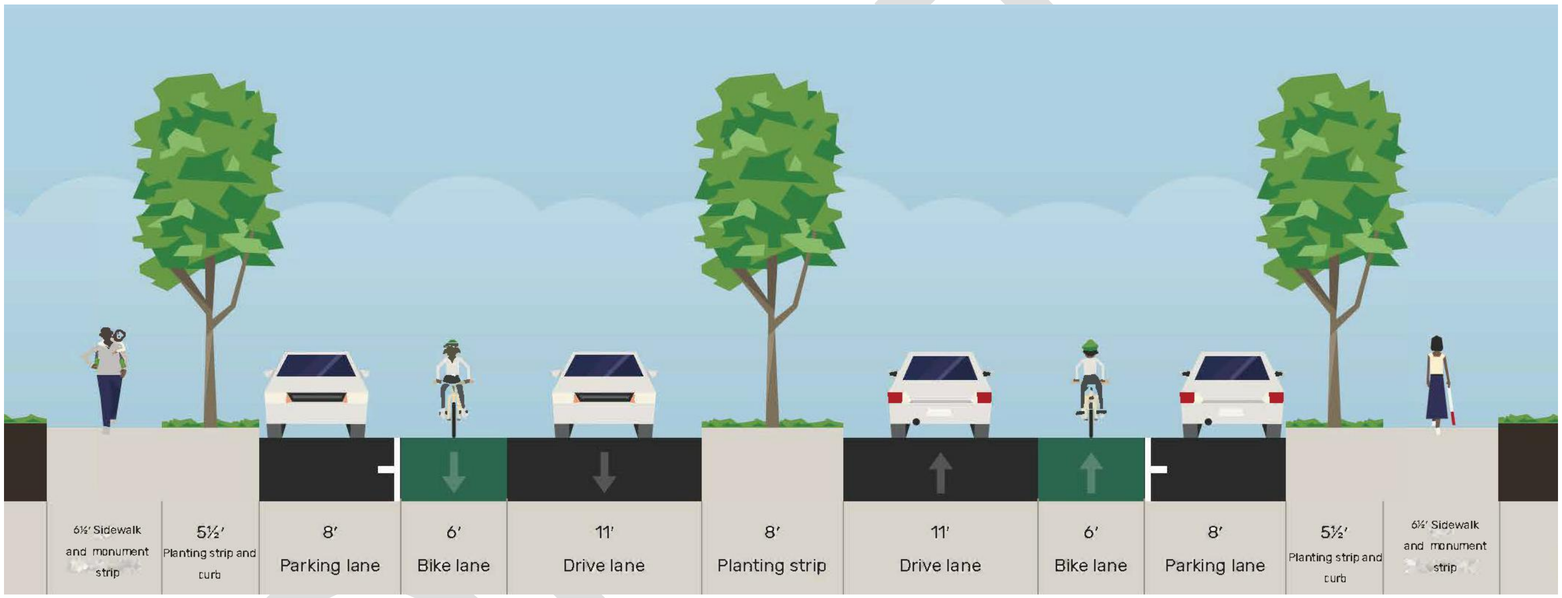
[7] Streetmix.net accessed 11/05/2021

Collectors

Some Collectors within Sandy include Industrial Way, Sandy Heights Street, and Jacoby Road. This street class should be spaced at half-mile intervals. Collector spacing in Sandy is currently less than half-mile intervals for all collectors (most are near 2000 feet). Design standards are show in Figure 10.

FIGURE 10: COLLECTOR CROSS SECTION[8]

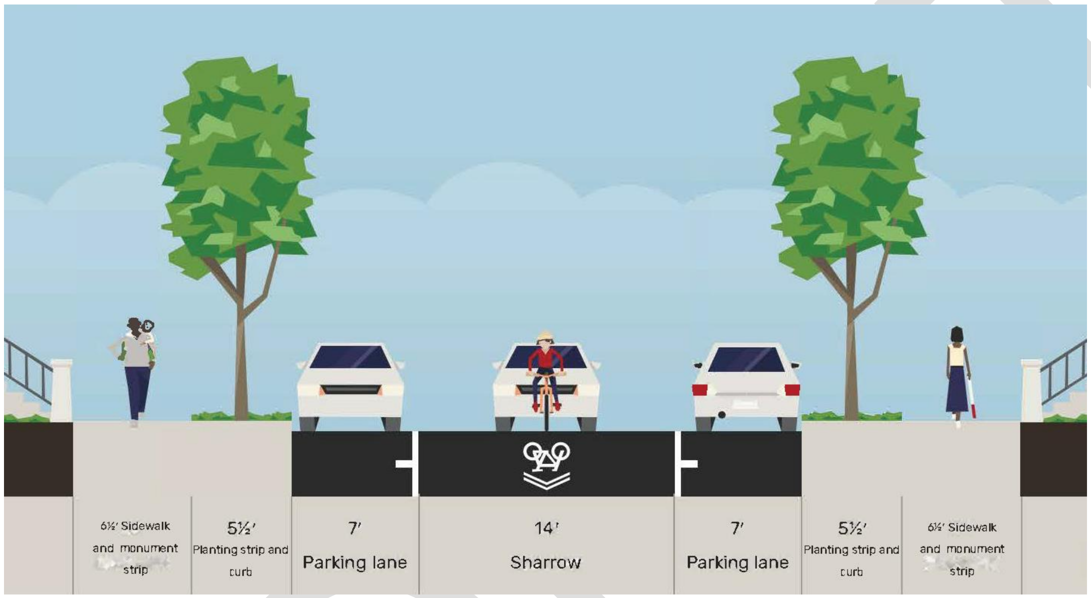


[8] Streetmix.net accessed 11/05/2021

Local Streets[9]

All streets not classified as Major Arterials, Minor/Residential Arterials, or Collectors are Local streets. Local streets should be spaced at 400 feet. Many local streets in Sandy are about 200 feet apart. Closer spacing of Local streets improves pedestrian connectivity but increases maintenance costs. Design standards are shown in Figures 11.

FIGURE 11: LOCAL STREET[10]



[9] The Junker Street Circulation Plan (2021) applies along Junker Street, Bruns Avenue, Strauss Avenue, and Pioneer Boulevard

[10] Streetmix.net accessed 11/05/2021

HIGH PRIORITY TRANSPORTATION IMPROVEMENTS

The preliminary list of high priority projects, shown in Table 9, addresses the multimodal needs previously identified based on the evaluation criteria. Community input and further technical analysis will further refine the recommended solutions to be included in the TSP update. The TSP planning process eliminates any project that may not be feasible for reasons other than financial (such as environmental or existing development limitations).

The full list includes 38 projects. Each project was assigned a primary source of funding for planning purposes (City or State) although such designations do not create any obligation for funding. The project design elements depicted are identified for the purpose of creating a reasonable cost estimate for planning purposes. The actual design elements for any project are subject to change and will ultimately be determined through a preliminary and final design process and are subject to City and/or ODOT approval.

TABLE 10: PRELIMINARY HIGH PRIORITY PROJECTS

PROJECT ID	NAME	DESCRIPTION	COST	PRIMARY FUNDING
		PEDESTRIAN IMPROVEMENTS		
P1	362nd Dr.	Sidewalk infill Chinook Dr. to Industrial Wy.	$1,500,600	City
P7	Dubarko Rd.	Sidewalk infill Langensand Rd. to Antler Ave.	$47,580	City
P11	Langensand Rd.	Sidewalk infill Dubarko Rd. to US 26	$100,040	City
P14	Pleasant St.	Sidewalk infill Beers Ave. to Revenue Ave.	$211,060	City
P16	Sandy Heights St.	Sidewalk infill Bluff Rd. to Tupper Rd.	$214,720	City
P17	Downtown Core Pedestrian	Sidewalk infill side streets perpendicular to US 26	$350,140	City
P22	US 26[A]	Sidewalk infill Ten Eyck Rd. to Vista Loop Dr. West	Included in B12	ODOT
		ROADWAY CROSSING IMPROVEMENTS		
C1	Sandy Shopper Crossing - Evans	Evans Street Senior Apartments, traffic calming and other crossing improvements are needed. Project may include pedestrian crossing advisory signage, curb extensions, and marked crosswalks.	$17,550	City

PROJECT ID	NAME	DESCRIPTION	COST	PRIMARY FUNDING
C2	OR 211 Dubarko Crossing	Project may include pedestrian crossing advisory signage, curb extensions, marked crosswalks, and installation of RRFB. Coordinate with D9.	$111,150	City
C5	CRMS - Bluff Road at Marcy	Intersection improvement project may include: a Rectangular Rapid Flashing Beacon (RRFB) with School Crossing Assembly (S1-1 and W16-7P), and high visibility crosswalks across the north and east sides of the intersection.	$111,150	City
C6	CRMS - Bluff Road at Hood	Intersection improvement project may include: Install a curb extension including perpendicular curb ramps and tactile domes at northeast corner of Hood St. Install a curb extension to provide clearance from existing pole, including perpendicular curb ramps and tactile domes, at southeast corner. Mark crosswalk and stop bar across the east leg of intersection.	$17,550	City
C7	CRMS - Bluff Road at US 26	Intersection improvement project may include: Increase pedestrian signal crossing time to be based on a walking rate of 3.0 feet per second. Reconfigure crossing to provide perpendicular curb ramps with tactile domes and reduce curb radius at all corners. Add pedestrian-scale lighting. Reallocate existing roadway space to provide buffered bike lanes along Highway 26 and consider the use of green pavement markings in the vicinity of Bluff Rd. Consider installing vertical delineators with buffered bike lanes contingent on city maintenance agreement or construct a fully grade-separated bicycle facility.	$111,150	ODOT
C11	SGS - Hood/Strauss	Intersection improvement project may include:Relocate southbound school advance crossing assembly (S1-1 & W16-9P) and school speed limit assembly (S4-3P & R2-1) along Strauss Ave to approximately 100 ft and 175 ft north of intersection, respectively. Repair approximately 150 LF of	$351,000	City

PROJECT ID	NAME	DESCRIPTION	COST	PRIMARY FUNDING
		degraded sidewalk along the east side of Strauss Ave at the intersection with Hood St and widen sidewalk at encroaching utility pole or relocate pole. Install a curb ramp on the east side of the south leg of the intersection of Strauss Ave at Hood St. Add tactile domes and a stop bar associated with the crosswalk across the west leg of the intersection.		
C12	SGS - Pleasant/Strauss	Intersection improvement project may include: Mark stop bars in advance of crosswalks. Consider revising the intersection of Pleasant St and Strauss Ave to be a four-way stop (currently STOP control north- and southbound only).	$17,550	City
C13	SGS - Pleasant/Alt	Intersection improvement project may include: Mark stop bars in advance of crosswalks. Replace existing diagonal curb ramps at all four corners with perpendicular curb ramps with tactile domes. Construct a raised intersection at Pleasant St at Alt Ave.	$351,000	City
C15	SGS - Alt/US 26	Intersection improvement project may include: Increase pedestrian signal crossing time to be based on a walking rate of 3.0 feet per second. Upgrade pedestrian push-buttons to meet current standards with audible indications. Consolidate the two existing crosswalks across Highway 26 at Alt Ave with one high visibility continental crosswalk on the east side of the intersection including advance stop bar, bulbouts, curb ramps, and pedestrian scale lighting.	$111,150	ODOT
C18	Scales/Proctor	Intersection improvement project may include: marked crosswalks on all four legs with tactile domes on the ramps	$17,550	ODOT
C19	Scales/Pioneer	Intersection improvement project may include: marked crosswalks on all four legs with tactile domes on the ramps	$17,550	ODOT

PROJECT ID	NAME	DESCRIPTION	COST	PRIMARY FUNDING
C20	Bruns/Proctor	Intersection improvement project may include: marked crosswalks on all four legs with tactile domes on the ramps	$17,550	ODOT
C21	Bruns/Pioneer	Intersection improvement project may include: marked crosswalks on all four legs with tactile domes on the ramps	$17,550	ODOT
		BICYCLE IMPROVEMENTS		
B1	362nd Dr.	Widen shoulder to 6 feet minimum for bike access from Dubarko Rd. to UGB	$1,500,600	City
B2	Bluff Rd.	Re-stripe roadway to provide bike lanes from US 26 to Miller Rd.	$48,800	City
B3	Bornstedt Rd.	Widen roadway to provide bike lanes from OR 211 to UGB	$2,533,050	City
B4	Dubarko Rd.	Re-stripe roadway to provide bike lanes from 362nd Dr. to Eldridge Dr.	$43,920	City
B5	Dubarko Rd.	Re-stripe roadway to provide bike lanes from Sandy Heights St. to Melissa Ave.	$43,920	City
B6	Langensand Rd.	Re-stripe roadway to provide bike lanes from US 26 to UGB	$74,664	City
B7	Meinig Ave.	Re-stripe roadway to provide bike lanes from Scenic St. to US 26	$74,420	City
B8	Meinig Ave.	Re-stripe roadway to provide bike lanes from Barker Ct. to Dubarko Rd.	$20,740	City
B9	Sandy Heights	Re-stripe roadway to provide bike lanes from Bluff Rd. to Tupper Rd.	$48,800	City
B10	Tupper Rd.	Widen roadway to provide bike lanes from Long Circle to OR 211	$2,990,000	City
B12	US 26	Widen shoulder to 6 feet from Ten Eyck Rd. to UGB	$3,977,200	ODOT
		SAFETY IMPROVEMENTS		

PROJECT ID	NAME	DESCRIPTION	COST	PRIMARY FUNDING
S1	US 26 Adaptive Signal System	Install an adaptive signal control system between Orient Drive and Ruben Lane	$200,000	ODOT
		DRIVING IMPROVEMENTS		
D3	US 26 & 362nd Drive Intersection Improvement	Reduce congestion for the westbound left turn and accommodate the 362nd Drive Extension 1. Project may include minor widening to accommodate a second westbound left turn lane and receiving lane on 362nd Drive, minor widening to accommodate a northbound through lane, construction of a three-lane southbound approach with a right turn lane, through lane, and left turn lane, and an eastbound left turn lane.	$6,527,000	ODOT
D14A	Extend Bell St. to 362nd Dr[B]	Extend Bell Street to 362nd Drive Extension 1 at Minor Arterial cross section standards	$9,945,000	City
D15A	Extend 362nd Dr to Bell Street[B]	Extend 362nd Drive to Bell Street Extension 1 at Minor Arterial cross section standards	$2,985,000	City
D20	Extend Dubarko Rd. to US 26 opposite Vista Loop Dr. (West)	Extend Dubarko Road to US 26/Vista Loop Road (west) at Minor Arterial cross section standards. Coordinate with D9 and C17.	$3,744,000	City
D21F	Village Blvd Ext 1	Connect Village Boulevard at Collector standards between Cascadia Village Drive and Juniper Street	$865,800	City
D24	OR 211 Turn Lane to Gunderson	Intersection improvement project includes a northbound left turn lane from OR 211 to Gunderson Road	$1,700,000	City
D26	Alt Avenue	Reconstruct Alt Avenue from Proctor Blvd to Pleasant St to improve walkability and access to the Sandy Library	$10,941,750	City
TOTAL COST			$51,758,254	

A. A project completing the gap on the northern side of US 26 is currently funded.

B. This project is currently funded

APPENDIX

CONTENTS

SECTION 1. HCM RESULTS

SECTION 2. BYPASS PRELIMINARY DESIGN

SANDY BYPASS FEASIBILITY REEVALUATION REPORT

OCTOBER 2021

PREPARED FOR:

CITY OF SANDY

SANDY

ODOT

Oregon Department of Transportation

PREPARED BY DKS ASSOCIATES

DKS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

THIS REPORT PRESENTS THE FEASIBILITY REEVALUATION CONDUCTED FOR THE US 26 BYPASS PROJECT IDENTIFIED IN THE 2011 SANDY TRANSPORTATION SYSTEM PLAN (TSP).[1] THE REPORT PROVIDES AN EXECUTIVE SUMMARY FOR EACH REEVALUATION PHASE: EXISTING AND FUTURE TRANSPORTATION SYSTEM PERFORMANCE, BENEFIT COST ANALYSIS, AND POLICY AND REGULATORY CONSIDERATIONS. THE DETAILED ANALYSIS FOR EACH OF THESE PHASES ARE DOCUMENTED IN THE APPENDIX MATERIALS. THE SANDY TSP IS CURRENTLY BEING UPDATED. THE TSP UPDATE PLANNING PROCESS WILL INCORPORATE THE FINDINGS AND RECOMMENDATIONS FROM THIS REEVALUATION OF THE BYPASS WHEN DEVELOPING THE MOTOR VEHICLE PROJECT LIST AND PRIORITIES.

EXISTING AND FUTURE TRANSPORTATION SYSTEM PERFORMANCE

EXISTING PERFORMANCE

The existing transportation system was evaluated along US 26 through Sandy, focused on the segment between the intersections of SE Orient Drive and Firwood Drive at Shorty's Corner. The existing transportation system performance analysis documented the current vehicle travel conditions through the City and provided a framework to compare and evaluate the effectiveness of a potential alternative route to US 26.

The existing conditions are based on October 2020 count data that was adjusted to represent the level of traffic that is typically encountered during the peak travel month. The existing motor vehicle operations analysis revealed that two intersections do not meet mobility targets during the peak hour; US 26/Orient Drive and US 26/362nd Drive. At both intersections, the eastbound though-traffic volume on US 26 is at or near the available capacity, a condition that has a significant impact on the overall operation of each intersection.

A travel pattern analysis was conducted using StreetLight data, a big-data provider that aggregates location-based information that can be analyzed to provide insight into travel behavior. The existing travel patterns in Sandy and on US 26 suggested around 30 to 40 percent of vehicles on US 26 would likely divert to a new bypass facility. The StreetLight data was also used to approximate existing travel times on US 26 through Sandy to determine potential benefits associated with a bypass project.

[1] Sandy Transportation System Plan, DKS Associates, adopted December 2011.

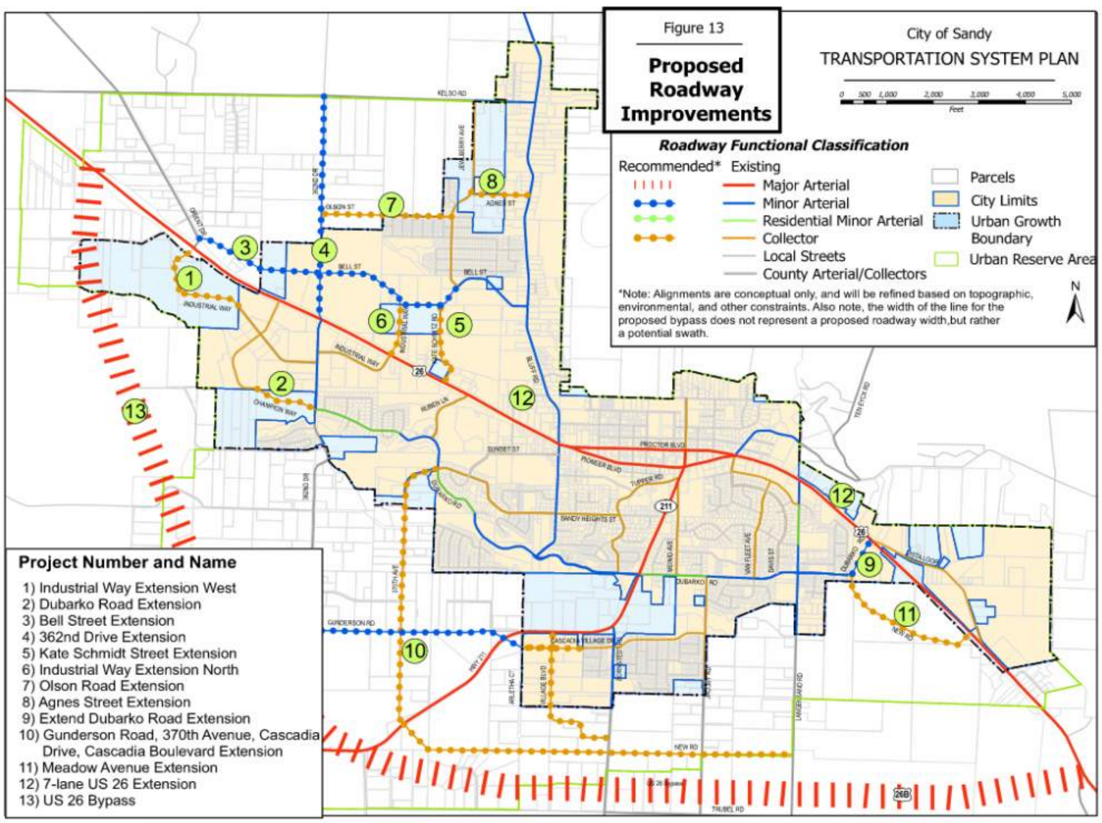
FUTURE PERFORMANCE

Future improvement alternatives were previously developed as part of the 2011 Sandy Transportation System Plan (TSP)[2]. Three of the prior TSP alternatives were carried forward and incorporated into this Sandy Bypass Feasibility Reevaluation, as described below. TSP Alternative #2 was not included in this study. The Future Transportation System Performance memo in the Appendix provides details on the alternatives and the operations analysis.

2040 No Build Alternative represented the existing system plus several roadway projects that are fully funded and/or currently in the design phase.

2040 Alternative #1 included several street connectivity projects and intersection capacity projects as shown in Figure 1, excluding the conceptual bypass alignment.

FIGURE 1: SANDY TSP MOTOR VEHICLE SYSTEM PLAN



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[2] Sandy TSP Update, Technical Memo #2: Transportation Alternatives and Improvement Strategies, DKS Associates, February 25, 2011.

2040 Alternative #3 included all the same projects as Alternative #1 but added a bypass of the existing US 26 corridor around the south side of the City from a point west of Orient Drive to approximately Shorty's Corner.

Key findings from the future conditions alternative analysis include:

- Under the 2040 No Build Alternative, 8 study intersections (4 on US 26) would exceed mobility targets.
- With the addition of local connections and intersection improvements under 2040 Alternative #1, 6 study intersections (4 on US 26) would continue to exceed mobility targets.
- Adding the bypass under Alternative #3 would improve traffic operations, only one study intersection would continue to exceed mobility targets (US 26 and Orient Drive)
- Approximately 60% of bypass users during peak periods would represent through trips, 40% would be local trips accessing the southern portion of Sandy.
- Approximately 1,500 vehicles an hour would use the bypass during the 2040 peak hour.
- Compared to the 2040 No Build Alternative, adding Alternative #1 improvements would reduce travel times on US 26 approximately 3 minutes 30 seconds travelling eastbound and 4 minutes travelling westbound
- Adding the Alternative #3 bypass facility to Alternative #1 improvements would reduce travel times an additional 4 minutes and 30 seconds travelling eastbound and no change travelling westbound on existing US 26.
- Under Alternative #3, the bypass facility would have shorter travel times through the study area compared to existing US 26, saving 1 minute travelling eastbound and 2 minutes 30 seconds travelling westbound.

BENEFIT COST ANALYSIS

A benefit cost analysis was conducted to provide a planning-level assessment of the potential benefits and costs associated with the bypass facility using performance measures related to the construction cost, value of travel time, safety, local businesses, and regulatory requirements. The following sections summarize the findings.

PREFERRED CONCEPTUAL ALIGNMENT

A conceptual alignment and planning-level cost estimate was developed for the bypass. The US 26 bypass conceptual alignment developed for the 2011 Sandy TSP was refined based on updated future traffic operations and more detailed design considerations for topography, environmental constraints, and freeway design standards.

The conceptual alignment for the bypass is shown in Figure 2 and Appendix Section 1. The bypass features and design parameters are summarized below.

- The facility would be located south of the Sandy Urban Growth Boundary and approximately 5.8 miles long.
- The west end of the bypass would connect to US 26 approximately 2,400 feet west of Orient Drive. The new intersection on US 26 would be an interchange configuration.
- The east end of the bypass would connect to US 26 at Firwood Road (Shorty's Corner). The existing intersection would be converted to an interchange configuration.
- The new bypass intersection with OR 211 would be an interchange configuration.
- The bypass facility would provide a grade separated overcrossing at 362nd Drive.
- The facility would provide a 120-foot-wide right-of-way to accommodate four travel lanes (two each direction), raised median, shoulder area, lighting, trees and public utility easement.

FIGURE 2: US 26 BYPASS CONCEPTUAL ALIGNMENT

The primary purpose of the bypass is to serve regional traffic demand that currently travels on US 26 through Sandy. The interchanges at each end of the bypass and OR 211 would provide the primary access to the bypass. The rest of the facility would be limited to right-in/right-out access at key intersections to reduce conflicts and provide reliable free-flow traffic operations. The remaining streets that intersect the bypass conceptual alignment would be closed and an alternative street network would be provided.

A cost estimate was prepared based on a 10% design concept for the bypass shown in Figure 1. The total cost estimate accounts for construction, utility and slope easements, right-of-way acquisition and professional services to administer design and construction management. The cost estimate is approximately $365 to $390 million in current year 2021 dollars. The detailed cost estimate is shown in Appendix Section 2. The cost estimate when adjusted for inflation to represent year 2040 is approximately $980 million to $1 billion.

VALUE OF TIME IN TRAVEL

Comparing No Build and Alternative #3, the hourly time savings benefit during the 2040 peak hour is approximately $3,700. If this benefit is realized for one hour every weekday, the annual benefit is estimated at $1 million per year. If the benefit is realized for 6 hours every weekday, the annual benefit is estimate at $6,000,000 per year. If this time savings benefit can be sustained for 20 years at an interest rate of 5%, the net present value of the benefit is approximately $74.8 million.

Based on the travel time savings between Alternative #1 and Alternative #3 shown in Table 2, the hourly benefit during the 2040 peak hour is approximately $1,900. If this benefit is realized for one hour every weekday, the annual benefit is estimated at $500,000 per year. If the benefit is realized for 6 hours every weekday, the annual benefit is estimate at $3,000,000 per year. If this time savings benefit can be sustained for 20 years at an interest rate of 5%, the net present value of the benefit is approximately $37.4 million.

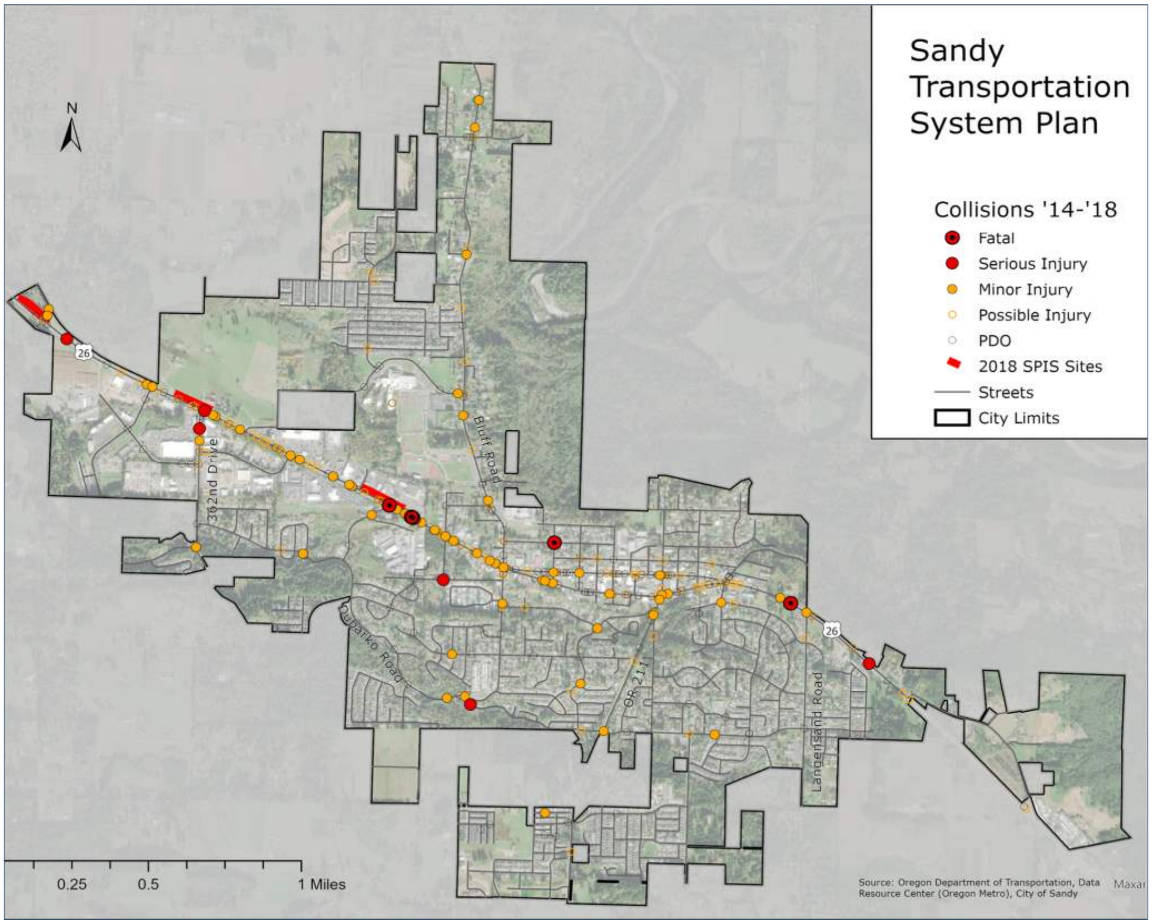
SAFETY ANALYSIS

A safety analysis was conducted for US 26 between the bypass end points. The most recent five years of available collision data, 2014 to 2018, was reviewed to document the severity of collisions and calculate the crash rate. The collision data compiled for the Sandy TSP Update is shown in Figure 3 and includes the focused US 26 safety data used for this analysis.

In total, the US 26 corridor experienced 338 crashes over the five-year study period, including four fatal crashes and five serious injury crashes. All four fatal crashes involved a driver under the influence of alcohol or drugs. The study corridor experienced a total of 213 crashes that were non-intersection related. Key findings include:

- The segment along US 26 between Ruben Lane and Bluff Road reported the highest number of crashes and the highest crash rate compared to the other segments.
- The top three collision types reported for segments were rear-end (56%), turning (16%), and sideswipe (13%).
- The top three contributing circumstances were reported failure to avoid (32%), failure to yield (16%), and following too close (14%).

FIGURE 3: SANDY SAFETY ASSESSMENT – 2014 TO 2018



It is estimated the construction of the bypass facility would moderately improve safety on US 26 between Orient Drive and Firwood Road. Based on the literature review, it is likely that the number of crashes on the existing US 26 through Sandy would be reduced if proper safety measures are implemented for the bypass construction. In particular, appropriate wayfinding signage and speed limit setting for both the main road and the new bypass would need to be planned thoughtfully for both local residents and regional travelers.

Overall, construction of the bypass facility is expected to reduce the level of traffic traveling on the existing US 26 and avoid vulnerable travelers (i.e. pedestrians and bicyclists) by rerouting traffic away from the commercial and downtown areas. Regional traffic travelling on the bypass facility would experience fewer conflict points compared to travelling on the existing US 26 through Sandy.

BENEFITS OR IMPACTS TO LOCAL BUSINESSES

Accounting for a city's unique characteristics and commercial competition outside the city is the only way to truly assess how a particular economy may be impacted by a new bypass. The City of Sandy is a mixed economic environment with local and big-box businesses. Many are auto-oriented and cater to highway pass-through traffic such as gas stations, convenience stores, drive-through coffee shops and fast food/high turnover restaurants. A major segment of retail customers are recreational visitors travelling through Sandy to Mt. Hood and Central Oregon. These unique customers support specialized local businesses such as outdoor equipment stores.

Some of these businesses serving pass through traffic may see an impact if their services cannot be easily replaced. For example, customers will need to determine if the travel time savings from taking the bypass outweighs the convenience of shopping in Sandy. Customers may choose to shop near their home before they leave or at their destination instead. Other existing auto-oriented businesses, such as gas stations, would likely be impacted by traffic diverted away from town and on to a bypass route. Customers may choose to stop for gas outside Sandy to save time travelling on the bypass. There are several gas stations to the east and west of Sandy within a few miles. The existing gas station at Firwood Road (Shorty's Corner) would be conveniently located on the east end of the bypass. Note that Sandy has a local gas tax that generates revenue to fund various transportation needs including facility maintenance. The diversion of vehicles to the bypass would likely reduce local gas tax revenue.

It is challenging to forecast the potential impact of the bypass to local businesses along US 26. With the forecasted local growth over the next 20 years, the associated local demand for goods and services could compensate for some of the business loss due to the bypass. However, the projected growth is based on the existing transportation system. With the bypass in place, the forecasted business growth along US 26 may decrease resulting in lower local demand for goods and services and an increased impact to future businesses. An analysis of employment data from 2018[3] (the most recent year available) showed that approximately 5,000 Sandy residents work outside of the city, 3,000 workers commute into the city, and 600 residents work within the city. Of the 3,600 jobs within Sandy, most are classified as retail trade (25%) followed by accommodation and food services (15%) and educational services (12%). Of these, retail and food services may be the most vulnerable to impacts from a bypass.

The majority of the bypass alignment is outside the urban growth boundary and would travel through areas with rural zoning and land uses. Urban development would be prohibited, eliminating the possibility for new commercial development along the bypass that could compete with existing businesses on US 26. The biggest commercial competition is found in the Portland Metro area, approximately seven miles west of Sandy, which can provide almost all the retail and service businesses highway drivers could need.

[3] https://onthemap.ces.census.gov/

The bypass is forecasted to serve 1,500 vehicles peak hour in the 2040 peak hour. A portion of these vehicles are potential Sandy business customers that choose the travel time savings of the bypass over the convenience of shopping at a business on US 26. To counter that impact, lower traffic volumes on the highway may make downtown highway-fronting businesses more attractive for certain types of businesses.

US 26 JURISDICTIONAL TRANSFER TO THE CITY

A new bypass facility would be constructed and operated by ODOT. With the bypass in place, ODOT would transfer the jurisdiction of the existing section of US 26 being bypassed to the City. The ongoing maintenance and operation of the facility would be a cost burden for the City. This segment of US 26 is approximately 5 miles long with four to five travel lanes, street lighting, and numerous traffic signals. The average annual cost to maintain a comparable urban highway is $20,000 to $30,000 per mile. Over the next 20 years with inflation, the maintenance cost for the City is estimated to be $5 to $8 million.

The City taking jurisdiction of US 26 also brings opportunities to make local changes to the facility. Future traffic demand on the existing US 26 will decrease significantly with 1,500 vehicles during the peak hour diverting to the bypass. This demand reduction would potentially allow the reconstruction of the existing five-lane sections (outside the downtown couplet) to three-lanes and provide additional design features such as landscaping, wider sidewalks, protected bicycle lanes, median treatments, and diagonal parking with the extra roadway width. This would result in benefits to overall safety and livability and encourage more walking, biking, and transit activity. Reconstruction of US 26 would be a major capital project with potential modifications to traffic signals, drainage, utilities, street lighting, pavement markings and signage. Based on planning level cost estimates for comparable corridor reconstruction projects, the cost estimate could range from $20 to $40 million for improvements. When adjusted for inflation over the next 20 years, the corridor reconstruction cost estimate could range from $55 to $105 million. The conversion of US 26 to a three-lane facility could also significantly increase travel times through Sandy to the point it would be slower than Alternative #1. The safety and livability benefits should be balanced with the travel time impacts.

POLICY AND REGULATORY REQUIREMENTS

A detailed evaluation of the policy and regulatory considerations associated with a potential bypass was conducted for this analysis, as provided in the Appendix, Section 4 and summarized below.

The construction of a US 26 bypass around the city of Sandy represents a significant investment in public infrastructure with the potential to impact transportation, urban and rural lands, Goal 5 resources, and the local and regional economy. Demonstration of compliance with several related policies and regulations will need to be addressed if this alternative is pursued and further developed.

A preferred bypass alternative would be documented in a facility plan, ultimately adopted by the Oregon Transportation Commission (OTC) and ODOT, thereby amending the Oregon Highway Plan (OHP). Planning for new bypasses is governed by OHP Policy 1G: Major Improvements and Policy 1H: Bypasses. Policy 1G states that existing facilities should be maintained and enhanced to improve performance and safety before adding capacity. The construction of a new facility such as a bypass is categorized under the lowest level of priority under this policy. The planning process must demonstrate that alternatives that do not include a bypass cannot adequately support safety, growth management, and other livability and economic objectives.

Sandy and Clackamas County will need to work collaboratively on developing any necessary amendments to local plans (such as the comprehensive plan, TSPs, local land use, and subdivision codes) to ensure consistency with the facility plan for the proposed bypass. While both the state and the local governments adopt the facility plan, or elements thereof, the adoption processes are different and the roles and responsibilities for the different levels of government are not the same.

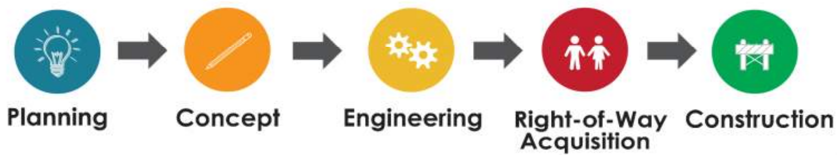
Both Sandy and Clackamas County would amend their respective TSPs to incorporate elements of the facility plan. Local approval may require the adoption of new transportation-related policies, consistent with the findings and supportive of the recommendations of the facility plan. New ordinances or amendments to existing ordinances, resolutions, and Inter-Governmental Agreements (IGA) may be necessary to ensure that the access management, the land use management, and the coordination elements of the facility plan are achieved. The approval process would include Planning Commission/City Council hearings with the City of Sandy and Planning Commission/County Commission hearings with Clackamas County.

The preferred bypass alignment would most likely impact County land designated for EFU or Forest use and the County would need to support adoption with goal exception findings.[4] Following successful local adoption by the City and County, the facility plan could be presented to the OTC for its review and approval.

[4] Note that the adoption action is an amendment to the TSP, the transportation element of the local Comprehensive Plan. The comprehensive plan amendment becomes acknowledged after the 21-day appeal period and no appeals have been filed (see https://www.oregonlaws.org/ors/197.625.)

SCHEDULE AND FUNDING CONSIDERATIONS

Construction in 2040 is the soonest the bypass could reasonably be built due to the magnitude of the project. The general process for building a major infrastructure project is shown below. The primary challenges for the bypass project are related to regulations, acquiring right of way and funding that would likely extend the length of the process beyond 2040.



Major infrastructure projects use a wide variety of revenue and funding from federal, state, local, and private sources. Each phase of the project would likely be funded by multiple sources as they become available. ODOT receives about half a billion dollars from the Federal Highway Administration each year for construction projects on the state's roads, including the interstate, as well as planning and engineering. The State Highway Fund, collected from local fees and taxes, can be used for both construction projects and the day-to-day maintenance and operations of the state's roads.

The Statewide Transportation Improvement Program (STIP) is ODOT's capital improvement program for state and federally-funded projects. ODOT and the OTC allocate STIP funding to projects through a competitive process in coordination with a wide range of stakeholders and the public. The bypass project could be a candidate for the STIP Enhance program that funds projects to enhance or expand the transportation system. Area Commissions on Transportation recommend high-priority investments from state and local transportation plans in many of the Enhance programs. In addition, the Oregon legislature can pass a house bill to create new revenue sources and expand the state's investment in transportation system improvements.

The Dundee Bypass is a recent example of a major infrastructure project in Oregon. Phase 1 of the project constructed a four-mile facility which opened in 2018 and cost $252 million. The $22.4 million funding for Phase 2 design came from House Bill 2017 passed by the Oregon Legislature. Construction of Phase 2 is estimated at $200 million but the source has not been identified.

TSP UPDATE PROCESS

The Sandy TSP is currently being updated and will consider the findings from this bypass reevaluation with the development of the revised motor vehicle projects and priorities. The TSP update will also assess the need for alternative mobility targets for US 26 at locations where meeting the existing ODOT mobility targets is infeasible or impractical based on specific criteria. If needed, alternative mobility targets will be developed as a TSP solution to address mobility and local growth objectives over the next 20 years. The bypass project is a potential long-term and unfunded TSP solution to address mobility and local growth objectives beyond 2040.

SUMMARY

To support the reevaluation of the US 26 bypass project, a planning-level assessment of the potential benefits and costs of the bypass was conducted with various measures of performance. The key findings are summarized in Table 1. These findings will contribute to TSP discussions and future decisions on pursuing the bypass concept.

TABLE 1: POTENTIAL COST AND BENEFIT SUMMARY OF BYPASS FACILITY

Measure	Cost/Impact	Benefit	Consideration
Project Planning and Construction Cost	Bypass would cost $980 million to $1 billion (in 2040 dollars) for construction, right-of-way acquisition, easements, design and construction management		The cost estimates are for planning purposes only and could change significantly due to the high level of uncertainty regarding the construction year, NEPA process and final design and alignment.
2040 Future Traffic Demand		Bypass is estimated to serve 1,500 vehicles during future peak hour. Existing US 26 is estimated to serve 2,300 vehicles during future peak hour.	Forecasting future demand estimated 40% of the total US 26 traffic would divert to the bypass facility.
2040 Future Travel Time		Adding the bypass to other Alternative #1 projects would save an additional 4 minutes and 30 seconds travelling eastbound and no savings travelling westbound on existing US 26. Under Alternative #3, the bypass would have shorter travel times compared to existing US 26, saving 1 minute travelling eastbound and 2 minutes 30 seconds travelling westbound.	Other roadway capacity projects are likely to be built by 2040 that would improve US 26 traffic flow and reduce the estimated time savings (5.5 minutes eastbound and 2.5 minutes westbound).
Travel Time Value		Save $6 million per year, $75 million over 20 years	Cost saving estimate is highly variable depending on future traffic patterns and duration of congested conditions.

Measure	Cost/Impact	Benefit	Consideration
Safety		Overall reduction in crashes on existing US 26 expected with lower volumes and fewer conflicts with pedestrians and cyclists downtown.	
Local Businesses	Diverts potential customers from highway-oriented businesses on US 26. Local gas tax revenue would likely be lower.	Reducing traffic volumes in the downtown area could increase walking and biking activity and make fronting businesses more attractive.	Current zoning and land use patterns encourage commercial development along the highway. A bypass outside the UGB would not allow for adjacent commercial development. If the bypass was inside the UGB, new adjacent commercial development may compete with businesses on US 26.
Jurisdictional Transfer to City	City would be responsible for US 26 maintenance after construction of the bypass, estimated to cost $5 to 8 million over 20 years. Potential reconstruction of US 26 with reduced vehicle lanes and multimodal improvements could increase congestion and travel times through Sandy.	Potential reconstruction of US 26 with reduced vehicle lanes and multimodal improvements, estimated to cost $55 to $105 million	City would need to find new ongoing funding for maintenance. The cost for reconstruction is highly variable due to uncertainty regarding the final design and year of construction.
Policy and Regulation Requirements	Demonstration of compliance with numerous related policies, regulations and ordinances will need to be addressed to gain project approval.		Amendments to the Oregon Highway Plan require adoption by the OTC and ODOT. A robust NEPA planning process will be needed to address potential impacts to Goal 5 resources and designated forest use lands.

APPENDIX

CONTENTS

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SECTION 1. EXISTING TRANSPORTATION SYSTEM PERFORMANCE MEMO

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EXISTING TRANSPORTATION SYSTEM PERFORMANCE

DATE: April 19, 2020

TO: Project Management Team

FROM: Reah Flisakowski, Kevin Chewuk, Dock Rosenthal | DKS Associates

SUBJECT: Sandy Bypass Feasibility Reevaluation P# 20020-007

This memorandum summarizes the existing transportation conditions along US 26 through the City of Sandy, Oregon. This assessment generally includes the US 26 segment between the intersections with SE Orient Drive and Firwood Drive at Shorty's Corner. Analyzing the existing transportation system performance documents the current vehicle travel conditions through the City and provides a framework to compare and evaluate the effectiveness of a potential alternative route to US 26 as identified in the 2011 City of Sandy Transportation System Plan. A documentation of existing pedestrian, bicycle and transit conditions will be provided as part of the on-going update of the City's Transportation System Plan.

MOTOR VEHICLE CONDITIONS

Current operating conditions for vehicles along US 26 through the City were assessed using data on existing vehicle travel behavior and volumes.[1] The data includes information on where vehicle trips are coming from through the City, how much delay these trips experience and how long it takes them to make their trip. The following sections summarize this analysis.

TRAVEL PATTERN ANALYSIS

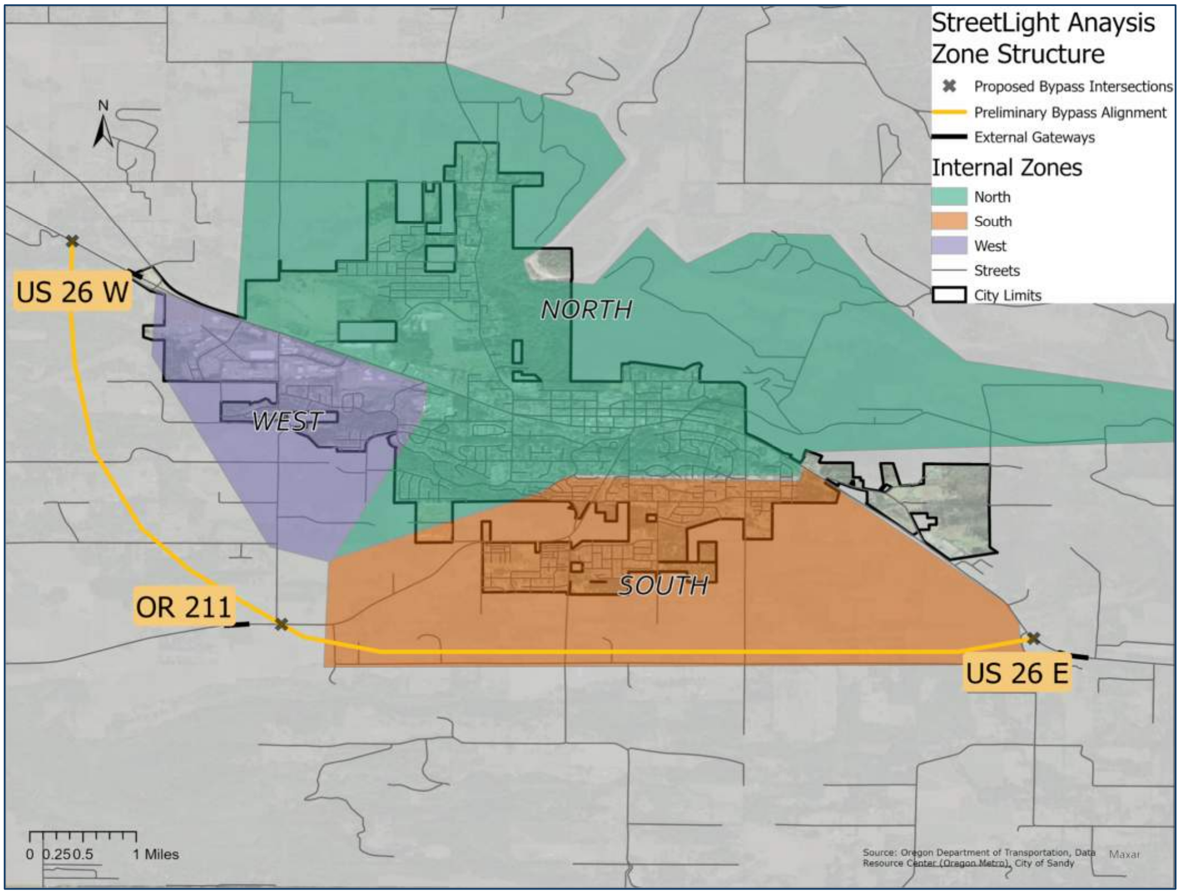
The travel pattern analysis was completed using StreetLight data. StreetLight data is a big data provider that aggregates a variety of location-based information and can provide insight into travel behavior. The StreetLight data was used to answer the following questions.

- What are the travel routes between highways (US 26 and OR 211) and various areas of the City?
- What is the typical travel time along US 26 through the City?

The zone structure shown in Figure 1 was used to evaluate these questions.

[1] Traffic counts were collected on October 22, 2020.

FIGURE 1: STREETLIGHT ZONE STRUCTURE



- The North zone covers the portion of Sandy that is not expected to use a future bypass due to the proposed route south of the City.
- The South and West zones cover areas that could potentially benefit from access to a future bypass.
- The three highway segment zones, shown as black lines in the map, capture the trips entering and exiting the study area. For example, the US 26 W zone represents all trips coming from or going to places west of that segment. All trips between these zones are expected to use a future bypass.

TRAVEL ROUTES

Table 1 shows a breakdown of the proportion of total p.m. peak period trips (4 p.m. to 6 p.m.) that travel between the zones. As shown, most trips in the p.m. peak come from the west, enter Sandy via US 26 and end at some location in the North analysis zone. Similarly, most trips are coming from or going to US 26 W or the North analysis zone indicating that these areas are attractive locations for drivers. The zones that generate the most trips are US 26 W and the North zone, with 34 percent and 24 percent respectively. These zones also generate the most trip destinations, with the North zone more attractive with 30 percent of the destinations, while US 26 W attracts 21 percent.

Some other key highlights include:

- Internal trips (between the North, South and West zones) = 23%
- External trips (between US 26 W, US 26 E and OR 211)[2] = 18%
- Trips entering or exiting Sandy = 59%
- Highest activity: between US 26 W and the North zone = 22%

TABLE 1: PROPORTION OF TOTAL PM PEAK TRIPS BETWEEN ZONES

	US 26 W	US 26 E	OR 211	NORTH	SOUTH	WEST	Origin Total
US 26 W	0%	6%	2%	14%	6%	6%	34%
US 26 E	6%	0%	1%	2%	0%	1%	10%
OR 211	1%	1%	0%	4%	2%	1%	9%
NORTH	8%	4%	3%	0%	5%	4%	24%
SOUTH	3%	0%	1%	5%	0%	1%	10%
WEST	3%	1%	2%	5%	2%	0%	13%
Destination Total	21%	12%	9%	30%	15%	13%	

The shaded cells in the table above represent the trips expected to use a future bypass.[3]

- The trips between the South zone and US 26 W, in either direction.
- Trips between the West zone and US 26 E, in either direction.

[2] The sensitivity of this result was tested by looking at the proportion of external trips for an average 24-hour period, for a typical daily volume, including weekend days. This resulted in a small increase to 21 percent.

[3] Other origin-destination pairs in Table 1 are expected to remain on US 26 or use other local streets due the access restrictions assumed in the current configuration of the bypass. It is assumed that most drivers will avoid out-of-direction travel for local trips.

- Trips between the external highway zones (i.e., US 26 W, US 26 E and OR 211) are also expected to divert to the potential future bypass.

Based on these assumptions, a diversion proportion can be estimated at around 28 percent of the total p.m. peak period trips, which roughly correlates to 2,800 trips.

MOTOR VEHICLE OPERATIONS

Intersection turning movement counts were collected in October 2020. The ODOT traffic volume patterns report that monitors the impact of COVID-19 indicated that traffic volumes on US 26 were within five percent of 2019 volumes for the week counts were collected indicating that the collected counts were within a reasonable range and were appropriate to use for the subject analysis.

The methodology from the ODOT Analysis Procedures Manual was applied to determine the 30th highest annual hour volume (30 HV) for the study intersections. The 30 HV is commonly used for design purposes and represents the level of congestion that is typically encountered during the peak travel month.

To determine when the 30th highest annual hour volume occurs, data is examined from Automatic Traffic Recorder (ATR) stations that record highway traffic volumes year-round. If no on-site ATR is present, one with similar characteristics can be identified using ODOT's ATR Characteristics Table. If these do not produce a similar ATR with average annual daily traffic volumes (AADT) within 10% of study area volumes, the seasonal trend method should be used. The seasonal trend method averages seasonal trend groupings from the ATR Characteristics Table. For the study area, a nearby ATR (#26-033 US 26 near SE Powell Valley Road) was utilized to develop a calculated seasonal factor of 1.066. This factor was applied to the existing count data.

Jurisdictional Mobility Standards

The mobility standards for intersections vary according to the agency of jurisdiction for each intersection. Five of the study intersections are under City jurisdiction (362nd Drive/Industrial Way – North and South, Bluff Road/Bell Street, OR 211/Bornstedt, and OR 211/Dubarko) while the remaining 11 intersections are under ODOT jurisdiction. Current ODOT mobility targets require a volume to capacity ratio between 0.80 and 0.90 or less to be maintained at study intersections (see Table 2) and the City of Sandy operating standards require that a level of service "D" or better be maintained for any signalized intersection and unsignalized intersections with stop control on the minor approach[4].

[4] City of Sandy Transportation System Plan (2011)

Existing Intersection Operations

Motor vehicle conditions were evaluated during the 2020 p.m. peak hour at the 16 study intersections (shown in Table 2). The evaluation utilized the Highway Capacity Manual (HCM) 6th Edition methodology. As shown, two intersections exceed current mobility targets, including the intersections of US 26 with Orient Drive and 362nd Drive. The US 26 intersection at Orient Drive serves high eastbound through traffic volumes and high southbound left traffic volumes that typically extend their green phases to the maximum length. These two movements are not served simultaneously so they require additional green time from the cycle that is not available resulting in the HCM analysis exceeding the mobility target. The US 26 intersection at 362nd Drive serves a high eastbound through volume that is approaching the available capacity of the existing timing and a high northbound left volume. Similar to the operations at US 26 and Orient Drive, these two movements require additional green time that is already allocated to other movements.

TABLE 2: EXISTING INTERSECTION OPERATIONS (2020)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	C	33	**0.90**
US 26/362ND DRIVE	Signal	ODOT	0.80	C	28	**0.83**
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	C	28	0.72
362ND DRIVE/ INDUSTRIAL WAY (NORTH)	TWSC[b]	City of Sandy	D	A [C]	8 [18]	0.24
362ND DRIVE/ INDUSTRIAL WAY (SOUTH)	AWSC	City of Sandy	D	D	32	0.70
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	C	27	0.73
US 26/BLUFF ROAD	Signal	ODOT	0.85	D	36	0.79
BLUFF ROAD/BELL STREET	TWSC	City of Sandy	D	A [B]	8 [15]	0.08
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	29	0.68
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	33	0.71
OR 211/ DUBARKO RD	TWSC	City of Sandy	D	A [D]	8 [29]	0.29
OR 211/BORNSTEDT ROD	TWSC	City of Sandy	D	A [C]	9 [17]	0.36
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	31	0.58

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	B [F]	13 [63]	0.30
US 26/VISTA LOOP DRIVE W	TWSC	ODOT	0.80	B [C]	10 [19]	0.09
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	A [E]	10 [37]	0.05

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

CORRIDOR TRAVEL TIME

Using the StreetLight data and zone structure as depicted in Figure 1, an estimate of travel time along the US 26 corridor through Sandy was estimated for a typical weekday (Tuesday through Thursday) in the p.m. peak period (4 p.m. to 6 p.m.). This travel time estimate provides a baseline to compare benefits associated with a potential alternative highway route to the south of the City. Overall, the estimated total travel time (including intersection delay and segment travel time) is:

- Westbound total travel time: 9 minutes 54 seconds
- Eastbound total travel time:9 minutes 36 seconds

Corridor delay was also estimated to establish a baseline to compare against the future alternatives. The intersection delay, including the impact of queuing, was estimated at:

- Westbound intersection delay: 2 minutes 48 seconds
- Eastbound intersection delay: 3 minutes 10 seconds

This total intersection delay estimate, subtracted from the StreetLight travel time estimate, provided a road segment travel time estimate and average speed. This information provides a reasonableness check of the StreetLight data and a baseline travel time that can be used to estimate future conditions. For comparison, a vehicle traveling at the posted speed along the length of the study corridor, with no intersection delay, would average approximately 45 miles per hour (mph). As shown below, the StreetLight free-flow speeds for eastbound and westbound directions deviate only slightly from the 45-mph speed estimate.

- Westbound segment travel time: 7 minutes 6 seconds, 43 miles per hour
- Eastbound segment travel time: 6 minutes 26 seconds, 47 miles per hour

SUMMARY

The existing motor vehicle operations analysis revealed that two intersections in Sandy, US 26 and Orient Drive and US 26 and 362nd Drive do not meet mobility targets. At both intersections, the eastbound though volume is at or near the available capacity which has a significant impact on the overall operation of each intersection.

The StreetLight origin-destination (OD) analysis showed that most of the activity coming from the US 26 W zone, west of the City of Sandy, is destined for the North analysis zone, the area generally north of US 26 which is not expected to use a future bypass. However, these trips may benefit from the Bell Street extension to 362nd Drive that is currently in the design phase. With this improvement in place some trips that are destined for the North zone would be able to exit the US 26 corridor at the intersection with 362nd instead of continuing to Bluff Road.

The OD pairs that are expected to use the bypass, including the highway through trips and trips to and from zones near the proposed bypass connections comprise 28% of the total traffic during the p.m. peak period.

The findings above will contribute to the content and analysis in subsequent memoranda including the Benefit Cost Analysis Memorandum and the Sandy Bypass Feasibility Reevaluation Report.

APPENDIX

CONTENTS

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SECTION 1. EXISTING CONDITION HCM REPORTS

HCM 6th Signalized Intersection Summary
1: SE Jarl Road/SE Orient Drive & US 26

01/20/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	1790	5	5	1200	185	5	5	5	230	5	10
Future Volume (veh/h)	15	1790	5	5	1200	185	5	5	5	230	5	10
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	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	16	1946	5	5	1304	0	5	5	5	250	5	11
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	4	4	4	14	14	14	2	2	2
Cap, veh/h	78	1940	865	77	1910		13	13	13	295	6	13
Arrive On Green	0.05	0.58	0.58	0.05	0.58	0.00	0.03	0.03	0.03	0.19	0.19	0.19
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	496	496	496	1579	32	69
Grp Volume(v), veh/h	16	1946	5	5	1304	0	15	0	0	266	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1489	0	0	1680	0	0
Q Serve(g_s), s	0.9	56.0	0.1	0.3	26.7	0.0	1.0	0.0	0.0	14.9	0.0	0.0
Cycle Q Clear(g_c), s	0.9	56.0	0.1	0.3	26.7	0.0	1.0	0.0	0.0	14.9	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.33		0.33	0.94		0.04
Lane Grp Cap(c), veh/h	78	1940	865	77	1910		38	0	0	314	0	0
V/C Ratio(X)	0.20	1.00	0.01	0.07	0.68		0.39	0.00	0.00	0.85	0.00	0.00
Avail Cap(c_a), veh/h	191	1940	865	188	1910		169	0	0	363	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	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	44.6	20.6	8.8	44.3	14.4	0.0	46.4	0.0	0.0	38.2	0.0	0.0
Incr Delay (d2), s/veh	0.8	21.1	0.0	0.2	1.3	0.0	2.4	0.0	0.0	15.1	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	0.4	22.7	0.0	0.1	8.3	0.0	0.4	0.0	0.0	7.4	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	45.4	41.7	8.8	44.5	15.7	0.0	48.8	0.0	0.0	53.2	0.0	0.0
LnGrp LOS	D	F	A	D	B		D	A	A	D	A	A
Approach Vol, veh/h		1967			1309	A		15			266	
Approach Delay, s/veh		41.7			15.8			48.8			53.2	
Approach LOS		D			B			D			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.5	60.0		22.2	8.5	60.0		6.5				
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5				
Max Green Setting (Gmax), s	10.5	53.0		20.0	10.5	53.0		10.5				
Max Q Clear Time (g_c+I1), s	2.9	28.7		16.9	2.3	58.0		3.0				
Green Ext Time (p_c), s	0.0	13.6		0.3	0.0	0.0		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			33.0									
HCM 6th LOS			C									

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1415	340	265	1115	320	305
Future Volume (veh/h)	1415	340	265	1115	320	305
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	1772	1772	1744	1744	1786	1786
Adj Flow Rate, veh/h	1505	362	282	1186	340	324
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	2	2	4	4	1	1
Cap, veh/h	1727	770	423	2688	431	578
Arrive On Green	0.51	0.51	0.25	0.81	0.13	0.13
Sat Flow, veh/h	3455	1502	1661	3400	3300	1514
Grp Volume(v), veh/h	1505	362	282	1186	340	324
Grp Sat Flow(s),veh/h/ln	1683	1502	1661	1657	1650	1514
Q Serve(g_s), s	54.3	21.4	21.0	14.5	13.8	0.0
Cycle Q Clear(g_c), s	54.3	21.4	21.0	14.5	13.8	0.0
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	1727	770	423	2688	431	578
V/C Ratio(X)	0.87	0.47	0.67	0.44	0.79	0.56
Avail Cap(c_a), veh/h	1732	773	423	2688	717	709
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.73	0.73	1.00	1.00
Uniform Delay (d), s/veh	29.6	21.6	46.1	3.8	58.1	33.5
Incr Delay (d2), s/veh	6.4	2.1	2.6	0.4	2.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	21.5	7.4	8.7	3.1	5.8	8.6
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	36.0	23.6	48.7	4.2	60.1	34.1
LnGrp LOS	D	C	D	A	E	C
Approach Vol, veh/h	1867			1468	664	
Approach Delay, s/veh	33.6			12.8	47.4	
Approach LOS	C			B	D	

Timer - Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	41.2	74.8				116.0		22.0
Change Period (Y+Rc), s	6.0	* 6				6.0		4.5
Max Green Setting (Gmax), s	25.0	* 69				98.0		29.5
Max Q Clear Time (g_c+I1), s	23.0	56.3				16.5		15.8
Green Ext Time (p_c), s	0.2	12.5				67.6		1.8

Intersection Summary			
HCM 6th Ctrl Delay			28.2
HCM 6th LOS			C

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Edition methodology expects strict NEMA phasing.

HCM Signalized Intersection Capacity Analysis
4: Industrial Way & US 26

01/20/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	1615	5	25	1245	35	40	20	70	160	10	65
Future Volume (vph)	50	1615	5	25	1245	35	40	20	70	160	10	65
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0		4.0		4.0	4.0	4.0
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00		1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85		0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (prot)	1676	3316		1644	3358	1471		1627		1624	1638	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (perm)	1676	3316		1644	3358	1471		1627		1624	1638	1508
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	51	1648	5	26	1270	36	41	20	71	163	10	66
RTOR Reduction (vph)	0	0	0	0	0	16	0	29	0	0	0	59
Lane Group Flow (vph)	51	1653	0	26	1270	20	0	103	0	86	87	7
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	18.7	96.2		5.0	82.5	82.5		13.7		15.7	15.7	15.7
Effective Green, g (s)	19.2	97.6		5.0	83.9	83.9		13.7		15.7	15.7	15.7
Actuated g/C Ratio	0.13	0.66		0.03	0.57	0.57		0.09		0.11	0.11	0.11
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4		4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4		3.0		2.3	2.3	2.3
Lane Grp Cap (vph)	217	2186		55	1903	833		150		172	173	159
v/s Ratio Prot	0.03	c0.50		0.02	c0.38			c0.06		0.05	c0.05	
v/s Ratio Perm						0.01						0.00
v/c Ratio	0.24	0.76		0.47	0.67	0.02		0.69		0.50	0.50	0.04
Uniform Delay, d1	57.8	17.1		70.2	22.3	14.1		65.1		62.4	62.5	59.4
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	1.00
Incremental Delay, d2	0.3	2.5		3.7	1.9	0.1		12.3		1.3	1.3	0.1
Delay (s)	58.1	19.6		73.9	24.2	14.1		77.3		63.8	63.8	59.5
Level of Service	E	B		E	C	B		E		E	E	E
Approach Delay (s)		20.8			24.9			77.3			62.6	
Approach LOS		C			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	27.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	148.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th Edition methodology does not support turning movements with shared & exclusive lanes.

HCM Signalized Intersection Capacity Analysis
5: Ruben Lane & US 26

01/20/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	110	1630	110	40	1230	65	50	20	35	165	25	80
Future Volume (vph)	110	1630	110	40	1230	65	50	20	35	165	25	80
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.94	1.00	1.00	*0.97	1.00		1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.97		1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.97	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1676	3318	1466	1644	3358	1431		1687	1461	1624	1649	1507
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.97	1.00	0.95	0.96	1.00
Satd. Flow (perm)	1676	3318	1466	1644	3358	1431		1687	1461	1624	1649	1507
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	111	1646	111	40	1242	66	51	20	35	167	25	81
RTOR Reduction (vph)	0	0	28	0	0	25	0	0	32	0	0	74
Lane Group Flow (vph)	111	1646	83	40	1242	41	0	71	3	95	97	7
Confl. Peds. (#/hr)			1			3	1		4	4		1
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	0%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases			2			6		8	8			4
Actuated Green, G (s)	12.6	92.1	92.1	9.7	89.2	89.2		13.7	13.7	13.1	13.1	13.1
Effective Green, g (s)	12.6	93.5	93.5	9.7	90.6	90.6		13.7	13.7	13.1	13.1	13.1
Actuated g/C Ratio	0.09	0.64	0.64	0.07	0.62	0.62		0.09	0.09	0.09	0.09	0.09
Clearance Time (s)	4.0	5.4	5.4	4.0	5.4	5.4		4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4	5.4	2.3	5.4	5.4		2.3	2.3	2.3	2.3	2.3
Lane Grp Cap (vph)	144	2124	938	109	2083	888		158	137	145	147	135
v/s Ratio Prot	0.07	c0.50		0.02	c0.37			c0.04		0.06	c0.06	
v/s Ratio Perm			0.06			0.03			0.00			0.00
v/c Ratio	0.77	0.77	0.09	0.37	0.60	0.05		0.45	0.02	0.66	0.66	0.05
Uniform Delay, d1	65.3	18.7	10.0	65.2	16.7	10.8		62.6	60.1	64.3	64.3	60.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	20.9	2.8	0.2	1.2	1.3	0.1		1.2	0.0	8.6	8.7	0.1
Delay (s)	86.2	21.6	10.2	66.4	18.0	10.9		63.8	60.1	72.9	73.0	60.9
Level of Service	F	C	B	E	B	B		E	E	E	E	E
Approach Delay (s)		24.7			19.0			62.6			69.4	
Approach LOS		C			B			E			E	

Intersection Summary			
HCM 2000 Control Delay	27.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	146.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th Signalized Intersection Summary
6: Bluff Rd & US 26

01/20/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	120	1570	150	65	1155	150	95	40	60	155	45	115
Future Volume (veh/h)	120	1570	150	65	1155	150	95	40	60	155	45	115
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		0.97	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	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	122	1602	153	66	1179	153	97	41	61	158	46	117
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	357	2036	907	83	1285	640	119	71	106	182	66	169
Arrive On Green	0.21	0.60	0.60	0.05	0.44	0.44	0.07	0.11	0.12	0.11	0.15	0.15
Sat Flow, veh/h	1688	3367	1499	1647	2941	1464	1701	637	948	1701	445	1132
Grp Volume(v), veh/h	122	1602	153	66	1179	153	97	0	102	158	0	163
Grp Sat Flow(s),veh/h/ln	1688	1683	1499	1647	1470	1464	1701	0	1586	1701	0	1577
Q Serve(g_s), s	7.8	45.6	5.7	5.0	47.9	5.8	7.1	0.0	7.7	11.6	0.0	12.4
Cycle Q Clear(g_c), s	7.8	45.6	5.7	5.0	47.9	5.8	7.1	0.0	7.7	11.6	0.0	12.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.60	1.00		0.72
Lane Grp Cap(c), veh/h	357	2036	907	83	1285	640	119	0	178	182	0	235
V/C Ratio(X)	0.34	0.79	0.17	0.80	0.92	0.24	0.81	0.00	0.57	0.87	0.00	0.69
Avail Cap(c_a), veh/h	357	2036	907	143	1297	646	188	0	375	188	0	373
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)	0.59	0.59	0.59	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	42.5	18.9	11.0	59.7	33.6	11.0	58.2	0.0	53.4	55.8	0.0	51.1
Incr Delay (d2), s/veh	0.2	1.9	0.2	10.1	11.8	0.9	9.7	0.0	1.8	31.2	0.0	2.3
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	3.2	16.8	2.0	2.4	19.0	3.0	3.4	0.0	3.2	6.6	0.0	5.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	42.7	20.8	11.3	69.8	45.4	11.8	67.9	0.0	55.1	87.0	0.0	53.4
LnGrp LOS	D	C	B	E	D	B	E	A	E	F	A	D
Approach Vol, veh/h		1877			1398			199			321	
Approach Delay, s/veh		21.5			42.9			61.4			69.9	
Approach LOS		C			D			E			E	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.4	80.8	12.9	22.9	31.7	59.5	17.6	18.2
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.8	* 4	4.0	4.5
Max Green Setting (Gmax), s	11.0	55.2	14.0	29.5	11.0	* 56	14.0	29.5
Max Q Clear Time (g_c+I1), s	7.0	47.6	9.1	14.4	9.8	49.9	13.6	9.7
Green Ext Time (p_c), s	0.0	7.3	0.0	0.5	0.0	5.7	0.0	0.3

Intersection Summary	
HCM 6th Ctrl Delay	35.5
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	55	75	210	250	5
Future Vol, veh/h	5	55	75	210	250	5
Conflicting Peds, #/hr	1	1	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	180	0	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	6	63	85	239	284	6

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	699	290	292	0	-	0
Stage 1	289	-	-	-	-	-
Stage 2	410	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.11	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.209	-	-	-
Pot Cap-1 Maneuver	403	744	1275	-	-	-
Stage 1	756	-	-	-	-	-
Stage 2	666	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	374	742	1273	-	-	-
Mov Cap-2 Maneuver	374	-	-	-	-	-
Stage 1	704	-	-	-	-	-
Stage 2	665	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.7	2.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1273	-	374	742	-	-
HCM Lane V/C Ratio	0.067	-	0.015	0.084	-	-
HCM Control Delay (s)	8	0	14.8	10.3	-	-
HCM Lane LOS	A	A	B	B	-	-
HCM 95th %tile Q(veh)	0.2	-	0	0.3	-	-

Intersection	
Int Delay, s/veh	1.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	40	40	410	35	25	470
Future Vol, veh/h	40	40	410	35	25	470
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	125	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	43	43	436	37	27	500

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1009	457	0	0	473	0
Stage 1	455	-	-	-	-	-
Stage 2	554	-	-	-	-	-
Critical Hdwy	6.44	6.24	-	-	4.13	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	-	-	2.227	-
Pot Cap-1 Maneuver	264	599	-	-	1084	-
Stage 1	635	-	-	-	-	-
Stage 2	572	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	257	598	-	-	1084	-
Mov Cap-2 Maneuver	257	-	-	-	-	-
Stage 1	635	-	-	-	-	-
Stage 2	558	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	18.1	0	0.4
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	359	1084	-
HCM Lane V/C Ratio	-	-	0.237	0.025	-
HCM Control Delay (s)	-	-	18.1	8.4	-
HCM Lane LOS	-	-	C	A	-
HCM 95th %tile Q(veh)	-	-	0.9	0.1	-

Intersection	
Intersection Delay, s/veh	24.4
Intersection LOS	C

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	130	160	90	315	480	30
Future Vol, veh/h	130	160	90	315	480	30
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles, %	0	0	1	1	1	1
Mvmt Flow	138	170	96	335	511	32
Number of Lanes	1	0	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	1	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	1
HCM Control Delay	16.1	21.3	31.5
HCM LOS	C	C	D

Lane	NBLn1	EBLn1	SBLn1
Vol Left, %	22%	45%	0%
Vol Thru, %	78%	0%	94%
Vol Right, %	0%	55%	6%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	405	290	510
LT Vol	90	130	0
Through Vol	315	0	480
RT Vol	0	160	30
Lane Flow Rate	431	309	543
Geometry Grp	1	1	1
Degree of Util (X)	0.696	0.529	0.842
Departure Headway (Hd)	5.813	6.168	5.584
Convergence, Y/N	Yes	Yes	Yes
Cap	616	580	646
Service Time	3.897	4.256	3.661
HCM Lane V/C Ratio	0.7	0.533	0.841
HCM Control Delay	21.3	16.1	31.5
HCM Lane LOS	C	C	D
HCM 95th-tile Q	5.5	3.1	9.2

Intersection	
Int Delay, s/veh	0.1

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Traffic Vol, veh/h	3	1055	850	5	5	0
Future Vol, veh/h	3	1055	850	5	5	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	150	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	1122	904	5	5	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	909	0	-	0	1474	455
Stage 1	-	-	-	-	907	-
Stage 2	-	-	-	-	567	-
Critical Hdwy	4.14	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.22	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	745	-	-	-	117	552
Stage 1	-	-	-	-	354	-
Stage 2	-	-	-	-	531	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	745	-	-	-	117	552
Mov Cap-2 Maneuver	-	-	-	-	117	-
Stage 1	-	-	-	-	353	-
Stage 2	-	-	-	-	531	-

Approach	SE	NW	SW
HCM Control Delay, s	0	0	37.2
HCM LOS			E

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1
Capacity (veh/h)	-	-	745	-	117
HCM Lane V/C Ratio	-	-	0.004	-	0.045
HCM Control Delay (s)	-	-	9.9	-	37.2
HCM Lane LOS	-	-	A	-	E
HCM 95th %tile Q(veh)	-	-	0	-	0.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	155	995	15	270	45	0	0	35	25
Future Volume (veh/h)	0	0	0	155	995	15	270	45	0	0	35	25
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.99	0.99		1.00	1.00		0.99
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				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				168	1082	16	293	49	0	0	38	27
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				224	1520	23	354	49	0	0	262	186
Arrive On Green				0.52	0.52	0.52	0.27	0.27	0.00	0.00	0.27	0.27
Sat Flow, veh/h				434	2949	45	1076	180	0	0	960	682
Grp Volume(v), veh/h				661	0	605	342	0	0	0	0	65
Grp Sat Flow(s),veh/h/ln				1708	0	1721	1256	0	0	0	0	1642
Q Serve(g_s), s				33.6	0.0	28.9	26.6	0.0	0.0	0.0	0.0	3.3
Cycle Q Clear(g_c), s				33.6	0.0	28.9	29.9	0.0	0.0	0.0	0.0	3.3
Prop In Lane				0.25		0.03	0.86		0.00	0.00		0.42
Lane Grp Cap(c), veh/h				880	0	887	403	0	0	0	0	448
V/C Ratio(X)				0.75	0.00	0.68	0.85	0.00	0.00	0.00	0.00	0.15
Avail Cap(c_a), veh/h				1118	0	1126	403	0	0	0	0	448
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	0.00	1.00	0.91	0.00	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				21.1	0.0	19.9	41.6	0.0	0.0	0.0	0.0	30.3
Incr Delay (d2), s/veh				5.9	0.0	4.2	17.9	0.0	0.0	0.0	0.0	0.1
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				14.5	0.0	12.4	11.2	0.0	0.0	0.0	0.0	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				26.9	0.0	24.2	59.5	0.0	0.0	0.0	0.0	30.4
LnGrp LOS				C	A	C	E	A	A	A	A	C
Approach Vol, veh/h					1266			342			65	
Approach Delay, s/veh					25.6			59.5			30.4	
Approach LOS					C			E			C	
Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				34.0		60.7		34.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				30.0		72.0		30.0				
Max Q Clear Time (g_c+I1), s				5.3		35.6		31.9				
Green Ext Time (p_c), s				0.2		21.0		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			32.7									
HCM 6th LOS			C									

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	1310	365	0	0	0	0	240	125	25	185	0
Future Volume (veh/h)	75	1310	365	0	0	0	0	240	125	25	185	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		0.99	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	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	79	1379	0				0	253	132	26	195	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	97	1777					0	580	484	33	663	0
Arrive On Green	0.54	0.54	0.00				0.00	0.33	0.33	0.01	0.13	0.00
Sat Flow, veh/h	178	3268	1502				0	1772	1480	1647	1730	0
Grp Volume(v), veh/h	781	677	0				0	253	132	26	195	0
Grp Sat Flow(s),veh/h/ln	1763	1683	1502				0	1772	1480	1647	1730	0
Q Serve(g_s), s	39.9	33.8	0.0				0.0	12.3	7.2	1.7	11.2	0.0
Cycle Q Clear(g_c), s	39.9	33.8	0.0				0.0	12.3	7.2	1.7	11.2	0.0
Prop In Lane	0.10		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	959	915					0	580	484	33	663	0
V/C Ratio(X)	0.81	0.74					0.00	0.44	0.27	0.79	0.29	0.00
Avail Cap(c_a), veh/h	959	915					0	580	484	150	786	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	20.6	19.2	0.0				0.0	29.0	27.3	54.4	34.5	0.0
Incr Delay (d2), s/veh	7.6	5.4	0.0				0.0	2.4	1.4	22.2	0.1	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	17.8	14.1	0.0				0.0	5.5	2.7	0.9	5.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	28.1	24.5	0.0				0.0	31.4	28.7	76.6	34.7	0.0
LnGrp LOS	C	C					A	C	C	E	C	A
Approach Vol, veh/h		1458	A					385			221	
Approach Delay, s/veh		26.4						30.5			39.6	
Approach LOS		C						C			D	
Timer - Assigned Phs		2		4			7	8				
Phs Duration (G+Y+Rc), s		63.8		46.2			6.2	40.0				
Change Period (Y+Rc), s		4.0		4.0			4.0	4.8				
Max Green Setting (Gmax), s		52.0		50.0			10.0	35.2				
Max Q Clear Time (g_c+I1), s		41.9		13.2			3.7	14.3				
Green Ext Time (p_c), s		8.6		0.5			0.0	1.1				

Intersection Summary			
HCM 6th Ctrl Delay			28.6
HCM 6th LOS			C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱		✥			✥	
Traffic Volume (veh/h)	160	1095	125	5	815	20	95	25	10	45	20	120
Future Volume (veh/h)	160	1095	125	5	815	20	95	25	10	45	20	120
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	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	168	1153	132	5	858	21	100	26	11	47	21	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, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	607	1607	716	399	1176	524	177	43	14	92	42	173
Arrive On Green	0.36	0.48	0.48	0.25	0.36	0.36	0.16	0.17	0.15	0.16	0.17	0.15
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	717	254	85	305	252	1032
Grp Volume(v), veh/h	168	1153	132	5	858	21	137	0	0	194	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1056	0	0	1589	0	0
Q Serve(g_s), s	7.8	29.9	5.5	0.3	25.3	1.0	2.2	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	7.8	29.9	5.5	0.3	25.3	1.0	14.8	0.0	0.0	12.7	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.73		0.08	0.24		0.65
Lane Grp Cap(c), veh/h	607	1607	716	399	1176	524	229	0	0	300	0	0
V/C Ratio(X)	0.28	0.72	0.18	0.01	0.73	0.04	0.60	0.00	0.00	0.65	0.00	0.00
Avail Cap(c_a), veh/h	607	2020	900	399	1793	800	261	0	0	335	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	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	25.0	22.8	16.5	31.4	30.3	22.6	44.7	0.0	0.0	43.9	0.0	0.0
Incr Delay (d2), s/veh	0.1	2.8	0.6	0.0	4.0	0.1	2.3	0.0	0.0	3.2	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	3.2	12.3	2.0	0.1	10.1	0.4	3.8	0.0	0.0	5.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.2	25.6	17.0	31.4	34.3	22.7	47.0	0.0	0.0	47.1	0.0	0.0
LnGrp LOS	C	C	B	C	C	C	D	A	A	D	A	A
Approach Vol, veh/h		1453			884			137			194	
Approach Delay, s/veh		24.8			34.0			47.0			47.1	
Approach LOS		C			C			D			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	31.1	56.5		22.4	43.6	44.0		22.4				
Change Period (Y+Rc), s	4.5	4.0		5.5	4.5	4.0		5.5				
Max Green Setting (Gmax), s	10.5	66.0		19.5	15.5	61.0		19.5				
Max Q Clear Time (g_c+I1), s	2.3	31.9		14.7	9.8	27.3		16.8				
Green Ext Time (p_c), s	0.0	20.6		0.2	0.2	12.7		0.1				
Intersection Summary												
HCM 6th Ctrl Delay			30.6									
HCM 6th LOS			C									

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	50	1050	850	0	5	20
Future Vol, veh/h	50	1050	850	0	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	300	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	3	3	6	6	0	0
Mvmt Flow	53	1105	895	0	5	21

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	895	0	-	0	1554	448
Stage 1	-	-	-	-	895	-
Stage 2	-	-	-	-	659	-
Critical Hdwy	4.16	-	-	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	2.23	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	748	-	-	-	106	564
Stage 1	-	-	-	-	364	-
Stage 2	-	-	-	-	482	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	748	-	-	-	98	564
Mov Cap-2 Maneuver	-	-	-	-	98	-
Stage 1	-	-	-	-	338	-
Stage 2	-	-	-	-	482	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	18.7
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	748	-	-	-	289
HCM Lane V/C Ratio	0.07	-	-	-	0.091
HCM Control Delay (s)	10.2	-	-	-	18.7
HCM Lane LOS	B	-	-	-	C
HCM 95th %tile Q(veh)	0.2	-	-	-	0.3

Intersection	
Int Delay, s/veh	4.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	45	60	30	45	25	50	260	50	15	365	15
Future Vol, veh/h	10	45	60	30	45	25	50	260	50	15	365	15
Conflicting Peds, #/hr	1	0	0	0	0	1	4	0	1	1	0	4
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	125	-	-	125	-	-	-	-	-	-	-	325
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	2	2	2	2	2	2	3	3	3
Mvmt Flow	11	49	65	33	49	27	54	283	54	16	397	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	890	879	401	913	868	312	417	0	0	338	0	0
Stage 1	433	433	-	419	419	-	-	-	-	-	-	-
Stage 2	457	446	-	494	449	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.12	6.52	6.22	4.12	-	-	4.13	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.518	4.018	3.318	2.218	-	-	2.227	-	-
Pot Cap-1 Maneuver	266	288	653	254	290	728	1142	-	-	1216	-	-
Stage 1	605	585	-	612	590	-	-	-	-	-	-	-
Stage 2	587	577	-	557	572	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	207	265	651	185	267	727	1138	-	-	1215	-	-
Mov Cap-2 Maneuver	207	265	-	185	267	-	-	-	-	-	-	-
Stage 1	567	573	-	575	555	-	-	-	-	-	-	-
Stage 2	484	542	-	451	560	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18	21.5	1.2	0.3
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1138	-	-	207	401	185	345	1215	-	-
HCM Lane V/C Ratio	0.048	-	-	0.053	0.285	0.176	0.221	0.013	-	-
HCM Control Delay (s)	8.3	0	-	23.4	17.5	28.6	18.4	8	0	-
HCM Lane LOS	A	A	-	C	C	D	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.2	1.2	0.6	0.8	0	-	-

Intersection	
Int Delay, s/veh	4.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	240	60	210	235	35	115
Future Vol, veh/h	240	60	210	235	35	115
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	3	3	1	1	1	1
Mvmt Flow	267	67	233	261	39	128

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	334	0	1028	301
Stage 1	-	-	-	-	301	-
Stage 2	-	-	-	-	727	-
Critical Hdwy	-	-	4.11	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	-	-	2.209	-	3.509	3.309
Pot Cap-1 Maneuver	-	-	1231	-	260	741
Stage 1	-	-	-	-	753	-
Stage 2	-	-	-	-	480	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1231	-	211	741
Mov Cap-2 Maneuver	-	-	-	-	211	-
Stage 1	-	-	-	-	753	-
Stage 2	-	-	-	-	389	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4.1	16.9
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	467	-	-	1231	-
HCM Lane V/C Ratio	0.357	-	-	0.19	-
HCM Control Delay (s)	16.9	-	-	8.6	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	1.6	-	-	0.7	-

Intersection	
Int Delay, s/veh	1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1085	85	20	845	25	20
Future Vol, veh/h	1085	85	20	845	25	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	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	1154	90	21	899	27	21

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1244	0	1646	577
Stage 1	-	-	-	-	1154	-
Stage 2	-	-	-	-	492	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	534	-	92	465
Stage 1	-	-	-	-	267	-
Stage 2	-	-	-	-	586	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	534	-	88	465
Mov Cap-2 Maneuver	-	-	-	-	88	-
Stage 1	-	-	-	-	267	-
Stage 2	-	-	-	-	563	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	40.7
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	88	465	-	-	534	-
HCM Lane V/C Ratio	0.302	0.046	-	-	0.04	-
HCM Control Delay (s)	62.7	13.1	-	-	12	-
HCM Lane LOS	F	B	-	-	B	-
HCM 95th %tile Q(veh)	1.1	0.1	-	-	0.1	-

SECTION 2. FUTURE TRANSPORTATION SYSTEM PERFORMANCE MEMO

FUTURE TRANSPORTATION SYSTEM PERFORMANCE

DATE: June 28, 2021

TO: Project Management Team

FROM: Reah Flisakowski, Dock Rosenthal | DKS Associates

SUBJECT: Sandy Bypass Feasibility Reevaluation P# 20020-007

This memorandum summarizes the future transportation system performance along US 26 through the City of Sandy, Oregon. This assessment generally includes the US 26 segment between the intersections with SE Orient Drive and Firwood Drive at Shorty's Corner. Analyzing the future transportation system performance documents, the expected year 2040 vehicle travel conditions through the City and provides an evaluation of a potential alternative route to US 26 as identified in the 2011 City of Sandy Transportation System Plan. A documentation of future pedestrian, bicycle and transit conditions will be provided as part of the on-going update of the City's Transportation System Plan (TSP).

MOTOR VEHICLE CONDITIONS

Future year 2040 operating conditions for vehicles were assessed using data and findings developed for the existing conditions analysis[1] and available growth pattern data for the study area and US 26. The following sections summarize this analysis.

MOTOR VEHICLE ALTERNATIVES

Future improvement alternatives were previously developed and evaluated as part of the 2011 Sandy TSP[2] to enhance connectivity, provide access to developing lands, and address congestion in the US 26 corridor. The objective for each improvement alternative ranged from relying mainly on management and enhancement of the existing transportation system to large investments in new facilities to increase corridor capacity.

Three of the prior TSP alternatives were carried forward and incorporated into this Sandy Bypass Feasibility Reevaluation, as described in the following sections. Note the prior TSP Alternative #2 – US 26 Widening was not included in this analysis.

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[1] Existing Transportation System Performance memo, DKS Associates, April 19, 2021.

[2] Sandy TSP Update, Technical Memo #2: Transportation Alternatives and Improvement Strategies, DKS Associates, February 25, 2011.

2040 NO BUILD ALTERNATIVE

A No Build Alternative would typically be based on the existing system and not include future improvements. However, there are several roadway projects that are fully funded and/or currently in the design phase. It was determined these projects should be included in the No Build Alternative due to the high level of certainty that they will be part of the future system. These projects are listed below. A figure showing the project locations by project ID is provided in the appendix.

- Dubarko Road connection to Champion Way (#2)
- Extend Bell Street to 362nd Avenue (portion of #3)
- Extend 362nd Avenue to Bell Street (portion of #4)
- Extend Dubarko Road to US 26 opposite Vista Loop Drive West (#9)
- Signalized control at the intersection of OR 211 and Dubarko Road and US 26 and Vista Loop Drive (west)/Dubarko extension

2040 ALTERNATIVE #1 – LOCAL SYSTEM ENHANCEMENTS AND MINOR HIGHWAY IMPROVEMENTS

The emphasis of this alternative was to improve overall street connectivity, provide access to lands that would develop in the future, and improve operations on US 26 by enhancing the supporting City street network so that local trips would have less need to travel on US 26.

The future improvement projects included in the 2040 Alternative #1 are listed below. They include roadway and intersection capacity projects. A figure showing the project locations by project ID is provided in the appendix.

Roadway Improvements

- Industrial Way extension to Jarl Road/ US 26 (#1)
- Dubarko Road connection to Champion Way (#2)
- Extend Bell Street to Orient Drive (#3)
- Extend 362nd Drive to Kelso Road (#4)
- Extend Kate Schmidt Street from US 26 to the proposed Bell Street extension (#5)
- Extend Industrial Way north of US 26 to Bell Street Extension (#6)
- Extend Olson Road from 362nd Drive to Jewelberry Avenue (#7)
- Extend Agnes Street to Jewelberry Avenue (#8)
- Extend Dubarko Road to US 26 opposite Vista Loop Drive West (#9)
- Gunderson Road, Sandy Heights St./370th Avenue, Colorado Road, Arletha Court (#10)
- Construct a new road from Dubarko Road to US 26 opposite Vista Loop Drive East (#11)

Intersection Improvements

- US 26/ 362nd Drive - Construct a second westbound left turn lane, receiving lane for second westbound left turn lane, northbound through lane, new southbound leg with through, right turn and left turn lane
- US 26/ Industrial Way – Change southbound approach to dual left turn lanes and a shared through/right lane, construct a northbound left turn lane
- US 26/Ruben Lane - Change southbound approach to dual left turn lanes and a shared through/right lane, change northbound approach to left turn lane, and shared through/right lane
- OR 211/ Proctor Boulevard (US 26) – Construct a northbound left turn lane (restriping only)
- US 26/ Ten Eyck Road/Wolf Drive – Construct a northbound and southbound left turn lane
- US 26/ Vista Loop Drive West – Realign Vista Loop Drive to be perpendicular to US 26
- OR 211/ Dubarko Road - Construct a traffic signal, northbound right turn lane, southbound left turn lane, northbound left turn lane
- OR 211/ Bornstedt Road – Prohibit left turn movements out
- OR 211/ Arletha Court - Realign intersection to create a four-legged intersection with the Gunderson Road extension
- 362nd Drive/ Industrial Way (West) - Construct an eastbound left turn lane with 50 feet of storage
- 362nd Drive/ Dubarko Road - Construct a single-lane roundabout

2040 ALTERNATIVE #3 – LOCAL SYSTEM ENHANCEMENTS AND US 26 BYPASS

Alternative #3 included all the same projects as Alternative #1 but added a bypass of the existing US 26 corridor around the south side of the City from a point west of Orient Drive to approximately Shorty's Corner. A figure showing the high-level conceptual alignment of the bypass (#13) is provided in the appendix.

For the purpose of this analysis, the bypass concept was assumed to have the following design characteristics:

- Four-lane facility (two lanes in each direction)
- 45 mph posted speed and 50 mph design speed
- Limited access facility
    - interchange at the east and west end connections with US 26
    - at-grade intersection at OR 211 controlled by a traffic signal or roundabout
    - remaining key street intersections limited to right-in/right-out

The bypass conceptual alignment and design characteristics will be further refined during the next phase of the analysis, the Bypass Benefit Cost Analysis.

MOTOR VEHICLE OPERATIONS

FUTURE FORECASTING

Traffic forecasts for each of the future 2040 alternatives were developed using a combination of available data and prior modeling analysis and findings. The forecasts relied on recent year 2020 intersection counts[3], year 2029 analysis from the 2011 Sandy TSP and ODOT Volume Tables. The forecasts were developed for the TSP study intersections and focused on the peak hour. Future volumes can be found in the operation reports in the appendix.

Future 2040 No Build Alternative forecasts were based on the 2020 count data and growth rates available from the 2029 forecasts. The addition of the Alternative #1 improvements would result in moderate changes to local travel patterns with better connectivity and intersection capacity. The 2040 No Build Alternative forecasts were refined to represent the 2040 Alternative #1 using growth rates available from the 2029 forecasts.

The addition of the bypass would result in significant changes to regional travel patterns. Future 2040 Alternative #3 forecasts were developed using the Alternative #1 volumes, growth rates available from the 2029 forecasts and current travel pattern data.

A travel pattern analysis was completed using StreetLight data which provided information on where vehicle trips are coming from through the City, how much delay these trips experience and how long it takes them to make their trip. The data showed the proposed bypass would attract up to 28% of the total US 26 traffic during the peak hour. For a conservative analysis and for alignment with the 2011 Sandy TSP findings, the forecasting assumed 40% of the total US 26 traffic would divert to the bypass.

The 2040 Alternative #1 volumes were adjusted to account for use of the US 26 bypass to develop 2040 Alternative #3 volumes. US 26 is forecasted to serve approximately 3,800 vehicles during the peak hour under the 2040 No Build Alternative. Under the 2040 Alternative #3, US 26 is forecasted to serve approximately 2,300 vehicles and the bypass is forecasted to serve approximately 1,500 vehicles during the peak hour.

JURISDICTIONAL MOBILITY STANDARDS

The mobility standards for intersections vary according to the agency of jurisdiction for each intersection. Five of the study intersections are under City jurisdiction (362nd Drive/Industrial Way – North and South, Bluff Road/Bell Street, OR 211/Bornstedt, and OR 211/Dubarko) while the remaining 11 intersections are under ODOT jurisdiction. Current ODOT mobility targets require a volume to capacity ratio between 0.80 and 0.90 or less to be maintained at study intersections (see Table 2) and the City of Sandy operating standards require that a level of service "D" or better

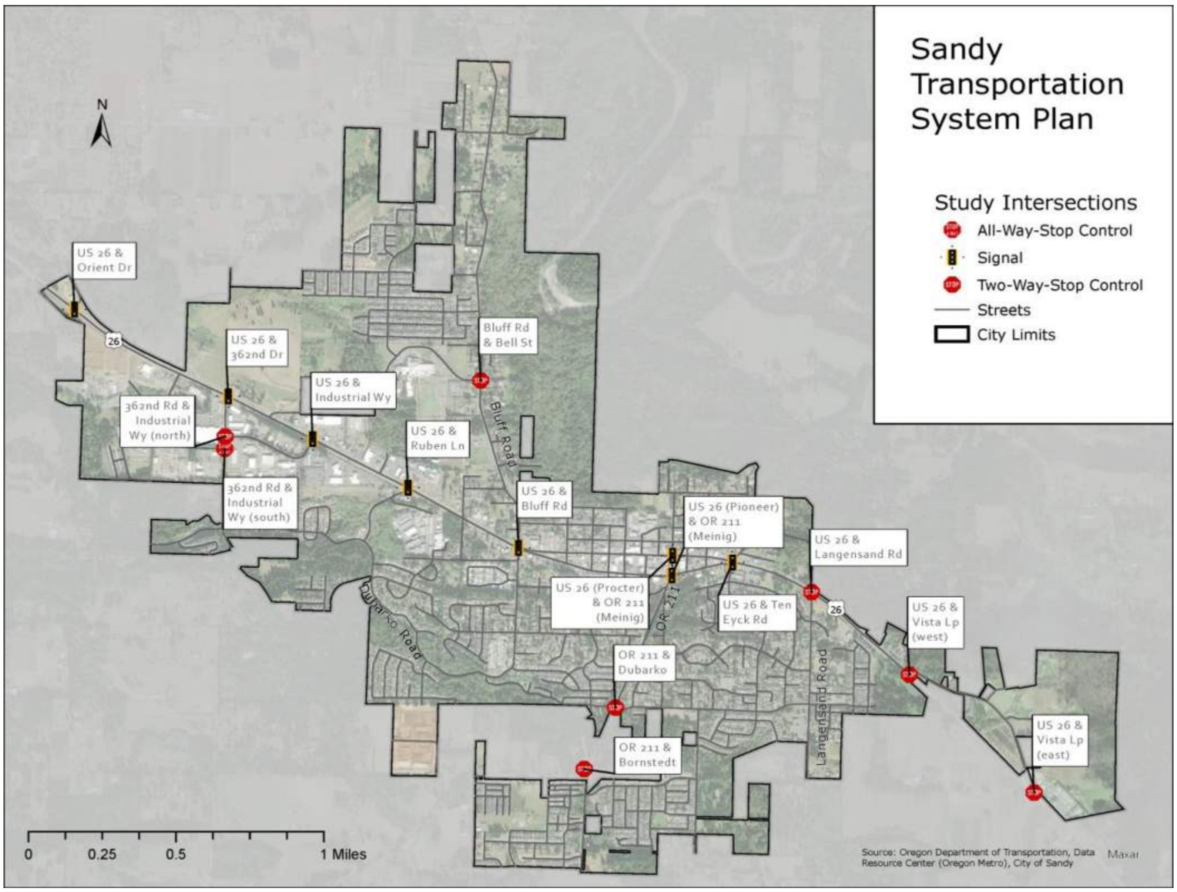
[3] Traffic counts were collected on October 22, 2020.

be maintained for any signalized intersection and unsignalized intersections with stop control on the minor approach[4].

FUTURE INTERSECTION OPERATIONS

Motor vehicle conditions were evaluated for the 2040 peak hour at the 16 study intersections under each of the future improvement alternatives. The evaluation utilized the Highway Capacity Manual (HCM) 6th Edition methodology. The detailed intersection operation reports are shown in the appendix.

FIGURE 1: STUDY INTERSECTIONS WITH EXISTING CONTROL



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4 City of Sandy Transportation System Plan, DKS Associates, 2011.

2040 No Build

As shown in Table 1, eight intersections are forecasted to exceed mobility targets.

- **US 26 and Orient Drive** – The eastbound through movement at this intersection requires more capacity but is limited by the split phasing for Orient Drive/Jarl Road which serves a high southbound left turn volume with only a single approach lane.
- **US 26 and 362nd Drive** – More capacity is needed for the eastbound and westbound left and through movements at this intersection but green time for those movements is limited by the split phasing of the northbound and southbound approaches.
- **US 26 and Industrial Way** – The eastbound through movement and northbound approach are both over capacity at this intersection. The split phasing of the northbound and southbound approaches also limits the green time available to the US 26 movements.
- **362nd Drive and Industrial Way (north)** – High northbound and southbound volumes result in limited gaps for the Industrial Way approach at this two-way-stop-controlled intersection.
- **362nd Drive and Industrial Way (south)** – High traffic volumes at all approaches result in long delays for all movements at this all-way-stop-controlled intersection.
- **US 26 and Ruben Lane** - The eastbound through movement and southbound approach are both over capacity at this intersection. The split phasing of the northbound and southbound approaches also limits the green time available to the US 26 movements.
- **US 26 and Bluff Road** – The eastbound left and through, westbound left and through, and northbound left movements are all over capacity at this intersection.
- **OR 211 and Bornstedt Road** - High eastbound and westbound volumes result in limited gaps for the Bornstedt Road approach at this two-way-stop-controlled intersection.

TABLE 1: 2040 NO BUILD INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	F	134	**1.19**
US 26/362ND DRIVE	Signal	ODOT	0.80	F	121	**1.16**
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	E	74	**1.10**
362ND DRIVE/ INDUSTRIAL WAY (NORTH)	TWSC[b]	City of Sandy	D	**B [F]**	11 [117]	0.49 [0.94]
362ND DRIVE/ INDUSTRIAL WAY (SOUTH)	AWSC	City of Sandy	D	**F**	214	1.43
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	C	35	**0.97**
US 26/BLUFF ROAD	Signal	ODOT	0.85	F	112	**1.12**
BLUFF ROAD/BELL STREET	TWSC	City of Sandy	D	A [C]	9 [23]	0.29 [0.09]
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	30	0.81
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	32	0.84
OR 211/ DUBARKO ROAD	Signal	City of Sandy	D	C	21	0.81
OR 211/BORNSTEDT ROAD	TWSC	City of Sandy	D	**A [F]**	10 [240]	0.35 [1.32]
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	29	0.80
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	C [F]	16 [>300]	0.48 [0.91]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	C	25	0.66
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	B [F]	12 [117]	0.48 [0.25]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

2040 Alternative #1

The improvements included in Alternative 1 were analyzed to assess operation benefits at the study intersections resulting from new system network and added capacity. Two intersections that did not meet mobility targets will do so with the improvements in Alternative #1.

- The intersection of US 26 and Industrial Way meets mobility targets with a reduction in demand at the eastbound, westbound and northbound approaches.
- The intersection of OR 211 and Bornstedt Road meets mobility targets with the prohibition of the northbound left turn movement.

Operations under Alternative #1 conditions are show in Table 2. With the new local network connections north of US 26, particularly the Bell Street extension to Orient Drive, through volumes along US 26 are reduced in Alternative #1 which results in improvements to the operation of intersections along the highway.

Six intersections still fail to meet mobility targets under Alternative #1.

- **US 26 and Orient Drive** – There is a higher eastbound left traffic volume and lower eastbound through volume relative to the No Build condition however this reduction does not improve conditions enough for this intersection to meet mobility targets.
- **US 26 and 362nd Drive** – Lower traffic volumes for the eastbound and westbound approaches improve conditions at this intersection but it still fails to meet mobility targets.
- **362nd Drive and Industrial Way (north)** – With an additional southbound through lane that widens this intersection and increased traffic volumes, conditions remain LOS F for the Industrial Way approach.
- **362nd Drive and Industrial Way (south)** – The eastbound left turn lane improves conditions for that approach, but higher northbound and southbound volumes degrade conditions for the major approaches.
- **US 26 and Ruben Lane** - Lower traffic volumes for the eastbound and westbound approaches improve conditions at this intersection but it still fails to meet mobility targets.
- **US 26 and Bluff Road** – Lower traffic volumes for the eastbound left and through and westbound through movements improve conditions at this intersection but it still fails to meet mobility targets.

TABLE 2: 2040 ALTERNATIVE #1 INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	F	134	**1.11**
US 26/362ND DRIVE	Signal	ODOT	0.80	D	41	**1.00**
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	D	18	0.79
362ND DRIVE/ INDUSTRIAL WAY (NORTH)	TWSC[b]	City of Sandy	D	**A [F]**	10 [107]	0.46 [1.04]
362ND DRIVE/ INDUSTRIAL WAY (SOUTH)	AWSC	City of Sandy	D	**F**	>300	1.52
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	D	48	**0.84**
US 26/BLUFF ROAD	Signal	ODOT	0.85	E	73	**0.86**
BLUFF ROAD/BELL STREET	TWSC	City of Sandy	D	A [C]	8 [16]	0.24 [0.10]
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	32	0.80
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	27	0.72
OR 211/ DUBARKO RD	Signal	City of Sandy	D	B	16	0.68
OR 211/BORNSTEDT ROD	TWSC	City of Sandy	D	B [B]	11 [15]	0.5 [0.04]
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	28	0.73
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	C [F]	18 [>300]	0.51 [1.21]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	B	17	0.61
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	B [F]	12 [121]	0.48 [0.26]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

Alternative #3

The improvements included in Alternative 1, combined with the bypass of the existing US 26 corridor, were analyzed to assess operation benefits at the study intersections. Because the impacts on the City street network will vary significantly with the locations and types of access allowed to the bypass, only the US 26 corridor intersections were evaluated to see how much the bypass could relieve congestion.

As shown in Table 3, with the addition of a US 26 bypass only the intersection of US 26 and Orient Drive would exceed mobility targets. The eastbound through and southbound left movements at this intersection continue to compete for available green time in the cycle even with the addition of the bypass.

TABLE 3: 2040 ALTERNATIVE #3 INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	C	32	**0.83**
US 26/362ND DRIVE	Signal	ODOT	0.80	C	34	0.76
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	C	22	0.56
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	C	31	0.65
US 26/BLUFF ROAD	Signal	ODOT	0.85	D	42	0.64
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	27	0.59
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	29	0.67
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	26	0.54
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	B [D]	10 [33]	0.25 [0.17]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	A	4	0.48
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	A [F]	10 [62]	0.28 [0.14]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

MOTOR VEHICLE TRAVEL TIME ESTIMATES

The US 26 bypass is expected to serve a moderate future volume and improve traffic flow on US 26 through Sandy. It was estimated that approximately 1,500 vehicles per hour would use the bypass during the year 2040 peak hour. Approximately 60% of the bypass users during the peak hour would be through traffic with no origin or destination in Sandy, while the other 40% would be comprised of local trips accessing the southern end of Sandy.

As an additional measure for evaluating the effectiveness of each alternative, travel times along US 26 through the study area were estimated. Table 4 shows the travel time estimates for each alternative. Improvements in travel times among the alternatives are generally consistent with the improvements shown for intersection operations, with the provision of a bypass in Alternative #3 resulting in moderate reductions in through travel time.

TABLE 4: ESTIMATED US 26 CORRIDOR TRAVEL TIMES (PEAK HOUR)

ALTERNATIVE		TRAVEL TIME EASTBOUND (MM:SS)	TRAVEL TIME WESTBOUND (MM:SS)
2020 EXISTING		09:36	09:54
2040 NO BUILD		16:49	14:26
2040 ALTERNATIVE #1		13:18	10:15
2040 ALTERNATIVE #3	US 26 FACILITY	08:54	10:19
	BYPASS FACILITY	07:56	07:56

BYPASS FACILITY CROSS-SECTION CONSIDERATION

The expected 2040 peak hour volumes using the bypass suggest the facility could adequately accommodate demands with a narrower cross-section providing 2 lanes (one in each direction). The highest 2040 volume on the bypass is not expected to exceed 1,000 vehicles in either direction. If the bypass concept was reduced to a 2- lane facility, the connection with OR 211 may require a full interchange instead of an at-grade intersection with traffic signal or roundabout control. The analysis and findings in this future conditions memo would not change since free-flow operations are expected on the bypass with either 2 or 4 lanes and the same future volumes would be served. Both cross-sections options will be considered and further refined during the next phase of the analysis, the Bypass Benefit Cost Analysis.

SUMMARY

The future conditions findings from this analysis will contribute to the content and analysis in subsequent memoranda including the Benefit Cost Analysis Memorandum and the Sandy Bypass Feasibility Reevaluation Report.

Key findings from the future conditions alternative analysis include:

- Under the 2040 No Build Alternative, 8 study intersections (4 on US 26) would exceed mobility targets.
- The addition of local connections and intersection improvements under 2040 Alternative #1, 6 study intersections (4 on US 26) would continue to exceed mobility targets.
- Adding the bypass under Alternative #3 would improve traffic operations, only one study intersection would continue to exceed mobility targets (US 26 and Orient Drive)
- Approximately 1,500 vehicles an hour would use the bypass during the 2040 peak hour.
- Approximately 60% of bypass users during peak periods would represent through trips, 40% would be local trips accessing the southern end of Sandy.
- Compared to the 2040 No Build Alternative, the addition of local connections and intersection improvements under 2040 Alternative #1 would decrease travel times on US 26 approximately 3 minutes 30 seconds eastbound and 4 minutes westbound
- Compared to the 2040 No Build Alternative, the addition of the bypass under 2040 Alternative #3 would decrease travel times on US 26 approximately 8 minutes eastbound and 4 minutes westbound
- Under Alternative #3, the bypass would save travel time through the study area compared to US 26 (1 minute eastbound and 2 minutes 30 seconds westbound)

APPENDIX

CONTENTS

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SHAPING A SMARTER TRANSPORTATION EXPERIENCE™

AN EMPLOYEE-OWNED COMPANY

SECTION 1. FUTURE ROADWAY

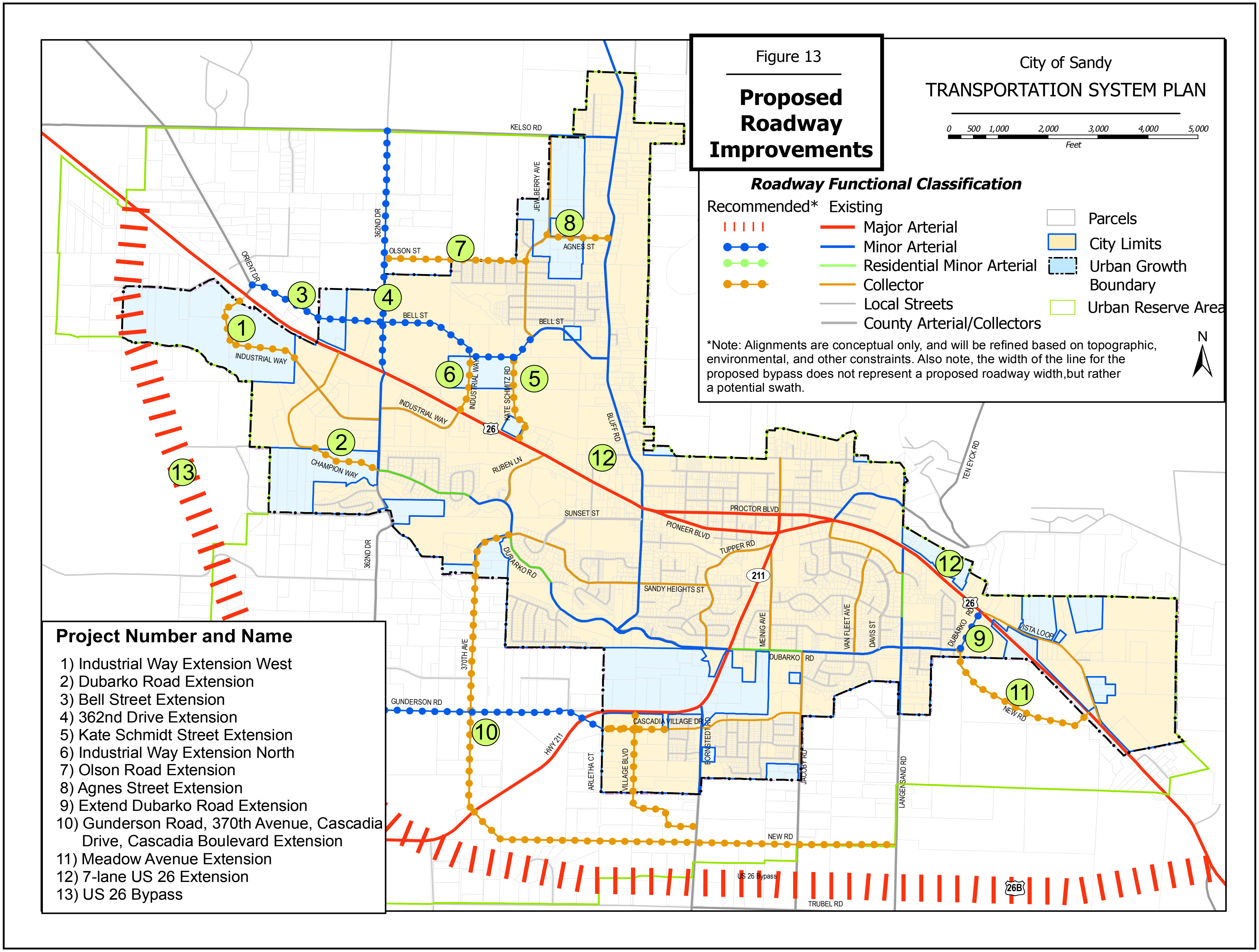


Figure 13
Proposed Roadway Improvements
City of Sandy
TRANSPORTATION SYSTEM PLAN
0 500 1,000 2,000 3,000 4,000 5,000
Feet
Roadway Functional Classification
Recommended* Existing
Major Arterial
Minor Arterial
Residential Minor Arterial
Collector
Local Streets
County Arterial/Collectors
Parcels
City Limits
Urban Growth Boundary
Urban Reserve Area
*Note: Alignments are conceptual only, and will be refined based on topographic, environmental, and other constraints. Also note, the width of the line for the proposed bypass does not represent a proposed roadway width,but rather a potential swath.
N
Project Number and Name
1) Industrial Way Extension West
2) Dubarko Road Extension
3) Bell Street Extension
4) 362nd Drive Extension
5) Kate Schmidt Street Extension
6) Industrial Way Extension North
7) Olson Road Extension
8) Agnes Street Extension
9) Extend Dubarko Road Extension
10) Gunderson Road, 370th Avenue, Cascadia Drive, Cascadia Boulevard Extension
11) Meadow Avenue Extension
12) 7-lane US 26 Extension
13) US 26 Bypass
KELSO RD
JEWELBERRY AVE
362ND DR
OLSON ST
AGNES ST
ORIENT DR
BELL ST
INDUSTRIAL WAY
KATE SCHMITZ RD
BLUFF RD
CHAMPION WAY
RUBEN LN
SUNSET ST
PROCTOR BLVD
PIONEER BLVD
TUPPER RD
TEN EYCK RD
DUBARKO RD
SANDY HEIGHTS ST
MEINIG AVE
VAN FLEET AVE
DAVIS ST
VISTA LOOP
NEW RD
370TH AVE
GUNDERSON RD
HWY 211
CASCADIA VILLAGE DR
BORNSTEDT RD
JACOBY RD
ARLETHA CT
VILLAGE BLVD
LANGENSAND RD
US 26 Bypass
TRUBEL RD
26
211
26B

SECTION 2. FUTURE CONDITION HCM REPORTS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	2520	5	10	1750	225	10	50	10	260	10	20
Future Volume (veh/h)	60	2520	5	10	1750	225	10	50	10	260	10	20
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	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	63	2653	5	11	1842	0	11	53	11	274	11	21
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, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	81	1907	850	65	1847		14	69	14	288	12	22
Arrive On Green	0.05	0.57	0.57	0.04	0.56	0.00	0.07	0.06	0.07	0.19	0.19	0.19
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	227	1096	227	1501	60	115
Grp Volume(v), veh/h	63	2653	5	11	1842	0	75	0	0	306	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1551	0	0	1676	0	0
Q Serve(g_s), s	4.2	65.0	0.2	0.7	63.6	0.0	5.5	0.0	0.0	20.7	0.0	0.0
Cycle Q Clear(g_c), s	4.2	65.0	0.2	0.7	63.6	0.0	5.5	0.0	0.0	20.7	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.15		0.15	0.90		0.07
Lane Grp Cap(c), veh/h	81	1907	850	65	1847		98	0	0	321	0	0
V/C Ratio(X)	0.78	1.39	0.01	0.17	1.00		0.76	0.00	0.00	0.95	0.00	0.00
Avail Cap(c_a), veh/h	81	1907	850	80	1847		101	0	0	321	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	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	54.0	24.9	10.8	53.3	25.3	0.0	52.8	0.0	0.0	45.9	0.0	0.0
Incr Delay (d2), s/veh	35.6	179.5	0.0	0.7	20.2	0.0	24.9	0.0	0.0	37.6	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	2.5	69.1	0.1	0.3	26.1	0.0	2.8	0.0	0.0	12.0	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	89.7	204.4	10.8	54.1	45.5	0.0	77.7	0.0	0.0	83.5	0.0	0.0
LnGrp LOS	F	F	B	D	D		E	A	A	F	A	A
Approach Vol, veh/h		2721			1853	A		75			306	
Approach Delay, s/veh		201.3			45.6			77.7			83.5	
Approach LOS		F			D			E			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.5	68.0		26.0	8.5	69.0		11.3
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5
Max Green Setting (Gmax), s	5.0	61.0		21.0	5.0	61.0		7.0
Max Q Clear Time (g_c+I1), s	6.2	65.6		22.7	2.7	67.0		7.5
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.0

Intersection Summary	
HCM 6th Ctrl Delay	133.9
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑	↱	↰	↑	↱
Traffic Volume (veh/h)	300	1600	420	265	1525	340	335	150	325	150	175	170
Future Volume (veh/h)	300	1600	420	265	1525	340	335	150	325	150	175	170
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	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	316	1684	442	279	1605	358	353	158	342	158	184	179
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, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	198	1243	884	258	1397	820	761	402	343	236	248	210
Arrive On Green	0.08	0.37	0.36	0.16	0.56	0.54	0.23	0.23	0.23	0.14	0.14	0.14
Sat Flow, veh/h	1688	3367	1502	1661	3313	1502	3300	1772	1512	1688	1772	1502
Grp Volume(v), veh/h	316	1684	442	279	1605	358	353	158	342	158	184	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1502	1650	1772	1512	1688	1772	1502
Q Serve(g_s), s	11.0	48.0	22.3	15.8	54.8	15.9	12.0	9.8	29.4	11.6	13.0	15.1
Cycle Q Clear(g_c), s	11.0	48.0	22.3	15.8	54.8	15.9	12.0	9.8	29.4	11.6	13.0	15.1
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	198	1243	884	258	1397	820	761	402	343	236	248	210
V/C Ratio(X)	1.59	1.35	0.50	1.08	1.15	0.44	0.46	0.39	1.00	0.67	0.74	0.85
Avail Cap(c_a), veh/h	198	1243	884	258	1397	820	761	402	343	376	395	335
HCM Platoon Ratio	1.00	1.00	1.00	1.33	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.20	0.20	0.20	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.3	41.0	15.6	52.8	28.5	13.2	43.1	42.7	50.2	53.1	53.7	54.6
Incr Delay (d2), s/veh	290.0	165.0	2.0	50.9	68.8	0.3	0.3	0.4	47.8	2.4	3.3	9.5
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	20.4	47.0	12.5	11.3	30.1	6.0	4.9	4.3	15.5	5.1	6.0	6.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	327.3	206.0	17.6	103.7	97.4	13.5	43.3	43.0	98.0	55.5	56.9	64.1
LnGrp LOS	F	F	B	F	F	B	D	D	F	E	E	E
Approach Vol, veh/h		2442			2242			853			521	
Approach Delay, s/veh		187.6			84.8			65.2			59.0	
Approach LOS		F			F			E			E	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	21.8	52.0		22.2	15.0	58.8		34.0
Change Period (Y+Rc), s	6.0	* 6		4.0	4.0	6.0		4.5
Max Green Setting (Gmax), s	7.0	* 46		29.0	11.0	42.0		29.5
Max Q Clear Time (g_c+I1), s	17.8	50.0		17.1	13.0	56.8		31.4
Green Ext Time (p_c), s	0.0	0.0		1.0	0.0	0.0		0.0

Intersection Summary	
HCM 6th Ctrl Delay	121.2
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM Signalized Intersection Capacity Analysis
4: Industrial Way & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	65	1945	5	25	1795	50	170	35	250	230	15	170
Future Volume (vph)	65	1945	5	25	1795	50	170	35	250	230	15	170
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0		4.0		4.0	4.0	4.0
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00		1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85		0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (prot)	1676	3316		1644	3358	1471		1620		1624	1638	1508
Flt Permitted	0.06	1.00		0.06	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (perm)	100	3316		101	3358	1471		1620		1624	1638	1508
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	66	1985	5	26	1832	51	173	36	255	235	15	173
RTOR Reduction (vph)	0	0	0	0	0	23	0	33	0	0	0	112
Lane Group Flow (vph)	66	1990	0	26	1832	28	0	431	0	125	125	61
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						4
Actuated Green, G (s)	74.3	70.3		71.1	68.7	68.7		22.6		17.3	17.3	17.3
Effective Green, g (s)	75.3	71.7		71.1	70.1	70.1		22.6		17.3	17.3	17.3
Actuated g/C Ratio	0.58	0.55		0.55	0.54	0.54		0.17		0.13	0.13	0.13
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4		4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4		3.0		2.3	2.3	2.3
Lane Grp Cap (vph)	112	1828		83	1810	793		281		216	217	200
v/s Ratio Prot	c0.02	c0.60		0.01	0.55			c0.27		c0.08	0.08	
v/s Ratio Perm	0.32			0.16		0.02						0.04
v/c Ratio	0.59	1.09		0.31	1.01	0.03		1.53		0.58	0.58	0.31
Uniform Delay, d1	56.5	29.1		59.7	30.0	14.1		53.7		52.9	52.9	50.9
Progression Factor	0.43	0.45		0.79	0.67	2.57		1.00		1.00	1.00	1.00
Incremental Delay, d2	2.8	45.0		0.8	19.5	0.0		257.3		2.8	2.7	0.5
Delay (s)	27.4	58.1		47.8	39.4	36.2		311.0		55.7	55.6	51.4
Level of Service	C	E		D	D	D		F		E	E	D
Approach Delay (s)		57.1			39.5			311.0			53.9	
Approach LOS		E			D			F			D	

Intersection Summary			
HCM 2000 Control Delay	74.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	102.9%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
5: Ruben Lane & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	175	2045	195	45	1650	100	120	35	40	270	35	135
Future Volume (vph)	175	2045	195	45	1650	100	120	35	40	270	35	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.94	1.00	1.00	*0.97	1.00		1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.97		1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1676	3318	1467	1644	3358	1432		1682	1461	1624	1646	1506
Flt Permitted	0.07	1.00	1.00	0.06	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (perm)	132	3318	1467	96	3358	1432		1682	1461	1624	1646	1506
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	177	2066	197	45	1667	101	121	35	40	273	35	136
RTOR Reduction (vph)	0	0	40	0	0	36	0	0	34	0	0	126
Lane Group Flow (vph)	177	2066	157	45	1667	65	0	156	6	153	155	10
Confl. Peds. (#/hr)			1			3	1		4	4		1
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	0%	0%	0%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases	2		2	6		6		8	8			4
Actuated Green, G (s)	81.5	80.1	80.1	75.5	75.5	75.5		19.3	19.3	10.0	10.0	10.0
Effective Green, g (s)	81.5	81.5	81.5	75.5	76.9	76.9		19.3	19.3	10.0	10.0	10.0
Actuated g/C Ratio	0.63	0.63	0.63	0.58	0.59	0.59		0.15	0.15	0.08	0.08	0.08
Clearance Time (s)	4.0	5.4	5.4	4.0	5.4	5.4		4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4	5.4	2.3	5.4	5.4		2.3	2.3	2.3	2.3	2.3
Lane Grp Cap (vph)	175	2080	919	93	1986	847		249	216	124	126	115
v/s Ratio Prot	0.06	c0.62		0.01	c0.50			c0.09		c0.09	0.09	
v/s Ratio Perm	c0.57		0.11	0.27		0.05			0.00			0.01
v/c Ratio	1.01	0.99	0.17	0.48	0.84	0.08		0.63	0.03	1.23	1.23	0.09
Uniform Delay, d1	42.5	24.0	10.1	30.2	21.5	11.4		52.0	47.3	60.0	60.0	55.8
Progression Factor	0.66	0.41	0.29	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	23.3	4.6	0.0	2.3	4.5	0.2		3.9	0.0	156.7	154.7	0.2
Delay (s)	51.1	14.5	2.9	32.5	26.0	11.5		55.9	47.4	216.7	214.7	56.0
Level of Service	D	B	A	C	C	B		E	D	F	F	E
Approach Delay (s)		16.2			25.4			54.2			166.8	
Approach LOS		B			C			D			F	

Intersection Summary			
HCM 2000 Control Delay	34.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	285	1910	155	95	1430	245	145	55	120	155	45	255
Future Volume (veh/h)	285	1910	155	95	1430	245	145	55	120	155	45	255
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		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	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	291	1949	158	97	1459	250	148	56	122	158	46	260
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	247	1681	748	75	1150	572	139	78	170	250	53	299
Arrive On Green	0.15	0.50	0.50	0.05	0.39	0.39	0.08	0.16	0.16	0.15	0.23	0.23
Sat Flow, veh/h	1688	3367	1499	1647	2941	1464	1701	493	1075	1701	232	1313
Grp Volume(v), veh/h	291	1949	158	97	1459	250	148	0	178	158	0	306
Grp Sat Flow(s),veh/h/ln	1688	1683	1499	1647	1470	1464	1701	0	1569	1701	0	1546
Q Serve(g_s), s	16.1	54.9	6.5	5.0	43.0	13.8	9.0	0.0	11.8	9.6	0.0	20.9
Cycle Q Clear(g_c), s	16.1	54.9	6.5	5.0	43.0	13.8	9.0	0.0	11.8	9.6	0.0	20.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.69	1.00		0.85
Lane Grp Cap(c), veh/h	247	1681	748	75	1150	572	139	0	248	250	0	352
V/C Ratio(X)	1.18	1.16	0.21	1.30	1.27	0.44	1.06	0.00	0.72	0.63	0.00	0.87
Avail Cap(c_a), veh/h	247	1681	748	75	1150	572	139	0	428	250	0	422
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)	0.13	0.13	0.13	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	46.9	27.5	15.4	52.5	33.5	24.6	50.5	0.0	43.8	44.1	0.0	40.7
Incr Delay (d2), s/veh	85.1	72.7	0.1	202.2	128.1	2.4	94.2	0.0	2.4	4.4	0.0	14.3
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	12.4	37.1	2.2	6.3	35.5	5.2	7.5	0.0	4.8	4.4	0.0	9.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	132.0	100.2	15.5	254.7	161.6	27.0	144.7	0.0	46.2	48.5	0.0	54.9
LnGrp LOS	F	F	B	F	F	C	F	A	D	D	A	D
Approach Vol, veh/h		2398			1806			326			464	
Approach Delay, s/veh		98.5			148.0			90.9			52.7	
Approach LOS		F			F			F			D	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	9.0	58.9	13.0	29.1	20.9	47.0	20.7	21.4				
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.8	* 4	4.5	* 4.5				
Max Green Setting (Gmax), s	5.0	49.2	9.0	29.5	12.0	* 43	9.0	* 30				
Max Q Clear Time (g_c+I1), s	7.0	56.9	11.0	22.9	18.1	45.0	11.6	13.8				
Green Ext Time (p_c), s	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.6				

Intersection Summary		
HCM 6th Ctrl Delay		111.7
HCM 6th LOS		F

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	55	100	465	405	5
Future Vol, veh/h	5	55	100	465	405	5
Conflicting Peds, #/hr	1	1	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	180	0	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	5	58	105	489	426	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1131	432	433	0	-	0
Stage 1	431	-	-	-	-	-
Stage 2	700	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.11	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.209	-	-	-
Pot Cap-1 Maneuver	223	619	1132	-	-	-
Stage 1	651	-	-	-	-	-
Stage 2	489	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	201	617	1130	-	-	-
Mov Cap-2 Maneuver	201	-	-	-	-	-
Stage 1	589	-	-	-	-	-
Stage 2	488	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.4	1.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1130	-	201	617	-	-
HCM Lane V/C Ratio	0.093	-	0.026	0.094	-	-
HCM Control Delay (s)	8.5	0	23.4	11.4	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0.3	-	0.1	0.3	-	-

Intersection						
Int Delay, s/veh	10.9					
Movement	**WBL**	**WBR**	**NBT**	**NBR**	**SBL**	**SBT**
Lane Configurations						
Traffic Vol, veh/h	55	80	575	210	190	530
Future Vol, veh/h	55	80	575	210	190	530
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	125	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	58	84	605	221	200	558

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1674	718	0	0	826	0
Stage 1	716	-	-	-	-	-
Stage 2	958	-	-	-	-	-
Critical Hdwy	6.44	6.24	-	-	4.13	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	-	-	2.227	-
Pot Cap-1 Maneuver	104	426	-	-	800	-
Stage 1	481	-	-	-	-	-
Stage 2	369	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	78	425	-	-	800	-
Mov Cap-2 Maneuver	78	-	-	-	-	-
Stage 1	481	-	-	-	-	-
Stage 2	277	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	116.9	0	2.9
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	151	800	-
HCM Lane V/C Ratio	-	-	0.941	0.25	-
HCM Control Delay (s)	-	-	116.9	11	-
HCM Lane LOS	-	-	F	B	-
HCM 95th %tile Q(veh)	-	-	6.8	1	-

Intersection	
Intersection Delay, s/veh	133.5
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	180	230	125	605	555	30
Future Vol, veh/h	180	230	125	605	555	30
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles, %	0	0	1	1	1	1
Mvmt Flow	189	242	132	637	584	32
Number of Lanes	1	0	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	1	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	1
HCM Control Delay	35.2	214.3	101.6
HCM LOS	E	F	F

Lane	NBLn1	EBLn1	SBLn1
Vol Left, %	17%	44%	0%
Vol Thru, %	83%	0%	95%
Vol Right, %	0%	56%	5%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	730	410	585
LT Vol	125	180	0
Through Vol	605	0	555
RT Vol	0	230	30
Lane Flow Rate	768	432	616
Geometry Grp	1	1	1
Degree of Util (X)	1.407	0.809	1.116
Departure Headway (Hd)	6.863	7.495	7.139
Convergence, Y/N	Yes	Yes	Yes
Cap	538	488	511
Service Time	4.863	5.495	5.139
HCM Lane V/C Ratio	1.428	0.885	1.205
HCM Control Delay	214.3	35.2	101.6
HCM Lane LOS	F	E	F
HCM 95th-tile Q	34.7	7.6	18.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	175	1375	15	270	45	0	0	65	40
Future Volume (veh/h)	0	0	0	175	1375	15	270	45	0	0	65	40
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.99	1.00		1.00	1.00		0.99
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				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				184	1447	16	284	47	0	0	68	42
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				205	1702	20	422	60	0	0	362	224
Arrive On Green				0.56	0.56	0.56	0.35	0.35	0.00	0.00	0.35	0.35
Sat Flow, veh/h				366	3034	35	1018	169	0	0	1022	631
Grp Volume(v), veh/h				861	0	786	331	0	0	0	0	110
Grp Sat Flow(s),veh/h/ln				1712	0	1723	1187	0	0	0	0	1653
Q Serve(g_s), s				48.9	0.0	40.5	24.4	0.0	0.0	0.0	0.0	5.1
Cycle Q Clear(g_c), s				48.9	0.0	40.5	29.4	0.0	0.0	0.0	0.0	5.1
Prop In Lane				0.21		0.02	0.86		0.00	0.00		0.38
Lane Grp Cap(c), veh/h				960	0	967	482	0	0	0	0	586
V/C Ratio(X)				0.90	0.00	0.81	0.69	0.00	0.00	0.00	0.00	0.19
Avail Cap(c_a), veh/h				980	0	987	482	0	0	0	0	586
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	0.00	1.00	0.79	0.00	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				21.3	0.0	19.5	34.7	0.0	0.0	0.0	0.0	24.5
Incr Delay (d2), s/veh				12.8	0.0	7.5	6.2	0.0	0.0	0.0	0.0	0.1
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				22.0	0.0	17.5	8.9	0.0	0.0	0.0	0.0	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				34.1	0.0	26.9	40.9	0.0	0.0	0.0	0.0	24.7
LnGrp LOS				C	A	C	D	A	A	A	A	C
Approach Vol, veh/h					1647			331			110	
Approach Delay, s/veh					30.7			40.9			24.7	
Approach LOS					C			D			C	
Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				43.0		65.7		43.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				39.0		63.0		39.0				
Max Q Clear Time (g_c+I1), s				7.1		50.9		31.4				
Green Ext Time (p_c), s				0.3		10.8		0.9				

Intersection Summary			
HCM 6th Ctrl Delay			32.0
HCM 6th LOS			C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	1535	555	0	0	0	0	240	245	40	210	0
Future Volume (veh/h)	75	1535	555	0	0	0	0	240	245	40	210	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	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
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	79	1616	0				0	253	258	42	221	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	97	2082					0	403	334	52	498	0
Arrive On Green	0.63	0.63	0.00				0.00	0.23	0.23	0.01	0.10	0.00
Sat Flow, veh/h	153	3294	1502				0	1772	1470	1647	1730	0
Grp Volume(v), veh/h	908	787	0				0	253	258	42	221	0
Grp Sat Flow(s),veh/h/ln	1764	1683	1502				0	1772	1470	1647	1730	0
Q Serve(g_s), s	42.9	35.5	0.0				0.0	14.2	18.1	2.8	13.3	0.0
Cycle Q Clear(g_c), s	42.9	35.5	0.0				0.0	14.2	18.1	2.8	13.3	0.0
Prop In Lane	0.09		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	1115	1064					0	403	334	52	498	0
V/C Ratio(X)	0.81	0.74					0.00	0.63	0.77	0.81	0.44	0.00
Avail Cap(c_a), veh/h	1115	1064					0	403	334	75	535	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	0.97	0.97	0.99	0.99	0.00
Uniform Delay (d), s/veh	15.3	14.0	0.0				0.0	38.3	39.8	54.1	41.5	0.0
Incr Delay (d2), s/veh	6.6	4.6	0.0				0.0	7.0	15.4	26.3	0.4	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	18.1	14.0	0.0				0.0	6.8	7.8	1.6	6.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.9	18.6	0.0				0.0	45.3	55.2	80.4	41.8	0.0
LnGrp LOS	C	B					A	D	E	F	D	A
Approach Vol, veh/h		1695	A					511			263	
Approach Delay, s/veh		20.4						50.3			48.0	
Approach LOS		C						D			D	
Timer - Assigned Phs		2		4			7	8				
Phs Duration (G+Y+Rc), s		73.5		36.5			7.5	29.0				
Change Period (Y+Rc), s		4.0		* 4.8			4.0	4.8				
Max Green Setting (Gmax), s		68.0		* 34			5.0	24.2				
Max Q Clear Time (g_c+I1), s		44.9		15.3			4.8	20.1				
Green Ext Time (p_c), s		19.7		0.5			0.0	0.7				

Intersection Summary			
HCM 6th Ctrl Delay			29.5
HCM 6th LOS			C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
15: Wolf Drive/SE Ten Eyck Rd & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	1450	125	10	1180	25	100	25	10	175	20	120
Future Volume (veh/h)	170	1450	125	10	1180	25	100	25	10	175	20	120
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	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	179	1526	132	11	1242	26	105	26	11	184	21	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, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	343	2075	925	24	1398	623	272	64	23	258	24	142
Arrive On Green	0.20	0.62	0.62	0.01	0.43	0.43	0.25	0.26	0.24	0.25	0.26	0.24
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	842	250	92	812	96	558
Grp Volume(v), veh/h	179	1526	132	11	1242	26	142	0	0	331	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1185	0	0	1465	0	0
Q Serve(g_s), s	10.4	35.0	4.1	0.7	39.0	1.1	0.0	0.0	0.0	12.7	0.0	0.0
Cycle Q Clear(g_c), s	10.4	35.0	4.1	0.7	39.0	1.1	11.3	0.0	0.0	24.0	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.74		0.08	0.56		0.38
Lane Grp Cap(c), veh/h	343	2075	925	24	1398	623	354	0	0	418	0	0
V/C Ratio(X)	0.52	0.74	0.14	0.45	0.89	0.04	0.40	0.00	0.00	0.79	0.00	0.00
Avail Cap(c_a), veh/h	343	2075	925	66	1446	645	413	0	0	481	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	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	39.0	14.8	8.9	53.7	28.8	18.1	34.8	0.0	0.0	39.8	0.0	0.0
Incr Delay (d2), s/veh	1.0	2.4	0.3	7.9	8.8	0.1	0.5	0.0	0.0	7.2	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	4.4	13.4	1.4	0.3	15.8	0.4	3.3	0.0	0.0	9.5	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	40.0	17.2	9.2	61.7	37.5	18.2	35.3	0.0	0.0	47.1	0.0	0.0
LnGrp LOS	D	B	A	E	D	B	D	A	A	D	A	A
Approach Vol, veh/h		1837			1279			142			331	
Approach Delay, s/veh		18.8			37.4			35.3			47.1	
Approach LOS		B			D			D			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.6	72.3		32.1	26.4	51.5		32.1				
Change Period (Y+Rc), s	4.5	* 4.5		5.5	4.5	4.0		5.5				
Max Green Setting (Gmax), s	4.0	* 61		31.3	15.5	49.2		31.3				
Max Q Clear Time (g_c+I1), s	2.7	37.0		26.0	12.4	41.0		13.3				
Green Ext Time (p_c), s	0.0	19.6		0.5	0.1	6.6		0.4				
Intersection Summary												
HCM 6th Ctrl Delay			28.7									
HCM 6th LOS			C									

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection						
Int Delay, s/veh	3.4					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Traffic Vol, veh/h	1535	90	30	1230	25	70
Future Vol, veh/h	1535	90	30	1230	25	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	1616	95	32	1295	26	74

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1711	0	2328	808
Stage 1	-	-	-	-	1616	-
Stage 2	-	-	-	-	712	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	350	-	32	328
Stage 1	-	-	-	-	151	-
Stage 2	-	-	-	-	453	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	350	-	29	328
Mov Cap-2 Maneuver	-	-	-	-	29	-
Stage 1	-	-	-	-	151	-
Stage 2	-	-	-	-	412	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	102.1
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	29	328	-	-	350	-
HCM Lane V/C Ratio	0.907	0.225	-	-	0.09	-
HCM Control Delay (s)	$ 334.4	19.1	-	-	16.3	-
HCM Lane LOS	F	C	-	-	C	-
HCM 95th %tile Q(veh)	3	0.8	-	-	0.3	-

HCM 6th Signalized Intersection Summary
17: US 26 & Vista Loop West

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	1435	0	100	1140	0	5	5	100	5	0	120
Future Volume (veh/h)	170	1435	0	100	1140	0	5	5	100	5	0	120
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	1758	1758	1723	1723	1716	1716	1723	1723	1723	1800	1723	1800
Adj Flow Rate, veh/h	179	1511	0	105	1200	0	5	5	105	5	0	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	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	547	2609	1141	436	2509	0	74	0	3	74	0	3
Arrive On Green	0.07	0.78	0.00	0.06	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1460	1641	3346	0	75	75	1569	66	0	1654
Grp Volume(v), veh/h	179	1511	0	105	1200	0	115	0	0	131	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1460	1641	1630	0	1719	0	0	1719	0	0
Q Serve(g_s), s	1.2	9.2	0.0	0.7	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	1.2	9.2	0.0	0.7	6.8	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.00	0.04		0.91	0.04		0.96
Lane Grp Cap(c), veh/h	547	2609	1141	436	2509	0	77	0	0	77	0	0
V/C Ratio(X)	0.33	0.58	0.00	0.24	0.48	0.00	1.48	0.00	0.00	1.70	0.00	0.00
Avail Cap(c_a), veh/h	888	4942	2160	660	4566	0	855	0	0	851	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	0.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	1.8	2.2	0.0	2.2	2.1	0.0	25.4	0.0	0.0	25.4	0.0	0.0
Incr Delay (d2), s/veh	0.3	0.4	0.0	0.2	0.3	0.0	228.6	0.0	0.0	323.2	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	0.0	0.2	0.0	0.0	0.1	0.0	5.8	0.0	0.0	7.8	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	2.1	2.7	0.0	2.4	2.4	0.0	254.0	0.0	0.0	348.6	0.0	0.0
LnGrp LOS	A	A	A	A	A	A	F	A	A	F	A	A
Approach Vol, veh/h		1690			1305			115			131	
Approach Delay, s/veh		2.6			2.4			254.0			348.6	
Approach LOS		A			A			F			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.7	43.0		0.0	7.1	43.6		0.0				
Change Period (Y+Rc), s	4.0	6.0		4.0	4.0	6.0		4.0				
Max Green Setting (Gmax), s	14.0	69.0		23.0	10.0	73.0		23.0				
Max Q Clear Time (g_c+I1), s	3.2	8.8		0.0	2.7	11.2		0.0				
Green Ext Time (p_c), s	0.3	17.7		0.0	0.1	26.4		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			25.4									
HCM 6th LOS			C									

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	1535	1235	25	10	0
Future Vol, veh/h	5	1535	1235	25	10	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	150	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	1616	1300	26	11	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1326	0	-	0	2131	663
Stage 1	-	-	-	-	1313	-
Stage 2	-	-	-	-	818	-
Critical Hdwy	4.14	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.22	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	517	-	-	-	42	404
Stage 1	-	-	-	-	216	-
Stage 2	-	-	-	-	394	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	517	-	-	-	42	404
Mov Cap-2 Maneuver	-	-	-	-	42	-
Stage 1	-	-	-	-	214	-
Stage 2	-	-	-	-	394	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	117.3
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	517	-	-	-	42
HCM Lane V/C Ratio	0.01	-	-	-	0.251
HCM Control Delay (s)	12	-	-	-	117.3
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0	-	-	-	0.8

HCM 6th Signalized Intersection Summary
20: Hwy 211 & Dubarko Rd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	190	90	160	70	30	110	230	130	50	535	40
Future Volume (veh/h)	30	190	90	160	70	30	110	230	130	50	535	40
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	1800	1800	1800	1772	1772	1772	1772	1772	1772	1758	1758	1758
Adj Flow Rate, veh/h	32	200	95	168	74	32	116	242	137	53	563	42
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, %	0	0	0	2	2	2	2	2	2	3	3	3
Cap, veh/h	429	238	113	317	327	141	294	748	631	494	704	594
Arrive On Green	0.03	0.21	0.21	0.10	0.28	0.28	0.06	0.42	0.42	0.04	0.40	0.40
Sat Flow, veh/h	1714	1152	547	1688	1173	507	1688	1772	1495	1674	1758	1482
Grp Volume(v), veh/h	32	0	295	168	0	106	116	242	137	53	563	42
Grp Sat Flow(s),veh/h/ln	1714	0	1700	1688	0	1680	1688	1772	1495	1674	1758	1482
Q Serve(g_s), s	1.0	0.0	11.3	5.0	0.0	3.3	2.8	6.2	4.0	1.3	19.2	1.2
Cycle Q Clear(g_c), s	1.0	0.0	11.3	5.0	0.0	3.3	2.8	6.2	4.0	1.3	19.2	1.2
Prop In Lane	1.00		0.32	1.00		0.30	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	429	0	351	317	0	468	294	748	631	494	704	594
V/C Ratio(X)	0.07	0.00	0.84	0.53	0.00	0.23	0.39	0.32	0.22	0.11	0.80	0.07
Avail Cap(c_a), veh/h	484	0	524	348	0	617	294	1067	900	530	1058	893
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	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.4	0.0	25.9	18.3	0.0	18.9	14.3	13.2	12.5	11.8	18.0	12.6
Incr Delay (d2), s/veh	0.1	0.0	6.6	1.0	0.0	0.2	0.6	0.5	0.4	0.1	4.8	0.1
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	0.0	5.0	1.9	0.0	1.2	0.9	2.2	1.3	0.4	7.6	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.5	0.0	32.5	19.3	0.0	19.1	14.9	13.7	12.9	11.8	22.8	12.7
LnGrp LOS	C	A	C	B	A	B	B	B	B	B	C	B
Approach Vol, veh/h		327			274			495			658	
Approach Delay, s/veh		31.4			19.2			13.8			21.3	
Approach LOS		C			B			B			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	6.5	32.8	10.8	18.1	8.0	31.3	5.8	23.0
Change Period (Y+Rc), s	4.0	4.8	4.0	4.0	4.0	4.8	4.0	4.0
Max Green Setting (Gmax), s	4.0	40.2	8.0	21.0	4.0	40.2	4.0	25.0
Max Q Clear Time (g_c+I1), s	3.3	8.2	7.0	13.3	4.8	21.2	3.0	5.3
Green Ext Time (p_c), s	0.0	3.5	0.0	0.6	0.0	5.3	0.0	0.2

Intersection Summary	
HCM 6th Ctrl Delay	20.7
HCM 6th LOS	C

Intersection						
Int Delay, s/veh	31					
Movement	**EBT**	**EBR**	**WBL**	**WBT**	**NBL**	**NBR**
Lane Configurations						
Traffic Vol, veh/h	400	120	230	570	105	80
Future Vol, veh/h	400	120	230	570	105	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	3	3	1	1	1	1
Mvmt Flow	421	126	242	600	111	84

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	547	0	1568	484
Stage 1	-	-	-	-	484	-
Stage 2	-	-	-	-	1084	-
Critical Hdwy	-	-	4.11	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	-	-	2.209	-	3.509	3.309
Pot Cap-1 Maneuver	-	-	1027	-	123	585
Stage 1	-	-	-	-	622	-
Stage 2	-	-	-	-	326	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1027	-	~ 94	585
Mov Cap-2 Maneuver	-	-	-	-	~ 94	-
Stage 1	-	-	-	-	622	-
Stage 2	-	-	-	-	249	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.8	239.8
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	148	-	-	1027	-
HCM Lane V/C Ratio	1.316	-	-	0.236	-
HCM Control Delay (s)	239.8	-	-	9.6	-
HCM Lane LOS	F	-	-	A	-
HCM 95th %tile Q(veh)	12	-	-	0.9	-

Notes

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	250	2205	15	10	1435	165	70	50	10	165	10	90
Future Volume (veh/h)	250	2205	15	10	1435	165	70	50	10	165	10	90
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	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	263	2321	16	11	1511	0	74	53	11	174	11	95
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, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	182	1735	774	73	1496		65	46	10	207	13	113
Arrive On Green	0.11	0.52	0.52	0.04	0.45	0.00	0.08	0.08	0.08	0.21	0.21	0.21
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	826	591	123	1008	64	550
Grp Volume(v), veh/h	263	2321	16	11	1511	0	138	0	0	280	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1540	0	0	1622	0	0
Q Serve(g_s), s	11.0	52.5	0.5	0.6	46.0	0.0	8.0	0.0	0.0	16.9	0.0	0.0
Cycle Q Clear(g_c), s	11.0	52.5	0.5	0.6	46.0	0.0	8.0	0.0	0.0	16.9	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.54		0.08	0.62		0.34
Lane Grp Cap(c), veh/h	182	1735	774	73	1496		121	0	0	333	0	0
V/C Ratio(X)	1.44	1.34	0.02	0.15	1.01		1.14	0.00	0.00	0.84	0.00	0.00
Avail Cap(c_a), veh/h	182	1735	774	73	1496		121	0	0	541	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	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	45.4	24.7	12.1	46.9	27.9	0.0	46.8	0.0	0.0	38.9	0.0	0.0
Incr Delay (d2), s/veh	227.8	156.2	0.0	0.6	25.8	0.0	124.9	0.0	0.0	6.4	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	15.9	55.0	0.2	0.3	21.0	0.0	7.3	0.0	0.0	7.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	273.3	180.9	12.1	47.4	53.8	0.0	171.7	0.0	0.0	45.3	0.0	0.0
LnGrp LOS	F	F	B	D	F		F	A	A	D	A	A
Approach Vol, veh/h		2600			1522	A		138			280	
Approach Delay, s/veh		189.2			53.7			171.7			45.3	
Approach LOS		F			D			F			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	15.0	50.0		24.9	8.5	56.5		12.0
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5
Max Green Setting (Gmax), s	10.5	43.0		33.0	4.0	49.5		7.5
Max Q Clear Time (g_c+I1), s	13.0	48.0		18.9	2.6	54.5		10.0
Green Ext Time (p_c), s	0.0	0.0		1.0	0.0	0.0		0.0

Intersection Summary			
HCM 6th Ctrl Delay			134.3
HCM 6th LOS			F

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
3: 362nd Dr & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	200	1355	450	225	1415	250	185	260	300	50	150	65
Future Volume (veh/h)	200	1355	450	225	1415	250	185	260	300	50	150	65
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	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	211	1426	474	237	1489	263	195	274	316	53	158	68
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, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	261	1450	1003	463	1725	851	745	393	336	104	109	92
Arrive On Green	0.07	0.43	0.43	0.29	1.00	1.00	0.23	0.22	0.22	0.06	0.06	0.06
Sat Flow, veh/h	1688	3367	1502	3222	3313	1502	3300	1772	1511	1688	1772	1502
Grp Volume(v), veh/h	211	1426	474	237	1489	263	195	274	316	53	158	68
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1611	1657	1502	1650	1772	1511	1688	1772	1502
Q Serve(g_s), s	9.0	54.4	19.9	8.0	0.0	0.0	6.3	18.5	26.7	4.0	8.0	5.8
Cycle Q Clear(g_c), s	9.0	54.4	19.9	8.0	0.0	0.0	6.3	18.5	26.7	4.0	8.0	5.8
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	261	1450	1003	463	1725	851	745	393	336	104	109	92
V/C Ratio(X)	0.81	0.98	0.47	0.51	0.86	0.31	0.26	0.70	0.94	0.51	1.45	0.74
Avail Cap(c_a), veh/h	261	1450	1003	463	1725	851	761	402	343	234	245	208
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.51	0.51	0.51	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.1	36.5	10.5	42.5	0.0	0.0	41.4	46.5	49.7	59.1	61.0	60.0
Incr Delay (d2), s/veh	16.5	20.0	1.6	0.3	3.2	0.5	0.1	4.5	33.1	2.9	223.6	8.3
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	1.8	24.5	11.9	2.8	0.8	0.1	2.6	8.6	13.1	1.8	10.3	2.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	46.5	56.5	12.1	42.8	3.2	0.5	41.5	51.1	82.9	62.0	284.6	68.2
LnGrp LOS	D	E	B	D	A	A	D	D	F	E	F	E
Approach Vol, veh/h		2111			1989			785			279	
Approach Delay, s/veh		45.5			7.6			61.5			189.6	
Approach LOS		D			A			E			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	24.7	60.0		12.0	13.0	71.7		33.4				
Change Period (Y+Rc), s	6.0	* 6		4.0	4.0	6.0		4.5				
Max Green Setting (Gmax), s	10.0	* 54		18.0	9.0	55.0		29.5				
Max Q Clear Time (g_c+I1), s	11.0	56.4		7.8	11.0	2.0		28.7				
Green Ext Time (p_c), s	0.0	0.0		0.2	0.0	51.5		0.1				

Intersection Summary		
HCM 6th Ctrl Delay		41.1
HCM 6th LOS		D

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM Signalized Intersection Capacity Analysis
4: Industrial Way & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	1645	10	40	1595	50	170	25	100	220	45	135
Future Volume (vph)	50	1645	10	40	1595	50	170	25	100	220	45	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00	1.00	1.00		0.97	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.88		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	3315		1644	3358	1471	1693	1569		3317	1580	
Flt Permitted	0.08	1.00		0.06	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	140	3315		102	3358	1471	1693	1569		3317	1580	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	51	1679	10	41	1628	51	173	26	102	224	46	138
RTOR Reduction (vph)	0	0	0	0	0	20	0	91	0	0	71	0
Lane Group Flow (vph)	51	1689	0	41	1628	31	173	37	0	224	113	0
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						
Actuated Green, G (s)	82.0	78.8		82.0	78.8	78.8	13.5	13.5		17.1	17.1	
Effective Green, g (s)	83.0	80.2		82.0	80.2	80.2	14.5	13.5		17.1	17.1	
Actuated g/C Ratio	0.64	0.62		0.63	0.62	0.62	0.11	0.10		0.13	0.13	
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4	3.0	3.0		2.3	2.3	
Lane Grp Cap (vph)	133	2045		102	2071	907	188	162		436	207	
v/s Ratio Prot	c0.01	c0.51		0.01	0.48		c0.10	0.02		0.07	c0.07	
v/s Ratio Perm	0.23			0.24		0.02						
v/c Ratio	0.38	0.83		0.40	0.79	0.03	0.92	0.23		0.51	0.54	
Uniform Delay, d1	35.2	19.4		40.6	18.5	9.7	57.2	53.5		52.6	52.8	
Progression Factor	0.38	0.21		0.47	0.46	0.50	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	2.4		1.0	2.1	0.0	43.5	0.7		0.6	2.0	
Delay (s)	14.1	6.4		20.1	10.6	4.9	100.7	54.2		53.2	54.8	
Level of Service	B	A		C	B	A	F	D		D	D	
Approach Delay (s)		6.6			10.7			80.9			53.9	
Approach LOS		A			B			F			D	

Intersection Summary			
HCM 2000 Control Delay	18.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	1625	210	55	1450	95	115	80	35	210	55	165
Future Volume (veh/h)	125	1625	210	55	1450	95	115	80	35	210	55	165
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		0.99	1.00		0.98
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	1772	1772	1772	1744	1744	1744	1758	1758	1758	1800	1800	1800
Adj Flow Rate, veh/h	126	1641	0	56	1465	96	116	81	35	212	56	167
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	4	4	4	3	3	3	0	0	0
Cap, veh/h	420	2226		232	1638	713	184	118	51	256	30	90
Arrive On Green	0.41	1.00	0.00	0.03	0.48	0.48	0.11	0.10	0.10	0.08	0.08	0.08
Sat Flow, veh/h	1688	3331	1502	1661	3383	1473	1674	1160	501	3326	393	1173
Grp Volume(v), veh/h	126	1641	0	56	1465	96	116	0	116	212	0	223
Grp Sat Flow(s),veh/h/ln	1688	1666	1502	1661	1692	1473	1674	0	1661	1663	0	1567
Q Serve(g_s), s	0.0	0.0	0.0	2.5	51.2	4.7	8.6	0.0	8.8	8.2	0.0	10.0
Cycle Q Clear(g_c), s	0.0	0.0	0.0	2.5	51.2	4.7	8.6	0.0	8.8	8.2	0.0	10.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.75
Lane Grp Cap(c), veh/h	420	2226		232	1638	713	184	0	169	256	0	121
V/C Ratio(X)	0.30	0.74		0.24	0.89	0.13	0.63	0.00	0.69	0.83	0.00	1.85
Avail Cap(c_a), veh/h	420	2226		234	1639	714	476	0	460	256	0	121
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.53	0.53	0.00	0.46	0.46	0.46	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	30.0	0.0	0.0	19.8	30.5	18.5	55.4	0.0	56.4	59.2	0.0	60.0
Incr Delay (d2), s/veh	0.1	1.2	0.0	0.1	4.0	0.2	2.2	0.0	3.0	19.2	0.0	412.7
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	2.3	0.4	0.0	0.9	20.7	1.6	3.8	0.0	3.9	4.2	0.0	17.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.2	1.2	0.0	19.9	34.5	18.7	57.6	0.0	59.3	78.3	0.0	472.7
LnGrp LOS	C	A		B	C	B	E	A	E	E	A	F
Approach Vol, veh/h		1767	A		1617			232			435	
Approach Delay, s/veh		3.3			33.0			58.5			280.5	
Approach LOS		A			C			E			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	7.9	90.9		14.0	31.8	66.9		17.3
Change Period (Y+Rc), s	4.0	* 5.4		4.0	* 5.4	* 5.4		4.0
Max Green Setting (Gmax), s	4.0	* 63		10.0	* 5	* 62		36.0
Max Q Clear Time (g_c+I1), s	4.5	2.0		12.0	2.0	53.2		10.8
Green Ext Time (p_c), s	0.0	59.0		0.0	0.1	8.3		0.8

Intersection Summary			
HCM 6th Ctrl Delay			48.1
HCM 6th LOS			D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
6: Bluff Rd & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	1640	180	70	1370	295	90	5	25	265	145	85
Future Volume (veh/h)	80	1640	180	70	1370	295	90	5	25	265	145	85
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		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	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	82	1673	184	71	1398	301	92	5	26	270	148	87
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	127	1408	626	375	1675	834	115	30	155	216	191	112
Arrive On Green	0.04	0.42	0.42	0.19	0.57	0.57	0.07	0.12	0.13	0.13	0.18	0.19
Sat Flow, veh/h	1688	3367	1498	1647	2941	1465	1701	245	1275	1701	1053	619
Grp Volume(v), veh/h	82	1673	184	71	1398	301	92	0	31	270	0	235
Grp Sat Flow(s),veh/h/ln	1688	1683	1498	1647	1470	1465	1701	0	1520	1701	0	1672
Q Serve(g_s), s	3.4	46.0	6.6	0.0	42.9	12.3	5.9	0.0	2.0	14.0	0.0	14.7
Cycle Q Clear(g_c), s	3.4	46.0	6.6	0.0	42.9	12.3	5.9	0.0	2.0	14.0	0.0	14.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.84	1.00		0.37
Lane Grp Cap(c), veh/h	127	1408	626	375	1675	834	115	0	185	216	0	303
V/C Ratio(X)	0.65	1.19	0.29	0.19	0.83	0.36	0.80	0.00	0.17	1.25	0.00	0.78
Avail Cap(c_a), veh/h	127	1408	626	375	1675	834	186	0	414	216	0	486
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)	0.55	0.55	0.55	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	28.3	32.0	11.4	36.3	19.4	12.8	50.6	0.0	43.1	48.0	0.0	42.8
Incr Delay (d2), s/veh	5.3	89.0	0.7	0.1	5.1	1.2	7.7	0.0	0.3	143.7	0.0	2.6
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	1.5	34.9	2.3	1.6	15.2	4.2	2.8	0.0	0.8	14.6	0.0	6.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	33.6	121.0	12.1	36.4	24.5	14.0	58.2	0.0	43.4	191.7	0.0	45.4
LnGrp LOS	C	F	B	D	C	B	E	A	D	F	A	D
Approach Vol, veh/h		1939			1770			123			505	
Approach Delay, s/veh		106.9			23.2			54.5			123.7	
Approach LOS		F			C			D			F	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	24.6	50.0	11.4	23.9	8.0	66.6	18.0	17.4
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.0	4.0	4.0	4.5
Max Green Setting (Gmax), s	4.0	45.2	12.0	31.5	4.0	46.0	14.0	29.5
Max Q Clear Time (g_c+I1), s	12.0	48.0	7.9	16.7	5.4	44.9	16.0	4.0
Green Ext Time (p_c), s	0.0	0.0	0.0	0.7	0.0	1.1	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	73.2
HCM 6th LOS	E

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	60	15	395	380	5
Future Vol, veh/h	5	60	15	395	380	5
Conflicting Peds, #/hr	1	1	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	180	0	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	5	63	16	416	400	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	854	406	407	0	-	0
Stage 1	405	-	-	-	-	-
Stage 2	449	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.11	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.209	-	-	-
Pot Cap-1 Maneuver	326	641	1157	-	-	-
Stage 1	669	-	-	-	-	-
Stage 2	639	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	320	639	1155	-	-	-
Mov Cap-2 Maneuver	320	-	-	-	-	-
Stage 1	658	-	-	-	-	-
Stage 2	638	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.7	0.3	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1155	-	320	639	-	-
HCM Lane V/C Ratio	0.014	-	0.016	0.099	-	-
HCM Control Delay (s)	8.2	0	16.4	11.3	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	0.3	-	-

Intersection	
Int Delay, s/veh	17

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	185	85	505	245	15	670
Future Vol, veh/h	185	85	505	245	15	670
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	125	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	195	89	532	258	16	705

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1046	663	0	0	790	0
Stage 1	661	-	-	-	-	-
Stage 2	385	-	-	-	-	-
Critical Hdwy	6.66	6.26	-	-	4.145	-
Critical Hdwy Stg 1	5.46	-	-	-	-	-
Critical Hdwy Stg 2	5.86	-	-	-	-	-
Follow-up Hdwy	3.538	3.338	-	-	2.2285	-
Pot Cap-1 Maneuver	235	456	-	-	822	-
Stage 1	508	-	-	-	-	-
Stage 2	653	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	231	455	-	-	822	-
Mov Cap-2 Maneuver	231	-	-	-	-	-
Stage 1	508	-	-	-	-	-
Stage 2	641	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	106.6	0	0.2
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	273	822	-
HCM Lane V/C Ratio	-	-	1.041	0.019	-
HCM Control Delay (s)	-	-	106.6	9.5	-
HCM Lane LOS	-	-	F	A	-
HCM 95th %tile Q(veh)	-	-	11	0.1	-

Intersection	
Intersection Delay, s/veh	221.9
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	100	255	65	650	850	5
Future Vol, veh/h	100	255	65	650	850	5
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles, %	0	0	1	1	1	1
Mvmt Flow	105	268	68	684	895	5
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	18.1	203.4	322
HCM LOS	C	F	F

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	9%	100%	0%	0%	0%
Vol Thru, %	91%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	715	100	255	850	5
LT Vol	65	100	0	0	0
Through Vol	650	0	0	850	0
RT Vol	0	0	255	0	5
Lane Flow Rate	753	105	268	895	5
Geometry Grp	4	7	7	7	7
Degree of Util (X)	1.376	0.237	0.514	1.66	0.009
Departure Headway (Hd)	7.422	9.469	8.203	7.144	6.423
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	497	382	443	519	561
Service Time	5.422	7.169	5.903	4.844	4.123
HCM Lane V/C Ratio	1.515	0.275	0.605	1.724	0.009
HCM Control Delay	203.4	15.1	19.3	323.8	9.2
HCM Lane LOS	F	C	C	F	A
HCM 95th-tile Q	30.9	0.9	2.9	48.1	0

HCM 6th Signalized Intersection Summary
13: Hwy 211 & US 26/Procter Blvd 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	55	1390	15	250	50	0	0	100	25
Future Volume (veh/h)	0	0	0	55	1390	15	250	50	0	0	100	25
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.99	1.00		1.00	1.00		0.99
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				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				58	1463	16	263	53	0	0	105	26
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				68	1811	21	441	612	0	0	473	117
Arrive On Green				0.55	0.55	0.55	0.58	0.58	0.00	0.00	0.35	0.35
Sat Flow, veh/h				124	3284	38	1289	1772	0	0	1369	339
Grp Volume(v), veh/h				805	0	732	263	53	0	0	0	131
Grp Sat Flow(s),veh/h/ln				1724	0	1723	1289	1772	0	0	0	1708
Q Serve(g_s), s				43.2	0.0	36.5	17.5	1.5	0.0	0.0	0.0	6.0
Cycle Q Clear(g_c), s				43.2	0.0	36.5	23.5	1.5	0.0	0.0	0.0	6.0
Prop In Lane				0.07		0.02	1.00		0.00	0.00		0.20
Lane Grp Cap(c), veh/h				950	0	950	441	612	0	0	0	590
V/C Ratio(X)				0.85	0.00	0.77	0.60	0.09	0.00	0.00	0.00	0.22
Avail Cap(c_a), veh/h				1003	0	1002	441	612	0	0	0	590
HCM Platoon Ratio				1.00	1.00	1.00	1.67	1.67	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.87	0.87	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				20.8	0.0	19.3	22.5	15.5	0.0	0.0	0.0	25.5
Incr Delay (d2), s/veh				9.2	0.0	6.0	5.1	0.2	0.0	0.0	0.0	0.1
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				19.1	0.0	15.7	5.1	0.6	0.0	0.0	0.0	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				30.0	0.0	25.3	27.6	15.8	0.0	0.0	0.0	25.7
LnGrp LOS				C	A	C	C	B	A	A	A	C
Approach Vol, veh/h					1537			316			131	
Approach Delay, s/veh					27.7			25.7			25.7	
Approach LOS					C			C			C	
Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				42.0		64.7		42.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				38.0		64.0		38.0				
Max Q Clear Time (g_c+I1), s				8.0		45.2		25.5				
Green Ext Time (p_c), s				0.4		15.4		1.1				
Intersection Summary												
HCM 6th Ctrl Delay			27.3									
HCM 6th LOS			C									

HCM 6th Signalized Intersection Summary
14: Hwy 211 & Pioneer Blvd 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	1320	520	0	0	0	0	225	295	85	70	0
Future Volume (veh/h)	80	1320	520	0	0	0	0	225	295	85	70	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	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
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	84	1389	0				0	237	311	89	74	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	107	1853					0	451	375	111	620	0
Arrive On Green	0.57	0.57	0.00				0.00	0.25	0.25	0.02	0.12	0.00
Sat Flow, veh/h	188	3258	1502				0	1772	1473	1647	1730	0
Grp Volume(v), veh/h	789	684	0				0	237	311	89	74	0
Grp Sat Flow(s),veh/h/ln	1763	1683	1502				0	1772	1473	1647	1730	0
Q Serve(g_s), s	38.4	32.5	0.0				0.0	12.7	21.9	5.9	4.2	0.0
Cycle Q Clear(g_c), s	38.4	32.5	0.0				0.0	12.7	21.9	5.9	4.2	0.0
Prop In Lane	0.11		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	1002	957					0	451	375	111	620	0
V/C Ratio(X)	0.79	0.71					0.00	0.53	0.83	0.80	0.12	0.00
Avail Cap(c_a), veh/h	1002	957					0	451	375	165	676	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	0.93	0.93	0.98	0.98	0.00
Uniform Delay (d), s/veh	18.5	17.2	0.0				0.0	35.3	38.7	53.0	33.0	0.0
Incr Delay (d2), s/veh	6.2	4.6	0.0				0.0	4.0	17.6	11.3	0.1	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	16.7	13.3	0.0				0.0	5.8	9.5	2.9	1.8	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	24.7	21.8	0.0				0.0	39.3	56.4	64.3	33.0	0.0
LnGrp LOS	C	C					A	D	E	E	C	A
Approach Vol, veh/h		1473	A					548			163	
Approach Delay, s/veh		23.4						49.0			50.1	
Approach LOS		C						D			D	

Timer - Assigned Phs		2		4			7	8				
Phs Duration (G+Y+Rc), s		66.6		43.4			11.4	32.0				
Change Period (Y+Rc), s		4.0		4.0			4.0	4.8				
Max Green Setting (Gmax), s		59.0		43.0			11.0	27.2				
Max Q Clear Time (g_c+I1), s		40.4		6.2			7.9	23.9				
Green Ext Time (p_c), s		14.8		0.2			0.0	0.7				

Intersection Summary		
HCM 6th Ctrl Delay		31.8
HCM 6th LOS		C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
15: Wolf Drive/SE Ten Eyck Rd & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	155	1365	130	10	1175	20	90	25	10	135	20	150
Future Volume (veh/h)	155	1365	130	10	1175	20	90	25	10	135	20	150
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	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	163	1437	137	11	1237	21	95	26	11	142	21	158
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, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	366	1887	841	192	1494	666	193	254	108	331	38	283
Arrive On Green	0.22	0.56	0.56	0.12	0.46	0.46	0.21	0.21	0.20	0.21	0.21	0.20
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	1259	1201	508	1399	178	1339
Grp Volume(v), veh/h	163	1437	137	11	1237	21	95	0	37	142	0	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1259	0	1709	1399	0	1517
Q Serve(g_s), s	9.2	36.0	4.9	0.7	36.7	0.9	8.1	0.0	1.9	10.1	0.0	11.7
Cycle Q Clear(g_c), s	9.2	36.0	4.9	0.7	36.7	0.9	19.8	0.0	1.9	12.0	0.0	11.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.88
Lane Grp Cap(c), veh/h	366	1887	841	192	1494	666	193	0	362	331	0	321
V/C Ratio(X)	0.44	0.76	0.16	0.06	0.83	0.03	0.49	0.00	0.10	0.43	0.00	0.56
Avail Cap(c_a), veh/h	366	2121	945	192	1640	732	203	0	376	342	0	334
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	37.3	18.5	11.7	43.0	25.8	16.1	48.1	0.0	35.1	40.2	0.0	39.4
Incr Delay (d2), s/veh	0.5	3.0	0.4	0.1	5.4	0.1	1.5	0.0	0.1	0.7	0.0	1.6
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	3.9	14.3	1.7	0.3	14.3	0.3	2.6	0.0	0.8	3.5	0.0	4.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	37.8	21.5	12.1	43.1	31.2	16.2	49.5	0.0	35.2	40.9	0.0	40.9
LnGrp LOS	D	C	B	D	C	B	D	A	D	D	A	D
Approach Vol, veh/h		1737			1269			132			321	
Approach Delay, s/veh		22.3			31.0			45.5			40.9	
Approach LOS		C			C			D			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	17.1	65.7		27.3	27.9	54.8		27.3				
Change Period (Y+Rc), s	4.5	4.0		5.5	4.5	4.0		5.5				
Max Green Setting (Gmax), s	4.0	69.3		22.7	17.5	55.8		22.7				
Max Q Clear Time (g_c+I1), s	2.7	38.0		14.0	11.2	38.7		21.8				
Green Ext Time (p_c), s	0.0	23.7		0.7	0.2	12.2		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		28.1
HCM 6th LOS		C

Intersection	
Int Delay, s/veh	5.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1390	100	110	1220	25	85
Future Vol, veh/h	1390	100	110	1220	25	85
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	1463	105	116	1284	26	89

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1568	0	2337	732
Stage 1	-	-	-	-	1463	-
Stage 2	-	-	-	-	874	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	398	-	32	368
Stage 1	-	-	-	-	183	-
Stage 2	-	-	-	-	373	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	398	-	~ 23	368
Mov Cap-2 Maneuver	-	-	-	-	~ 23	-
Stage 1	-	-	-	-	183	-
Stage 2	-	-	-	-	264	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	122.9
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	23	368	-	-	398	-
HCM Lane V/C Ratio	1.144	0.243	-	-	0.291	-
HCM Control Delay (s)	$ 479.7	17.9	-	-	17.7	-
HCM Lane LOS	F	C	-	-	C	-
HCM 95th %tile Q(veh)	3.4	0.9	-	-	1.2	-

Notes

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

HCM 6th Signalized Intersection Summary
17: Dubarko Ext/Vista Loop West & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	1350	5	100	1240	0	5	5	100	5	0	100
Future Volume (veh/h)	130	1350	5	100	1240	0	5	5	100	5	0	100
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	1758	1758	1772	1772	1716	1716	1772	1772	1772	1800	1723	1800
Adj Flow Rate, veh/h	137	1421	5	106	1305	0	5	5	105	5	0	105
Peak Hour Factor	0.95	0.95	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	177	2488	1119	136	2347	0	82	0	4	82	0	4
Arrive On Green	0.11	0.75	0.75	0.08	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1502	1688	3346	0	77	77	1614	78	0	1641
Grp Volume(v), veh/h	137	1421	5	106	1305	0	115	0	0	110	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1502	1688	1630	0	1768	0	0	1719	0	0
Q Serve(g_s), s	3.7	8.7	0.0	2.8	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	3.7	8.7	0.0	2.8	8.6	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.00	0.04		0.91	0.05		0.95
Lane Grp Cap(c), veh/h	177	2488	1119	136	2347	0	86	0	0	86	0	0
V/C Ratio(X)	0.77	0.57	0.00	0.78	0.56	0.00	1.34	0.00	0.00	1.28	0.00	0.00
Avail Cap(c_a), veh/h	656	5089	2288	551	4754	0	969	0	0	938	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	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	20.0	2.6	1.5	20.7	3.0	0.0	23.0	0.0	0.0	23.0	0.0	0.0
Incr Delay (d2), s/veh	5.3	0.4	0.0	6.9	0.4	0.0	166.7	0.0	0.0	141.6	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	1.4	0.2	0.0	1.1	0.1	0.0	4.8	0.0	0.0	4.2	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.3	3.0	1.5	27.6	3.4	0.0	189.7	0.0	0.0	164.6	0.0	0.0
LnGrp LOS	C	A	A	C	A	A	F	A	A	F	A	A
Approach Vol, veh/h		1563			1411			115			110	
Approach Delay, s/veh		5.0			5.3			189.7			164.6	
Approach LOS		A			A			F			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.9	37.1		0.0	7.7	38.2		0.0				
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0				
Max Green Setting (Gmax), s	18.0	67.0		23.0	15.0	70.0		23.0				
Max Q Clear Time (g_c+I1), s	5.7	10.6		0.0	4.8	10.7		0.0				
Green Ext Time (p_c), s	0.2	20.0		0.0	0.2	23.6		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			17.2									
HCM 6th LOS			B									

Intersection												
Int Delay, s/veh	21.3											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	1450	5	100	1335	25	5	5	100	10	0	0
Future Vol, veh/h	5	1450	5	100	1335	25	5	5	100	10	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	150	-	100	150	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	1526	5	105	1405	26	5	5	105	11	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1431	0	0	1531	0	0	2449	3177	763	2404	-	-
Stage 1	-	-	-	-	-	-	1536	1536	-	1628	-	-
Stage 2	-	-	-	-	-	-	913	1641	-	776	-	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	-	-
Pot Cap-1 Maneuver	471	-	-	431	-	-	16	10	347	17	0	0
Stage 1	-	-	-	-	-	-	121	176	-	106	0	0
Stage 2	-	-	-	-	-	-	294	156	-	356	0	0
Platoon blocked, %		-	-		-	-						-
Mov Cap-1 Maneuver	471	-	-	431	-	-	13	7	347	~ 4	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	13	7	-	~ 4	-	-
Stage 1	-	-	-	-	-	-	120	174	-	105	-	-
Stage 2	-	-	-	-	-	-	222	118	-	238	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	1.1	$ 357.9	$ 2367.8
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	79	471	-	-	431	-	-	4
HCM Lane V/C Ratio	1.466	0.011	-	-	0.244	-	-	2.632
HCM Control Delay (s)	$ 357.9	12.7	-	-	16	-		$ 2367.8
HCM Lane LOS	F	B	-	-	C	-	-	F
HCM 95th %tile Q(veh)	9.3	0	-	-	0.9	-	-	2.4

Notes

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

HCM 6th Signalized Intersection Summary
20: Hwy 211 & Dubarko Rd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	40	30	135	240	105	30	30	300	415	10	470	15
Future Volume (veh/h)	40	30	135	240	105	30	30	300	415	10	470	15
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		0.99
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	1800	1800	1800	1772	1772	1772	1772	1772	1772	1758	1758	1758
Adj Flow Rate, veh/h	42	32	142	253	111	32	32	316	437	11	495	16
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, %	0	0	0	2	2	2	2	2	2	3	3	3
Cap, veh/h	378	43	193	436	355	102	302	728	614	337	693	584
Arrive On Green	0.03	0.15	0.15	0.15	0.27	0.27	0.03	0.41	0.41	0.01	0.39	0.39
Sat Flow, veh/h	1714	288	1277	1688	1322	381	1688	1772	1494	1674	1758	1482
Grp Volume(v), veh/h	42	0	174	253	0	143	32	316	437	11	495	16
Grp Sat Flow(s),veh/h/ln	1714	0	1565	1688	0	1703	1688	1772	1494	1674	1758	1482
Q Serve(g_s), s	1.2	0.0	6.2	6.8	0.0	3.9	0.7	7.4	14.2	0.2	13.8	0.4
Cycle Q Clear(g_c), s	1.2	0.0	6.2	6.8	0.0	3.9	0.7	7.4	14.2	0.2	13.8	0.4
Prop In Lane	1.00		0.82	1.00		0.22	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	378	0	236	436	0	458	302	728	614	337	693	584
V/C Ratio(X)	0.11	0.00	0.74	0.58	0.00	0.31	0.11	0.43	0.71	0.03	0.71	0.03
Avail Cap(c_a), veh/h	438	0	565	499	0	820	371	1158	977	434	1149	969
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	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.8	0.0	23.6	15.7	0.0	17.0	12.1	12.3	14.3	11.2	14.8	10.8
Incr Delay (d2), s/veh	0.1	0.0	3.3	1.0	0.0	0.3	0.1	0.9	3.3	0.0	2.9	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	0.5	0.0	2.3	2.4	0.0	1.4	0.2	2.5	4.6	0.1	5.0	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.9	0.0	26.9	16.7	0.0	17.3	12.2	13.1	17.5	11.2	17.8	10.8
LnGrp LOS	B	A	C	B	A	B	B	B	B	B	B	B
Approach Vol, veh/h		216			396			785			522	
Approach Delay, s/veh		25.5			16.9			15.5			17.4	
Approach LOS		C			B			B			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	4.7	27.9	12.8	12.8	5.6	26.9	6.0	19.6
Change Period (Y+Rc), s	4.0	4.8	4.0	4.0	4.0	4.8	4.0	4.0
Max Green Setting (Gmax), s	4.0	37.2	11.0	21.0	4.0	37.2	4.0	28.0
Max Q Clear Time (g_c+I1), s	2.2	16.2	8.8	8.2	2.7	15.8	3.2	5.9
Green Ext Time (p_c), s	0.0	6.9	0.2	0.4	0.0	4.5	0.0	0.4

Intersection Summary			
HCM 6th Ctrl Delay			17.5
HCM 6th LOS			B

Intersection	
Int Delay, s/veh	1.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	740	60	210	615	0	15
Future Vol, veh/h	740	60	210	615	0	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	3	3	1	1	1	1
Mvmt Flow	779	63	221	647	0	16

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	842	0	-	811
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	4.11	-	-	6.21
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	2.209	-	-	3.309
Pot Cap-1 Maneuver	-	-	798	-	0	381
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	798	-	-	381
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.9	14.9
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	381	-	-	798	-
HCM Lane V/C Ratio	0.041	-	-	0.277	-
HCM Control Delay (s)	14.9	-	-	11.2	-
HCM Lane LOS	B	-	-	B	-
HCM 95th %tile Q(veh)	0.1	-	-	1.1	-

HCM 6th Signalized Intersection Summary
1: SE Jarl Road/SE Orient Drive & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	100	1525	5	5	745	165	25	40	10	245	20	30
Future Volume (veh/h)	100	1525	5	5	745	165	25	40	10	245	20	30
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	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	105	1605	5	5	784	0	26	42	11	258	21	32
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, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	145	1750	780	73	1583		32	52	14	303	25	38
Arrive On Green	0.09	0.52	0.52	0.04	0.48	0.00	0.07	0.06	0.07	0.22	0.22	0.22
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	507	818	214	1387	113	172
Grp Volume(v), veh/h	105	1605	5	5	784	0	79	0	0	311	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1540	0	0	1672	0	0
Q Serve(g_s), s	6.2	45.1	0.2	0.3	16.7	0.0	5.2	0.0	0.0	18.4	0.0	0.0
Cycle Q Clear(g_c), s	6.2	45.1	0.2	0.3	16.7	0.0	5.2	0.0	0.0	18.4	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.33		0.14	0.83		0.10
Lane Grp Cap(c), veh/h	145	1750	780	73	1583		97	0	0	365	0	0
V/C Ratio(X)	0.73	0.92	0.01	0.07	0.50		0.81	0.00	0.00	0.85	0.00	0.00
Avail Cap(c_a), veh/h	229	1765	787	73	1583		97	0	0	552	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	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	45.9	22.7	11.9	47.2	18.4	0.0	47.5	0.0	0.0	38.7	0.0	0.0
Incr Delay (d2), s/veh	4.2	8.4	0.0	0.2	0.5	0.0	36.8	0.0	0.0	8.1	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	2.6	17.0	0.1	0.1	5.7	0.0	3.0	0.0	0.0	8.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	50.1	31.1	11.9	47.5	18.9	0.0	84.3	0.0	0.0	46.7	0.0	0.0
LnGrp LOS	D	C	B	D	B		F	A	A	D	A	A
Approach Vol, veh/h		1715			789	A		79			311	
Approach Delay, s/veh		32.2			19.1			84.3			46.7	
Approach LOS		C			B			F			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	12.8	53.2		26.5	8.5	57.5		10.5
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5
Max Green Setting (Gmax), s	13.5	41.5		33.0	4.0	51.0		6.0
Max Q Clear Time (g_c+I1), s	8.2	18.7		20.4	2.3	47.1		7.2
Green Ext Time (p_c), s	0.1	7.3		1.1	0.0	3.5		0.0

Intersection Summary			
HCM 6th Ctrl Delay			31.6
HCM 6th LOS			C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	300	670	450	235	635	365	185	250	315	40	145	150
Future Volume (veh/h)	300	670	450	235	635	365	185	250	315	40	145	150
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	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	316	705	474	247	668	384	195	263	332	42	153	158
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, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	447	1461	1015	296	1306	750	761	402	343	203	214	181
Arrive On Green	0.13	0.43	0.43	0.18	0.79	0.76	0.23	0.23	0.23	0.12	0.12	0.12
Sat Flow, veh/h	1688	3367	1502	3222	3313	1502	3300	1772	1512	1688	1772	1502
Grp Volume(v), veh/h	316	705	474	247	668	384	195	263	332	42	153	158
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1611	1657	1502	1650	1772	1512	1688	1772	1502
Q Serve(g_s), s	14.2	19.5	19.4	9.6	9.3	13.3	6.3	17.5	28.3	2.9	10.8	13.4
Cycle Q Clear(g_c), s	14.2	19.5	19.4	9.6	9.3	13.3	6.3	17.5	28.3	2.9	10.8	13.4
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	447	1461	1015	296	1306	750	761	402	343	203	214	181
V/C Ratio(X)	0.71	0.48	0.47	0.83	0.51	0.51	0.26	0.65	0.97	0.21	0.72	0.87
Avail Cap(c_a), veh/h	614	1461	1015	397	1306	750	761	402	343	234	245	208
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.83	0.83	0.83	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.1	26.4	10.0	52.1	9.3	7.7	40.9	45.6	49.8	51.6	55.0	56.2
Incr Delay (d2), s/veh	1.8	1.1	1.5	8.0	1.2	2.1	0.1	3.3	39.8	0.4	7.4	27.6
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	5.3	7.6	11.8	3.8	2.5	3.5	2.6	8.0	14.3	1.3	5.3	6.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.9	27.5	11.5	60.1	10.5	9.7	41.0	48.9	89.6	51.9	62.4	83.7
LnGrp LOS	C	C	B	E	B	A	D	D	F	D	E	F
Approach Vol, veh/h		1495			1299			790			353	
Approach Delay, s/veh		21.0			19.7			64.1			70.7	
Approach LOS		C			B			E			E	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	15.9	60.4		19.7	21.1	55.2		34.0
Change Period (Y+Rc), s	4.0	6.0		4.0	4.0	6.0		4.5
Max Green Setting (Gmax), s	16.0	48.0		18.0	30.0	34.0		29.5
Max Q Clear Time (g_c+I1), s	11.6	21.5		15.4	16.2	15.3		30.3
Green Ext Time (p_c), s	0.3	15.5		0.2	0.9	15.8		0.0

Intersection Summary	
HCM 6th Ctrl Delay	33.7
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	965	10	55	920	50	190	25	145	220	45	135
Future Volume (vph)	50	965	10	55	920	50	190	25	145	220	45	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00	1.00	1.00		0.97	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.87		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	3313		1644	3358	1471	1693	1555		3317	1580	
Flt Permitted	0.24	1.00		0.21	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	422	3313		361	3358	1471	1693	1555		3317	1580	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	51	985	10	56	939	51	194	26	148	224	46	138
RTOR Reduction (vph)	0	0	0	0	0	22	0	126	0	0	98	0
Lane Group Flow (vph)	51	995	0	56	939	29	194	48	0	224	86	0
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						
Actuated Green, G (s)	77.3	72.6		76.1	72.0	72.0	19.2	19.2		16.7	16.7	
Effective Green, g (s)	78.3	74.0		76.1	73.4	73.4	20.2	19.2		16.7	16.7	
Actuated g/C Ratio	0.60	0.57		0.59	0.56	0.56	0.16	0.15		0.13	0.13	
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4	3.0	3.0		2.3	2.3	
Lane Grp Cap (vph)	304	1885		251	1895	830	263	229		426	202	
v/s Ratio Prot	0.01	c0.30		c0.01	0.28		c0.11	0.03		c0.07	0.05	
v/s Ratio Perm	0.09			0.12		0.02						
v/c Ratio	0.17	0.53		0.22	0.50	0.03	0.74	0.21		0.53	0.43	
Uniform Delay, d1	19.9	17.2		23.3	17.1	12.6	52.4	48.7		52.9	52.2	
Progression Factor	0.58	0.61		0.40	0.46	0.06	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.9		0.2	0.8	0.1	10.3	0.5		0.8	0.8	
Delay (s)	11.7	11.5		9.4	8.6	0.8	62.7	49.2		53.7	53.1	
Level of Service	B	B		A	A	A	E	D		D	D	
Approach Delay (s)		11.5			8.3			56.3			53.4	
Approach LOS		B			A			E			D	

Intersection Summary			
HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th Signalized Intersection Summary
5: Ruben Lane & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	1105	90	85	775	105	90	70	25	220	50	150
Future Volume (veh/h)	130	1105	90	85	775	105	90	70	25	220	50	150
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		0.99	1.00		0.99
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	1772	1772	1772	1744	1744	1744	1758	1758	1758	1800	1800	1800
Adj Flow Rate, veh/h	131	1116	0	86	783	106	91	71	25	222	51	152
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	4	4	4	3	3	3	0	0	0
Cap, veh/h	634	2049		279	1248	543	163	111	39	409	49	145
Arrive On Green	0.57	1.00	0.00	0.05	0.37	0.37	0.10	0.09	0.09	0.12	0.12	0.12
Sat Flow, veh/h	1688	3331	1502	1661	3383	1472	1674	1237	436	3326	395	1179
Grp Volume(v), veh/h	131	1116	0	86	783	106	91	0	96	222	0	203
Grp Sat Flow(s),veh/h/ln	1688	1666	1502	1661	1692	1472	1674	0	1673	1663	0	1574
Q Serve(g_s), s	0.0	0.0	0.0	4.7	24.7	6.4	6.7	0.0	7.2	8.2	0.0	16.0
Cycle Q Clear(g_c), s	0.0	0.0	0.0	4.7	24.7	6.4	6.7	0.0	7.2	8.2	0.0	16.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.26	1.00		0.75
Lane Grp Cap(c), veh/h	634	2049		279	1248	543	163	0	150	409	0	194
V/C Ratio(X)	0.21	0.54		0.31	0.63	0.20	0.56	0.00	0.64	0.54	0.00	1.05
Avail Cap(c_a), veh/h	634	2049		300	1379	600	476	0	463	409	0	194
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.00	0.87	0.87	0.87	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.1	0.0	0.0	29.6	33.7	27.9	56.0	0.0	57.2	53.6	0.0	57.0
Incr Delay (d2), s/veh	0.1	0.9	0.0	0.3	2.1	0.7	1.8	0.0	2.8	1.1	0.0	77.8
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	1.5	0.3	0.0	1.9	10.3	2.3	3.0	0.0	3.2	3.5	0.0	10.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	14.2	0.9	0.0	30.0	35.8	28.6	57.8	0.0	59.9	54.6	0.0	134.8
LnGrp LOS	B	A		C	D	C	E	A	E	D	A	F
Approach Vol, veh/h		1247	A		975			187			425	
Approach Delay, s/veh		2.3			34.5			58.9			92.9	
Approach LOS		A			C			E			F	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	10.4	84.0	20.0	42.4	52.0	15.7
Change Period (Y+Rc), s	4.0	* 5.4	4.0	* 5.4	* 5.4	4.0
Max Green Setting (Gmax), s	8.0	* 53	16.0	* 9	* 52	36.0
Max Q Clear Time (g_c+I1), s	6.7	2.0	18.0	2.0	26.7	9.2
Green Ext Time (p_c), s	0.0	43.3	0.0	0.2	19.8	0.6

Intersection Summary	
HCM 6th Ctrl Delay	30.7
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	1175	90	45	790	210	60	5	15	255	60	90
Future Volume (veh/h)	75	1175	90	45	790	210	60	5	15	255	60	90
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		0.97	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	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	77	1199	92	46	806	214	61	5	15	260	61	92
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	536	1282	570	425	1037	516	77	36	109	278	137	206
Arrive On Green	0.24	0.38	0.38	0.22	0.35	0.35	0.05	0.09	0.10	0.16	0.21	0.22
Sat Flow, veh/h	1688	3367	1498	1647	2941	1464	1701	384	1152	1701	641	967
Grp Volume(v), veh/h	77	1199	92	46	806	214	61	0	20	260	0	153
Grp Sat Flow(s),veh/h/ln	1688	1683	1498	1647	1470	1464	1701	0	1536	1701	0	1609
Q Serve(g_s), s	0.0	37.7	3.5	0.0	26.9	7.7	3.9	0.0	1.3	16.6	0.0	9.1
Cycle Q Clear(g_c), s	0.0	37.7	3.5	0.0	26.9	7.7	3.9	0.0	1.3	16.6	0.0	9.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.75	1.00		0.60
Lane Grp Cap(c), veh/h	536	1282	570	425	1037	516	77	0	146	278	0	342
V/C Ratio(X)	0.14	0.94	0.16	0.11	0.78	0.41	0.79	0.00	0.14	0.93	0.00	0.45
Avail Cap(c_a), veh/h	536	1285	572	425	1123	559	139	0	419	278	0	570
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)	0.79	0.79	0.79	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	27.0	32.7	13.9	33.8	31.7	10.9	52.0	0.0	45.5	45.4	0.0	37.5
Incr Delay (d2), s/veh	0.1	11.5	0.5	0.1	5.7	2.4	10.3	0.0	0.3	36.4	0.0	0.6
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	1.5	16.6	1.6	1.0	10.3	2.8	1.9	0.0	0.5	9.8	0.0	3.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	27.0	44.2	14.3	33.9	37.5	13.3	62.3	0.0	45.8	81.9	0.0	38.1
LnGrp LOS	C	D	B	C	D	B	E	A	D	F	A	D
Approach Vol, veh/h		1368			1066			81			413	
Approach Delay, s/veh		41.3			32.5			58.2			65.6	
Approach LOS		D			C			E			E	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	27.7	45.9	9.0	27.4	30.8	42.8	22.0	14.4				
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.0	4.0	4.0	4.5				
Max Green Setting (Gmax), s	4.0	41.2	9.0	38.5	4.0	42.0	18.0	29.5				
Max Q Clear Time (g_c+I1), s	2.0	39.7	5.9	11.1	2.0	28.9	18.6	3.3				
Green Ext Time (p_c), s	0.0	1.4	0.0	0.6	0.0	9.9	0.0	0.0				
Intersection Summary												
HCM 6th Ctrl Delay			42.0									
HCM 6th LOS			D									

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	280	705	15	395	50	0	0	35	5
Future Volume (veh/h)	0	0	0	280	705	15	395	50	0	0	35	5
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.98	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				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				295	742	16	416	53	0	0	37	5
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				357	956	21	734	870	0	0	750	101
Arrive On Green				0.39	0.39	0.39	0.82	0.82	0.00	0.00	0.49	0.49
Sat Flow, veh/h				910	2439	54	1398	1772	0	0	1527	206
Grp Volume(v), veh/h				546	0	507	416	53	0	0	0	42
Grp Sat Flow(s),veh/h/ln				1684	0	1719	1398	1772	0	0	0	1734
Q Serve(g_s), s				32.1	0.0	28.0	13.1	0.6	0.0	0.0	0.0	1.4
Cycle Q Clear(g_c), s				32.1	0.0	28.0	14.5	0.6	0.0	0.0	0.0	1.4
Prop In Lane				0.54		0.03	1.00		0.00	0.00		0.12
Lane Grp Cap(c), veh/h				660	0	674	734	870	0	0	0	851
V/C Ratio(X)				0.83	0.00	0.75	0.57	0.06	0.00	0.00	0.00	0.05
Avail Cap(c_a), veh/h				735	0	750	734	870	0	0	0	851
HCM Platoon Ratio				1.00	1.00	1.00	1.67	1.67	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.86	0.86	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				30.1	0.0	28.8	6.6	5.1	0.0	0.0	0.0	14.6
Incr Delay (d2), s/veh				11.4	0.0	7.6	2.7	0.1	0.0	0.0	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				14.9	0.0	12.9	2.7	0.3	0.0	0.0	0.0	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				41.5	0.0	36.4	9.4	5.2	0.0	0.0	0.0	14.6
LnGrp LOS				D	A	D	A	A	A	A	A	B
Approach Vol, veh/h					1053			469			42	
Approach Delay, s/veh					39.0			8.9			14.6	
Approach LOS					D			A			B	
Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				58.0		47.1		58.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				54.0		48.0		54.0				
Max Q Clear Time (g_c+I1), s				3.4		34.1		16.5				
Green Ext Time (p_c), s				0.1		9.0		2.2				
Intersection Summary												
HCM 6th Ctrl Delay			29.3									
HCM 6th LOS			C									

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	850	520	0	0	0	0	360	270	15	300	0
Future Volume (veh/h)	85	850	520	0	0	0	0	360	270	15	300	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		0.99	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	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	89	895	0				0	379	284	16	316	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	153	1613					0	644	539	23	716	0
Arrive On Green	0.51	0.51	0.00				0.00	0.36	0.36	0.00	0.14	0.00
Sat Flow, veh/h	297	3143	1502				0	1772	1482	1647	1730	0
Grp Volume(v), veh/h	526	458	0				0	379	284	16	316	0
Grp Sat Flow(s),veh/h/ln	1757	1683	1502				0	1772	1482	1647	1730	0
Q Serve(g_s), s	22.9	20.0	0.0				0.0	19.0	16.6	1.1	18.5	0.0
Cycle Q Clear(g_c), s	22.9	20.0	0.0				0.0	19.0	16.6	1.1	18.5	0.0
Prop In Lane	0.17		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	902	864					0	644	539	23	716	0
V/C Ratio(X)	0.58	0.53					0.00	0.59	0.53	0.69	0.44	0.00
Avail Cap(c_a), veh/h	902	864					0	644	539	60	755	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	18.6	17.9	0.0				0.0	28.3	27.6	54.5	35.8	0.0
Incr Delay (d2), s/veh	2.8	2.3	0.0				0.0	3.9	3.7	20.0	0.3	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	9.8	8.2	0.0				0.0	8.4	6.2	0.6	8.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.3	20.2	0.0				0.0	32.2	31.2	74.5	36.1	0.0
LnGrp LOS	C	C					A	C	C	E	D	A
Approach Vol, veh/h		984	A					663			332	
Approach Delay, s/veh		20.8						31.8			37.9	
Approach LOS		C						C			D	

Timer - Assigned Phs		2		4			7	8				
Phs Duration (G+Y+Rc), s		60.5		49.5			5.5	44.0				
Change Period (Y+Rc), s		4.0		4.0			4.0	4.8				
Max Green Setting (Gmax), s		54.0		48.0			4.0	39.2				
Max Q Clear Time (g_c+I1), s		24.9		20.5			3.1	21.0				
Green Ext Time (p_c), s		13.6		0.9			0.0	2.0				

Intersection Summary			
HCM 6th Ctrl Delay			27.4
HCM 6th LOS			C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	190	850	150	10	750	20	100	25	10	50	20	150
Future Volume (veh/h)	190	850	150	10	750	20	100	25	10	50	20	150
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	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	200	895	158	11	789	21	105	26	11	53	21	158
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, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	599	2196	979	24	1025	457	203	263	111	341	39	293
Arrive On Green	0.35	0.65	0.65	0.01	0.32	0.32	0.21	0.22	0.21	0.21	0.22	0.21
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	1259	1201	508	1399	178	1339
Grp Volume(v), veh/h	200	895	158	11	789	21	105	0	37	53	0	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1259	0	1709	1399	0	1517
Q Serve(g_s), s	9.5	13.8	4.5	0.7	24.3	1.1	8.9	0.0	1.9	3.5	0.0	11.6
Cycle Q Clear(g_c), s	9.5	13.8	4.5	0.7	24.3	1.1	20.5	0.0	1.9	5.4	0.0	11.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.88
Lane Grp Cap(c), veh/h	599	2196	979	24	1025	457	203	0	374	341	0	332
V/C Ratio(X)	0.33	0.41	0.16	0.45	0.77	0.05	0.52	0.00	0.10	0.16	0.00	0.54
Avail Cap(c_a), veh/h	599	2196	979	74	1323	590	236	0	419	378	0	372
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	26.0	9.1	7.4	53.7	33.9	26.0	47.6	0.0	34.5	36.8	0.0	38.6
Incr Delay (d2), s/veh	0.2	0.6	0.4	7.9	5.6	0.2	1.5	0.0	0.1	0.2	0.0	1.0
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	3.9	5.0	1.5	0.3	10.0	0.4	2.9	0.0	0.8	1.2	0.0	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	26.2	9.6	7.8	61.7	39.5	26.2	49.1	0.0	34.5	37.0	0.0	39.7
LnGrp LOS	C	A	A	E	D	C	D	A	C	D	A	D
Approach Vol, veh/h		1253			821			142			232	
Approach Delay, s/veh		12.0			39.5			45.3			39.0	
Approach LOS		B			D			D			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.6	76.3		28.1	43.0	38.9		28.1				
Change Period (Y+Rc), s	4.5	* 4.5		5.5	4.5	4.0		5.5				
Max Green Setting (Gmax), s	4.5	* 66		25.5	25.5	45.0		25.5				
Max Q Clear Time (g_c+I1), s	2.7	15.8		13.6	11.5	26.3		22.5				
Green Ext Time (p_c), s	0.0	19.2		0.6	0.4	8.6		0.1				
Intersection Summary												
HCM 6th Ctrl Delay			25.7									
HCM 6th LOS			C									

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection						
Int Delay, s/veh	0.9					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	740	150	35	800	25	40
Future Vol, veh/h	740	150	35	800	25	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	779	158	37	842	26	42

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	937	0	1274	390
Stage 1	-	-	-	-	779	-
Stage 2	-	-	-	-	495	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	703	-	162	614
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	584	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	703	-	153	614
Mov Cap-2 Maneuver	-	-	-	-	153	-
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	553	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	19.8
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	153	614	-	-	703	-
HCM Lane V/C Ratio	0.172	0.069	-	-	0.052	-
HCM Control Delay (s)	33.4	11.3	-	-	10.4	-
HCM Lane LOS	D	B	-	-	B	-
HCM 95th %tile Q(veh)	0.6	0.2	-	-	0.2	-

HCM 6th Signalized Intersection Summary
17: Dubarko Ext/Vista Loop West & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	145	630	5	100	745	5	5	5	5	25	0	110
Future Volume (veh/h)	145	630	5	100	745	5	5	5	5	25	0	110
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	1758	1758	1772	1772	1716	1716	1772	1772	1772	1800	1723	1800
Adj Flow Rate, veh/h	153	663	5	106	784	5	5	5	5	26	0	116
Peak Hour Factor	0.95	0.95	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	678	1754	789	704	1662	11	235	3	3	207	0	7
Arrive On Green	0.11	0.53	0.53	0.09	0.50	0.36	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1502	1688	3321	21	581	581	581	313	0	1395
Grp Volume(v), veh/h	153	663	5	106	385	404	15	0	0	142	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1502	1688	1630	1712	1743	0	0	1707	0	0
Q Serve(g_s), s	1.1	2.4	0.0	0.8	3.2	3.2	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	1.1	2.4	0.0	0.8	3.2	3.2	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.01	0.33		0.33	0.18		0.82
Lane Grp Cap(c), veh/h	678	1754	789	704	816	857	240	0	0	214	0	0
V/C Ratio(X)	0.23	0.38	0.01	0.15	0.47	0.47	0.06	0.00	0.00	0.66	0.00	0.00
Avail Cap(c_a), veh/h	2187	10812	4861	1697	4725	4963	2496	0	0	2385	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	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	3.5	2.9	2.3	3.5	3.4	3.4	10.4	0.0	0.0	10.4	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.1	0.0	0.1	0.3	0.3	0.1	0.0	0.0	2.6	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	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.6	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	3.7	3.0	2.3	3.6	3.7	3.7	10.5	0.0	0.0	13.0	0.0	0.0
LnGrp LOS	A	A	A	A	A	A	B	A	A	B	A	A
Approach Vol, veh/h		821			895			15			142	
Approach Delay, s/veh		3.1			3.7			10.5			13.0	
Approach LOS		A			A			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.3	14.4		0.0	5.8	14.9		0.0				
Change Period (Y+Rc), s	4.0	7.0		4.0	4.0	7.0		4.0				
Max Green Setting (Gmax), s	21.0	57.0		27.0	14.0	64.0		27.0				
Max Q Clear Time (g_c+I1), s	3.1	5.2		0.0	2.8	4.4		0.0				
Green Ext Time (p_c), s	0.3	2.2		0.0	0.2	2.2		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			4.2									
HCM 6th LOS			A									

HCM 6th TWSC
18: US 26 & Vista Loop East

06/28/2021

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	650	5	100	840	50	5	5	5	10	0	0
Future Vol, veh/h	5	650	5	100	840	50	5	5	5	10	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	150	-	100	150	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	684	5	105	884	53	5	5	5	11	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	937	0	0	689	0	0	1346	1841	342	1476	-	-
Stage 1	-	-	-	-	-	-	694	694	-	1121	-	-
Stage 2	-	-	-	-	-	-	652	1147	-	355	-	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	-	-
Pot Cap-1 Maneuver	727	-	-	901	-	-	110	74	654	88	0	0
Stage 1	-	-	-	-	-	-	399	442	-	220	0	0
Stage 2	-	-	-	-	-	-	423	272	-	635	0	0
Platoon blocked, %		-	-		-	-						-
Mov Cap-1 Maneuver	727	-	-	901	-	-	100	65	654	74	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	100	65	-	74	-	-
Stage 1	-	-	-	-	-	-	396	439	-	218	-	-
Stage 2	-	-	-	-	-	-	374	240	-	618	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	1	42.7	61.6
HCM LOS			E	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	111	727	-	-	901	-	-	74
HCM Lane V/C Ratio	0.142	0.007	-	-	0.117	-	-	0.142
HCM Control Delay (s)	42.7	10	-	-	9.5	-	-	61.6
HCM Lane LOS	E	A	-	-	A	-	-	F
HCM 95th %tile Q(veh)	0.5	0	-	-	0.4	-	-	0.5

SECTION 3. BENEFIT COST ANALYSIS MEMO

DRAFT TECHNICAL MEMORANDUM

DATE: July 26, 2021

TO: Project Management Team

FROM: Reah Flisakowski, Dock Rosenthal | DKS Associates
Chris Beatty, Jeff Elston | HHPR
Joel Ainsworth | ECONOrthwest
Darci Rudzinski | APG

SUBJECT: Sandy Bypass Feasibility Reevaluation – Benefit Cost Analysis P# 20020-007

This memorandum presents the benefit cost analysis that was conducted to support the reevaluation of the US 26 bypass project that is identified in the 2011 Sandy Transportation System Plan (TSP). The goal of the analysis is to provide a planning-level assessment of the potential benefits and costs associated with the bypass using measures of performance related to the value of travel time, safety, and local businesses. The Sandy TSP is currently being updated and will incorporate the findings and recommendations from this assessment when developing the motor vehicle project list and priorities.

The following sections present the US 26 preferred conceptual alignment and the benefit cost analysis for value of time, safety, and local businesses.

PREFERRED CONCEPTUAL ALIGNMENT

To support the benefit cost analysis, a conceptual alignment (10% design) and planning-level cost estimate was developed for the bypass. The US 26 bypass conceptual alignment developed for the 2011 Sandy TSP was refined based on updated future traffic operations and more detailed design considerations for topography, environmental constraints, and freeway design standards.

The conceptual alignment for the bypass is shown in Figure 1 and Appendix Section 1. The bypass features and design parameters are summarized below.

- The facility would be located south of the Sandy Urban Growth Boundary and approximately 5.8 miles long.
- The west end of the bypass would connect to US 26 approximately 2,400 feet west of Orient Drive. The new intersection on US 26 would be an interchange configuration.
- The east end of the bypass would connect to US 26 at Firwood Road (Shorty's Corner). The existing intersection would be converted to an interchange configuration.
- The new bypass intersection with OR 211 would be an interchange configuration.
- The bypass facility would provide a grade separated overcrossing at 362nd Drive.

- The facility would provide a 120-foot-wide right-of-way to accommodate four travel lanes (two each direction), raised median, shoulder area, lighting, trees and public utility easement.

FIGURE 1: US 26 BYPASS CONCEPTUAL ALIGNMENT

The primary purpose of the bypass is to serve regional traffic demand that currently travels on US 26 through Sandy. The interchanges at each end of the bypass and OR 211 would provide the primary access to the bypass. The rest of the facility would be limited to right-in/right-out access at key intersections to reduce conflicts and provide reliable free-flow traffic operations. The remaining streets that intersect the bypass conceptual alignment would be closed and an alternative street network would be provided. The conceptual alignment and potential network changes are shown in Appendix Section 1.

A cost estimate was prepared based on the 10% design concept for the bypass shown in Figure 1. The total cost estimate accounts for construction, utility and slope easements, right-of-way acquisition and professional services to administer design and construction management. The cost estimate is approximately $365 to $390 million in current year 2021 dollars. The detailed cost estimate is shown in Appendix Section 2. The cost estimate when adjusted for inflation to represent year 2040 is approximately $980 million to $1 billion. Construction in 2040 is the soonest the bypass could reasonably be built due to magnitude of the project related to regulatory and funding challenges.

VALUE OF TIME IN TRAVEL

To identify potential benefits and costs associated with the US 26 bypass, a traffic analysis was conducted to provide a comparison of the future network improvement alternatives listed below. The supporting transportation data, analysis, and findings used for this benefit cost analysis are documented in the Future Transportation System Performance memo[1] in the Appendix Section 3. This includes a detailed description of the projects and improvements included in each alternative.

- 2040 No Build Alternative includes the extension of Dubarko Road to SE Vista Loop Drive (west).
- 2040 Alternative #1 includes a significant investment in local enhancements and minor improvements to US 26.
- 2040 Alternative #3 adds the US 26 bypass to Alternative #1.

The US 26 bypass is expected to serve a moderate future volume and improve traffic flow on US 26 through Sandy. It was estimated that approximately 1,500 vehicles per hour would use the bypass during the peak hour in year 2040. Approximately 60% of the bypass users during the peak hour would be through traffic with no origin or destination in Sandy, while the other 40% would be comprised of local trips accessing the south portion of Sandy.

As an additional measure for evaluating the effectiveness of each alternative, travel times along US 26 through the study area were estimated. Table 1 shows the travel time estimates for each alternative. Improvements in travel times among the alternatives are generally consistent with the improvements shown for intersection operations, with the provision of a bypass in Alternative #3 resulting in moderate reductions in through travel time.

TABLE 1: ESTIMATED US 26 CORRIDOR TRAVEL TIMES (PEAK HOUR)

ALTERNATIVE		TRAVEL TIME EASTBOUND (MM:SS)	TRAVEL TIME WESTBOUND (MM:SS)
2020 EXISTING		09:35	09:55
2040 NO BUILD		16:50	14:25
2040 ALTERNATIVE #1		13:20	10:15
2040 ALTERNATIVE #3	TRAVEL ON US 26 FACILITY	08:55	10:20
	TRAVEL ON BYPASS FACILITY	07:55	07:55

[1] Future Transportation System Performance memo, DKS Associates, June 28, 2021.

The future year 2040 travel time estimates developed for the No Build, Alternative #1, and Alternative #3 were used to evaluate potential future travel time benefits. With the bypass facility, year 2040 travel times through Sandy would result in the travel time savings shown in Table 2.

TABLE 2: ESTIMATED US 26 CORRIDOR TRAVEL TIMES SAVINGS (PEAK HOUR)

ALTERNATIVES COMPARED	TRAVEL TIME SAVINGS EASTBOUND (MM:SS)	TRAVEL TIME SAVINGS WESTBOUND (MM:SS)
2040 NO BUILD TO ALTERNATIVE #3	- 8:55	- 6:30
2040 ALTERNATIVE #1 TO ALTERNATIVE #3	- 5:25	- 2:20

The value of time in travel savings (VTTS) was estimated to measure a potential benefit of the bypass. The Benefit-Cost Analysis Guidelines for Discretionary Grant Programs[2] was the source for the value of travel time savings (cost per person hour) and average vehicle occupancy inputs in the calculations. Detailed assumptions are provided in Appendix Section 4.

The total VTTS was estimated at $19.21 per person hour for travel along US 26. This value was adjusted to reflect a slightly higher VTTS than the national average based on slightly higher household income and employee compensation in the City of Sandy and the Portland-Vancouver-Hillsboro metropolitan area. The VTTS for commercial traffic was estimated at $32.19 per person hour. This is consistent with the national rates recommended and scaled to 2021 dollars.

Based on the travel time savings between Alternative #1 and Alternative #3 shown in Table 2, the hourly benefit during the 2040 peak hour is approximately $1,900. If this benefit is realized for one hour every weekday, the annual benefit is estimated at $500,000 per year. If the benefit is realized for 6 hours every weekday, the annual benefit is estimate at $3,000,000 per year. If this time savings benefit can be sustained for 20 years at an interest rate of 5%, the net present value of the benefit is approximately $37.4 million.

Comparing No Build and Alternative #3, the hourly benefit during the 2040 peak hour is approximately $3,700. If this benefit is realized for one hour every weekday, the annual benefit is estimated at $1,000,000 per year. If the benefit is realized for 6 hours every weekday, the annual benefit is estimate at $6,000,000 per year. If this time savings benefit can be sustained for 20 years at an interest rate of 5%, the net present value of the benefit is approximately $74.8 million.

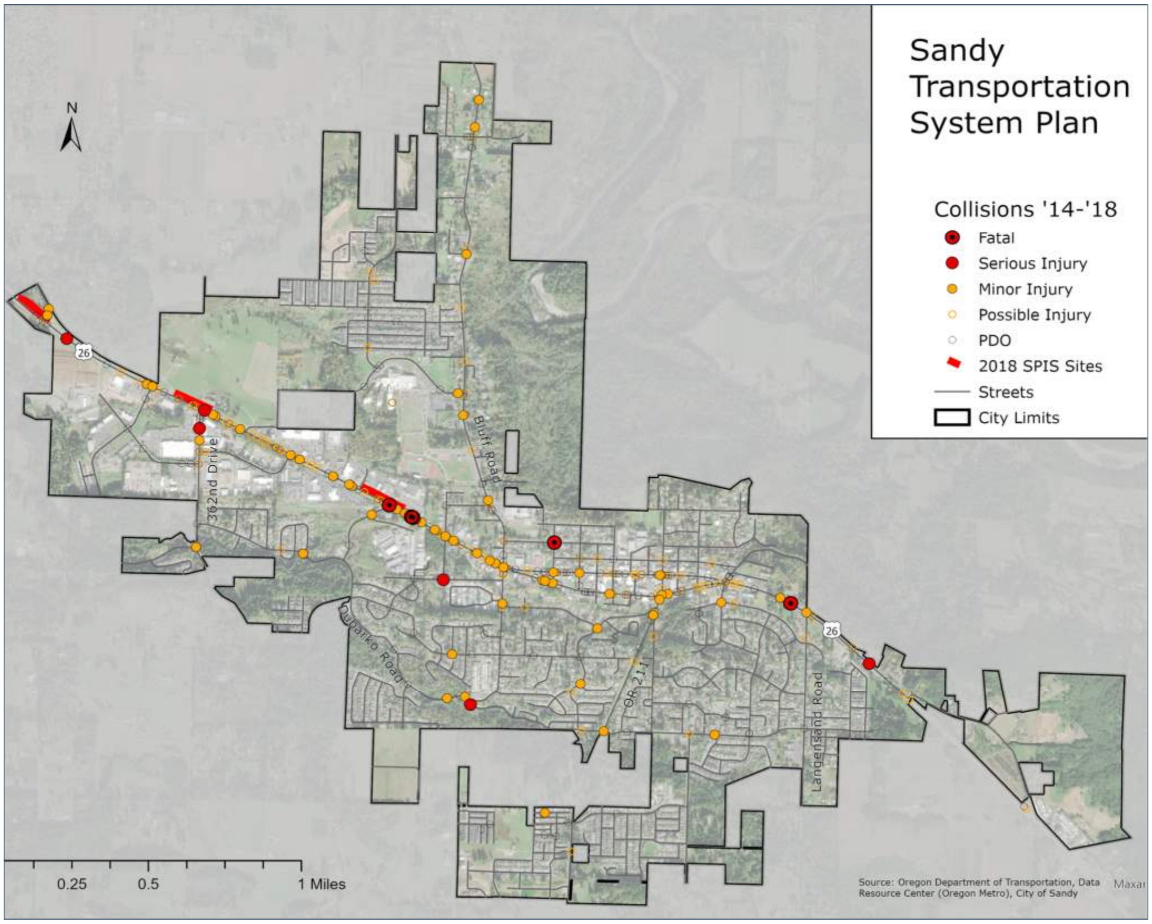
[2] Benefit-Cost Analysis Guidelines for Discretionary Grant Programs, USDOT, December 2018.

SAFETY ANALYSIS

COLLISION DATA

A safety analysis was conducted for US 26 between the end points of the bypass conceptual alignment. The most recent five years of available collision data, 2014 to 2018, was reviewed to document the severity of collisions and calculate the crash rate. The collision data compiled for the Sandy TSP Update is shown in Figure 2 and includes the US 26 safety data used for this analysis.

FIGURE 2: SANDY SAFETY ASSESSMENT – 2014 TO 2018



The crash records were summarized by study intersection for intersection-related crashes in Table 2 and non-intersection related crashes by study segments are summarized in Table 3. In total, the study corridor experienced 338 crashes over the five-year study period, including four fatal crashes and five serious injury crashes. The following key findings are summarized below all 338 crashes:

- All four fatal crashes involved a driver under the influence of alcohol or drugs.

- Three of the four crashes involved a pedestrian fatality.
- Two fatal crashes occurred in front of the Safeway along US 26 between Ruben Ln and Industrial Way.

- The most common crash type was rear-end crashes (53%) and the top contributing factor was failure to avoid (34%).
- The study intersection of 362nd Dr and US 26 reported the highest number of crashes and the highest crash rate. Whereas the intersection of US 26 and Ruben Ln experienced the highest number of high severity crashes (one fatal and two serious injury crashes).
- The study segment between Ruben Ln and Bluff Rd experienced the highest number of crashes and the highest crash rate, including two fatal crashes.
- One in four crashes occurred on wet road surface conditions.

TABLE 2: US 26 INTERSECTION COLLISION DATA (2014 TO 2018)

STUDY INTERSECTION	FATAL	INJURY	PROPERTY DAMAGE ONLY	TOTAL[A]	CRASH RATE [B]
ORIENT DR/US 26	0	1	2	3	0.053
362ND DR/US 26	0	25	10	35	0.566
INDUSTRIAL WAY/ US 26	0	6	5	11	0.201
RUBEN LN/US 26	1	13	4	18	0.309
BLUFF RD/US 26	0	9	10	19	0.311
MEINIG AVE (OR 211)/PROCTER BLVD (US 26)	0	4	6	10	0.391
MEINIG AVE (OR 211)/PIONEER BLVD (US 26)	0	6	5	11	0.290
TEN EYCK RD/US 26	0	7	5	12	0.293
LANGENSAND RD/US 26	0	4	2	6	0.182
VISTA LOOP DR W/US 26	0	0	0	0	0
VISTA LOOP DR E/US 26	0	0	0	0	0

[A] Intersection crashes were filtered to crashes that were only intersection related.
[B] Crash rate is calculated based on FHWA intersection crash rate calculation: https://safety.fhwa.dot.gov/local_rural/training/fhwasa1210/s3.cfm

Overall, the 11 study intersections experienced a total of 125 crashes, including one fatal crash and three serious injury crashes. The following key findings for 125 intersection related crashes are summarized below:

- One fatal crash occurred at the intersection of Ruben Ln and US 26 that involved a driver, who was reported under the influence of alcohol, driving westbound along US 26 and disregarded the traffic signal and hit a pedestrian crossing the crosswalk.

- Two of the three serious injury crashes involved a vehicle making a turning movement from the westbound approach at Ruben Ln and US 26.
- 362nd Dr and US 26 intersection reported the highest number of crashes and the highest crash rate compared to the other study intersection.
- The top three collision types reported at the study intersections were rear-end (49%), turning (35%), and pedestrian related (6%).
- The top three contributing circumstances were reported failure to avoid (36%), failure to yield (24%), and disregarding the signal (8%).
- 31% of crashes were reported on wet road surface conditions.

TABLE 3: US 26 SEGMENT COLLISION DATA (2014 TO 2018)

HIGHWAY SEGMENT	LENGTH (MILES)	FATAL	INJURY	PROPERTY DAMAGE ONLY	TOTAL	CRASH RATE[A]
1000 FEET WEST OF ORIENT DR – ORIENT DR	0.189	0	0	1	1	9.676
ORIENT DR – 362ND DR	0.602	0	10	9	19	66.104
362ND DR – INDUSTRIAL WAY	0.326	0	19	4	23	141.466
INDUSTRIAL WAY – RUBEN LN	0.368	0	18	9	27	139.838
RUBEN LN – BLUFF RD	0.421	2	39	20	61	283.660
BLUFF RD – MEINIG AVE (OR 211) ON PIONEER BLVD	0.526	0	7	13	20	119.152
BLUFF RD – MEINIG AVE (OR 211) ON PROCTOR BLVD	0.523	0	8	19	27	206.289
MEINIG AVE (OR 211) – TEN EYCK RD ON PIONEER BLVD	0.215	0	5	5	10	174.438
MEINIG AVE (OR 211) – TEN EYCK RD ON PROCTOR BLVD	0.204	0	2	5	7	161.571
TEN EYCK RD – LANGENSAND RD	0.292	1	4	1	6	56.007
LANGENSAND RD – VISTA LOOP DR EAST	1.030	0	6	6	12	24.366
VISTA LOOP DR EAST – SE LUZON LN	0.188	0	0	0	0	45.903

[A] Crash rate is calculated based on FHWA road segment crash rate calculation: https://safety.fhwa.dot.gov/local_rural/training/fhwasa1210/s3.cfm

Overall, the study corridor experienced a total of 213 crashes that were non-intersection related, including three fatal crashes and two serious injury crashes. The following key findings for 213 segment crashes are summarized below:

- Three fatal crashes occurred over the five-year study period:
  - Two fatal crashes occurred along US 26, between Ruben Lane and Industrial Way, including one pedestrian fatality. Both of these crashes involved a driver reportedly under the influence of drugs.
  - The other fatal crash involved a driver, who was reported under the influence of alcohol and drugs, hit a pedestrian walking eastbound along the shoulder of US 26, between Ten Eyck Rd and Langensand Rd, where there is no sidewalk present.
- The segment along US 26 between Ruben Lane and Bluff Road reported the highest number of crashes and the highest crash rate compared to the other segments.
- The top three collision types reported for segments were rear-end (56%), turning (16%), and sideswipe (13%).
- The top three contributing circumstances were reported failure to avoid (32%), failure to yield (16%), and following too close (14%).
- One in five crashes were reported on wet road surface conditions.
- Eight crashes (4%) reported a driver under the influence of alcohol or drugs, including three fatal crashes and four injury crashes.

BYPASS SAFETY EVALUATION

By rerouting traffic around the main corridor of cities, highway bypasses can provide several direct transportation benefits, including improved roadway safety. A high-level safety evaluation of US 26 was conducted to identify potential safety benefits from the bypass. The evaluation included a review of literature and outcomes from bypass facilities as follows:

California Bypass Study (2006)[3]

This report summarizes the impacts of bypasses for local communities by presenting case studies of bypasses throughout the United States. Based on the case studies found in this report, constructing bypasses can improve traffic safety by reducing the number of conflict points between trucks, automobiles, motorcycles, bicyclists, and pedestrians. In particular, bypasses can divert freight traffic away from downtown areas, and it can improve travel times for goods to be moved between areas. Bypasses can also improve the perception of safety by addressing concerns related to truck traffic, improve local downtown circulation and reduce the idling noise in urban areas. The

[3] Caltrans California Bypass Study (2006): https://rosap.ntl.bts.gov/view/dot/27518

report also summarized case studies of bypasses in other states, such as Iowa, where the bypass increased local business sales "due to local residents taking advantage of easier access to downtown businesses as a result of less traffic congestion, improved traffic safety and easier parking".

New Roads and Human Health: A Systemic Review (2003)[4]

This journal article conducted a review of 32 different before-and-after bypass studies worldwide and their safety impacts. The research compared the number of injury accidents on the main road through town in the "before" period and the number of injury accidents in the "after" period for both the main road and the new bypass. In particular, a Norway case study conducted a meta-analysis of 20 bypasses that observed a 19% decrease in injury accidents on average. Overall, the bypass studies showed a general decline in the number of injury accidents after the opening of the new bypass facilities.

A Bayesian Assessment of the Effect of Highway Bypasses in Iowa on Crashes and Crash Rate (2011)[5]

This journal article assessed the impact of highway bypasses in the state of Iowa. The study evaluated several years before and after the construction of a bypass for 19 sites and compared them to 6 other "non-treatment" sites. The "non-treatment" sites were six cities that were scheduled to be bypassed but had not started construction prior to the study completion. The research results indicated the construction of the bypasses resulted in improved safety with a reduction of the number of crashes on both the old and new (bypass) road networks considered in the study. On average, the crash frequencies "were reduced by 50% on the old road network and 62% on the new road network". Also, the "crash rates on average were reduced 33% on the old road network and 59% on the new road network". Overall, the study concluded that the bypass construction increased traffic safety by reducing the number of crashes.

SAFETY BENEFITS

It is estimated the construction of the US 26 bypass in Alternative #3 would moderately improve safety on US 26 between Orient Drive and Firwood Road. Based on the literature review, it is likely that the number of crashes on US 26 through Sandy will be reduced if proper safety measures are implemented for the bypass construction. In particular, appropriate wayfinding signage and speed limit setting for both the main road and the new bypass should be planned thoughtfully for both local residents and regional travelers. Also, ensuring effective collaboration and consultation with relevant stakeholders, such as law enforcement, will ensure the continued safety for local residents and travelers on both routes. Furthermore, the City of Sandy should consider some educational

[4] Eagan, M., M. Petticrew, D. Ogilvie, V. Hamilton. 2003. American Journal of Public Health: https://ajph.aphapublications.org/doi/full/10.2105/AJPH.93.9.1463

[5] Lorenzo G. Cena, Nir Keren, Wen Li, Alicia L. Carriquiry, Michael D. Pawlovich, & Steven A. Freeman. (2011). *Journal of Safety Research*: https://doi.org/10.1016/j.jsr.2011.05.007

outreach efforts to inform local residents of how to safely traverse interchanges (merging, diverging and ramps) and to prevent driving under the influence of drugs/alcohol to reduce fatalities.

Overall, the bypass is expected to reduce the number of conflict points and avoid vulnerable travelers (i.e. pedestrians and bicyclists) by rerouting traffic away from the commercial and downtown areas.

BENEFITS OR IMPACTS TO LOCAL BUSINESSES

To establish a baseline understanding of the potential effect of highway bypasses on communities similar to Sandy, available economic literature was reviewed and summarized in the following sections. This information is intended to inform the range of potential benefits or impacts to local businesses from the estimated reduction in vehicle trips on US 26 through Sandy.

CHARACTERISTICS OF BYPASSES

Bypasses arise out of a need to correct safety and traffic concerns for state highways that are serving as both a regional highway and main street by diverting traffic away from a downtown or urban area and providing alternative routes for through traffic. Ideally, this has the potential to improve local access to goods and services for residents and visitors by decreasing traffic delays.[6] Bypasses can be used to enhance quality of life (e.g., less noise and air pollution), add roadway capacity for existing or anticipated traffic needs, and upgrade existing roadway conditions.[7]

When urban activities become more centered around highways, highways may be unable to efficiently serve the community and are instead used for local trips—as opposed to through traffic. Downtown areas need parking access for businesses and safe, walkable environments while regional travel areas need fewer stops, higher speeds, and limited access facilities.

In Oregon, new bypasses can take the form of freeways or expressways and can be located within an Urban Growth Boundary (UGB) and/or outside of a UGB, with a Transportation Planning Rule goal exception. The primary distinction between these two roadways is the degree of local access. Freeways are high speed and have fully controlled access to prioritize through traffic and safety. When access connections are necessary, grade-separated interchanges are integrated.

Expressways have more access, albeit strictly controlled, to manage inter and intra-urban traffic. When expressway connections are necessary, they are at-grade signalized and unsignalized public

[6] Amendment to 1999 Oregon Highway Plan BYPASS POLICY, April 16, 2003.

[7] System Metrics Group, Inc. et al. 2006. *California Bypass Study, The Economic Impacts of Bypasses: Volume 1: Planning Reference.* Sacramento, CA: California Department of Transportation, Transportation Economics.

road intersections and interchanges. In general, rural areas should not have traffic signals and private-property access is discouraged although some exceptions may apply.[8]

THE IMPACT OF BYPASSES ON SMALL-TOWN ECONOMIES

Some business owners and local stakeholders may express concerns about how a bypass will impact their local economy, while elected officials may view the new infrastructure as an opportunity for economic development. These changes can leave residents and local business owners wondering about the economic impacts of diverted traffic or the competitive effects of potential development adjacent to the new roadway. Economic concerns may include, but are not limited to:

- Will the businesses seeking development opportunities be locally owned or national chains or franchises likely to order their supplies and spend profits elsewhere?
- Will there be a loss of local character if the existing business mix is altered?
- Will new business development adjacent to the bypass increase competition for the existing businesses?

Each of these questions are complex and challenging to predict without extensive project and geographic information. Given the limited scope, this assessment focuses on the characteristics of bypasses that can affect a community's economy. The following section describes those differing characteristics.

HOW CAN A BYPASS IMPACT DIFFERENT TYPES OF TOWNS AND BUSINESSES?

How the construction of a new bypass interacts with a local economy depends on several interrelated factors including the types of services and sectors a town specializes in, the customer base that town appeals to, and its geographic location. Key questions that often arise when attempting to evaluate the economic effect of a bypass on a community's economy are:

- Is the town located along a major trade route or near a large metropolitan area?
- What types of industry does the local economy support?
- Does the town cater primarily to tourists and pass-through traffic or residents?

Answering all these questions is imperative when evaluating the economic impacts of bypasses on local economies. While the variance of economic effects can be wide, some generalized relationships have been established through research. In 2006, the California Department of Transportation (Caltrans) published a comprehensive study[9] that assessed the impacts of bypasses on small-town economies by reviewing existing literature on bypasses, performing field work, and developing a proprietary Highway Bypass Impact (HBI) Model. The authors identified a variety of factors that influence how a bypass interacts with a local, small-town economy.

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[8] Amendment to 1999 Oregon Highway Plan BYPASS POLICY, April 16, 2003.

[9] California Bypass Study, The Economic Impacts of Bypasses, May 2006.

The study identifies several key features that should be considered during the design phase of bypasses:

- Time savings
- Direct access
- Proximity to commercial areas
- Visibility

The time savings drivers incur is a determining factor in how many vehicles will opt to utilize the new bypass over the old route. This feature is one of the most significant benefits from bypasses. Bypasses connected to highway interchanges may impact businesses in one of two ways. One positive feature is that they can increase access to existing businesses if they are located along the bypass. A potential drawback is the bypass could draw traffic away from established businesses, encouraging new development adjacent to the bypass and increasing competition for existing businesses. The availability of parking in commercial areas (e.g., downtown) is a strong indicator of how well existing businesses can withstand potential competition from newly accessible land. And lastly, the more visible a business is from a bypass and the closer the business is to a commercial area (e.g., downtown), the less likely it is to experience negative effects from new traffic flows.

Communities with heavy local traffic or through traffic that does not stop are the least likely to be impacted by bypasses while communities that provide goods and services to pass-through traffic are most likely to experience adverse effects. In essence, the more a community relies on local traffic, the less likely the new bypass will impact businesses because there is an existing customer base. Even though local traffic-dependent communities may not stand to gain much from the addition of a bypass, they could experience increased and more efficient traffic flows if a bypass reduces truck traffic.

Residential communities and tourist destinations are the most likely to benefit from bypasses resulting in less traffic congestion and increased safety. Local business owners in these areas may have to partner with government officials to mitigate any potential negative impacts from the new traffic patterns. These strategies could involve capital improvements (e.g., increasing walkability, additional parking) or downtown redevelopment. Towns that offer a variety of visitor services (e.g., hotels, art galleries) attract more tourists as opposed to travelers passing through on their way to somewhere else and may experience positive economic impacts if a downtown area serves as a destination.

The types of towns that will have the most difficult time transitioning their economy after a bypass is constructed are those that are highway oriented. In particular, businesses that cater to pass-through traffic, like fast food chains and gas stations, are the most likely to be affected by bypasses. One critical question for these types of communities is whether travelers make opportunistic stops or if they incorporate the stop into their travel plans ahead of time? If travelers plan in advance on stopping at a particular location, ensuring convenient access for them is crucial to maintain the health of local businesses. If the businesses are more opportunistic for travelers, then advertising and proximity to the bypass is imperative. For example, tourist-related businesses can mitigate negative impacts by relocating to properties adjacent to the bypass.

RESEARCH SUMMARY

Throughout the 1990s and 2000s, researchers and local and state governments evaluated the impacts of bypasses on local economies. A broad range of studies and reports emerged with many focusing on small-town economies.

In 1998, the Wisconsin Department of Transportation (WisDOT) published a report that analyzed the impact of bypasses on 17 smaller communities[10] relative to 14 control communities since 1980. Researchers found that average traffic patterns over the long term on the older routes in the medium-to-large communities were close to the pre-bypass counts.[11] Overall, residents and business owners viewed the bypasses as beneficial, citing development opportunities, less truck traffic, and improved traffic flows. These effects allowed businesses—retail and traffic-dependent businesses, in particular—to flourish and the medium-to-large communities to experience continued economic growth. Additionally, the bypasses caused little relocation of retail businesses adjacent to the new roadway. Despite these positives, the authors noted that bypasses had an increased potential for harm to communities with fewer than 1,000 residents.[12]

Similar to WisDOT's study, the Texas Department of Transportation (TxDOT) asked researchers to perform an analysis investigating the economic impacts of highway bypasses on small communities. While business owners, residents, and local elected officials held mixed reviews of the bypasses initially, they felt that traffic congestion had greatly improved, subsequently increasing safety and local business access. Despite these positives, the traffic diversion had negative impacts on highway-oriented businesses (e.g., service stations, motels, fast food restaurants), downtown businesses, and those along the bypass. However, the authors noted these impacts were not uniformly distributed and depended largely on the function of the downtown area, in particular whether the area focused on civic or service-related businesses.[13]

In 2001, the University of Kentucky Center for Business and Economic Research performed an analysis with the Kentucky Transportation Center to assess the impacts of bypasses on both local economies and quality of life. Researchers found that the construction of new bypasses did impact retail sales, but not overall employment. Employment growth was likely to increase if the bypasses were located near a city's business district. Other key findings included the size of a community was not a determinant in employment growth and some rearrangement of economic activity resulted from bypasses (e.g., increased vacancy rates in downtown areas). Residents reported

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[10] These communities ranged from 300 to 30,000 residents.

[11] According to the authors, most of the bypass communities had experienced a significant amount of economic growth prior to the construction of the new infrastructure and exceeded the growth in the control (i.e., non-bypass) communities.

[12] Wisconsin Department of Transportation. 1998. *The Economic Impacts of Highway Bypasses on Communities, Summary*.

[13] Civic-related businesses include courts, bail bonds companies, title companies, and law offices.

greater satisfaction with improved traffic flows and most downtown business owners felt that the bypass either assisted them or had no meaningful impact on their businesses.[14]

A larger study conducted through the National Cooperative Highway Research Program (NCHRP) used national survey data from both the United States and Canada to assess the impacts of bypasses on smaller economies (i.e., 5,000 residents). While the findings were largely inconclusive, the authors did determine that highway-oriented businesses in small towns were the most negatively impacted by traffic diversions and that perceived effects were more profound than the actual effects. Although there was an observed initial drop in sales, the local economies typically recovered due to decreased congestion and noise pollution. Small and rural communities stood to benefit as development potential along the new roadway and traffic safety increased. Additionally, land values increased along both the new bypasses and old routes. The researchers also concluded that population density had a large effect on a community's economic performance following bypass construction and that a town's ability to extend its political boundaries (and subsequently garner additional tax revenue from development) could have a positive impact as well.[15]

POTENTIAL IMPACTS FOR SANDY

Accounting for a city's unique characteristics and commercial competition outside the city is the only way to truly assess how a particular economy may be impacted by a new bypass. The City of Sandy is a mixed economic environment with local and big-box businesses. Many are auto-oriented and cater to highway pass through traffic such as gas stations, convenience stores, drive-through coffee shops and fast food/high turnover restaurants. A major segment of retail customers are recreational visitors travelling through Sandy to Mt. Hood and Central Oregon. These unique customers support specialized local businesses such as outdoor equipment stores.

Some of these businesses serving pass through traffic may see an impact if their services cannot be easily replaced. For example, customers will need to determine if the travel time savings from taking the bypass outweighs the convenience of shopping in Sandy. Customers may choose to shop near their home before they leave or at their destination instead. Other auto-oriented businesses, such as gas stations, will likely be impacted. Customers may choose to stop for gas outside Sandy to save time travelling on the bypass. There are several gas stations to the east and west of Sandy within a few miles. The existing gas station at Firwood Road (Shorty's Corner) would be conveniently located on the east end of the bypass. Note that Sandy has a local gas tax that generates revenue to fund various transportation needs including facility maintenance. The diversion of vehicles to the bypass would likely reduce local gas tax revenue.

With the forecasted local growth over the next 20 years, it is unlikely these businesses would experience a high impact from a bypass. An analysis of employment inflow and outflow from

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[14] Thompson, E., J., Miller, and J., Roenker. 2001. *The Impact of a New Bypass Route on the Local Economy and Quality of Life, Research Report KTC-01-10/SPR219-00-21*. June 2001. Lexington, KY: University of Kentucky.

[15] National Cooperative Highway Research Program (NCHRP). 1996. "Effects of Highway Bypasses on Rural Communities and Small Urban Areas." *Research Results Digest* Number 210.

2018[16] (the most recent year available) showed that approximately 5,000 Sandy residents work outside of the city, 3,000 workers commute into the city, and 600 residents work within the city. Of the jobs within Sandy, most are classified as retail trade (~1,000 or 25%) followed by accommodation and food services (~500, 15%) and educational services (~400, 12%). Of these, retail and food services may be the most vulnerable to impacts from a bypass.

The majority of the bypass alignment is outside the urban growth boundary with rural zoning and land use. Urban development would be prohibited, eliminating the possibility for new commercial development along the bypass that could compete with existing businesses on US 26. The biggest commercial competition is the Portland Metro area, approximately seven miles west of Sandy, which can provide almost all the retail and service businesses highway drivers could need.

The bypass is forecasted to serve 1,500 vehicles peak hour in the 2040 peak hour. A portion of these vehicles are potential Sandy business customers that choose the travel time savings of the bypass over the convenience of shopping at a business on US 26. To counter that impact, lower traffic volumes on the highway may make downtown highway fronting businesses more attractive.

OTHER CONSIDERATIONS

There are other potential benefits and costs related to constructing a bypass that should be considered beyond the value of travel time, safety and local businesses previously presented. These other considerations include maintenance of the facility and policy and regulatory requirements as descripted in the following sections.

US 26 JURISDICTIONAL TRANSFER TO CITY

A new bypass facility would be constructed and operated by ODOT. With the bypass in place, ODOT would transfer the jurisdiction of the existing section of US 26 being bypassed to the City. The ongoing maintenance and operation of the facility would be a cost burden for the City. This segment of US 26 is approximately 5 miles long with four to five travel lanes, street lighting and numerous traffic signals. The average annual cost to maintain a comparable urban highway is $20,000 to $30,000 per miles. Over the next 20 years, the maintenance cost for the City is estimated to be $2 to $3 million.

The City taking jurisdiction of US 26 also brings opportunities to make local changes to the facility. With the bypass in place, the future traffic volumes on US 26 will decrease significantly and potentially allow the reconstruction of the existing five-lane sections (outside the downtown couplet) to three-lanes and provide additional design features such as landscaping, wider sidewalks, protected bicycle lanes, median treatments, and diagonal parking with the extra roadway width. This would result in benefits to overall safety and livability and encourage more walking, biking, and transit activity. Reconstruction of US 26 would be a major capital project with

[16] https://onthemap.ces.census.gov/

potential modifications to traffic signals, drainage, utilities, street lighting, pavement markings and signage. Based on planning level cost estimates for comparable corridor reconstruction projects, the cost estimate could range from $20 to $40 million for improvements.

POLICY AND REGULATORY REQUIREMENTS

A detailed evaluation of the policy and regulatory considerations associated with a potential bypass was conducted for this analysis, as provided in the Appendix, Section 4 and summarized below.

The construction of a US 26 bypass around the city of Sandy represents a significant investment in public infrastructure with the potential to impact transportation, urban and rural lands, Goal 5 resources, and the local and regional economy. Demonstration of compliance with several related policies and regulations will need to be addressed if this alternative is pursued and further developed.

A preferred bypass alternative would be documented in a facility plan, ultimately adopted by the Oregon Transportation Commission (OTC) and Oregon Department of Transportation (ODOT), thereby amending the Oregon Highway Plan (OHP). The City of Sandy and Clackamas County will need to work collaboratively on developing any necessary amendments to local plans (such as the comprehensive plan, TSPs, local land use, and subdivision codes) to ensure consistency with the facility plan for the proposed bypass. While both the state and the local governments adopt the facility plan, or elements thereof, the adoption processes are different and the roles and responsibilities for the different levels of government are not the same.

Both the City of Sandy and Clackamas County would amend their respective TSPs to incorporate elements of the facility plan. Local approval may require the adoption of new transportation-related policies, consistent with the findings and supportive of the recommendations of the facility plan. New ordinances or amendments to existing ordinances, resolutions, and Inter-Governmental Agreements (IGA) may be necessary to ensure that the access management, the land use management, and the coordination elements of the facility plan are achieved. The approval process would include Planning Commission/City Council hearings with the City of Sandy and Planning Commission/County Commission hearings with Clackamas County.

If the preferred bypass alignment impacts County land designated for EFU or Forest use, the County would need to support adoption with goal exception findings.[17] Following successful local adoption by the City and County, the facility plan could be presented to the OTC for its review and approval.

[17] Note that the adoption action is an amendment to the TSP, the transportation element of the local Comprehensive Plan. The comprehensive plan amendment becomes acknowledged after the 21-day appeal period and no appeals have been filed (see https://www.oregonlaws.org/ors/197.625.)

SUMMARY

To support the reevaluation of the US 26 bypass project, a planning-level assessment of the potential benefits and costs of the bypass was conducted with measures of performance related to various measures. The key findings are summarized in Table 4. These findings will contribute to the content and analysis in subsequent memoranda including the Sandy Bypass Feasibility Reevaluation Report.

TABLE 4: COST AND BENEFIT SUMMARY OF BYPASS FACILITY

Measure	Cost/Impact	Benefit	Consideration
Project Planning and Construction	$980 million to $1 billion for construction, right-of-way acquisition, easements, design and construction management		The cost estimate is for planning purposes only and could change significantly due to the high level of uncertainty regarding the construction year, NEPA process and final design and alignment.
Future Volume and Travel Time		Bypass estimated to serve 1,500 vehicles per hour in 2040 peak hour. Bypass compared to 2040 No Build alternative peak hour: Estimated to save 9 minutes eastbound and 6.5 minutes westbound	Other roadway capacity projects are likely to be built by 2040 that would improve US 26 traffic flow and reduce the estimated time savings (5.5 minutes eastbound and 2.5 minutes westbound).
Travel Time Value		$6 million per year, $75 million over 20 years	Cost saving estimate is highly variable depending on future traffic patterns and duration of congested conditions.
Safety		Overall reduction in crashes on US 26 expected with lower volumes and fewer conflicts with pedestrians and cyclists downtown.	
Local Businesses	Diverts potential customers from highway-oriented businesses on US 26. Local gas tax revenue would likely be lower.	Reducing traffic volumes in the downtown area could increase walking and biking activity and make fronting businesses more attractive.	Current zoning and land use patterns encourage commercial development along the highway. A bypass outside the UGB would not allow for adjacent commercial development. If the bypass was inside the UGB, new adjacent commercial development may compete with businesses on US 26.

Jurisdictional Transfer to City	City would be responsible for US 26 maintenance, estimated to cost $2 to 3 million over next 20 years.	Potential reconstruction of US 26 with reduced vehicle lanes and multimodal improvements, estimated to cost $20 to $40 million	City would need to find new ongoing funding for maintenance. The cost for reconstruction is highly variable due to uncertainty regarding the final design and year of construction.
Policy and Regulation Requirements	Demonstration of compliance with numerous related policies, regulations and ordinances will need to be addressed to gain project approval.		Amendments to the Oregon Highway Plan require adoption by the OTC and ODOT. A robust NEPA planning process will be needed to address potential impacts to Goal 5 resources and designated forest use lands.

APPENDIX

CONTENTS

DKS

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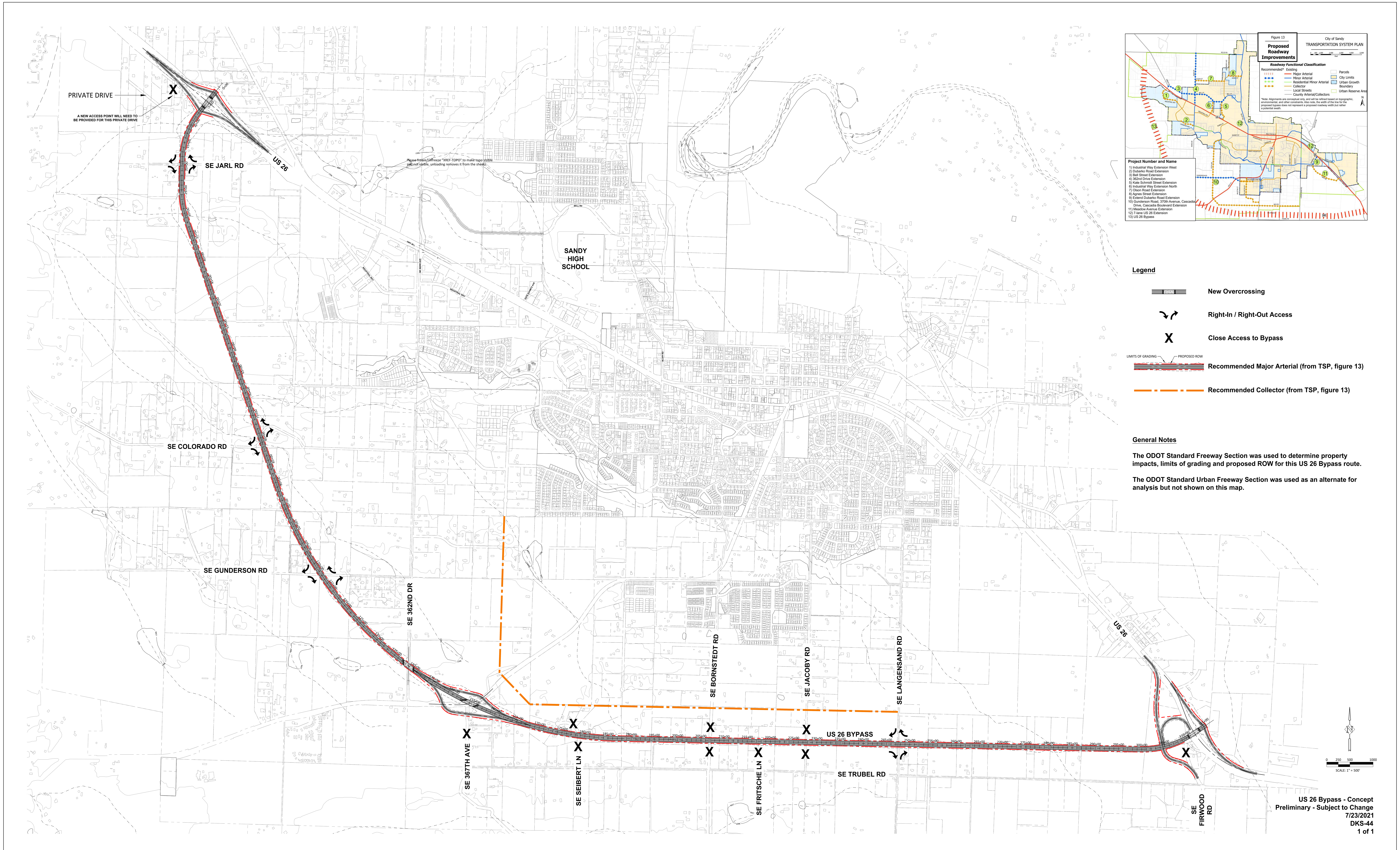
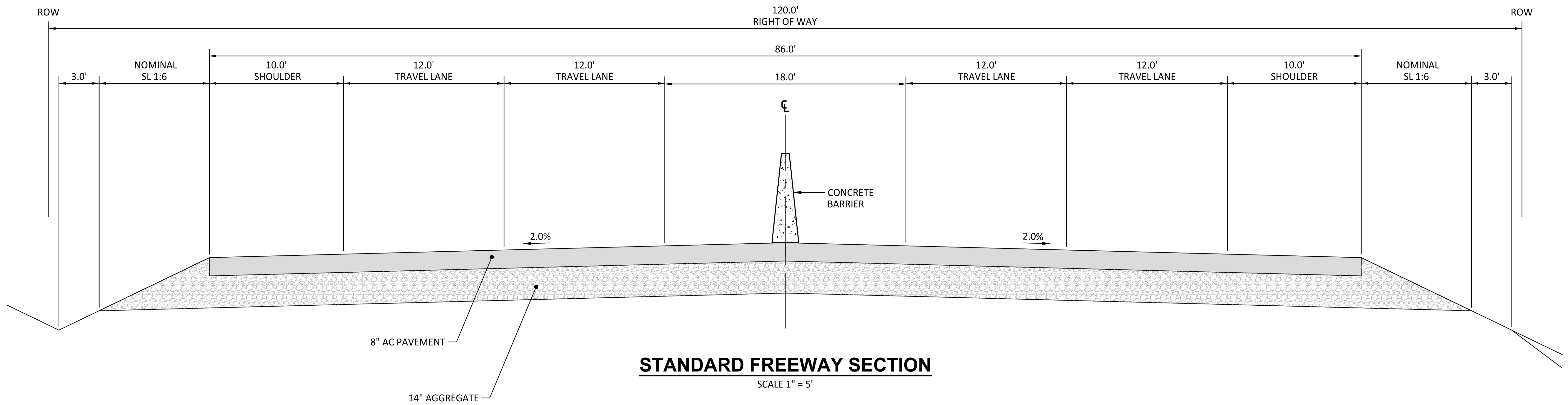
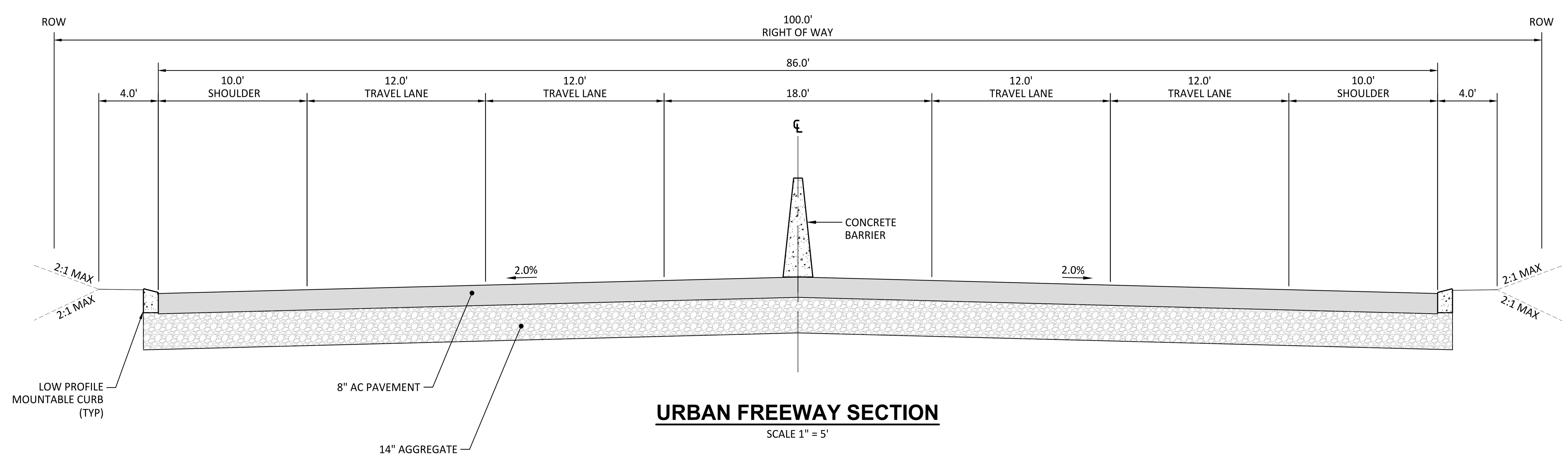
SECTION 1. BYPASS CONCEPT DRAWINGS


PRIVATE DRIVE
A NEW ACCESS POINT WILL NEED TO BE PROVIDED FOR THIS PRIVATE DRIVE
SE JARL RD
US 26
Please freeze/unfreeze "XREF-TOPO" to make topo visible and not visible, unloading removes it from the sheets.
SANDY HIGH SCHOOL
SE COLORADO RD
SE GUNDERSON RD
SE 362ND DR
SE 367TH AVE
SE SEIBERT LN
SE BORNSTEDT RD
SE FRITSCHE LN
SE JACOBY RD
SE LANGENSAND RD
US 26 BYPASS
SE TRUBEL RD
US 26
SE FIRWOOD RD
Figure 13
Proposed Roadway Improvements
City of Sandy
TRANSPORTATION SYSTEM PLAN
Roadway Functional Classification
Recommended* Existing
Major Arterial
Minor Arterial
Residential Minor Arterial
Collector
Local Streets
County Arterial/Collectors
Parcels
City Limits
Urban Growth Boundary
Urban Reserve Area
*Note: Alignments are conceptual only, and will be refined based on topographic, environmental, and other constraints. Also note, the width of the line for the proposed bypass does not represent a proposed roadway width,but rather a potential swath.
Project Number and Name
1) Industrial Way Extension West
2) Dubarko Road Extension
3) Bell Street Extension
4) 362nd Drive Extension
5) Kate Schmidt Street Extension
6) Industrial Way Extension North
7) Olson Road Extension
8) Agnes Street Extension
9) Extend Dubarko Road Extension
10) Gunderson Road, 370th Avenue, Cascadia Drive, Cascadia Boulevard Extension
11) Meadow Avenue Extension
12) 7-lane US 26 Extension
13) US 26 Bypass
Legend
New Overcrossing
Right-In / Right-Out Access
Close Access to Bypass
LIMITS OF GRADING
PROPOSED ROW
Recommended Major Arterial (from TSP, figure 13)
Recommended Collector (from TSP, figure 13)
General Notes
The ODOT Standard Freeway Section was used to determine property impacts, limits of grading and proposed ROW for this US 26 Bypass route.
The ODOT Standard Urban Freeway Section was used as an alternate for analysis but not shown on this map.
0 250 500 1000
SCALE: 1" = 500'
US 26 Bypass - Concept
Preliminary - Subject to Change
7/23/2021
DKS-44
1 of 1



STANDARD FREEWAY SECTION

SCALE 1" = 5'



URBAN FREEWAY SECTION

SCALE 1" = 5'

US 26 Bypass - Typical Sections
Preliminary - Subject to Change
7/23/2021
DKS-44
1 of 1

Legend

Right-In / Right-Out Access

Close Access to Bypass

Proposed ROW

Proposed CL

Proposed limit of grading

Drainageway crossing with proposed
3 sided bridge or open bottom box culvert

General Notes

The ODOT Standard Freeway Section was used to determine property impacts, limits of grading and proposed ROW for this US 26 Bypass route.

The ODOT Standard Urban Freeway Section was used as an alternate for analysis but not shown on this map.

0 50 100 200
SCALE: 1" = 100'

US 26 Bypass - Plan & Profile
Preliminary - Subject to Change
7/23/2021
DKS-44
1 of 4

0 50 100 200
SCALE: 1" = 100'

US 26 Bypass - Plan & Profile
Preliminary - Subject to Change
7/23/2021
DKS-44
2 of 4

US 26 Bypass - Plan & Profile
Preliminary - Subject to Change
7/23/2021
DKS-44
3 of 4

US 26 Bypass - Interchanges
Plans & Profiles
Preliminary - Subject to Change
7/23/2021
DKS-44
4 of 4

SECTION 2. BYPASS COST ESTIMATES

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section

Job No. DKS-44
Date: 7/23/2021

Major Street Segments	Estimated Cost
US 26 Bypass - Freeway Section	$ 224,600,000
Interchange Ramps & SE Firwood Rd Realignment	$ 72,700,000

Overcrossings	Estimated Cost
Overcrossing at West Interchange	$ 16,700,000
Overcrossing at SE 362nd Dr	$ 17,100,000
Overcrossing at OR211 Interchange	$ 17,800,000
Overcrossing at East Interchange	$ 17,300,000

Major Intersections/Structures	Estimated Cost
Private Drive / West Interchange EB Off Ramp	$ 2,000,000
US 26 Bypass / SE Jarl Rd	$ 1,200,000
US 26 Bypass / SE Colorado Rd	$ 1,200,000
US 26 Bypass / SE Gunderson Rd	$ 1,200,000
US 26 Bypass / SE 367th Ave	$ 500,000
US 26 Bypass / SE Seibert Ln	$ 1,000,000
US 26 Bypass / SE Bornstedt Rd	$ 1,000,000
US 26 Bypass / SE Fritsche Ln	$ 500,000
US 26 Bypass / SE Jacoby Rd	$ 1,000,000
US 26 Bypass / SE Langensand Rd	$ 1,200,000

Other	Section Cost
Sanitary Sewer	$ 5,400,000
Waterline	$ 5,700,000

Total Project Development Cost (10%) **$ 388,100,000**

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section

Job No. DKS-44
Date: 7/23/2021

Global Cost Assumptions				
Construction Cost Contingency	%		30%	
Contractor LS Incidental	%		15%	(Mob, TPDT, EC, RSO, Staking, etc.)
Capital Project Mgmt. (design & const.)			10.0%	
Design Engineering			10.0%	
Design Survey			1.5%	
Public Involvement			0.5%	
Const. Engineering Support			6.0%	
Inspection			5.0%	
Roadwork				Assumptions
Bridge Structure	SQFT	$	400.00	
Concrete Curb & Gutter	FOOT	$	28.00	
Concrete Curb, Std. Type C	FOOT	$	20.00	
Concrete Curb, Low Profile Mountable	FOOT	$	25.00	
Concrete Barrier, Permanent	FOOT	$	75.00	
Sidewalk	SQFT	$	7.00	
Concrete Median (Paving)	SQFT	$	20.00	excludes curb
Asphalt Mixture	TON	$	100.00	
Aggregate Base	CUYD	$	78.00	
Geotextile Fabric	SQYD	$	1.00	
Earthwork	CUYD	$	30.00	
Topsoil	CUYD	$	45.00	
Bark Mulch (3" depth)	CUYD	$	90.00	
Groundcovers	SQFT	$	15.00	At 12" OC spacing, approx. 1/SF
Street Trees	EACH	$	650.00	
Root Barrier	FOOT	$	10.00	
Irrigation	SQFT	$	4.00	
Storm Main (24" dia)	FOOT	$	240.00	
Storm Lateral (12" dia)	FOOT	$	115.00	
Storm Manhole (48" dia)	EACH	$	5,000.00	
Storm Catch Basin	EACH	$	3,000.00	
Water Quality & Detention	SQFT	$	20.00	using 6% of imp. Area
Drainageway Crossing, 3 Sided Box Culvert	FOOT	$	300.00	
Sanitary Main (24" dia)	FOOT	$	350.00	
Sanitary Main (8" dia)	FOOT	$	150.00	no laterals - to be installed with development
Sanitary Manhole (60" dia)	EACH	$	15,000.00	
Sanitary Manhole (48" dia)	EACH	$	9,000.00	
Water Main (18" DI)	FOOT	$	225.00	
Water Main (8" DI)	FOOT	$	110.00	
Fire Hydrants (w/ lat & fittings)	EACH	$	10,000.00	
Purple Pipe (12" PVC)	FOOT	$	100.00	
Streetlights (incl conduit)	EACH	$	4,000.00	
Joint Trench	FOOT	$	40.00	
Underground Power (vaults)	EACH	$	15,000.00	
Underground Power (conduit)	FOOT	$	10.00	
Right-of-Way				
Right-of-Way (SF)	SQFT	$	10.00	Note: ROW costs are budgetary only and appr
Easement (SF)	SQFT	$	2.00	Note: ROW costs are budgetary only and appr

ODOT Sandy Bypass
Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Major Intersections
Includes extra width for turn lanes, signals, interconnect, ROW, ADA ramps, ped buttons, etc.

Intersection		Private Drive / West Interchange EB Off Ramp	US 26 Bypass / SE Jarl Rd	US 26 Bypass / SE Colorado Rd	US 26 Bypass / SE Gunderson Rd	US 26 Bypass / SE 367th Ave	US 26 Bypass / SE Seibert Ln	US 26 Bypass / SE Bornstedt Rd	US 26 Bypass / SE Fritsche Ln	US 26 Bypass / SE Jacoby Rd	US 26 Bypass / SE Langensand Rd
Construction Cost											
	LS Base Cost:	$ 1,000,000	$ 600,000	$ 600,000	$ 600,000	$ 250,000	$ 500,000	$ 500,000	$ 250,000	$ 500,000	$ 600,000
30%	Const. Contingency:	$ 300,000	$ 180,000	$ 180,000	$ 180,000	$ 75,000	$ 150,000	$ 150,000	$ 75,000	$ 150,000	$ 180,000
	Construction Subtotal:	$ 1,300,000	$ 780,000	$ 780,000	$ 780,000	$ 325,000	$ 650,000	$ 650,000	$ 325,000	$ 650,000	$ 780,000
15%	Construction Incidentals:	$ 195,000	$ 117,000	$ 117,000	$ 117,000	$ 48,750	$ 97,500	$ 97,500	$ 48,750	$ 97,500	$ 117,000
	Total Construction Cost	**$ 1,495,000**	**$ 897,000**	**$ 897,000**	**$ 897,000**	**$ 373,750**	**$ 747,500**	**$ 747,500**	**$ 373,750**	**$ 747,500**	**$ 897,000**
Professional Services (Design & Construction)											
10%	Cap. Proj Mgmt. (des & con)	$ 149,500	$ 89,700	$ 89,700	$ 89,700	$ 37,375	$ 74,750	$ 74,750	$ 37,375	$ 74,750	$ 89,700
10%	Design Engineering	$ 149,500	$ 89,700	$ 89,700	$ 89,700	$ 37,375	$ 74,750	$ 74,750	$ 37,375	$ 74,750	$ 89,700
2%	Design Survey	$ 22,425	$ 13,455	$ 13,455	$ 13,455	$ 5,606	$ 11,213	$ 11,213	$ 5,606	$ 11,213	$ 13,455
1%	Public Involvement	$ 7,475	$ 4,485	$ 4,485	$ 4,485	$ 1,869	$ 3,738	$ 3,738	$ 1,869	$ 3,738	$ 4,485
6%	Const. Engineering Support	$ 89,700	$ 53,820	$ 53,820	$ 53,820	$ 22,425	$ 44,850	$ 44,850	$ 22,425	$ 44,850	$ 53,820
5%	Inspection	$ 74,750	$ 44,850	$ 44,850	$ 44,850	$ 18,688	$ 37,375	$ 37,375	$ 18,688	$ 37,375	$ 44,850
	Total Professional Services	**$ 493,350**	**$ 296,010**	**$ 296,010**	**$ 296,010**	**$ 123,338**	**$ 246,675**	**$ 246,675**	**$ 123,338**	**$ 246,675**	**$ 296,010**
Right-of-Way											
	Extra R/W at Intersections										
	Total R/W Services	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total Intersection Cost	**$ 1,988,350**	**$ 1,193,010**	**$ 1,193,010**	**$ 1,193,010**	**$ 497,088**	**$ 994,175**	**$ 994,175**	**$ 497,088**	**$ 994,175**	**$ 1,193,010**

$300,000	Assumed $300,000 right-in/right-out per side.
$250,000	Will a cul-de-sac be created at each road closure? Assume $250,000 per CDS.

Note: ROW costs are budgetary only and appraisals have not been completed or a value established.

ODOT Sandy Bypass
Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: US 26 Bypass - Freeway Section

Typical Road Section	
Asphalt	8
Agg. Base	14

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
freeway section	200	31500	30,323	86.0	2,607,778	120.0	3,638,760	16.0	485,168
			-		-		-		-
			-		-		-		-
			-		-		-		-
			30,323		2,607,778		3,638,760		485,168

Roadway Section Costs (Volume)

	Area (sf)	Depth (ft)	Volume (CY)	Wt (Ton)	Unit Price	Total
Asphalt (Ton)	2,607,778	0.67	64,390	136,506	$ 100.00	$ 13,650,591
Aggregate Base			138,512		$ 78.00	$ 10,803,936
Earthwork					LS	$ 41,066,200

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Concrete Median		30,323	-		$ 20.00	$ -
Planted Median		30,323	-		$ 21.50	$ -
Sidewalk		30,323	-		$ 7.00	$ -
Landscape Strip		30,323	-		$ 21.50	$ -
Geotextile Fabric	-	-	-	373,984	$ 1.00	$ 373,984
W.Q. & Detention			156,467		$ 20.00	$ 3,129,334

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Curb & Gutter	30,323		-	$ 28.00	$ -
Concrete Curb, Std. Type C	30,323		-	$ 20.00	$ -
Concrete Curb, Low Profile Mountable	30,323		-	$ 25.00	$ -
Concrete Barrier, Permanent	29,380	1	29,380	$ 75.00	$ 2,203,500
Street Trees	30,323	2	60,646	$ 25.00	$ 1,516,150
Street Lights	30,323	2	60,646	$ 40.00	$ 2,425,840
Storm System	30,323	1	30,323	$ 344.45	$ 10,444,757
Joint Trench + PGE	30,323	1	30,323	$ 117.50	$ 3,562,953
Drainageway Crossing, 3 Sided Box Culvert			2,230	$ 300.00	$ 669,000

		Combined Items Subtotal:	$ 89,846,244
Contingency	30%		$ 26,953,873
		Construction Subtotal:	**$ 116,800,118**
Construction Incidentals	15%		$ 17,520,018
		Total Construction Cost	**$ 134,320,135**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 13,432,014
Design Engineering	10.0%	$ 13,432,014
Design Survey	1.5%	$ 2,014,802
Public Involvement	0.5%	$ 671,601
Const. Engineering Support	6.0%	$ 8,059,208
Inspection	5.0%	$ 6,716,007

Professional Services Total: $ 44,325,645

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	3,638,760		3,638,760		$ 10.00	$ 36,387,600
PUE's	485,168		485,168		$ 2.00	$ 970,336
Permanent Slope Easement	839,279		839,279		$ 2.00	$ 1,678,558
Building Removals	-		-	23	$ 300,000.00	$ 6,900,000

Right-of-Way Subtotal **$ 45,936,494**

Total Project Cost: $ 224,582,274

ODOT Sandy Bypass
Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: Interchange Ramps & SE Firwood Rd Realignment

Typical Road Section	
Asphalt	8
Agg. Base	14

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
West Interchange Ramps			6,780		210,396		129,844		-
Interchange at OR211			5,787		175,242		437,206		-
East Interchange Ramps			5,995		189,664		602,315		-
SE Firwood Rd			1,062		25,488		72,208		-
			19,624		600,790		1,241,572		-

Roadway Section Costs (Volume)

	Area (sf)	Depth (ft)	Volume (CY)	Wt (Ton)	Unit Price	Total
Asphalt (Ton)	600,790	0.67	14,834	31,449	$ 100.00	$ 3,144,876
Aggregate Base			38,588		$ 78.00	$ 3,009,864
Earthwork					LS	$ 11,305,770

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Concrete Median		19,624	-		$ 20.00	$ -
Planted Median		19,624	-		$ 21.50	$ -
Sidewalk		19,624	-		$ 7.00	$ -
Landscape Strip		19,624	-		$ 21.50	$ -
Geotextile Fabric	-	-	-	121,266	$ 1.00	$ 121,266
W.Q. & Detention			36,047		$ 20.00	$ 720,948

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Curb & Gutter	19,624		-	$ 28.00	$ -
Concrete Curb, Std. Type C	19,624		-	$ 20.00	$ -
Concrete Curb, Low Profile Mountable	19,624		-	$ 25.00	$ -
Concrete Barrier, Permanent	19,624		-	$ 75.00	$ -
Street Trees	19,624	2	39,248	$ 25.00	$ 981,200
Street Lights	19,624	2	39,248	$ 40.00	$ 1,569,920
Storm System	19,624	1	19,624	$ 295.00	$ 5,789,080
Joint Trench + PGE	19,624	1	19,624	$ 117.50	$ 2,305,820

		Combined Items Subtotal:	$ 28,948,744
Contingency	30%		$ 8,684,623
		Construction Subtotal:	**$ 37,633,367**
Construction Incidentals	15%		$ 5,645,005
		Total Construction Cost	**$ 43,278,372**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 4,327,837
Design Engineering	10.0%	$ 4,327,837
Design Survey	1.5%	$ 649,176
Public Involvement	0.5%	$ 216,392
Const. Engineering Support	6.0%	$ 2,596,702
Inspection	5.0%	$ 2,163,919
Professional Services Total:		**$ 14,281,863**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	1,241,572		1,241,572		$ 10.00	$ 12,415,724
PUE's	-		-		$ 2.00	$ -
Building Removals	-		-	9	$ 300,000.00	$ 2,700,000
					Right-of-Way Subtotal	**$ 15,115,724**

Total Project Cost: $ 72,675,959

ODOT Sandy Bypass
Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: Overcrossing at West Interchange

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
Overcrossing at West Interchange			237	86.0	20,382	120.0	28,440		-
									-
									-
									-
			237		20,382		28,440		-

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Bridge Structure	86.00	237	20,382		$ 400.00	$ 8,152,800

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Street Lights	237	2	474	$ 40.00	$ 18,960
Storm System	237	1	237	$ 344.45	$ 81,635

		Combined Items Subtotal:	$ 8,253,395
Contingency	30%		$ 2,476,018
		Construction Subtotal:	**$ 10,729,413**
Construction Incidentals	15%		$ 1,609,412
		Total Construction Cost	**$ 12,338,825**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 1,233,883
Design Engineering	10.0%	$ 1,233,883
Design Survey	1.5%	$ 185,082
Public Involvement	0.5%	$ 61,694
Const. Engineering Support	6.0%	$ 740,330
Inspection	5.0%	$ 616,941
	Professional Services Total:	**$ 4,071,812**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	28,440		28,440		$ 10.00	$ 284,400

Right-of-Way Subtotal **$ 284,400**

Total Project Cost: $ 16,695,037

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: Overcrossing at SE 362nd Dr

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
Overcrossing at SE 362nd Dr			243	86.0	20,898	120.0	29,160		-
									-
									-
									-
			243		20,898		29,160		-

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Bridge Structure	86.00	243	20,898		$ 400.00	$ 8,359,200

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Street Lights	243	2	486	$ 40.00	$ 19,440
Storm System	243	1	243	$ 344.45	$ 83,701

		Combined Items Subtotal:	$ 8,462,341
Contingency	30%		$ 2,538,702
		Construction Subtotal:	**$ 11,001,044**
Construction Incidentals	15%		$ 1,650,157
		Total Construction Cost	**$ 12,651,200**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 1,265,120
Design Engineering	10.0%	$ 1,265,120
Design Survey	1.5%	$ 189,768
Public Involvement	0.5%	$ 63,256
Const. Engineering Support	6.0%	$ 759,072
Inspection	5.0%	$ 632,560
	Professional Services Total:	**$ 4,174,896**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	29,160		29,160		$ 10.00	$ 291,600

Right-of-Way Subtotal **$ 291,600**

Total Project Cost: $ 17,117,696

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: Overcrossing at OR211 Interchange

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
Overcrossing at OR211 Interchange			252	86.0	21,672	120.0	30,240		-
									-
									-
									-
			252		21,672		30,240		-

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Bridge Structure	86.00	252	21,672		$ 400.00	$ 8,668,800

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Street Lights	252	2	504	$ 40.00	$ 20,160
Storm System	252	1	252	$ 344.45	$ 86,801

		Combined Items Subtotal:	$ 8,775,761
Contingency	30%		$ 2,632,728
		Construction Subtotal:	**$ 11,408,490**
Construction Incidentals	15%		$ 1,711,273
		Total Construction Cost	**$ 13,119,763**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 1,311,976
Design Engineering	10.0%	$ 1,311,976
Design Survey	1.5%	$ 196,796
Public Involvement	0.5%	$ 65,599
Const. Engineering Support	6.0%	$ 787,186
Inspection	5.0%	$ 655,988
	Professional Services Total:	**$ 4,329,522**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	30,240		30,240		$ 10.00	$ 302,400

Right-of-Way Subtotal **$ 302,400**

Total Project Cost: $ 17,751,685

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: Overcrossing at East Interchange

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
Overcrossing at East Interchange			245	86.0	21,070	120.0	29,400		-
									-
									-
									-
			245		21,070		29,400		-

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Bridge Structure	86.00	245	21,070		$ 400.00	$ 8,428,000

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length		Unit Price	Total
Street Lights	245	2	490		$ 40.00	$ 19,600
Storm System	245	1	245		$ 344.45	$ 84,390
					Combined Items Subtotal:	$ 8,531,990
Contingency			30%			$ 2,559,597
					Construction Subtotal:	**$ 11,091,587**
Construction Incidentals			15%			$ 1,663,738
					Total Construction Cost	**$ 12,755,325**

Professional Services (Design & Construction)

		Total
Capital Project Mgmt. (design & construction)	10.0%	$ 1,275,533
Design Engineering	10.0%	$ 1,275,533
Design Survey	1.5%	$ 191,330
Public Involvement	0.5%	$ 63,777
Const. Engineering Support	6.0%	$ 765,320
Inspection	5.0%	$ 637,766
	Professional Services Total:	**$ 4,209,257**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	29,400		29,400		$ 10.00	$ 294,000
					Right-of-Way Subtotal	**$ 294,000**

Total Project Cost: $ 17,258,583

Sanitary System

	24" PVC	8" PVC	60" Deep MH	48" MH	Subtotal	Total Cost	
Unit Prices:	$ 350.00	$ 150.00	$ 15,000.00	$ 9,000.00			
US 26 Bypass	0	31,300	0	79	$ 5,406,000	$ 5,406,000	Note: Used 400' spacing for manholes.
					$ -	$ -	
					$ -	$ -	
Total	-	31,300	-	79			

	Length	Width	Area	Unit Price	Total Cost	
Sanitary Easement	0	20	-	$ 2.00	$ -	Note: ROW costs are budgetary only and

Total Sanitary System **$5,406,000**

Domestic Water System

Unit Prices:

8" Ductile Iron Pipe	$ 110.00
Hydrants (incl. laterals)	$ 10,000.00

Assume 1 per 500' (roundup)

	8" DI	Hydrants	Subtotal	Fittings (40%)	Total Cost
US 26 Bypass	31,300	63	$ 4,073,000	$ 1,629,200	$ 5,702,200
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
		0	$ -	$ -	$ -

Other Specific Water Items	Length	
XXX		
XXX		
XXX		
XXX		

Total Domestic Water System **$5,702,200**

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Urban Freeway Section

Job No. DKS-44
Date: 7/23/2021

Major Street Segments	Estimated Cost
US 26 Bypass - Urban Freeway Section	$ 205,900,000
Interchange Ramps & SE Firwood Rd Realignment	$ 72,700,000

Overcrossings	Estimated Cost
Overcrossing at West Interchange	$ 16,700,000
Overcrossing at SE 362nd Dr	$ 17,100,000
Overcrossing at OR211 Interchange	$ 17,800,000
Overcrossing at East Interchange	$ 17,300,000

Major Intersections/Structures	Estimated Cost
Private Drive / West Interchange EB Off Ramp	$ 2,000,000
US 26 Bypass / SE Jarl Rd	$ 1,200,000
US 26 Bypass / SE Colorado Rd	$ 1,200,000
US 26 Bypass / SE Gunderson Rd	$ 1,200,000
US 26 Bypass / SE 367th Ave	$ 500,000
US 26 Bypass / SE Seibert Ln	$ 1,000,000
US 26 Bypass / SE Bornstedt Rd	$ 1,000,000
US 26 Bypass / SE Fritsche Ln	$ 500,000
US 26 Bypass / SE Jacoby Rd	$ 1,000,000
US 26 Bypass / SE Langensand Rd	$ 1,200,000

Other	Section Cost
Sanitary Sewer	$ 5,400,000
Waterline	$ 5,700,000

Total Project Development Cost (10%) **$ 369,400,000**

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Urban Freeway Section

Job No. DKS-44
Date: 7/23/2021

Global Cost Assumptions				
Construction Cost Contingency	%		30%	
Contractor LS Incidental	%		15%	(Mob, TPDT, EC, RSO, Staking, etc.)
Capital Project Mgmt. (design & const.)			10.0%	
Design Engineering			10.0%	
Design Survey			1.5%	
Public Involvement			0.5%	
Const. Engineering Support			6.0%	
Inspection			5.0%	
Roadwork				Assumptions
Bridge Structure	SQFT	$	300.00	
Concrete Curb & Gutter	FOOT	$	28.00	
Concrete Curb, Std. Type C	FOOT	$	20.00	
Concrete Curb, Low Profile Mountable	FOOT	$	25.00	
Concrete Barrier, Permanent	FOOT	$	75.00	
Sidewalk	SQFT	$	7.00	
Concrete Median (Paving)	SQFT	$	20.00	excludes curb
Asphalt Mixture	TON	$	100.00	
Aggregate Base	CUYD	$	78.00	
Geotextile Fabric	SQYD	$	1.00	
Earthwork	CUYD	$	30.00	
Topsoil	CUYD	$	45.00	
Bark Mulch (3" depth)	CUYD	$	90.00	
Groundcovers	SQFT	$	15.00	At 12" OC spacing, approx. 1/SF
Street Trees	EACH	$	650.00	
Root Barrier	FOOT	$	10.00	
Irrigation	SQFT	$	4.00	
Storm Main (24" dia)	FOOT	$	240.00	
Storm Lateral (12" dia)	FOOT	$	115.00	
Storm Manhole (48" dia)	EACH	$	5,000.00	
Storm Catch Basin	EACH	$	3,000.00	
Water Quality & Detention	SQFT	$	20.00	using 6% of imp. Area
Sanitary Main (24" dia)	FOOT	$	350.00	
Sanitary Main (8" dia)	FOOT	$	150.00	no laterals - to be installed with development
Sanitary Manhole (60" dia)	EACH	$	15,000.00	
Sanitary Manhole (48" dia)	EACH	$	9,000.00	
Water Main (18" DI)	FOOT	$	225.00	
Water Main (8" DI)	FOOT	$	110.00	
Fire Hydrants (w/ lat & fittings)	EACH	$	10,000.00	
Purple Pipe (12" PVC)	FOOT	$	100.00	
Streetlights (incl conduit)	EACH	$	4,000.00	
Joint Trench	FOOT	$	40.00	
Underground Power (vaults)	EACH	$	15,000.00	
Underground Power (conduit)	FOOT	$	10.00	
Right-of-Way				
Right-of-Way (SF)	SQFT	$	10.00	Note: ROW costs are budgetary only and appr
Easement (SF)	SQFT	$	2.00	Note: ROW costs are budgetary only and appr

ODOT Sandy Bypass

Conceptual 10% Design / Estimate - Summary with Urban Freeway Section
Roadway Section Analysis
Job No. DKS-44
Date: 7/23/2021

Road Section: US 26 Bypass - Urban Freeway Section

Typical Road Section	
Asphalt	8
Agg. Base	14

Road Section Data Entry:

Segment	Begin STA	End STA	Length (ft)	Road		Right of Way		Public Utility Easements	
				Width (ft)	Area (sf)	Width (ft)	Area (sf)	Width (ft)	Area (sf)
urban freeway section	200	31500	30,323	86.0	2,607,778	100.0	3,032,300	16.0	485,168
			-		-		-		-
			-		-		-		-
			-		-		-		-
			30,323		2,607,778		3,032,300		485,168

Roadway Section Costs (Volume)

	Area (sf)	Depth (ft)	Volume (CY)	Wt (Ton)	Unit Price	Total
Asphalt (Ton)	2,607,778	0.67	64,390	136,506	$ 100.00	$ 13,650,591
Aggregate Base			113,992		$ 78.00	$ 8,891,376
Earthwork					LS	$ 35,681,770

Roadway Section Costs (Area)

	Width (ft)	Length (ft)	Area (sf)	SY	Unit Price	Total
Concrete Median		30,323	-		$ 20.00	$ -
Planted Median		30,323	-		$ 21.50	$ -
Sidewalk		30,323	-		$ 7.00	$ -
Landscape Strip		30,323	-		$ 21.50	$ -
Geotextile Fabric	-	-	-	347,633	$ 1.00	$ 347,633
W.Q. & Detention			156,467		$ 20.00	$ 3,129,334

Roadway Section Costs (Length)

	Length (ft)	No. of Times	Total Length	Unit Price	Total
Curb & Gutter	30,323		-	$ 28.00	$ -
Concrete Curb, Std. Type C	30,323		-	$ 20.00	$ -
Concrete Curb, Low Profile Mountable	30,323	2	60,646	$ 25.00	$ 1,516,150
Concrete Barrier, Permanent	29,380	1	29,380	$ 75.00	$ 2,203,500
Street Trees	30,323	2	60,646	$ 25.00	$ 1,516,150
Street Lights	30,323	2	60,646	$ 40.00	$ 2,425,840
Storm System	30,323	1	30,323	$ 344.45	$ 10,444,757
Joint Trench + PGE	30,323	1	30,323	$ 117.50	$ 3,562,953
Drainageway Crossing, 3 Sided Box Culvert			2,180	$ 300.00	$ 654,000

		Combined Items Subtotal:	$ 84,024,053
Contingency	30%		$ 25,207,216
		Construction Subtotal:	**$ 109,231,270**
Construction Incidentals	15%		$ 16,384,690
		Total Construction Cost	**$ 125,615,960**

Professional Services (Design & Construction)

Capital Project Mgmt. (design & construction)	10.0%	$ 12,561,596
Design Engineering	10.0%	$ 12,561,596
Design Survey	1.5%	$ 1,884,239
Public Involvement	0.5%	$ 628,080
Const. Engineering Support	6.0%	$ 7,536,958
Inspection	5.0%	$ 6,280,798
	Professional Services Total:	**$ 41,453,267**

Right-of-Way

	Area (sf)	Reduce %	Area (sf)	EA	Unit Price	Total
Right-of-Way	3,032,300		3,032,300		$ 10.00	$ 30,323,000
PUE's	485,168		485,168		$ 2.00	$ 970,336
Permanent Slope Easements	746,353		746,353		$ 2.00	$ 1,492,706
Building Removals	-		-	20	$ 300,000.00	$ 6,000,000
					Right-of-Way Subtotal	**$ 38,786,042**

Total Project Cost: $ 205,855,269

Sanitary System

Unit Prices:	$ 350.00	$ 150.00	$ 15,000.00	$ 9,000.00			
	24" PVC	8" PVC	60" Deep MH	48" MH	Subtotal	Total Cost	
US 26 Bypass	0	31,300	0	79	$ 5,406,000	$ 5,406,000	Note: Used 400' spacing for manholes.
					$ -	$ -	
					$ -	$ -	
Total	-	31,300	-	79			

	Length	Width	Area	Unit Price	Total Cost	
Sanitary Easement	0	20	-	$ 2.00	$ -	Note: ROW costs are budgetary only and

Total Sanitary System **$5,406,000**

Domestic Water System

Unit Prices:

8" Ductile Iron Pipe	$ 110.00
Hydrants (incl. laterals)	$ 10,000.00

Assume 1 per 500' (roundup)

	8" DI	Hydrants	Subtotal	Fittings (40%)	Total Cost
US 26 Bypass	31,300	63	$ 4,073,000	$ 1,629,200	$ 5,702,200
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
	0	0	$ -	$ -	$ -
		0	$ -	$ -	$ -

Other Specific Water Items	Length	
XXX		
XXX		
XXX		
XXX		

Total Domestic Water System **$5,702,200**

SECTION 3. FUTURE TRANSPORTATION SYSTEM PERFORMANCE MEMO

FUTURE TRANSPORTATION SYSTEM PERFORMANCE

DATE: June 28, 2021

TO: Project Management Team

FROM: Reah Flisakowski, Dock Rosenthal | DKS Associates

SUBJECT: Sandy Bypass Feasibility Reevaluation P# 20020-007

This memorandum summarizes the future transportation system performance along US 26 through the City of Sandy, Oregon. This assessment generally includes the US 26 segment between the intersections with SE Orient Drive and Firwood Drive at Shorty's Corner. Analyzing the future transportation system performance documents, the expected year 2040 vehicle travel conditions through the City and provides an evaluation of a potential alternative route to US 26 as identified in the 2011 City of Sandy Transportation System Plan. A documentation of future pedestrian, bicycle and transit conditions will be provided as part of the on-going update of the City's Transportation System Plan (TSP).

MOTOR VEHICLE CONDITIONS

Future year 2040 operating conditions for vehicles were assessed using data and findings developed for the existing conditions analysis[1] and available growth pattern data for the study area and US 26. The following sections summarize this analysis.

MOTOR VEHICLE ALTERNATIVES

Future improvement alternatives were previously developed and evaluated as part of the 2011 Sandy TSP[2] to enhance connectivity, provide access to developing lands, and address congestion in the US 26 corridor. The objective for each improvement alternative ranged from relying mainly on management and enhancement of the existing transportation system to large investments in new facilities to increase corridor capacity.

Three of the prior TSP alternatives were carried forward and incorporated into this Sandy Bypass Feasibility Reevaluation, as described in the following sections. Note the prior TSP Alternative #2 – US 26 Widening was not included in this analysis.

[1] Existing Transportation System Performance memo, DKS Associates, April 19, 2021.

[2] Sandy TSP Update, Technical Memo #2: Transportation Alternatives and Improvement Strategies, DKS Associates, February 25, 2011.

2040 NO BUILD ALTERNATIVE

A No Build Alternative would typically be based on the existing system and not include future improvements. However, there are several roadway projects that are fully funded and/or currently in the design phase. It was determined these projects should be included in the No Build Alternative due to the high level of certainty that they will be part of the future system. These projects are listed below. A figure showing the project locations by project ID is provided in the appendix.

- Dubarko Road connection to Champion Way (#2)
- Extend Bell Street to 362nd Avenue (portion of #3)
- Extend 362nd Avenue to Bell Street (portion of #4)
- Extend Dubarko Road to US 26 opposite Vista Loop Drive West (#9)
- Signalized control at the intersection of OR 211 and Dubarko Road and US 26 and Vista Loop Drive (west)/Dubarko extension

2040 ALTERNATIVE #1 – LOCAL SYSTEM ENHANCEMENTS AND MINOR HIGHWAY IMPROVEMENTS

The emphasis of this alternative was to improve overall street connectivity, provide access to lands that would develop in the future, and improve operations on US 26 by enhancing the supporting City street network so that local trips would have less need to travel on US 26.

The future improvement projects included in the 2040 Alternative #1 are listed below. They include roadway and intersection capacity projects. A figure showing the project locations by project ID is provided in the appendix.

Roadway Improvements

- Industrial Way extension to Jarl Road/ US 26 (#1)
- Dubarko Road connection to Champion Way (#2)
- Extend Bell Street to Orient Drive (#3)
- Extend 362nd Drive to Kelso Road (#4)
- Extend Kate Schmidt Street from US 26 to the proposed Bell Street extension (#5)
- Extend Industrial Way north of US 26 to Bell Street Extension (#6)
- Extend Olson Road from 362nd Drive to Jewelberry Avenue (#7)
- Extend Agnes Street to Jewelberry Avenue (#8)
- Extend Dubarko Road to US 26 opposite Vista Loop Drive West (#9)
- Gunderson Road, Sandy Heights St./370th Avenue, Colorado Road, Arletha Court (#10)
- Construct a new road from Dubarko Road to US 26 opposite Vista Loop Drive East (#11)

Intersection Improvements

- US 26/ 362nd Drive - Construct a second westbound left turn lane, receiving lane for second westbound left turn lane, northbound through lane, new southbound leg with through, right turn and left turn lane
- US 26/ Industrial Way – Change southbound approach to dual left turn lanes and a shared through/right lane, construct a northbound left turn lane
- US 26/Ruben Lane - Change southbound approach to dual left turn lanes and a shared through/right lane, change northbound approach to left turn lane, and shared through/right lane
- OR 211/ Proctor Boulevard (US 26) – Construct a northbound left turn lane (restriping only)
- US 26/ Ten Eyck Road/Wolf Drive – Construct a northbound and southbound left turn lane
- US 26/ Vista Loop Drive West – Realign Vista Loop Drive to be perpendicular to US 26
- OR 211/ Dubarko Road - Construct a traffic signal, northbound right turn lane, southbound left turn lane, northbound left turn lane
- OR 211/ Bornstedt Road – Prohibit left turn movements out
- OR 211/ Arletha Court - Realign intersection to create a four-legged intersection with the Gunderson Road extension
- 362nd Drive/ Industrial Way (West) - Construct an eastbound left turn lane with 50 feet of storage
- 362nd Drive/ Dubarko Road - Construct a single-lane roundabout

2040 ALTERNATIVE #3 – LOCAL SYSTEM ENHANCEMENTS AND US 26 BYPASS

Alternative #3 included all the same projects as Alternative #1 but added a bypass of the existing US 26 corridor around the south side of the City from a point west of Orient Drive to approximately Shorty's Corner. A figure showing the high-level conceptual alignment of the bypass (#13) is provided in the appendix.

For the purpose of this analysis, the bypass concept was assumed to have the following design characteristics:

- Four-lane facility (two lanes in each direction)
- 45 mph posted speed and 50 mph design speed
- Limited access facility
    - interchange at the east and west end connections with US 26
    - at-grade intersection at OR 211 controlled by a traffic signal or roundabout
    - remaining key street intersections limited to right-in/right-out

The bypass conceptual alignment and design characteristics will be further refined during the next phase of the analysis, the Bypass Benefit Cost Analysis.

MOTOR VEHICLE OPERATIONS

FUTURE FORECASTING

Traffic forecasts for each of the future 2040 alternatives were developed using a combination of available data and prior modeling analysis and findings. The forecasts relied on recent year 2020 intersection counts[3], year 2029 analysis from the 2011 Sandy TSP and ODOT Volume Tables. The forecasts were developed for the TSP study intersections and focused on the peak hour. Future volumes can be found in the operation reports in the appendix.

Future 2040 No Build Alternative forecasts were based on the 2020 count data and growth rates available from the 2029 forecasts. The addition of the Alternative #1 improvements would result in moderate changes to local travel patterns with better connectivity and intersection capacity. The 2040 No Build Alternative forecasts were refined to represent the 2040 Alternative #1 using growth rates available from the 2029 forecasts.

The addition of the bypass would result in significant changes to regional travel patterns. Future 2040 Alternative #3 forecasts were developed using the Alternative #1 volumes, growth rates available from the 2029 forecasts and current travel pattern data.

A travel pattern analysis was completed using StreetLight data which provided information on where vehicle trips are coming from through the City, how much delay these trips experience and how long it takes them to make their trip. The data showed the proposed bypass would attract up to 28% of the total US 26 traffic during the peak hour. For a conservative analysis and for alignment with the 2011 Sandy TSP findings, the forecasting assumed 40% of the total US 26 traffic would divert to the bypass.

The 2040 Alternative #1 volumes were adjusted to account for use of the US 26 bypass to develop 2040 Alternative #3 volumes. US 26 is forecasted to serve approximately 3,800 vehicles during the peak hour under the 2040 No Build Alternative. Under the 2040 Alternative #3, US 26 is forecasted to serve approximately 2,300 vehicles and the bypass is forecasted to serve approximately 1,500 vehicles during the peak hour.

JURISDICTIONAL MOBILITY STANDARDS

The mobility standards for intersections vary according to the agency of jurisdiction for each intersection. Five of the study intersections are under City jurisdiction (362nd Drive/Industrial Way – North and South, Bluff Road/Bell Street, OR 211/Bornstedt, and OR 211/Dubarko) while the remaining 11 intersections are under ODOT jurisdiction. Current ODOT mobility targets require a volume to capacity ratio between 0.80 and 0.90 or less to be maintained at study intersections (see Table 2) and the City of Sandy operating standards require that a level of service "D" or better

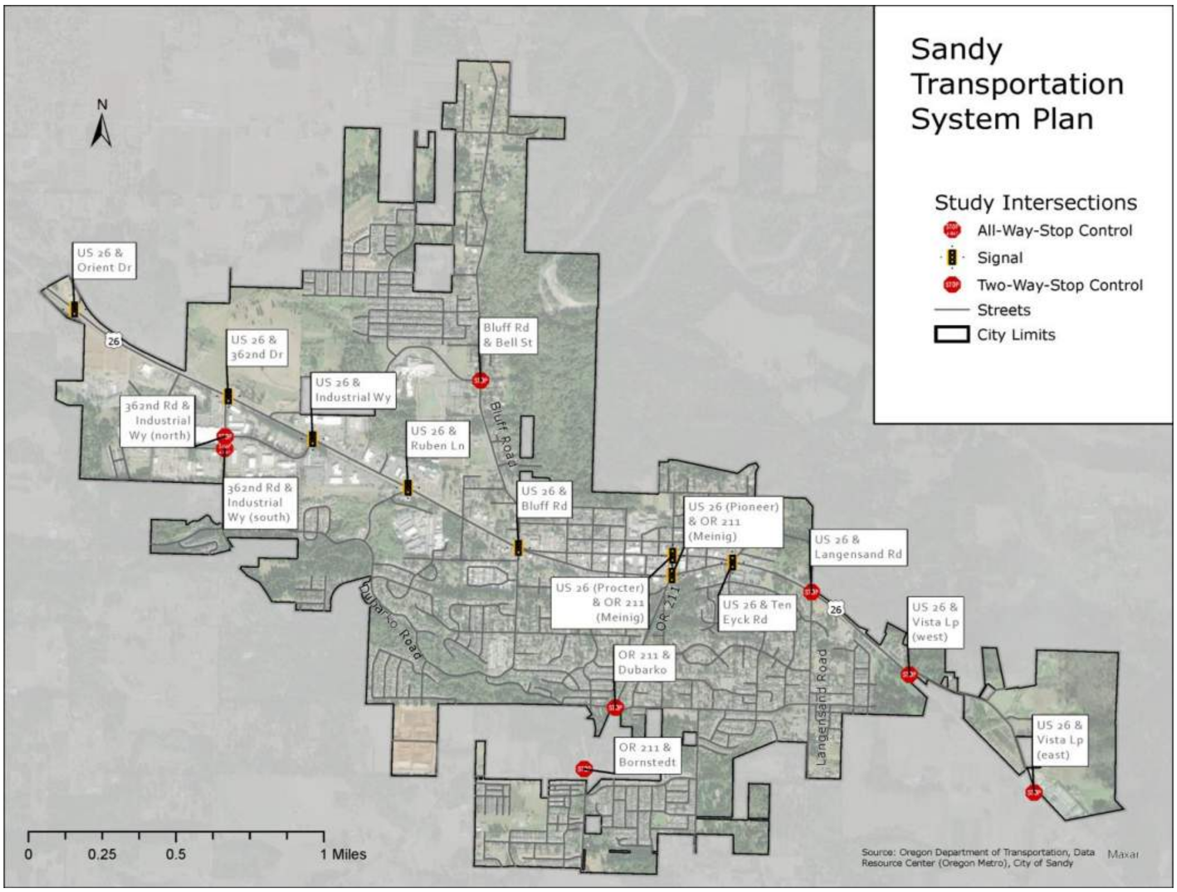
[3] Traffic counts were collected on October 22, 2020.

be maintained for any signalized intersection and unsignalized intersections with stop control on the minor approach[4].

FUTURE INTERSECTION OPERATIONS

Motor vehicle conditions were evaluated for the 2040 peak hour at the 16 study intersections under each of the future improvement alternatives. The evaluation utilized the Highway Capacity Manual (HCM) 6th Edition methodology. The detailed intersection operation reports are shown in the appendix.

FIGURE 1: STUDY INTERSECTIONS WITH EXISTING CONTROL



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[4] City of Sandy Transportation System Plan, DKS Associates, 2011.

2040 No Build

As shown in Table 1, eight intersections are forecasted to exceed mobility targets.

- **US 26 and Orient Drive** – The eastbound through movement at this intersection requires more capacity but is limited by the split phasing for Orient Drive/Jarl Road which serves a high southbound left turn volume with only a single approach lane.
- **US 26 and 362nd Drive** – More capacity is needed for the eastbound and westbound left and through movements at this intersection but green time for those movements is limited by the split phasing of the northbound and southbound approaches.
- **US 26 and Industrial Way** – The eastbound through movement and northbound approach are both over capacity at this intersection. The split phasing of the northbound and southbound approaches also limits the green time available to the US 26 movements.
- **362nd Drive and Industrial Way (north)** – High northbound and southbound volumes result in limited gaps for the Industrial Way approach at this two-way-stop-controlled intersection.
- **362nd Drive and Industrial Way (south)** – High traffic volumes at all approaches result in long delays for all movements at this all-way-stop-controlled intersection.
- **US 26 and Ruben Lane** - The eastbound through movement and southbound approach are both over capacity at this intersection. The split phasing of the northbound and southbound approaches also limits the green time available to the US 26 movements.
- **US 26 and Bluff Road** – The eastbound left and through, westbound left and through, and northbound left movements are all over capacity at this intersection.
- **OR 211 and Bornstedt Road** - High eastbound and westbound volumes result in limited gaps for the Bornstedt Road approach at this two-way-stop-controlled intersection.

TABLE 1: 2040 NO BUILD INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	F	134	**1.19**
US 26/362ND DRIVE	Signal	ODOT	0.80	F	121	**1.16**
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	E	74	**1.10**
362ND DRIVE/ INDUSTRIAL WAY (NORTH)	TWSC[b]	City of Sandy	D	**B [F]**	11 [117]	0.49 [0.94]
362ND DRIVE/ INDUSTRIAL WAY (SOUTH)	AWSC	City of Sandy	D	**F**	214	1.43
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	C	35	**0.97**
US 26/BLUFF ROAD	Signal	ODOT	0.85	F	112	**1.12**
BLUFF ROAD/BELL STREET	TWSC	City of Sandy	D	A [C]	9 [23]	0.29 [0.09]
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	30	0.81
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	32	0.84
OR 211/ DUBARKO ROAD	Signal	City of Sandy	D	C	21	0.81
OR 211/BORNSTEDT ROAD	TWSC	City of Sandy	D	**A [F]**	10 [240]	0.35 [1.32]
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	29	0.80
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	C [F]	16 [>300]	0.48 [0.91]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	C	25	0.66
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	B [F]	12 [117]	0.48 [0.25]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

2040 Alternative #1

The improvements included in Alternative 1 were analyzed to assess operation benefits at the study intersections resulting from new system network and added capacity. Two intersections that did not meet mobility targets will do so with the improvements in Alternative #1.

- The intersection of US 26 and Industrial Way meets mobility targets with a reduction in demand at the eastbound, westbound and northbound approaches.
- The intersection of OR 211 and Bornstedt Road meets mobility targets with the prohibition of the northbound left turn movement.

Operations under Alternative #1 conditions are show in Table 2. With the new local network connections north of US 26, particularly the Bell Street extension to Orient Drive, through volumes along US 26 are reduced in Alternative #1 which results in improvements to the operation of intersections along the highway.

Six intersections still fail to meet mobility targets under Alternative #1.

- **US 26 and Orient Drive** – There is a higher eastbound left traffic volume and lower eastbound through volume relative to the No Build condition however this reduction does not improve conditions enough for this intersection to meet mobility targets.
- **US 26 and 362nd Drive** – Lower traffic volumes for the eastbound and westbound approaches improve conditions at this intersection but it still fails to meet mobility targets.
- **362nd Drive and Industrial Way (north)** – With an additional southbound through lane that widens this intersection and increased traffic volumes, conditions remain LOS F for the Industrial Way approach.
- **362nd Drive and Industrial Way (south)** – The eastbound left turn lane improves conditions for that approach, but higher northbound and southbound volumes degrade conditions for the major approaches.
- **US 26 and Ruben Lane** - Lower traffic volumes for the eastbound and westbound approaches improve conditions at this intersection but it still fails to meet mobility targets.
- **US 26 and Bluff Road** – Lower traffic volumes for the eastbound left and through and westbound through movements improve conditions at this intersection but it still fails to meet mobility targets.

TABLE 2: 2040 ALTERNATIVE #1 INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	F	134	**1.11**
US 26/362ND DRIVE	Signal	ODOT	0.80	D	41	**1.00**
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	D	18	0.79
362ND DRIVE/ INDUSTRIAL WAY (NORTH)	TWSC[b]	City of Sandy	D	**A [F]**	10 [107]	0.46 [1.04]
362ND DRIVE/ INDUSTRIAL WAY (SOUTH)	AWSC	City of Sandy	D	**F**	>300	1.52
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	D	48	**0.84**
US 26/BLUFF ROAD	Signal	ODOT	0.85	E	73	**0.86**
BLUFF ROAD/BELL STREET	TWSC	City of Sandy	D	A [C]	8 [16]	0.24 [0.10]
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	32	0.80
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	27	0.72
OR 211/ DUBARKO RD	Signal	City of Sandy	D	B	16	0.68
OR 211/BORNSTEDT ROD	TWSC	City of Sandy	D	B [B]	11 [15]	0.5 [0.04]
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	28	0.73
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	C [F]	18 [>300]	0.51 [1.21]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	B	17	0.61
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	B [F]	12 [121]	0.48 [0.26]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

Alternative #3

The improvements included in Alternative 1, combined with the bypass of the existing US 26 corridor, were analyzed to assess operation benefits at the study intersections. Because the impacts on the City street network will vary significantly with the locations and types of access allowed to the bypass, only the US 26 corridor intersections were evaluated to see how much the bypass could relieve congestion.

As shown in Table 3, with the addition of a US 26 bypass only the intersection of US 26 and Orient Drive would exceed mobility targets. The eastbound through and southbound left movements at this intersection continue to compete for available green time in the cycle even with the addition of the bypass.

TABLE 3: 2040 ALTERNATIVE #3 INTERSECTION OPERATIONS (PEAK HOUR)

STUDY INTERSECTION	CONTROL TYPE	JURISDICTION	MOBILITY TARGET	LEVEL OF SERVICE	DELAY (SECONDS)	V/C RATIO
US 26/ORIENT DRIVE	Signal	ODOT	0.80	C	32	**0.83**
US 26/362ND DRIVE	Signal	ODOT	0.80	C	34	0.76
US 26/INDUSTRIAL WAY	Signal[a]	ODOT	0.80	C	22	0.56
US 26/RUBEN LANE	Signal[a]	ODOT	0.80	C	31	0.65
US 26/BLUFF ROAD	Signal	ODOT	0.85	D	42	0.64
PIONEER BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	27	0.59
PROCTOR BOULEVARD (US 26)/MEINIG AVENUE (OR 211)	Signal	ODOT	0.90	C	29	0.67
US 26/TEN EYCK ROAD	Signal	ODOT	0.85	C	26	0.54
US 26/LANGENSAND ROAD	TWSC	ODOT	0.80	B [D]	10 [33]	0.25 [0.17]
US 26/VISTA LOOP DRIVE W	Signal	ODOT	0.80	A	4	0.48
US 26/VISTA LOOP DRIVE E	TWSC	ODOT	0.80	A [F]	10 [62]	0.28 [0.14]

a. This signal reported using HCM 2000 due to non-standard characteristics.

b. Two-way Stop Controlled (TWSC) measures are reported as worst major [worst minor] approach for LOS and Delay and as worst movement for V/C.

MOTOR VEHICLE TRAVEL TIME ESTIMATES

The US 26 bypass is expected to serve a moderate future volume and improve traffic flow on US 26 through Sandy. It was estimated that approximately 1,500 vehicles per hour would use the bypass during the year 2040 peak hour. Approximately 60% of the bypass users during the peak hour would be through traffic with no origin or destination in Sandy, while the other 40% would be comprised of local trips accessing the southern end of Sandy.

As an additional measure for evaluating the effectiveness of each alternative, travel times along US 26 through the study area were estimated. Table 4 shows the travel time estimates for each alternative. Improvements in travel times among the alternatives are generally consistent with the improvements shown for intersection operations, with the provision of a bypass in Alternative #3 resulting in moderate reductions in through travel time.

TABLE 4: ESTIMATED US 26 CORRIDOR TRAVEL TIMES (PEAK HOUR)

ALTERNATIVE		TRAVEL TIME EASTBOUND (MM:SS)	TRAVEL TIME WESTBOUND (MM:SS)
2020 EXISTING		09:36	09:54
2040 NO BUILD		16:49	14:26
2040 ALTERNATIVE #1		13:18	10:15
2040 ALTERNATIVE #3	US 26 FACILITY	08:54	10:19
	BYPASS FACILITY	07:56	07:56

BYPASS FACILITY CROSS-SECTION CONSIDERATION

The expected 2040 peak hour volumes using the bypass suggest the facility could adequately accommodate demands with a narrower cross-section providing 2 lanes (one in each direction). The highest 2040 volume on the bypass is not expected to exceed 1,000 vehicles in either direction. If the bypass concept was reduced to a 2- lane facility, the connection with OR 211 may require a full interchange instead of an at-grade intersection with traffic signal or roundabout control. The analysis and findings in this future conditions memo would not change since free-flow operations are expected on the bypass with either 2 or 4 lanes and the same future volumes would be served. Both cross-sections options will be considered and further refined during the next phase of the analysis, the Bypass Benefit Cost Analysis.

SUMMARY

The future conditions findings from this analysis will contribute to the content and analysis in subsequent memoranda including the Benefit Cost Analysis Memorandum and the Sandy Bypass Feasibility Reevaluation Report.

Key findings from the future conditions alternative analysis include:

- Under the 2040 No Build Alternative, 8 study intersections (4 on US 26) would exceed mobility targets.
- The addition of local connections and intersection improvements under 2040 Alternative #1, 6 study intersections (4 on US 26) would continue to exceed mobility targets.
- Adding the bypass under Alternative #3 would improve traffic operations, only one study intersection would continue to exceed mobility targets (US 26 and Orient Drive)
- Approximately 1,500 vehicles an hour would use the bypass during the 2040 peak hour.
- Approximately 60% of bypass users during peak periods would represent through trips, 40% would be local trips accessing the southern end of Sandy.
- Compared to the 2040 No Build Alternative, the addition of local connections and intersection improvements under 2040 Alternative #1 would decrease travel times on US 26 approximately 3 minutes 30 seconds eastbound and 4 minutes westbound
- Compared to the 2040 No Build Alternative, the addition of the bypass under 2040 Alternative #3 would decrease travel times on US 26 approximately 8 minutes eastbound and 4 minutes westbound
- Under Alternative #3, the bypass would save travel time through the study area compared to US 26 (1 minute eastbound and 2 minutes 30 seconds westbound)

APPENDIX

CONTENTS

DKS

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SECTION 1. FUTURE ROADWAY

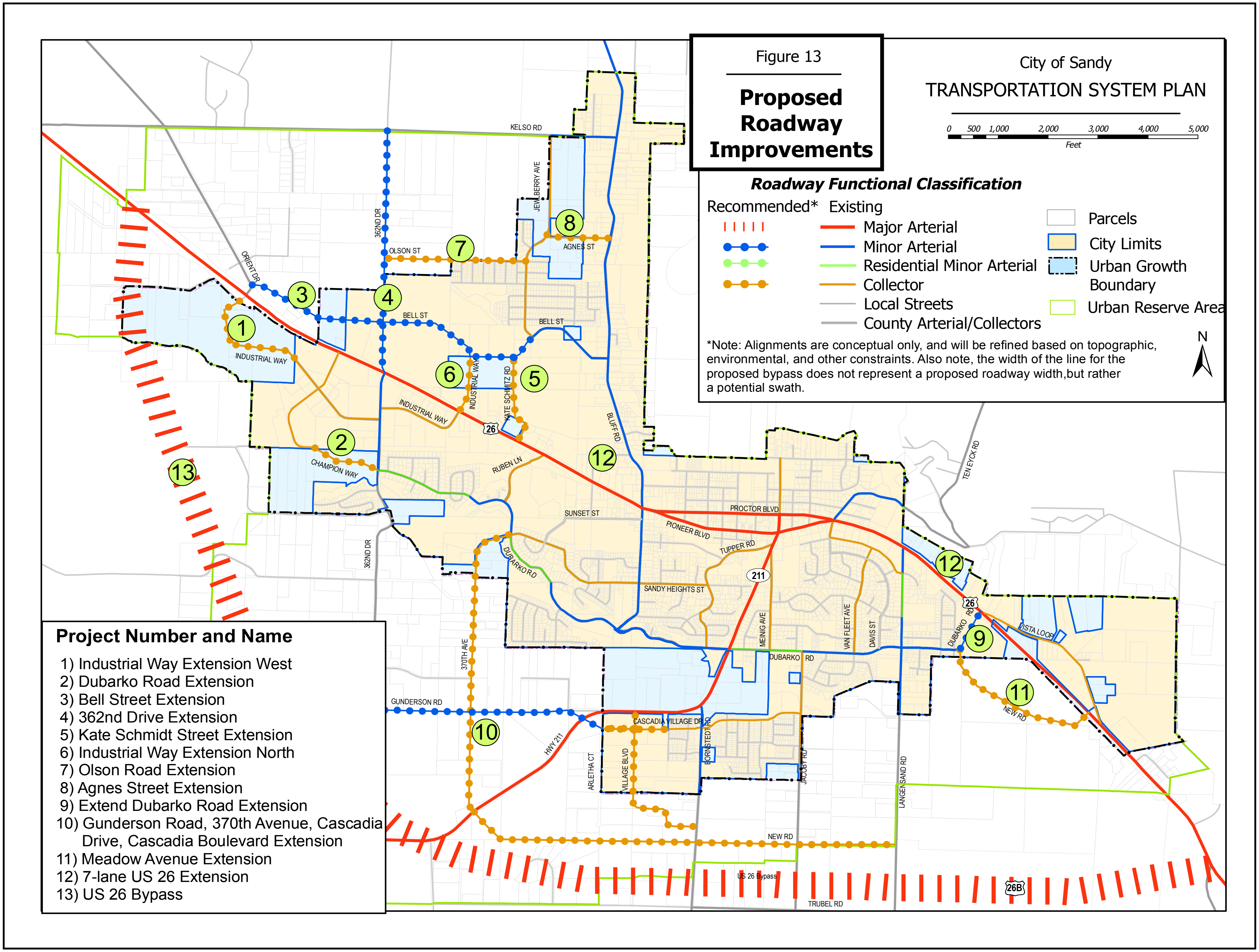
Figure 13
Proposed Roadway Improvements
City of Sandy
TRANSPORTATION SYSTEM PLAN
0 500 1,000 2,000 3,000 4,000 5,000
Feet
Roadway Functional Classification
Recommended* Existing
Major Arterial
Minor Arterial
Residential Minor Arterial
Collector
Local Streets
County Arterial/Collectors
Parcels
City Limits
Urban Growth Boundary
Urban Reserve Area
*Note: Alignments are conceptual only, and will be refined based on topographic, environmental, and other constraints. Also note, the width of the line for the proposed bypass does not represent a proposed roadway width,but rather a potential swath.
N
Project Number and Name
1) Industrial Way Extension West
2) Dubarko Road Extension
3) Bell Street Extension
4) 362nd Drive Extension
5) Kate Schmidt Street Extension
6) Industrial Way Extension North
7) Olson Road Extension
8) Agnes Street Extension
9) Extend Dubarko Road Extension
10) Gunderson Road, 370th Avenue, Cascadia Drive, Cascadia Boulevard Extension
11) Meadow Avenue Extension
12) 7-lane US 26 Extension
13) US 26 Bypass
KELSO RD
362ND DR
OLSON ST
ORIENT DR
JEWELBERRY AVE
AGNES ST
BELL ST
INDUSTRIAL WAY
KATE SCHMITZ RD
CHAMPION WAY
RUBEN LN
BLUFF RD
SUNSET ST
PROCTOR BLVD
PIONEER BLVD
TUPPER RD
TEN EYCK RD
DUBARKO RD
SANDY HEIGHTS ST
MEINIG AVE
VAN FLEET AVE
DAVIS ST
VISTA LOOP
NEW RD
370TH AVE
GUNDERSON RD
HWY 211
CASCADIA VILLAGE DR
ARLETHA CT
VILLAGE BLVD
BORNSTEDT RD
JACOBY RD
LANGENSAND RD
US 26 Bypass
TRUBEL RD
26
211
26B

SECTION 2. FUTURE CONDITION HCM REPORTS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	2520	5	10	1750	225	10	50	10	260	10	20
Future Volume (veh/h)	60	2520	5	10	1750	225	10	50	10	260	10	20
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	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	63	2653	5	11	1842	0	11	53	11	274	11	21
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, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	81	1907	850	65	1847		14	69	14	288	12	22
Arrive On Green	0.05	0.57	0.57	0.04	0.56	0.00	0.07	0.06	0.07	0.19	0.19	0.19
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	227	1096	227	1501	60	115
Grp Volume(v), veh/h	63	2653	5	11	1842	0	75	0	0	306	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1551	0	0	1676	0	0
Q Serve(g_s), s	4.2	65.0	0.2	0.7	63.6	0.0	5.5	0.0	0.0	20.7	0.0	0.0
Cycle Q Clear(g_c), s	4.2	65.0	0.2	0.7	63.6	0.0	5.5	0.0	0.0	20.7	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.15		0.15	0.90		0.07
Lane Grp Cap(c), veh/h	81	1907	850	65	1847		98	0	0	321	0	0
V/C Ratio(X)	0.78	1.39	0.01	0.17	1.00		0.76	0.00	0.00	0.95	0.00	0.00
Avail Cap(c_a), veh/h	81	1907	850	80	1847		101	0	0	321	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	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	54.0	24.9	10.8	53.3	25.3	0.0	52.8	0.0	0.0	45.9	0.0	0.0
Incr Delay (d2), s/veh	35.6	179.5	0.0	0.7	20.2	0.0	24.9	0.0	0.0	37.6	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	2.5	69.1	0.1	0.3	26.1	0.0	2.8	0.0	0.0	12.0	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	89.7	204.4	10.8	54.1	45.5	0.0	77.7	0.0	0.0	83.5	0.0	0.0
LnGrp LOS	F	F	B	D	D		E	A	A	F	A	A
Approach Vol, veh/h		2721			1853	A		75			306	
Approach Delay, s/veh		201.3			45.6			77.7			83.5	
Approach LOS		F			D			E			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.5	68.0		26.0	8.5	69.0		11.3				
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5				
Max Green Setting (Gmax), s	5.0	61.0		21.0	5.0	61.0		7.0				
Max Q Clear Time (g_c+I1), s	6.2	65.6		22.7	2.7	67.0		7.5				
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.0				

Intersection Summary			
HCM 6th Ctrl Delay			133.9
HCM 6th LOS			F

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
3: 362nd Dr & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	300	1600	420	265	1525	340	335	150	325	150	175	170
Future Volume (veh/h)	300	1600	420	265	1525	340	335	150	325	150	175	170
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	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	316	1684	442	279	1605	358	353	158	342	158	184	179
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, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	198	1243	884	258	1397	820	761	402	343	236	248	210
Arrive On Green	0.08	0.37	0.36	0.16	0.56	0.54	0.23	0.23	0.23	0.14	0.14	0.14
Sat Flow, veh/h	1688	3367	1502	1661	3313	1502	3300	1772	1512	1688	1772	1502
Grp Volume(v), veh/h	316	1684	442	279	1605	358	353	158	342	158	184	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1502	1650	1772	1512	1688	1772	1502
Q Serve(g_s), s	11.0	48.0	22.3	15.8	54.8	15.9	12.0	9.8	29.4	11.6	13.0	15.1
Cycle Q Clear(g_c), s	11.0	48.0	22.3	15.8	54.8	15.9	12.0	9.8	29.4	11.6	13.0	15.1
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	198	1243	884	258	1397	820	761	402	343	236	248	210
V/C Ratio(X)	1.59	1.35	0.50	1.08	1.15	0.44	0.46	0.39	1.00	0.67	0.74	0.85
Avail Cap(c_a), veh/h	198	1243	884	258	1397	820	761	402	343	376	395	335
HCM Platoon Ratio	1.00	1.00	1.00	1.33	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.20	0.20	0.20	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.3	41.0	15.6	52.8	28.5	13.2	43.1	42.7	50.2	53.1	53.7	54.6
Incr Delay (d2), s/veh	290.0	165.0	2.0	50.9	68.8	0.3	0.3	0.4	47.8	2.4	3.3	9.5
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	20.4	47.0	12.5	11.3	30.1	6.0	4.9	4.3	15.5	5.1	6.0	6.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	327.3	206.0	17.6	103.7	97.4	13.5	43.3	43.0	98.0	55.5	56.9	64.1
LnGrp LOS	F	F	B	F	F	B	D	D	F	E	E	E
Approach Vol, veh/h		2442			2242			853			521	
Approach Delay, s/veh		187.6			84.8			65.2			59.0	
Approach LOS		F			F			E			E	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	21.8	52.0		22.2	15.0	58.8		34.0
Change Period (Y+Rc), s	6.0	* 6		4.0	4.0	6.0		4.5
Max Green Setting (Gmax), s	7.0	* 46		29.0	11.0	42.0		29.5
Max Q Clear Time (g_c+I1), s	17.8	50.0		17.1	13.0	56.8		31.4
Green Ext Time (p_c), s	0.0	0.0		1.0	0.0	0.0		0.0

Intersection Summary	
HCM 6th Ctrl Delay	121.2
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	65	1945	5	25	1795	50	170	35	250	230	15	170
Future Volume (vph)	65	1945	5	25	1795	50	170	35	250	230	15	170
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0		4.0		4.0	4.0	4.0
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00		1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85		0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (prot)	1676	3316		1644	3358	1471		1620		1624	1638	1508
Flt Permitted	0.06	1.00		0.06	1.00	1.00		0.98		0.95	0.96	1.00
Satd. Flow (perm)	100	3316		101	3358	1471		1620		1624	1638	1508
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	66	1985	5	26	1832	51	173	36	255	235	15	173
RTOR Reduction (vph)	0	0	0	0	0	23	0	33	0	0	0	112
Lane Group Flow (vph)	66	1990	0	26	1832	28	0	431	0	125	125	61
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						4
Actuated Green, G (s)	74.3	70.3		71.1	68.7	68.7		22.6		17.3	17.3	17.3
Effective Green, g (s)	75.3	71.7		71.1	70.1	70.1		22.6		17.3	17.3	17.3
Actuated g/C Ratio	0.58	0.55		0.55	0.54	0.54		0.17		0.13	0.13	0.13
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4		4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4		3.0		2.3	2.3	2.3
Lane Grp Cap (vph)	112	1828		83	1810	793		281		216	217	200
v/s Ratio Prot	c0.02	c0.60		0.01	0.55			c0.27		c0.08	0.08	
v/s Ratio Perm	0.32			0.16		0.02						0.04
v/c Ratio	0.59	1.09		0.31	1.01	0.03		1.53		0.58	0.58	0.31
Uniform Delay, d1	56.5	29.1		59.7	30.0	14.1		53.7		52.9	52.9	50.9
Progression Factor	0.43	0.45		0.79	0.67	2.57		1.00		1.00	1.00	1.00
Incremental Delay, d2	2.8	45.0		0.8	19.5	0.0		257.3		2.8	2.7	0.5
Delay (s)	27.4	58.1		47.8	39.4	36.2		311.0		55.7	55.6	51.4
Level of Service	C	E		D	D	D		F		E	E	D
Approach Delay (s)		57.1			39.5			311.0			53.9	
Approach LOS		E			D			F			D	

Intersection Summary			
HCM 2000 Control Delay	74.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	102.9%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	175	2045	195	45	1650	100	120	35	40	270	35	135
Future Volume (vph)	175	2045	195	45	1650	100	120	35	40	270	35	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.94	1.00	1.00	*0.97	1.00		1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.97		1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1676	3318	1467	1644	3358	1432		1682	1461	1624	1646	1506
Flt Permitted	0.07	1.00	1.00	0.06	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (perm)	132	3318	1467	96	3358	1432		1682	1461	1624	1646	1506
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	177	2066	197	45	1667	101	121	35	40	273	35	136
RTOR Reduction (vph)	0	0	40	0	0	36	0	0	34	0	0	126
Lane Group Flow (vph)	177	2066	157	45	1667	65	0	156	6	153	155	10
Confl. Peds. (#/hr)			1			3	1		4	4		1
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	0%	0%	0%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases	2		2	6		6		8	8			4
Actuated Green, G (s)	81.5	80.1	80.1	75.5	75.5	75.5		19.3	19.3	10.0	10.0	10.0
Effective Green, g (s)	81.5	81.5	81.5	75.5	76.9	76.9		19.3	19.3	10.0	10.0	10.0
Actuated g/C Ratio	0.63	0.63	0.63	0.58	0.59	0.59		0.15	0.15	0.08	0.08	0.08
Clearance Time (s)	4.0	5.4	5.4	4.0	5.4	5.4		4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.3	5.4	5.4	2.3	5.4	5.4		2.3	2.3	2.3	2.3	2.3
Lane Grp Cap (vph)	175	2080	919	93	1986	847		249	216	124	126	115
v/s Ratio Prot	0.06	c0.62		0.01	c0.50			c0.09		c0.09	0.09	
v/s Ratio Perm	c0.57		0.11	0.27		0.05			0.00			0.01
v/c Ratio	1.01	0.99	0.17	0.48	0.84	0.08		0.63	0.03	1.23	1.23	0.09
Uniform Delay, d1	42.5	24.0	10.1	30.2	21.5	11.4		52.0	47.3	60.0	60.0	55.8
Progression Factor	0.66	0.41	0.29	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	23.3	4.6	0.0	2.3	4.5	0.2		3.9	0.0	156.7	154.7	0.2
Delay (s)	51.1	14.5	2.9	32.5	26.0	11.5		55.9	47.4	216.7	214.7	56.0
Level of Service	D	B	A	C	C	B		E	D	F	F	E
Approach Delay (s)		16.2			25.4			54.2			166.8	
Approach LOS		B			C			D			F	

Intersection Summary			
HCM 2000 Control Delay	34.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	285	1910	155	95	1430	245	145	55	120	155	45	255
Future Volume (veh/h)	285	1910	155	95	1430	245	145	55	120	155	45	255
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		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	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	291	1949	158	97	1459	250	148	56	122	158	46	260
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	247	1681	748	75	1150	572	139	78	170	250	53	299
Arrive On Green	0.15	0.50	0.50	0.05	0.39	0.39	0.08	0.16	0.16	0.15	0.23	0.23
Sat Flow, veh/h	1688	3367	1499	1647	2941	1464	1701	493	1075	1701	232	1313
Grp Volume(v), veh/h	291	1949	158	97	1459	250	148	0	178	158	0	306
Grp Sat Flow(s),veh/h/ln	1688	1683	1499	1647	1470	1464	1701	0	1569	1701	0	1546
Q Serve(g_s), s	16.1	54.9	6.5	5.0	43.0	13.8	9.0	0.0	11.8	9.6	0.0	20.9
Cycle Q Clear(g_c), s	16.1	54.9	6.5	5.0	43.0	13.8	9.0	0.0	11.8	9.6	0.0	20.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.69	1.00		0.85
Lane Grp Cap(c), veh/h	247	1681	748	75	1150	572	139	0	248	250	0	352
V/C Ratio(X)	1.18	1.16	0.21	1.30	1.27	0.44	1.06	0.00	0.72	0.63	0.00	0.87
Avail Cap(c_a), veh/h	247	1681	748	75	1150	572	139	0	428	250	0	422
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)	0.13	0.13	0.13	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	46.9	27.5	15.4	52.5	33.5	24.6	50.5	0.0	43.8	44.1	0.0	40.7
Incr Delay (d2), s/veh	85.1	72.7	0.1	202.2	128.1	2.4	94.2	0.0	2.4	4.4	0.0	14.3
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	12.4	37.1	2.2	6.3	35.5	5.2	7.5	0.0	4.8	4.4	0.0	9.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	132.0	100.2	15.5	254.7	161.6	27.0	144.7	0.0	46.2	48.5	0.0	54.9
LnGrp LOS	F	F	B	F	F	C	F	A	D	D	A	D
Approach Vol, veh/h		2398			1806			326			464	
Approach Delay, s/veh		98.5			148.0			90.9			52.7	
Approach LOS		F			F			F			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.0	58.9	13.0	29.1	20.9	47.0	20.7	21.4
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.8	* 4	4.5	* 4.5
Max Green Setting (Gmax), s	5.0	49.2	9.0	29.5	12.0	* 43	9.0	* 30
Max Q Clear Time (g_c+I1), s	7.0	56.9	11.0	22.9	18.1	45.0	11.6	13.8
Green Ext Time (p_c), s	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.6

Intersection Summary	
HCM 6th Ctrl Delay	111.7
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	55	100	465	405	5
Future Vol, veh/h	5	55	100	465	405	5
Conflicting Peds, #/hr	1	1	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	180	0	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	5	58	105	489	426	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1131	432	433	0	-	0
Stage 1	431	-	-	-	-	-
Stage 2	700	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.11	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.209	-	-	-
Pot Cap-1 Maneuver	223	619	1132	-	-	-
Stage 1	651	-	-	-	-	-
Stage 2	489	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	201	617	1130	-	-	-
Mov Cap-2 Maneuver	201	-	-	-	-	-
Stage 1	589	-	-	-	-	-
Stage 2	488	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.4	1.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1130	-	201	617	-	-
HCM Lane V/C Ratio	0.093	-	0.026	0.094	-	-
HCM Control Delay (s)	8.5	0	23.4	11.4	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0.3	-	0.1	0.3	-	-

Intersection						
Int Delay, s/veh	10.9					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	55	80	575	210	190	530
Future Vol, veh/h	55	80	575	210	190	530
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	125	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	58	84	605	221	200	558

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1674	718	0	0	826	0
Stage 1	716	-	-	-	-	-
Stage 2	958	-	-	-	-	-
Critical Hdwy	6.44	6.24	-	-	4.13	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	-	-	2.227	-
Pot Cap-1 Maneuver	104	426	-	-	800	-
Stage 1	481	-	-	-	-	-
Stage 2	369	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	78	425	-	-	800	-
Mov Cap-2 Maneuver	78	-	-	-	-	-
Stage 1	481	-	-	-	-	-
Stage 2	277	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	116.9	0	2.9
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	151	800	-
HCM Lane V/C Ratio	-	-	0.941	0.25	-
HCM Control Delay (s)	-	-	116.9	11	-
HCM Lane LOS	-	-	F	B	-
HCM 95th %tile Q(veh)	-	-	6.8	1	-

Intersection	
Intersection Delay, s/veh	133.5
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	180	230	125	605	555	30
Future Vol, veh/h	180	230	125	605	555	30
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles, %	0	0	1	1	1	1
Mvmt Flow	189	242	132	637	584	32
Number of Lanes	1	0	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	1	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	1
HCM Control Delay	35.2	214.3	101.6
HCM LOS	E	F	F

Lane	NBLn1	EBLn1	SBLn1
Vol Left, %	17%	44%	0%
Vol Thru, %	83%	0%	95%
Vol Right, %	0%	56%	5%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	730	410	585
LT Vol	125	180	0
Through Vol	605	0	555
RT Vol	0	230	30
Lane Flow Rate	768	432	616
Geometry Grp	1	1	1
Degree of Util (X)	1.407	0.809	1.116
Departure Headway (Hd)	6.863	7.495	7.139
Convergence, Y/N	Yes	Yes	Yes
Cap	538	488	511
Service Time	4.863	5.495	5.139
HCM Lane V/C Ratio	1.428	0.885	1.205
HCM Control Delay	214.3	35.2	101.6
HCM Lane LOS	F	E	F
HCM 95th-tile Q	34.7	7.6	18.6

HCM 6th Signalized Intersection Summary
13: Hwy 211 & US 26/Procter Blvd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	175	1375	15	270	45	0	0	65	40
Future Volume (veh/h)	0	0	0	175	1375	15	270	45	0	0	65	40
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.99	1.00		1.00	1.00		0.99
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				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				184	1447	16	284	47	0	0	68	42
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				205	1702	20	422	60	0	0	362	224
Arrive On Green				0.56	0.56	0.56	0.35	0.35	0.00	0.00	0.35	0.35
Sat Flow, veh/h				366	3034	35	1018	169	0	0	1022	631
Grp Volume(v), veh/h				861	0	786	331	0	0	0	0	110
Grp Sat Flow(s),veh/h/ln				1712	0	1723	1187	0	0	0	0	1653
Q Serve(g_s), s				48.9	0.0	40.5	24.4	0.0	0.0	0.0	0.0	5.1
Cycle Q Clear(g_c), s				48.9	0.0	40.5	29.4	0.0	0.0	0.0	0.0	5.1
Prop In Lane				0.21		0.02	0.86		0.00	0.00		0.38
Lane Grp Cap(c), veh/h				960	0	967	482	0	0	0	0	586
V/C Ratio(X)				0.90	0.00	0.81	0.69	0.00	0.00	0.00	0.00	0.19
Avail Cap(c_a), veh/h				980	0	987	482	0	0	0	0	586
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	0.00	1.00	0.79	0.00	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				21.3	0.0	19.5	34.7	0.0	0.0	0.0	0.0	24.5
Incr Delay (d2), s/veh				12.8	0.0	7.5	6.2	0.0	0.0	0.0	0.0	0.1
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				22.0	0.0	17.5	8.9	0.0	0.0	0.0	0.0	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				34.1	0.0	26.9	40.9	0.0	0.0	0.0	0.0	24.7
LnGrp LOS				C	A	C	D	A	A	A	A	C
Approach Vol, veh/h					1647			331			110	
Approach Delay, s/veh					30.7			40.9			24.7	
Approach LOS					C			D			C	

Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				43.0		65.7		43.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				39.0		63.0		39.0				
Max Q Clear Time (g_c+I1), s				7.1		50.9		31.4				
Green Ext Time (p_c), s				0.3		10.8		0.9				

Intersection Summary			
HCM 6th Ctrl Delay			32.0
HCM 6th LOS			C

HCM 6th Signalized Intersection Summary
14: Hwy 211 & Pioneer Blvd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	1535	555	0	0	0	0	240	245	40	210	0
Future Volume (veh/h)	75	1535	555	0	0	0	0	240	245	40	210	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	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
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	79	1616	0				0	253	258	42	221	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	97	2082					0	403	334	52	498	0
Arrive On Green	0.63	0.63	0.00				0.00	0.23	0.23	0.01	0.10	0.00
Sat Flow, veh/h	153	3294	1502				0	1772	1470	1647	1730	0
Grp Volume(v), veh/h	908	787	0				0	253	258	42	221	0
Grp Sat Flow(s),veh/h/ln	1764	1683	1502				0	1772	1470	1647	1730	0
Q Serve(g_s), s	42.9	35.5	0.0				0.0	14.2	18.1	2.8	13.3	0.0
Cycle Q Clear(g_c), s	42.9	35.5	0.0				0.0	14.2	18.1	2.8	13.3	0.0
Prop In Lane	0.09		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	1115	1064					0	403	334	52	498	0
V/C Ratio(X)	0.81	0.74					0.00	0.63	0.77	0.81	0.44	0.00
Avail Cap(c_a), veh/h	1115	1064					0	403	334	75	535	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	0.97	0.97	0.99	0.99	0.00
Uniform Delay (d), s/veh	15.3	14.0	0.0				0.0	38.3	39.8	54.1	41.5	0.0
Incr Delay (d2), s/veh	6.6	4.6	0.0				0.0	7.0	15.4	26.3	0.4	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	18.1	14.0	0.0				0.0	6.8	7.8	1.6	6.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.9	18.6	0.0				0.0	45.3	55.2	80.4	41.8	0.0
LnGrp LOS	C	B					A	D	E	F	D	A
Approach Vol, veh/h		1695	A					511			263	
Approach Delay, s/veh		20.4						50.3			48.0	
Approach LOS		C						D			D	

Timer - Assigned Phs		2		4			7	8				
Phs Duration (G+Y+Rc), s		73.5		36.5			7.5	29.0				
Change Period (Y+Rc), s		4.0		* 4.8			4.0	4.8				
Max Green Setting (Gmax), s		68.0		* 34			5.0	24.2				
Max Q Clear Time (g_c+I1), s		44.9		15.3			4.8	20.1				
Green Ext Time (p_c), s		19.7		0.5			0.0	0.7				

Intersection Summary			
HCM 6th Ctrl Delay			29.5
HCM 6th LOS			C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
15: Wolf Drive/SE Ten Eyck Rd & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	1450	125	10	1180	25	100	25	10	175	20	120
Future Volume (veh/h)	170	1450	125	10	1180	25	100	25	10	175	20	120
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	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	179	1526	132	11	1242	26	105	26	11	184	21	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, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	343	2075	925	24	1398	623	272	64	23	258	24	142
Arrive On Green	0.20	0.62	0.62	0.01	0.43	0.43	0.25	0.26	0.24	0.25	0.26	0.24
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	842	250	92	812	96	558
Grp Volume(v), veh/h	179	1526	132	11	1242	26	142	0	0	331	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1185	0	0	1465	0	0
Q Serve(g_s), s	10.4	35.0	4.1	0.7	39.0	1.1	0.0	0.0	0.0	12.7	0.0	0.0
Cycle Q Clear(g_c), s	10.4	35.0	4.1	0.7	39.0	1.1	11.3	0.0	0.0	24.0	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.74		0.08	0.56		0.38
Lane Grp Cap(c), veh/h	343	2075	925	24	1398	623	354	0	0	418	0	0
V/C Ratio(X)	0.52	0.74	0.14	0.45	0.89	0.04	0.40	0.00	0.00	0.79	0.00	0.00
Avail Cap(c_a), veh/h	343	2075	925	66	1446	645	413	0	0	481	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	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	39.0	14.8	8.9	53.7	28.8	18.1	34.8	0.0	0.0	39.8	0.0	0.0
Incr Delay (d2), s/veh	1.0	2.4	0.3	7.9	8.8	0.1	0.5	0.0	0.0	7.2	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	4.4	13.4	1.4	0.3	15.8	0.4	3.3	0.0	0.0	9.5	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	40.0	17.2	9.2	61.7	37.5	18.2	35.3	0.0	0.0	47.1	0.0	0.0
LnGrp LOS	D	B	A	E	D	B	D	A	A	D	A	A
Approach Vol, veh/h		1837			1279			142			331	
Approach Delay, s/veh		18.8			37.4			35.3			47.1	
Approach LOS		B			D			D			D	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	5.6	72.3	32.1	26.4	51.5	32.1
Change Period (Y+Rc), s	4.5	* 4.5	5.5	4.5	4.0	5.5
Max Green Setting (Gmax), s	4.0	* 61	31.3	15.5	49.2	31.3
Max Q Clear Time (g_c+I1), s	12.4	37.0	26.0	12.4	41.0	13.3
Green Ext Time (p_c), s	0.0	19.6	0.5	0.1	6.6	0.4

Intersection Summary	
HCM 6th Ctrl Delay	28.7
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
16: Langensand Rd & US 26 06/28/2021

Intersection	
Int Delay, s/veh	3.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1535	90	30	1230	25	70
Future Vol, veh/h	1535	90	30	1230	25	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	1616	95	32	1295	26	74

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1711	0	2328	808
Stage 1	-	-	-	-	1616	-
Stage 2	-	-	-	-	712	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	350	-	32	328
Stage 1	-	-	-	-	151	-
Stage 2	-	-	-	-	453	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	350	-	29	328
Mov Cap-2 Maneuver	-	-	-	-	29	-
Stage 1	-	-	-	-	151	-
Stage 2	-	-	-	-	412	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	102.1
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	29	328	-	-	350	-
HCM Lane V/C Ratio	0.907	0.225	-	-	0.09	-
HCM Control Delay (s)	$ 334.4	19.1	-	-	16.3	-
HCM Lane LOS	F	C	-	-	C	-
HCM 95th %tile Q(veh)	3	0.8	-	-	0.3	-

HCM 6th Signalized Intersection Summary
17: US 26 & Vista Loop West 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	1435	0	100	1140	0	5	5	100	5	0	120
Future Volume (veh/h)	170	1435	0	100	1140	0	5	5	100	5	0	120
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	1758	1758	1723	1723	1716	1716	1723	1723	1723	1800	1723	1800
Adj Flow Rate, veh/h	179	1511	0	105	1200	0	5	5	105	5	0	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	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	547	2609	1141	436	2509	0	74	0	3	74	0	3
Arrive On Green	0.07	0.78	0.00	0.06	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1460	1641	3346	0	75	75	1569	66	0	1654
Grp Volume(v), veh/h	179	1511	0	105	1200	0	115	0	0	131	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1460	1641	1630	0	1719	0	0	1719	0	0
Q Serve(g_s), s	1.2	9.2	0.0	0.7	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	1.2	9.2	0.0	0.7	6.8	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.00	0.04		0.91	0.04		0.96
Lane Grp Cap(c), veh/h	547	2609	1141	436	2509	0	77	0	0	77	0	0
V/C Ratio(X)	0.33	0.58	0.00	0.24	0.48	0.00	1.48	0.00	0.00	1.70	0.00	0.00
Avail Cap(c_a), veh/h	888	4942	2160	660	4566	0	855	0	0	851	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	0.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	1.8	2.2	0.0	2.2	2.1	0.0	25.4	0.0	0.0	25.4	0.0	0.0
Incr Delay (d2), s/veh	0.3	0.4	0.0	0.2	0.3	0.0	228.6	0.0	0.0	323.2	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	0.0	0.2	0.0	0.0	0.1	0.0	5.8	0.0	0.0	7.8	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	2.1	2.7	0.0	2.4	2.4	0.0	254.0	0.0	0.0	348.6	0.0	0.0
LnGrp LOS	A	A	A	A	A	A	F	A	A	F	A	A
Approach Vol, veh/h		1690			1305			115			131	
Approach Delay, s/veh		2.6			2.4			254.0			348.6	
Approach LOS		A			A			F			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.7	43.0		0.0	7.1	43.6		0.0				
Change Period (Y+Rc), s	4.0	6.0		4.0	4.0	6.0		4.0				
Max Green Setting (Gmax), s	14.0	69.0		23.0	10.0	73.0		23.0				
Max Q Clear Time (g_c+I1), s	3.2	8.8		0.0	2.7	11.2		0.0				
Green Ext Time (p_c), s	0.3	17.7		0.0	0.1	26.4		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			25.4									
HCM 6th LOS			C									

Intersection						
Int Delay, s/veh	0.4					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	1535	1235	25	10	0
Future Vol, veh/h	5	1535	1235	25	10	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	150	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	1616	1300	26	11	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1326	0	-	0	2131	663
Stage 1	-	-	-	-	1313	-
Stage 2	-	-	-	-	818	-
Critical Hdwy	4.14	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.22	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	517	-	-	-	42	404
Stage 1	-	-	-	-	216	-
Stage 2	-	-	-	-	394	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	517	-	-	-	42	404
Mov Cap-2 Maneuver	-	-	-	-	42	-
Stage 1	-	-	-	-	214	-
Stage 2	-	-	-	-	394	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	117.3
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	517	-	-	-	42
HCM Lane V/C Ratio	0.01	-	-	-	0.251
HCM Control Delay (s)	12	-	-	-	117.3
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0	-	-	-	0.8

HCM 6th Signalized Intersection Summary
20: Hwy 211 & Dubarko Rd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	190	90	160	70	30	110	230	130	50	535	40
Future Volume (veh/h)	30	190	90	160	70	30	110	230	130	50	535	40
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	1800	1800	1800	1772	1772	1772	1772	1772	1772	1758	1758	1758
Adj Flow Rate, veh/h	32	200	95	168	74	32	116	242	137	53	563	42
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, %	0	0	0	2	2	2	2	2	2	3	3	3
Cap, veh/h	429	238	113	317	327	141	294	748	631	494	704	594
Arrive On Green	0.03	0.21	0.21	0.10	0.28	0.28	0.06	0.42	0.42	0.04	0.40	0.40
Sat Flow, veh/h	1714	1152	547	1688	1173	507	1688	1772	1495	1674	1758	1482
Grp Volume(v), veh/h	32	0	295	168	0	106	116	242	137	53	563	42
Grp Sat Flow(s),veh/h/ln	1714	0	1700	1688	0	1680	1688	1772	1495	1674	1758	1482
Q Serve(g_s), s	1.0	0.0	11.3	5.0	0.0	3.3	2.8	6.2	4.0	1.3	19.2	1.2
Cycle Q Clear(g_c), s	1.0	0.0	11.3	5.0	0.0	3.3	2.8	6.2	4.0	1.3	19.2	1.2
Prop In Lane	1.00		0.32	1.00		0.30	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	429	0	351	317	0	468	294	748	631	494	704	594
V/C Ratio(X)	0.07	0.00	0.84	0.53	0.00	0.23	0.39	0.32	0.22	0.11	0.80	0.07
Avail Cap(c_a), veh/h	484	0	524	348	0	617	294	1067	900	530	1058	893
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	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.4	0.0	25.9	18.3	0.0	18.9	14.3	13.2	12.5	11.8	18.0	12.6
Incr Delay (d2), s/veh	0.1	0.0	6.6	1.0	0.0	0.2	0.6	0.5	0.4	0.1	4.8	0.1
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	0.0	5.0	1.9	0.0	1.2	0.9	2.2	1.3	0.4	7.6	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.5	0.0	32.5	19.3	0.0	19.1	14.9	13.7	12.9	11.8	22.8	12.7
LnGrp LOS	C	A	C	B	A	B	B	B	B	B	C	B
Approach Vol, veh/h		327			274			495			658	
Approach Delay, s/veh		31.4			19.2			13.8			21.3	
Approach LOS		C			B			B			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	6.5	32.8	10.8	18.1	8.0	31.3	5.8	23.0
Change Period (Y+Rc), s	4.0	4.8	4.0	4.0	4.0	4.8	4.0	4.0
Max Green Setting (Gmax), s	4.0	40.2	8.0	21.0	4.0	40.2	4.0	25.0
Max Q Clear Time (g_c+I1), s	3.3	8.2	7.0	13.3	4.8	21.2	3.0	5.3
Green Ext Time (p_c), s	0.0	3.5	0.0	0.6	0.0	5.3	0.0	0.2

Intersection Summary		
HCM 6th Ctrl Delay		20.7
HCM 6th LOS		C

Intersection						
Int Delay, s/veh	31					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	400	120	230	570	105	80
Future Vol, veh/h	400	120	230	570	105	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	3	3	1	1	1	1
Mvmt Flow	421	126	242	600	111	84

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	547	0	1568	484
Stage 1	-	-	-	-	484	-
Stage 2	-	-	-	-	1084	-
Critical Hdwy	-	-	4.11	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	-	-	2.209	-	3.509	3.309
Pot Cap-1 Maneuver	-	-	1027	-	123	585
Stage 1	-	-	-	-	622	-
Stage 2	-	-	-	-	326	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1027	-	~ 94	585
Mov Cap-2 Maneuver	-	-	-	-	~ 94	-
Stage 1	-	-	-	-	622	-
Stage 2	-	-	-	-	249	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.8	239.8
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	148	-	-	1027	-
HCM Lane V/C Ratio	1.316	-	-	0.236	-
HCM Control Delay (s)	239.8	-	-	9.6	-
HCM Lane LOS	F	-	-	A	-
HCM 95th %tile Q(veh)	12	-	-	0.9	-

Notes

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

HCM 6th Signalized Intersection Summary
1: SE Jarl Road/SE Orient Drive & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	250	2205	15	10	1435	165	70	50	10	165	10	90
Future Volume (veh/h)	250	2205	15	10	1435	165	70	50	10	165	10	90
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	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	263	2321	16	11	1511	0	74	53	11	174	11	95
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, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	182	1735	774	73	1496		65	46	10	207	13	113
Arrive On Green	0.11	0.52	0.52	0.04	0.45	0.00	0.08	0.08	0.08	0.21	0.21	0.21
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	826	591	123	1008	64	550
Grp Volume(v), veh/h	263	2321	16	11	1511	0	138	0	0	280	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1540	0	0	1622	0	0
Q Serve(g_s), s	11.0	52.5	0.5	0.6	46.0	0.0	8.0	0.0	0.0	16.9	0.0	0.0
Cycle Q Clear(g_c), s	11.0	52.5	0.5	0.6	46.0	0.0	8.0	0.0	0.0	16.9	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.54		0.08	0.62		0.34
Lane Grp Cap(c), veh/h	182	1735	774	73	1496		121	0	0	333	0	0
V/C Ratio(X)	1.44	1.34	0.02	0.15	1.01		1.14	0.00	0.00	0.84	0.00	0.00
Avail Cap(c_a), veh/h	182	1735	774	73	1496		121	0	0	541	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	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	45.4	24.7	12.1	46.9	27.9	0.0	46.8	0.0	0.0	38.9	0.0	0.0
Incr Delay (d2), s/veh	227.8	156.2	0.0	0.6	25.8	0.0	124.9	0.0	0.0	6.4	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	15.9	55.0	0.2	0.3	21.0	0.0	7.3	0.0	0.0	7.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	273.3	180.9	12.1	47.4	53.8	0.0	171.7	0.0	0.0	45.3	0.0	0.0
LnGrp LOS	F	F	B	D	F		F	A	A	D	A	A
Approach Vol, veh/h		2600			1522	A		138			280	
Approach Delay, s/veh		189.2			53.7			171.7			45.3	
Approach LOS		F			D			F			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	15.0	50.0		24.9	8.5	56.5		12.0				
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5				
Max Green Setting (Gmax), s	10.5	43.0		33.0	4.0	49.5		7.5				
Max Q Clear Time (g_c+I1), s	13.0	48.0		18.9	2.6	54.5		10.0				
Green Ext Time (p_c), s	0.0	0.0		1.0	0.0	0.0		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			134.3									
HCM 6th LOS			F									

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑	↱	↰	↑	↱
Traffic Volume (veh/h)	200	1355	450	225	1415	250	185	260	300	50	150	65
Future Volume (veh/h)	200	1355	450	225	1415	250	185	260	300	50	150	65
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	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	211	1426	474	237	1489	263	195	274	316	53	158	68
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, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	261	1450	1003	463	1725	851	745	393	336	104	109	92
Arrive On Green	0.07	0.43	0.43	0.29	1.00	1.00	0.23	0.22	0.22	0.06	0.06	0.06
Sat Flow, veh/h	1688	3367	1502	3222	3313	1502	3300	1772	1511	1688	1772	1502
Grp Volume(v), veh/h	211	1426	474	237	1489	263	195	274	316	53	158	68
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1611	1657	1502	1650	1772	1511	1688	1772	1502
Q Serve(g_s), s	9.0	54.4	19.9	8.0	0.0	0.0	6.3	18.5	26.7	4.0	8.0	5.8
Cycle Q Clear(g_c), s	9.0	54.4	19.9	8.0	0.0	0.0	6.3	18.5	26.7	4.0	8.0	5.8
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	261	1450	1003	463	1725	851	745	393	336	104	109	92
V/C Ratio(X)	0.81	0.98	0.47	0.51	0.86	0.31	0.26	0.70	0.94	0.51	1.45	0.74
Avail Cap(c_a), veh/h	261	1450	1003	463	1725	851	761	402	343	234	245	208
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.51	0.51	0.51	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.1	36.5	10.5	42.5	0.0	0.0	41.4	46.5	49.7	59.1	61.0	60.0
Incr Delay (d2), s/veh	16.5	20.0	1.6	0.3	3.2	0.5	0.1	4.5	33.1	2.9	223.6	8.3
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	1.8	24.5	11.9	2.8	0.8	0.1	2.6	8.6	13.1	1.8	10.3	2.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	46.5	56.5	12.1	42.8	3.2	0.5	41.5	51.1	82.9	62.0	284.6	68.2
LnGrp LOS	D	E	B	D	A	A	D	D	F	E	F	E
Approach Vol, veh/h		2111			1989			785			279	
Approach Delay, s/veh		45.5			7.6			61.5			189.6	
Approach LOS		D			A			E			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	24.7	60.0		12.0	13.0	71.7		33.4
Change Period (Y+Rc), s	6.0	* 6		4.0	4.0	6.0		4.5
Max Green Setting (Gmax), s	10.0	* 54		18.0	9.0	55.0		29.5
Max Q Clear Time (g_c+I1), s	11.0	56.4		7.8	11.0	2.0		28.7
Green Ext Time (p_c), s	0.0	0.0		0.2	0.0	51.5		0.1

Intersection Summary	
HCM 6th Ctrl Delay	41.1
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM Signalized Intersection Capacity Analysis
4: Industrial Way & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	1645	10	40	1595	50	170	25	100	220	45	135
Future Volume (vph)	50	1645	10	40	1595	50	170	25	100	220	45	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00	1.00	1.00		0.97	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.88		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	3315		1644	3358	1471	1693	1569		3317	1580	
Flt Permitted	0.08	1.00		0.06	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	140	3315		102	3358	1471	1693	1569		3317	1580	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	51	1679	10	41	1628	51	173	26	102	224	46	138
RTOR Reduction (vph)	0	0	0	0	0	20	0	91	0	0	71	0
Lane Group Flow (vph)	51	1689	0	41	1628	31	173	37	0	224	113	0
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						
Actuated Green, G (s)	82.0	78.8		82.0	78.8	78.8	13.5	13.5		17.1	17.1	
Effective Green, g (s)	83.0	80.2		82.0	80.2	80.2	14.5	13.5		17.1	17.1	
Actuated g/C Ratio	0.64	0.62		0.63	0.62	0.62	0.11	0.10		0.13	0.13	
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4	3.0	3.0		2.3	2.3	
Lane Grp Cap (vph)	133	2045		102	2071	907	188	162		436	207	
v/s Ratio Prot	c0.01	c0.51		0.01	0.48		c0.10	0.02		0.07	c0.07	
v/s Ratio Perm	0.23			0.24		0.02						
v/c Ratio	0.38	0.83		0.40	0.79	0.03	0.92	0.23		0.51	0.54	
Uniform Delay, d1	35.2	19.4		40.6	18.5	9.7	57.2	53.5		52.6	52.8	
Progression Factor	0.38	0.21		0.47	0.46	0.50	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	2.4		1.0	2.1	0.0	43.5	0.7		0.6	2.0	
Delay (s)	14.1	6.4		20.1	10.6	4.9	100.7	54.2		53.2	54.8	
Level of Service	B	A		C	B	A	F	D		D	D	
Approach Delay (s)		6.6			10.7			80.9			53.9	
Approach LOS		A			B			F			D	

Intersection Summary			
HCM 2000 Control Delay	18.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	1625	210	55	1450	95	115	80	35	210	55	165
Future Volume (veh/h)	125	1625	210	55	1450	95	115	80	35	210	55	165
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		0.99	1.00		0.98
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	1772	1772	1772	1744	1744	1744	1758	1758	1758	1800	1800	1800
Adj Flow Rate, veh/h	126	1641	0	56	1465	96	116	81	35	212	56	167
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	4	4	4	3	3	3	0	0	0
Cap, veh/h	420	2226		232	1638	713	184	118	51	256	30	90
Arrive On Green	0.41	1.00	0.00	0.03	0.48	0.48	0.11	0.10	0.10	0.08	0.08	0.08
Sat Flow, veh/h	1688	3331	1502	1661	3383	1473	1674	1160	501	3326	393	1173
Grp Volume(v), veh/h	126	1641	0	56	1465	96	116	0	116	212	0	223
Grp Sat Flow(s),veh/h/ln	1688	1666	1502	1661	1692	1473	1674	0	1661	1663	0	1567
Q Serve(g_s), s	0.0	0.0	0.0	2.5	51.2	4.7	8.6	0.0	8.8	8.2	0.0	10.0
Cycle Q Clear(g_c), s	0.0	0.0	0.0	2.5	51.2	4.7	8.6	0.0	8.8	8.2	0.0	10.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.75
Lane Grp Cap(c), veh/h	420	2226		232	1638	713	184	0	169	256	0	121
V/C Ratio(X)	0.30	0.74		0.24	0.89	0.13	0.63	0.00	0.69	0.83	0.00	1.85
Avail Cap(c_a), veh/h	420	2226		234	1639	714	476	0	460	256	0	121
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.53	0.53	0.00	0.46	0.46	0.46	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	30.0	0.0	0.0	19.8	30.5	18.5	55.4	0.0	56.4	59.2	0.0	60.0
Incr Delay (d2), s/veh	0.1	1.2	0.0	0.1	4.0	0.2	2.2	0.0	3.0	19.2	0.0	412.7
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	2.3	0.4	0.0	0.9	20.7	1.6	3.8	0.0	3.9	4.2	0.0	17.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.2	1.2	0.0	19.9	34.5	18.7	57.6	0.0	59.3	78.3	0.0	472.7
LnGrp LOS	C	A		B	C	B	E	A	E	E	A	F
Approach Vol, veh/h		1767	A		1617			232			435	
Approach Delay, s/veh		3.3			33.0			58.5			280.5	
Approach LOS		A			C			E			F	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	7.9	90.9	14.0	31.8	66.9	17.3
Change Period (Y+Rc), s	4.0	* 5.4	4.0	* 5.4	* 5.4	4.0
Max Green Setting (Gmax), s	4.0	* 63	10.0	* 5	* 62	36.0
Max Q Clear Time (g_c+I1), s	4.5	2.0	12.0	2.0	53.2	10.8
Green Ext Time (p_c), s	0.0	59.0	0.0	0.1	8.3	0.8

Intersection Summary	
HCM 6th Ctrl Delay	48.1
HCM 6th LOS	D

Notes

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	1640	180	70	1370	295	90	5	25	265	145	85
Future Volume (veh/h)	80	1640	180	70	1370	295	90	5	25	265	145	85
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		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	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	82	1673	184	71	1398	301	92	5	26	270	148	87
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	127	1408	626	375	1675	834	115	30	155	216	191	112
Arrive On Green	0.04	0.42	0.42	0.19	0.57	0.57	0.07	0.12	0.13	0.13	0.18	0.19
Sat Flow, veh/h	1688	3367	1498	1647	2941	1465	1701	245	1275	1701	1053	619
Grp Volume(v), veh/h	82	1673	184	71	1398	301	92	0	31	270	0	235
Grp Sat Flow(s),veh/h/ln	1688	1683	1498	1647	1470	1465	1701	0	1520	1701	0	1672
Q Serve(g_s), s	3.4	46.0	6.6	0.0	42.9	12.3	5.9	0.0	2.0	14.0	0.0	14.7
Cycle Q Clear(g_c), s	3.4	46.0	6.6	0.0	42.9	12.3	5.9	0.0	2.0	14.0	0.0	14.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.84	1.00		0.37
Lane Grp Cap(c), veh/h	127	1408	626	375	1675	834	115	0	185	216	0	303
V/C Ratio(X)	0.65	1.19	0.29	0.19	0.83	0.36	0.80	0.00	0.17	1.25	0.00	0.78
Avail Cap(c_a), veh/h	127	1408	626	375	1675	834	186	0	414	216	0	486
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)	0.55	0.55	0.55	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	28.3	32.0	11.4	36.3	19.4	12.8	50.6	0.0	43.1	48.0	0.0	42.8
Incr Delay (d2), s/veh	5.3	89.0	0.7	0.1	5.1	1.2	7.7	0.0	0.3	143.7	0.0	2.6
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	1.5	34.9	2.3	1.6	15.2	4.2	2.8	0.0	0.8	14.6	0.0	6.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	33.6	121.0	12.1	36.4	24.5	14.0	58.2	0.0	43.4	191.7	0.0	45.4
LnGrp LOS	C	F	B	D	C	B	E	A	D	F	A	D
Approach Vol, veh/h		1939			1770			123			505	
Approach Delay, s/veh		106.9			23.2			54.5			123.7	
Approach LOS		F			C			D			F	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	24.6	50.0	11.4	23.9	8.0	66.6	18.0	17.4
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.0	4.0	4.0	4.5
Max Green Setting (Gmax), s	4.0	45.2	12.0	31.5	4.0	46.0	14.0	29.5
Max Q Clear Time (g_c+I1), s	12.0	48.0	7.9	16.7	5.4	44.9	16.0	4.0
Green Ext Time (p_c), s	0.0	0.0	0.0	0.7	0.0	1.1	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	73.2
HCM 6th LOS	E

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	60	15	395	380	5
Future Vol, veh/h	5	60	15	395	380	5
Conflicting Peds, #/hr	1	1	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	180	0	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	5	63	16	416	400	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	854	406	407	0	-	0
Stage 1	405	-	-	-	-	-
Stage 2	449	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.11	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.209	-	-	-
Pot Cap-1 Maneuver	326	641	1157	-	-	-
Stage 1	669	-	-	-	-	-
Stage 2	639	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	320	639	1155	-	-	-
Mov Cap-2 Maneuver	320	-	-	-	-	-
Stage 1	658	-	-	-	-	-
Stage 2	638	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.7	0.3	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1155	-	320	639	-	-
HCM Lane V/C Ratio	0.014	-	0.016	0.099	-	-
HCM Control Delay (s)	8.2	0	16.4	11.3	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	0.3	-	-

Intersection						
Int Delay, s/veh	17					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	185	85	505	245	15	670
Future Vol, veh/h	185	85	505	245	15	670
Conflicting Peds, #/hr	0	2	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	125	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	4	1	1	3	3
Mvmt Flow	195	89	532	258	16	705

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1046	663	0	0	790	0
Stage 1	661	-	-	-	-	-
Stage 2	385	-	-	-	-	-
Critical Hdwy	6.66	6.26	-	-	4.145	-
Critical Hdwy Stg 1	5.46	-	-	-	-	-
Critical Hdwy Stg 2	5.86	-	-	-	-	-
Follow-up Hdwy	3.538	3.338	-	-	2.2285	-
Pot Cap-1 Maneuver	235	456	-	-	822	-
Stage 1	508	-	-	-	-	-
Stage 2	653	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	231	455	-	-	822	-
Mov Cap-2 Maneuver	231	-	-	-	-	-
Stage 1	508	-	-	-	-	-
Stage 2	641	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	106.6	0	0.2
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	273	822	-
HCM Lane V/C Ratio	-	-	1.041	0.019	-
HCM Control Delay (s)	-	-	106.6	9.5	-
HCM Lane LOS	-	-	F	A	-
HCM 95th %tile Q(veh)	-	-	11	0.1	-

Intersection	
Intersection Delay, s/veh	221.9
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	100	255	65	650	850	5
Future Vol, veh/h	100	255	65	650	850	5
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles, %	0	0	1	1	1	1
Mvmt Flow	105	268	68	684	895	5
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	18.1	203.4	322
HCM LOS	C	F	F

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	9%	100%	0%	0%	0%
Vol Thru, %	91%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	715	100	255	850	5
LT Vol	65	100	0	0	0
Through Vol	650	0	0	850	0
RT Vol	0	0	255	0	5
Lane Flow Rate	753	105	268	895	5
Geometry Grp	4	7	7	7	7
Degree of Util (X)	1.376	0.237	0.514	1.66	0.009
Departure Headway (Hd)	7.422	9.469	8.203	7.144	6.423
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	497	382	443	519	561
Service Time	5.422	7.169	5.903	4.844	4.123
HCM Lane V/C Ratio	1.515	0.275	0.605	1.724	0.009
HCM Control Delay	203.4	15.1	19.3	323.8	9.2
HCM Lane LOS	F	C	C	F	A
HCM 95th-tile Q	30.9	0.9	2.9	48.1	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	55	1390	15	250	50	0	0	100	25
Future Volume (veh/h)	0	0	0	55	1390	15	250	50	0	0	100	25
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.99	1.00		1.00	1.00		0.99
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				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				58	1463	16	263	53	0	0	105	26
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				68	1811	21	441	612	0	0	473	117
Arrive On Green				0.55	0.55	0.55	0.58	0.58	0.00	0.00	0.35	0.35
Sat Flow, veh/h				124	3284	38	1289	1772	0	0	1369	339
Grp Volume(v), veh/h				805	0	732	263	53	0	0	0	131
Grp Sat Flow(s),veh/h/ln				1724	0	1723	1289	1772	0	0	0	1708
Q Serve(g_s), s				43.2	0.0	36.5	17.5	1.5	0.0	0.0	0.0	6.0
Cycle Q Clear(g_c), s				43.2	0.0	36.5	23.5	1.5	0.0	0.0	0.0	6.0
Prop In Lane				0.07		0.02	1.00		0.00	0.00		0.20
Lane Grp Cap(c), veh/h				950	0	950	441	612	0	0	0	590
V/C Ratio(X)				0.85	0.00	0.77	0.60	0.09	0.00	0.00	0.00	0.22
Avail Cap(c_a), veh/h				1003	0	1002	441	612	0	0	0	590
HCM Platoon Ratio				1.00	1.00	1.00	1.67	1.67	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.87	0.87	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				20.8	0.0	19.3	22.5	15.5	0.0	0.0	0.0	25.5
Incr Delay (d2), s/veh				9.2	0.0	6.0	5.1	0.2	0.0	0.0	0.0	0.1
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				19.1	0.0	15.7	5.1	0.6	0.0	0.0	0.0	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				30.0	0.0	25.3	27.6	15.8	0.0	0.0	0.0	25.7
LnGrp LOS				C	A	C	C	B	A	A	A	C
Approach Vol, veh/h					1537			316			131	
Approach Delay, s/veh					27.7			25.7			25.7	
Approach LOS					C			C			C	
Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				42.0		64.7		42.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				38.0		64.0		38.0				
Max Q Clear Time (g_c+I1), s				8.0		45.2		25.5				
Green Ext Time (p_c), s				0.4		15.4		1.1				
Intersection Summary												
HCM 6th Ctrl Delay			27.3									
HCM 6th LOS			C									

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	1320	520	0	0	0	0	225	295	85	70	0
Future Volume (veh/h)	80	1320	520	0	0	0	0	225	295	85	70	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	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
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	84	1389	0				0	237	311	89	74	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	107	1853					0	451	375	111	620	0
Arrive On Green	0.57	0.57	0.00				0.00	0.25	0.25	0.02	0.12	0.00
Sat Flow, veh/h	188	3258	1502				0	1772	1473	1647	1730	0
Grp Volume(v), veh/h	789	684	0				0	237	311	89	74	0
Grp Sat Flow(s),veh/h/ln	1763	1683	1502				0	1772	1473	1647	1730	0
Q Serve(g_s), s	38.4	32.5	0.0				0.0	12.7	21.9	5.9	4.2	0.0
Cycle Q Clear(g_c), s	38.4	32.5	0.0				0.0	12.7	21.9	5.9	4.2	0.0
Prop In Lane	0.11		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	1002	957					0	451	375	111	620	0
V/C Ratio(X)	0.79	0.71					0.00	0.53	0.83	0.80	0.12	0.00
Avail Cap(c_a), veh/h	1002	957					0	451	375	165	676	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	0.93	0.93	0.98	0.98	0.00
Uniform Delay (d), s/veh	18.5	17.2	0.0				0.0	35.3	38.7	53.0	33.0	0.0
Incr Delay (d2), s/veh	6.2	4.6	0.0				0.0	4.0	17.6	11.3	0.1	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	16.7	13.3	0.0				0.0	5.8	9.5	2.9	1.8	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	24.7	21.8	0.0				0.0	39.3	56.4	64.3	33.0	0.0
LnGrp LOS	C	C					A	D	E	E	C	A
Approach Vol, veh/h		1473	A					548			163	
Approach Delay, s/veh		23.4						49.0			50.1	
Approach LOS		C						D			D	

Timer - Assigned Phs		2		4			7	8				
Phs Duration (G+Y+Rc), s		66.6		43.4			11.4	32.0				
Change Period (Y+Rc), s		4.0		4.0			4.0	4.8				
Max Green Setting (Gmax), s		59.0		43.0			11.0	27.2				
Max Q Clear Time (g_c+I1), s		40.4		6.2			7.9	23.9				
Green Ext Time (p_c), s		14.8		0.2			0.0	0.7				

Intersection Summary	
HCM 6th Ctrl Delay	31.8
HCM 6th LOS	C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	155	1365	130	10	1175	20	90	25	10	135	20	150
Future Volume (veh/h)	155	1365	130	10	1175	20	90	25	10	135	20	150
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	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	163	1437	137	11	1237	21	95	26	11	142	21	158
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, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	366	1887	841	192	1494	666	193	254	108	331	38	283
Arrive On Green	0.22	0.56	0.56	0.12	0.46	0.46	0.21	0.21	0.20	0.21	0.21	0.20
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	1259	1201	508	1399	178	1339
Grp Volume(v), veh/h	163	1437	137	11	1237	21	95	0	37	142	0	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1259	0	1709	1399	0	1517
Q Serve(g_s), s	9.2	36.0	4.9	0.7	36.7	0.9	8.1	0.0	1.9	10.1	0.0	11.7
Cycle Q Clear(g_c), s	9.2	36.0	4.9	0.7	36.7	0.9	19.8	0.0	1.9	12.0	0.0	11.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.88
Lane Grp Cap(c), veh/h	366	1887	841	192	1494	666	193	0	362	331	0	321
V/C Ratio(X)	0.44	0.76	0.16	0.06	0.83	0.03	0.49	0.00	0.10	0.43	0.00	0.56
Avail Cap(c_a), veh/h	366	2121	945	192	1640	732	203	0	376	342	0	334
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	37.3	18.5	11.7	43.0	25.8	16.1	48.1	0.0	35.1	40.2	0.0	39.4
Incr Delay (d2), s/veh	0.5	3.0	0.4	0.1	5.4	0.1	1.5	0.0	0.1	0.7	0.0	1.6
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	3.9	14.3	1.7	0.3	14.3	0.3	2.6	0.0	0.8	3.5	0.0	4.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	37.8	21.5	12.1	43.1	31.2	16.2	49.5	0.0	35.2	40.9	0.0	40.9
LnGrp LOS	D	C	B	D	C	B	D	A	D	D	A	D
Approach Vol, veh/h		1737			1269			132			321	
Approach Delay, s/veh		22.3			31.0			45.5			40.9	
Approach LOS		C			C			D			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	17.1	65.7		27.3	27.9	54.8		27.3				
Change Period (Y+Rc), s	4.5	4.0		5.5	4.5	4.0		5.5				
Max Green Setting (Gmax), s	4.0	69.3		22.7	17.5	55.8		22.7				
Max Q Clear Time (g_c+I1), s	12.7	38.0		14.0	11.2	38.7		21.8				
Green Ext Time (p_c), s	0.0	23.7		0.7	0.2	12.2		0.0				

Intersection Summary	
HCM 6th Ctrl Delay	28.1
HCM 6th LOS	C

Intersection	
Int Delay, s/veh	5.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1390	100	110	1220	25	85
Future Vol, veh/h	1390	100	110	1220	25	85
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	1463	105	116	1284	26	89

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1568	0	2337	732
Stage 1	-	-	-	-	1463	-
Stage 2	-	-	-	-	874	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	398	-	32	368
Stage 1	-	-	-	-	183	-
Stage 2	-	-	-	-	373	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	398	-	~ 23	368
Mov Cap-2 Maneuver	-	-	-	-	~ 23	-
Stage 1	-	-	-	-	183	-
Stage 2	-	-	-	-	264	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	122.9
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	23	368	-	-	398	-
HCM Lane V/C Ratio	1.144	0.243	-	-	0.291	-
HCM Control Delay (s)	$ 479.7	17.9	-	-	17.7	-
HCM Lane LOS	F	C	-	-	C	-
HCM 95th %tile Q(veh)	3.4	0.9	-	-	1.2	-

Notes

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

HCM 6th Signalized Intersection Summary
17: Dubarko Ext/Vista Loop West & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	1350	5	100	1240	0	5	5	100	5	0	100
Future Volume (veh/h)	130	1350	5	100	1240	0	5	5	100	5	0	100
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	1758	1758	1772	1772	1716	1716	1772	1772	1772	1800	1723	1800
Adj Flow Rate, veh/h	137	1421	5	106	1305	0	5	5	105	5	0	105
Peak Hour Factor	0.95	0.95	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	177	2488	1119	136	2347	0	82	0	4	82	0	4
Arrive On Green	0.11	0.75	0.75	0.08	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1502	1688	3346	0	77	77	1614	78	0	1641
Grp Volume(v), veh/h	137	1421	5	106	1305	0	115	0	0	110	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1502	1688	1630	0	1768	0	0	1719	0	0
Q Serve(g_s), s	3.7	8.7	0.0	2.8	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	3.7	8.7	0.0	2.8	8.6	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.00	0.04		0.91	0.05		0.95
Lane Grp Cap(c), veh/h	177	2488	1119	136	2347	0	86	0	0	86	0	0
V/C Ratio(X)	0.77	0.57	0.00	0.78	0.56	0.00	1.34	0.00	0.00	1.28	0.00	0.00
Avail Cap(c_a), veh/h	656	5089	2288	551	4754	0	969	0	0	938	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	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	20.0	2.6	1.5	20.7	3.0	0.0	23.0	0.0	0.0	23.0	0.0	0.0
Incr Delay (d2), s/veh	5.3	0.4	0.0	6.9	0.4	0.0	166.7	0.0	0.0	141.6	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	1.4	0.2	0.0	1.1	0.1	0.0	4.8	0.0	0.0	4.2	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.3	3.0	1.5	27.6	3.4	0.0	189.7	0.0	0.0	164.6	0.0	0.0
LnGrp LOS	C	A	A	C	A	A	F	A	A	F	A	A
Approach Vol, veh/h		1563			1411			115			110	
Approach Delay, s/veh		5.0			5.3			189.7			164.6	
Approach LOS		A			A			F			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.9	37.1		0.0	7.7	38.2		0.0				
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0				
Max Green Setting (Gmax), s	18.0	67.0		23.0	15.0	70.0		23.0				
Max Q Clear Time (g_c+I1), s	5.7	10.6		0.0	4.8	10.7		0.0				
Green Ext Time (p_c), s	0.2	20.0		0.0	0.2	23.6		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			17.2									
HCM 6th LOS			B									

HCM 6th TWSC
18: US 26 & Vista Loop East 06/28/2021

Intersection	
Int Delay, s/veh	21.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	1450	5	100	1335	25	5	5	100	10	0	0
Future Vol, veh/h	5	1450	5	100	1335	25	5	5	100	10	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	150	-	100	150	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	1526	5	105	1405	26	5	5	105	11	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1431	0	0	1531	0	0	2449	3177	763	2404	-	-
Stage 1	-	-	-	-	-	-	1536	1536	-	1628	-	-
Stage 2	-	-	-	-	-	-	913	1641	-	776	-	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	-	-
Pot Cap-1 Maneuver	471	-	-	431	-	-	16	10	347	17	0	0
Stage 1	-	-	-	-	-	-	121	176	-	106	0	0
Stage 2	-	-	-	-	-	-	294	156	-	356	0	0
Platoon blocked, %		-	-		-	-						-
Mov Cap-1 Maneuver	471	-	-	431	-	-	13	7	347	~ 4	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	13	7	-	~ 4	-	-
Stage 1	-	-	-	-	-	-	120	174	-	105	-	-
Stage 2	-	-	-	-	-	-	222	118	-	238	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	1.1	$ 357.9	$ 2367.8
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	79	471	-	-	431	-	-	4
HCM Lane V/C Ratio	1.466	0.011	-	-	0.244	-	-	2.632
HCM Control Delay (s)	$ 357.9	12.7	-	-	16	-	$ 2367.8	
HCM Lane LOS	F	B	-	-	C	-	-	F
HCM 95th %tile Q(veh)	9.3	0	-	-	0.9	-	-	2.4

Notes

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

HCM 6th Signalized Intersection Summary
20: Hwy 211 & Dubarko Rd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	40	30	135	240	105	30	30	300	415	10	470	15
Future Volume (veh/h)	40	30	135	240	105	30	30	300	415	10	470	15
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		0.99
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	1800	1800	1800	1772	1772	1772	1772	1772	1772	1758	1758	1758
Adj Flow Rate, veh/h	42	32	142	253	111	32	32	316	437	11	495	16
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, %	0	0	0	2	2	2	2	2	2	3	3	3
Cap, veh/h	378	43	193	436	355	102	302	728	614	337	693	584
Arrive On Green	0.03	0.15	0.15	0.15	0.27	0.27	0.03	0.41	0.41	0.01	0.39	0.39
Sat Flow, veh/h	1714	288	1277	1688	1322	381	1688	1772	1494	1674	1758	1482
Grp Volume(v), veh/h	42	0	174	253	0	143	32	316	437	11	495	16
Grp Sat Flow(s),veh/h/ln	1714	0	1565	1688	0	1703	1688	1772	1494	1674	1758	1482
Q Serve(g_s), s	1.2	0.0	6.2	6.8	0.0	3.9	0.7	7.4	14.2	0.2	13.8	0.4
Cycle Q Clear(g_c), s	1.2	0.0	6.2	6.8	0.0	3.9	0.7	7.4	14.2	0.2	13.8	0.4
Prop In Lane	1.00		0.82	1.00		0.22	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	378	0	236	436	0	458	302	728	614	337	693	584
V/C Ratio(X)	0.11	0.00	0.74	0.58	0.00	0.31	0.11	0.43	0.71	0.03	0.71	0.03
Avail Cap(c_a), veh/h	438	0	565	499	0	820	371	1158	977	434	1149	969
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	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.8	0.0	23.6	15.7	0.0	17.0	12.1	12.3	14.3	11.2	14.8	10.8
Incr Delay (d2), s/veh	0.1	0.0	3.3	1.0	0.0	0.3	0.1	0.9	3.3	0.0	2.9	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	0.5	0.0	2.3	2.4	0.0	1.4	0.2	2.5	4.6	0.1	5.0	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.9	0.0	26.9	16.7	0.0	17.3	12.2	13.1	17.5	11.2	17.8	10.8
LnGrp LOS	B	A	C	B	A	B	B	B	B	B	B	B
Approach Vol, veh/h		216			396			785			522	
Approach Delay, s/veh		25.5			16.9			15.5			17.4	
Approach LOS		C			B			B			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	4.7	27.9	12.8	12.8	5.6	26.9	6.0	19.6
Change Period (Y+Rc), s	4.0	4.8	4.0	4.0	4.0	4.8	4.0	4.0
Max Green Setting (Gmax), s	4.0	37.2	11.0	21.0	4.0	37.2	4.0	28.0
Max Q Clear Time (g_c+I1), s	2.2	16.2	8.8	8.2	2.7	15.8	3.2	5.9
Green Ext Time (p_c), s	0.0	6.9	0.2	0.4	0.0	4.5	0.0	0.4

Intersection Summary	
HCM 6th Ctrl Delay	17.5
HCM 6th LOS	B

Intersection						
Int Delay, s/veh	1.6					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	740	60	210	615	0	15
Future Vol, veh/h	740	60	210	615	0	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	3	3	1	1	1	1
Mvmt Flow	779	63	221	647	0	16

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	842	0	-	811
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	4.11	-	-	6.21
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	2.209	-	-	3.309
Pot Cap-1 Maneuver	-	-	798	-	0	381
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	798	-	-	381
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.9	14.9
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	381	-	-	798	-
HCM Lane V/C Ratio	0.041	-	-	0.277	-
HCM Control Delay (s)	14.9	-	-	11.2	-
HCM Lane LOS	B	-	-	B	-
HCM 95th %tile Q(veh)	0.1	-	-	1.1	-

HCM 6th Signalized Intersection Summary
1: SE Jarl Road/SE Orient Drive & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	100	1525	5	5	745	165	25	40	10	245	20	30
Future Volume (veh/h)	100	1525	5	5	745	165	25	40	10	245	20	30
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	1772	1772	1772	1744	1744	1744	1603	1603	1603	1772	1772	1772
Adj Flow Rate, veh/h	105	1605	5	5	784	0	26	42	11	258	21	32
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, %	2	2	2	4	4	4	14	14	14	2	2	2
Cap, veh/h	145	1750	780	73	1583		32	52	14	303	25	38
Arrive On Green	0.09	0.52	0.52	0.04	0.48	0.00	0.07	0.06	0.07	0.22	0.22	0.22
Sat Flow, veh/h	1688	3367	1502	1661	3313	1478	507	818	214	1387	113	172
Grp Volume(v), veh/h	105	1605	5	5	784	0	79	0	0	311	0	0
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1661	1657	1478	1540	0	0	1672	0	0
Q Serve(g_s), s	6.2	45.1	0.2	0.3	16.7	0.0	5.2	0.0	0.0	18.4	0.0	0.0
Cycle Q Clear(g_c), s	6.2	45.1	0.2	0.3	16.7	0.0	5.2	0.0	0.0	18.4	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	0.33		0.14	0.83		0.10
Lane Grp Cap(c), veh/h	145	1750	780	73	1583		97	0	0	365	0	0
V/C Ratio(X)	0.73	0.92	0.01	0.07	0.50		0.81	0.00	0.00	0.85	0.00	0.00
Avail Cap(c_a), veh/h	229	1765	787	73	1583		97	0	0	552	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	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	45.9	22.7	11.9	47.2	18.4	0.0	47.5	0.0	0.0	38.7	0.0	0.0
Incr Delay (d2), s/veh	4.2	8.4	0.0	0.2	0.5	0.0	36.8	0.0	0.0	8.1	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	2.6	17.0	0.1	0.1	5.7	0.0	3.0	0.0	0.0	8.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	50.1	31.1	11.9	47.5	18.9	0.0	84.3	0.0	0.0	46.7	0.0	0.0
LnGrp LOS	D	C	B	D	B		F	A	A	D	A	A
Approach Vol, veh/h		1715			789	A		79			311	
Approach Delay, s/veh		32.2			19.1			84.3			46.7	
Approach LOS		C			B			F			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	12.8	53.2		26.5	8.5	57.5		10.5
Change Period (Y+Rc), s	4.5	7.0		5.0	4.5	7.0		4.5
Max Green Setting (Gmax), s	13.5	41.5		33.0	4.0	51.0		6.0
Max Q Clear Time (g_c+I1), s	8.2	18.7		20.4	2.3	47.1		7.2
Green Ext Time (p_c), s	0.1	7.3		1.1	0.0	3.5		0.0

Intersection Summary	
HCM 6th Ctrl Delay	31.6
HCM 6th LOS	C

Notes
User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	300	670	450	235	635	365	185	250	315	40	145	150
Future Volume (veh/h)	300	670	450	235	635	365	185	250	315	40	145	150
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	1772	1772	1772	1744	1744	1772	1786	1772	1786	1772	1772	1772
Adj Flow Rate, veh/h	316	705	474	247	668	384	195	263	332	42	153	158
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, %	2	2	2	4	4	2	1	2	1	2	2	2
Cap, veh/h	447	1461	1015	296	1306	750	761	402	343	203	214	181
Arrive On Green	0.13	0.43	0.43	0.18	0.79	0.76	0.23	0.23	0.23	0.12	0.12	0.12
Sat Flow, veh/h	1688	3367	1502	3222	3313	1502	3300	1772	1512	1688	1772	1502
Grp Volume(v), veh/h	316	705	474	247	668	384	195	263	332	42	153	158
Grp Sat Flow(s),veh/h/ln	1688	1683	1502	1611	1657	1502	1650	1772	1512	1688	1772	1502
Q Serve(g_s), s	14.2	19.5	19.4	9.6	9.3	13.3	6.3	17.5	28.3	2.9	10.8	13.4
Cycle Q Clear(g_c), s	14.2	19.5	19.4	9.6	9.3	13.3	6.3	17.5	28.3	2.9	10.8	13.4
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	447	1461	1015	296	1306	750	761	402	343	203	214	181
V/C Ratio(X)	0.71	0.48	0.47	0.83	0.51	0.51	0.26	0.65	0.97	0.21	0.72	0.87
Avail Cap(c_a), veh/h	614	1461	1015	397	1306	750	761	402	343	234	245	208
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.83	0.83	0.83	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.1	26.4	10.0	52.1	9.3	7.7	40.9	45.6	49.8	51.6	55.0	56.2
Incr Delay (d2), s/veh	1.8	1.1	1.5	8.0	1.2	2.1	0.1	3.3	39.8	0.4	7.4	27.6
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	5.3	7.6	11.8	3.8	2.5	3.5	2.6	8.0	14.3	1.3	5.3	6.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.9	27.5	11.5	60.1	10.5	9.7	41.0	48.9	89.6	51.9	62.4	83.7
LnGrp LOS	C	C	B	E	B	A	D	D	F	D	E	F
Approach Vol, veh/h		1495			1299			790			353	
Approach Delay, s/veh		21.0			19.7			64.1			70.7	
Approach LOS		C			B			E			E	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	15.9	60.4		19.7	21.1	55.2		34.0				
Change Period (Y+Rc), s	4.0	6.0		4.0	4.0	6.0		4.5				
Max Green Setting (Gmax), s	16.0	48.0		18.0	30.0	34.0		29.5				
Max Q Clear Time (g_c+I1), s	11.6	21.5		15.4	16.2	15.3		30.3				
Green Ext Time (p_c), s	0.3	15.5		0.2	0.9	15.8		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		33.7
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

HCM Signalized Intersection Capacity Analysis
4: Industrial Way & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	965	10	55	920	50	190	25	145	220	45	135
Future Volume (vph)	50	965	10	55	920	50	190	25	145	220	45	135
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	3.5	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	
Lane Util. Factor	*1.00	*0.94		1.00	*0.97	1.00	1.00	1.00		0.97	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.87		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1676	3313		1644	3358	1471	1693	1555		3317	1580	
Flt Permitted	0.24	1.00		0.21	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	422	3313		361	3358	1471	1693	1555		3317	1580	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	51	985	10	56	939	51	194	26	148	224	46	138
RTOR Reduction (vph)	0	0	0	0	0	22	0	126	0	0	98	0
Lane Group Flow (vph)	51	995	0	56	939	29	194	48	0	224	86	0
Confl. Peds. (#/hr)							2					2
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	1%	1%	1%	0%	0%	0%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6						
Actuated Green, G (s)	77.3	72.6		76.1	72.0	72.0	19.2	19.2		16.7	16.7	
Effective Green, g (s)	78.3	74.0		76.1	73.4	73.4	20.2	19.2		16.7	16.7	
Actuated g/C Ratio	0.60	0.57		0.59	0.56	0.56	0.16	0.15		0.13	0.13	
Clearance Time (s)	4.0	5.4		4.0	5.4	5.4	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.3	5.4		2.3	5.4	5.4	3.0	3.0		2.3	2.3	
Lane Grp Cap (vph)	304	1885		251	1895	830	263	229		426	202	
v/s Ratio Prot	0.01	c0.30		c0.01	0.28		c0.11	0.03		c0.07	0.05	
v/s Ratio Perm	0.09			0.12		0.02						
v/c Ratio	0.17	0.53		0.22	0.50	0.03	0.74	0.21		0.53	0.43	
Uniform Delay, d1	19.9	17.2		23.3	17.1	12.6	52.4	48.7		52.9	52.2	
Progression Factor	0.58	0.61		0.40	0.46	0.06	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.9		0.2	0.8	0.1	10.3	0.5		0.8	0.8	
Delay (s)	11.7	11.5		9.4	8.6	0.8	62.7	49.2		53.7	53.1	
Level of Service	B	B		A	A	A	E	D		D	D	
Approach Delay (s)		11.5			8.3			56.3			53.4	
Approach LOS		B			A			E			D	

Intersection Summary			
HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th Signalized Intersection Summary
5: Ruben Lane & US 26 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↑↱		↰↰	↑↱	
Traffic Volume (veh/h)	130	1105	90	85	775	105	90	70	25	220	50	150
Future Volume (veh/h)	130	1105	90	85	775	105	90	70	25	220	50	150
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		0.99	1.00		0.99
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	1772	1772	1772	1744	1744	1744	1758	1758	1758	1800	1800	1800
Adj Flow Rate, veh/h	131	1116	0	86	783	106	91	71	25	222	51	152
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	4	4	4	3	3	3	0	0	0
Cap, veh/h	634	2049		279	1248	543	163	111	39	409	49	145
Arrive On Green	0.57	1.00	0.00	0.05	0.37	0.37	0.10	0.09	0.09	0.12	0.12	0.12
Sat Flow, veh/h	1688	3331	1502	1661	3383	1472	1674	1237	436	3326	395	1179
Grp Volume(v), veh/h	131	1116	0	86	783	106	91	0	96	222	0	203
Grp Sat Flow(s),veh/h/ln	1688	1666	1502	1661	1692	1472	1674	0	1673	1663	0	1574
Q Serve(g_s), s	0.0	0.0	0.0	4.7	24.7	6.4	6.7	0.0	7.2	8.2	0.0	16.0
Cycle Q Clear(g_c), s	0.0	0.0	0.0	4.7	24.7	6.4	6.7	0.0	7.2	8.2	0.0	16.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.26	1.00		0.75
Lane Grp Cap(c), veh/h	634	2049		279	1248	543	163	0	150	409	0	194
V/C Ratio(X)	0.21	0.54		0.31	0.63	0.20	0.56	0.00	0.64	0.54	0.00	1.05
Avail Cap(c_a), veh/h	634	2049		300	1379	600	476	0	463	409	0	194
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.00	0.87	0.87	0.87	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.1	0.0	0.0	29.6	33.7	27.9	56.0	0.0	57.2	53.6	0.0	57.0
Incr Delay (d2), s/veh	0.1	0.9	0.0	0.3	2.1	0.7	1.8	0.0	2.8	1.1	0.0	77.8
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	1.5	0.3	0.0	1.9	10.3	2.3	3.0	0.0	3.2	3.5	0.0	10.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	14.2	0.9	0.0	30.0	35.8	28.6	57.8	0.0	59.9	54.6	0.0	134.8
LnGrp LOS	B	A		C	D	C	E	A	E	D	A	F
Approach Vol, veh/h		1247	A		975			187			425	
Approach Delay, s/veh		2.3			34.5			58.9			92.9	
Approach LOS		A			C			E			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.4	84.0		20.0	42.4	52.0		15.7
Change Period (Y+Rc), s	4.0	* 5.4		4.0	* 5.4	* 5.4		4.0
Max Green Setting (Gmax), s	8.0	* 53		16.0	* 9	* 52		36.0
Max Q Clear Time (g_c+I1), s	6.7	2.0		18.0	2.0	26.7		9.2
Green Ext Time (p_c), s	0.0	43.3		0.0	0.2	19.8		0.6

Intersection Summary	
HCM 6th Ctrl Delay	30.7
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	1175	90	45	790	210	60	5	15	255	60	90
Future Volume (veh/h)	75	1175	90	45	790	210	60	5	15	255	60	90
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		0.97	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	1772	1772	1772	1730	1730	1730	1786	1786	1786	1786	1786	1786
Adj Flow Rate, veh/h	77	1199	92	46	806	214	61	5	15	260	61	92
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	5	5	5	1	1	1	1	1	1
Cap, veh/h	536	1282	570	425	1037	516	77	36	109	278	137	206
Arrive On Green	0.24	0.38	0.38	0.22	0.35	0.35	0.05	0.09	0.10	0.16	0.21	0.22
Sat Flow, veh/h	1688	3367	1498	1647	2941	1464	1701	384	1152	1701	641	967
Grp Volume(v), veh/h	77	1199	92	46	806	214	61	0	20	260	0	153
Grp Sat Flow(s),veh/h/ln	1688	1683	1498	1647	1470	1464	1701	0	1536	1701	0	1609
Q Serve(g_s), s	0.0	37.7	3.5	0.0	26.9	7.7	3.9	0.0	1.3	16.6	0.0	9.1
Cycle Q Clear(g_c), s	0.0	37.7	3.5	0.0	26.9	7.7	3.9	0.0	1.3	16.6	0.0	9.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.75	1.00		0.60
Lane Grp Cap(c), veh/h	536	1282	570	425	1037	516	77	0	146	278	0	342
V/C Ratio(X)	0.14	0.94	0.16	0.11	0.78	0.41	0.79	0.00	0.14	0.93	0.00	0.45
Avail Cap(c_a), veh/h	536	1285	572	425	1123	559	139	0	419	278	0	570
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)	0.79	0.79	0.79	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	27.0	32.7	13.9	33.8	31.7	10.9	52.0	0.0	45.5	45.4	0.0	37.5
Incr Delay (d2), s/veh	0.1	11.5	0.5	0.1	5.7	2.4	10.3	0.0	0.3	36.4	0.0	0.6
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	1.5	16.6	1.6	1.0	10.3	2.8	1.9	0.0	0.5	9.8	0.0	3.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	27.0	44.2	14.3	33.9	37.5	13.3	62.3	0.0	45.8	81.9	0.0	38.1
LnGrp LOS	C	D	B	C	D	B	E	A	D	F	A	D
Approach Vol, veh/h		1368			1066			81			413	
Approach Delay, s/veh		41.3			32.5			58.2			65.6	
Approach LOS		D			C			E			E	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	27.7	45.9	9.0	27.4	30.8	42.8	22.0	14.4				
Change Period (Y+Rc), s	4.0	4.8	4.0	4.5	4.0	4.0	4.0	4.5				
Max Green Setting (Gmax), s	4.0	41.2	9.0	38.5	4.0	42.0	18.0	29.5				
Max Q Clear Time (g_c+I1), s	2.0	39.7	5.9	11.1	2.0	28.9	18.6	3.3				
Green Ext Time (p_c), s	0.0	1.4	0.0	0.6	0.0	9.9	0.0	0.0				

Intersection Summary	
HCM 6th Ctrl Delay	42.0
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
13: Hwy 211 & US 26/Procter Blvd

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	280	705	15	395	50	0	0	35	5
Future Volume (veh/h)	0	0	0	280	705	15	395	50	0	0	35	5
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		0.98	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				1730	1730	1730	1772	1772	0	0	1772	1772
Adj Flow Rate, veh/h				295	742	16	416	53	0	0	37	5
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				5	5	5	2	2	0	0	2	2
Cap, veh/h				357	956	21	734	870	0	0	750	101
Arrive On Green				0.39	0.39	0.39	0.82	0.82	0.00	0.00	0.49	0.49
Sat Flow, veh/h				910	2439	54	1398	1772	0	0	1527	206
Grp Volume(v), veh/h				546	0	507	416	53	0	0	0	42
Grp Sat Flow(s),veh/h/ln				1684	0	1719	1398	1772	0	0	0	1734
Q Serve(g_s), s				32.1	0.0	28.0	13.1	0.6	0.0	0.0	0.0	1.4
Cycle Q Clear(g_c), s				32.1	0.0	28.0	14.5	0.6	0.0	0.0	0.0	1.4
Prop In Lane				0.54		0.03	1.00		0.00	0.00		0.12
Lane Grp Cap(c), veh/h				660	0	674	734	870	0	0	0	851
V/C Ratio(X)				0.83	0.00	0.75	0.57	0.06	0.00	0.00	0.00	0.05
Avail Cap(c_a), veh/h				735	0	750	734	870	0	0	0	851
HCM Platoon Ratio				1.00	1.00	1.00	1.67	1.67	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	0.86	0.86	0.00	0.00	0.00	1.00
Uniform Delay (d), s/veh				30.1	0.0	28.8	6.6	5.1	0.0	0.0	0.0	14.6
Incr Delay (d2), s/veh				11.4	0.0	7.6	2.7	0.1	0.0	0.0	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				14.9	0.0	12.9	2.7	0.3	0.0	0.0	0.0	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				41.5	0.0	36.4	9.4	5.2	0.0	0.0	0.0	14.6
LnGrp LOS				D	A	D	A	A	A	A	A	B
Approach Vol, veh/h					1053			469			42	
Approach Delay, s/veh					39.0			8.9			14.6	
Approach LOS					D			A			B	

Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				58.0		47.1		58.0				
Change Period (Y+Rc), s				4.0		4.0		4.0				
Max Green Setting (Gmax), s				54.0		48.0		54.0				
Max Q Clear Time (g_c+I1), s				3.4		34.1		16.5				
Green Ext Time (p_c), s				0.1		9.0		2.2				

Intersection Summary			
HCM 6th Ctrl Delay			29.3
HCM 6th LOS			C

HCM 6th Signalized Intersection Summary
14: Hwy 211 & Pioneer Blvd 06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	850	520	0	0	0	0	360	270	15	300	0
Future Volume (veh/h)	85	850	520	0	0	0	0	360	270	15	300	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		0.99	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	1772	1772	1772				0	1772	1772	1730	1730	0
Adj Flow Rate, veh/h	89	895	0				0	379	284	16	316	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	5	5	0
Cap, veh/h	153	1613					0	644	539	23	716	0
Arrive On Green	0.51	0.51	0.00				0.00	0.36	0.36	0.00	0.14	0.00
Sat Flow, veh/h	297	3143	1502				0	1772	1482	1647	1730	0
Grp Volume(v), veh/h	526	458	0				0	379	284	16	316	0
Grp Sat Flow(s),veh/h/ln	1757	1683	1502				0	1772	1482	1647	1730	0
Q Serve(g_s), s	22.9	20.0	0.0				0.0	19.0	16.6	1.1	18.5	0.0
Cycle Q Clear(g_c), s	22.9	20.0	0.0				0.0	19.0	16.6	1.1	18.5	0.0
Prop In Lane	0.17		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	902	864					0	644	539	23	716	0
V/C Ratio(X)	0.58	0.53					0.00	0.59	0.53	0.69	0.44	0.00
Avail Cap(c_a), veh/h	902	864					0	644	539	60	755	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	0.33	0.33	1.00
Upstream Filter(I)	1.00	1.00	0.00				0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	18.6	17.9	0.0				0.0	28.3	27.6	54.5	35.8	0.0
Incr Delay (d2), s/veh	2.8	2.3	0.0				0.0	3.9	3.7	20.0	0.3	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	9.8	8.2	0.0				0.0	8.4	6.2	0.6	8.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.3	20.2	0.0				0.0	32.2	31.2	74.5	36.1	0.0
LnGrp LOS	C	C					A	C	C	E	D	A
Approach Vol, veh/h		984	A					663			332	
Approach Delay, s/veh		20.8						31.8			37.9	
Approach LOS		C						C			D	

Timer - Assigned Phs		2		4			7	8				
Phs Duration (G+Y+Rc), s		60.5		49.5			5.5	44.0				
Change Period (Y+Rc), s		4.0		4.0			4.0	4.8				
Max Green Setting (Gmax), s		54.0		48.0			4.0	39.2				
Max Q Clear Time (g_c+I1), s		24.9		20.5			3.1	21.0				
Green Ext Time (p_c), s		13.6		0.9			0.0	2.0				

Intersection Summary		
HCM 6th Ctrl Delay		27.4
HCM 6th LOS		C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
15: Wolf Drive/SE Ten Eyck Rd & US 26

06/28/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	190	850	150	10	750	20	100	25	10	50	20	150
Future Volume (veh/h)	190	850	150	10	750	20	100	25	10	50	20	150
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	1772	1772	1772	1702	1702	1702	1800	1800	1800	1758	1758	1758
Adj Flow Rate, veh/h	200	895	158	11	789	21	105	26	11	53	21	158
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, %	2	2	2	7	7	7	0	0	0	3	3	3
Cap, veh/h	599	2196	979	24	1025	457	203	263	111	341	39	293
Arrive On Green	0.35	0.65	0.65	0.01	0.32	0.32	0.21	0.22	0.21	0.21	0.22	0.21
Sat Flow, veh/h	1688	3367	1500	1621	3233	1442	1259	1201	508	1399	178	1339
Grp Volume(v), veh/h	200	895	158	11	789	21	105	0	37	53	0	179
Grp Sat Flow(s),veh/h/ln	1688	1683	1500	1621	1617	1442	1259	0	1709	1399	0	1517
Q Serve(g_s), s	9.5	13.8	4.5	0.7	24.3	1.1	8.9	0.0	1.9	3.5	0.0	11.6
Cycle Q Clear(g_c), s	9.5	13.8	4.5	0.7	24.3	1.1	20.5	0.0	1.9	5.4	0.0	11.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.30	1.00		0.88
Lane Grp Cap(c), veh/h	599	2196	979	24	1025	457	203	0	374	341	0	332
V/C Ratio(X)	0.33	0.41	0.16	0.45	0.77	0.05	0.52	0.00	0.10	0.16	0.00	0.54
Avail Cap(c_a), veh/h	599	2196	979	74	1323	590	236	0	419	378	0	372
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	26.0	9.1	7.4	53.7	33.9	26.0	47.6	0.0	34.5	36.8	0.0	38.6
Incr Delay (d2), s/veh	0.2	0.6	0.4	7.9	5.6	0.2	1.5	0.0	0.1	0.2	0.0	1.0
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	3.9	5.0	1.5	0.3	10.0	0.4	2.9	0.0	0.8	1.2	0.0	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	26.2	9.6	7.8	61.7	39.5	26.2	49.1	0.0	34.5	37.0	0.0	39.7
LnGrp LOS	C	A	A	E	D	C	D	A	C	D	A	D
Approach Vol, veh/h		1253			821			142			232	
Approach Delay, s/veh		12.0			39.5			45.3			39.0	
Approach LOS		B			D			D			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.6	76.3		28.1	43.0	38.9		28.1				
Change Period (Y+Rc), s	4.5	* 4.5		5.5	4.5	4.0		5.5				
Max Green Setting (Gmax), s	4.5	* 66		25.5	25.5	45.0		25.5				
Max Q Clear Time (g_c+I1), s	2.7	15.8		13.6	11.5	26.3		22.5				
Green Ext Time (p_c), s	0.0	19.2		0.6	0.4	8.6		0.1				

Intersection Summary			
HCM 6th Ctrl Delay			25.7
HCM 6th LOS			C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	740	150	35	800	25	40
Future Vol, veh/h	740	150	35	800	25	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	300	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	6	6	0	0
Mvmt Flow	779	158	37	842	26	42

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	937	0	1274	390
Stage 1	-	-	-	-	779	-
Stage 2	-	-	-	-	495	-
Critical Hdwy	-	-	4.22	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.26	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	703	-	162	614
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	584	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	703	-	153	614
Mov Cap-2 Maneuver	-	-	-	-	153	-
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	553	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	19.8
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	153	614	-	-	703	-
HCM Lane V/C Ratio	0.172	0.069	-	-	0.052	-
HCM Control Delay (s)	33.4	11.3	-	-	10.4	-
HCM Lane LOS	D	B	-	-	B	-
HCM 95th %tile Q(veh)	0.6	0.2	-	-	0.2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	145	630	5	100	745	5	5	5	5	25	0	110
Future Volume (veh/h)	145	630	5	100	745	5	5	5	5	25	0	110
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	1758	1758	1772	1772	1716	1716	1772	1772	1772	1800	1723	1800
Adj Flow Rate, veh/h	153	663	5	106	784	5	5	5	5	26	0	116
Peak Hour Factor	0.95	0.95	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	3	3	2	2	6	6	2	2	2	0	2	0
Cap, veh/h	678	1754	789	704	1662	11	235	3	3	207	0	7
Arrive On Green	0.11	0.53	0.53	0.09	0.50	0.36	0.00	0.00	0.00	0.00	0.00	0.00
Sat Flow, veh/h	1674	3340	1502	1688	3321	21	581	581	581	313	0	1395
Grp Volume(v), veh/h	153	663	5	106	385	404	15	0	0	142	0	0
Grp Sat Flow(s),veh/h/ln	1674	1670	1502	1688	1630	1712	1743	0	0	1707	0	0
Q Serve(g_s), s	1.1	2.4	0.0	0.8	3.2	3.2	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	1.1	2.4	0.0	0.8	3.2	3.2	0.1	0.0	0.0	0.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		0.01	0.33		0.33	0.18		0.82
Lane Grp Cap(c), veh/h	678	1754	789	704	816	857	240	0	0	214	0	0
V/C Ratio(X)	0.23	0.38	0.01	0.15	0.47	0.47	0.06	0.00	0.00	0.66	0.00	0.00
Avail Cap(c_a), veh/h	2187	10812	4861	1697	4725	4963	2496	0	0	2385	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	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	3.5	2.9	2.3	3.5	3.4	3.4	10.4	0.0	0.0	10.4	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.1	0.0	0.1	0.3	0.3	0.1	0.0	0.0	2.6	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	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.6	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	3.7	3.0	2.3	3.6	3.7	3.7	10.5	0.0	0.0	13.0	0.0	0.0
LnGrp LOS	A	A	A	A	A	A	B	A	A	B	A	A
Approach Vol, veh/h		821			895			15			142	
Approach Delay, s/veh		3.1			3.7			10.5			13.0	
Approach LOS		A			A			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	6.3	14.4		0.0	5.8	14.9		0.0
Change Period (Y+Rc), s	4.0	7.0		4.0	4.0	7.0		4.0
Max Green Setting (Gmax), s	21.0	57.0		27.0	14.0	64.0		27.0
Max Q Clear Time (g_c+I1), s	3.1	5.2		0.0	2.8	4.4		0.0
Green Ext Time (p_c), s	0.3	2.2		0.0	0.2	2.2		0.0

Intersection Summary			
HCM 6th Ctrl Delay			4.2
HCM 6th LOS			A

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	650	5	100	840	50	5	5	5	10	0	0
Future Vol, veh/h	5	650	5	100	840	50	5	5	5	10	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	150	-	100	150	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	684	5	105	884	53	5	5	5	11	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	937	0	0	689	0	0	1346	1841	342	1476	-	-
Stage 1	-	-	-	-	-	-	694	694	-	1121	-	-
Stage 2	-	-	-	-	-	-	652	1147	-	355	-	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	-	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	-	-
Pot Cap-1 Maneuver	727	-	-	901	-	-	110	74	654	88	0	0
Stage 1	-	-	-	-	-	-	399	442	-	220	0	0
Stage 2	-	-	-	-	-	-	423	272	-	635	0	0
Platoon blocked, %		-	-		-	-						-
Mov Cap-1 Maneuver	727	-	-	901	-	-	100	65	654	74	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	100	65	-	74	-	-
Stage 1	-	-	-	-	-	-	396	439	-	218	-	-
Stage 2	-	-	-	-	-	-	374	240	-	618	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	1	42.7	61.6
HCM LOS			E	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	111	727	-	-	901	-	-	74
HCM Lane V/C Ratio	0.142	0.007	-	-	0.117	-	-	0.142
HCM Control Delay (s)	42.7	10	-	-	9.5	-	-	61.6
HCM Lane LOS	E	A	-	-	A	-	-	F
HCM 95th %tile Q(veh)	0.5	0	-	-	0.4	-	-	0.5

SECTION 4. VALUE OF TRAVEL TIME SAVINGS ASSUMPTIONS AND CALCULATIONS

DKS

TRAVEL TIME SAVINGS

The memorandum on Benefit Cost Analysis Guidance[18] uses the following value of travel time savings (VTTS) categories:

- Business travel – Estimated at $27.90 for the United States.
- Personal travel – Estimated at $16.50 for the United States.

These categories are averaged using a weight of 88.2% for Personal travel and 11.8% for Business travel resulting in a VTTS for All Purposes of $17.90.

A comparison of median household income and median employee compensation indicates that the City of Sandy and the Portland-Vancouver-Hillsboro metropolitan area exceed the national level for both categories.

- Business travel – Estimated at $29.64.[19]
- Personal travel – Estimated at $17.81.[20]

These categories were averaged using the same splits for Personal and Business travel resulting in a VTTS of $19.21.

For truck drivers the recommended rate of $30.80 (2019 dollars) was used resulted in a 2021 value of $32.19.

Vehicle occupancy information was averaged from two sources:

- NHTS[21] 5 p.m. weekday average vehicle occupancy for the Portland-Vancouver-Hillsboro: 1.44
- 2019 American Community Survey[22] 5-year estimates workers per car, truck or van for the City of Sandy: 1.07

This results in an estimated average vehicle occupancy of 1.26 for the weekday p.m. peak hour.

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[18] United States Department of Transportation, 2021

[19] Calculated using $19.83 (2019 dollars) from the Bureau of Labor Statistics median compensation for the State of Oregon and scaled based on the methodology outlined in the Revised Value of Travel Time Guidance (2016). Then finally increased to 2021 dollars.

[20] Calculated based on the weighted average of 60% 2019 Sandy household median income and 40% 2019 Oregon household median income. This is based on the assumption that up to 40% of trips using the bypass will not be local. This average was scaled using the methodology outlined in the Revised Value of Travel Time Guidance (2016). Then finally increased to 2021 dollars.

[21] National Household Travel Survey, 2017

[22] US Census Bureau, Commuting Characteristics by Sex, S0801

Approximately 1,500 vehicles are estimated to use the proposed bypass during the peak hour with 1,200 through trips and 300 local trips. The individual origin-destination of these local trips is unknown so only the 1,200 through trips were used to evaluate the value of travel time savings (VTTS). Of these 1,200, 720 are eastbound trips and 480 are westbound trips. The percentage of truck drivers is estimated to be 3 percent in the eastbound direction (22 truck drivers) and 4 percent in the westbound direction (19 truck drivers). The final estimated traveler characteristics are shown in Table 1.

TABLE 1: TRAVELER CHARACTERISTICS OF BYPASS USERS

	General Travel	Commercial Drivers
Eastbound	**879**	**22**
Westbound	**581**	**19**

The bi-directional travel time on the proposed bypass is estimated to be 7 minutes 56 seconds with interchanges at either end of the bypass and a traffic signal at the intersection with OR 211. The eastbound travel time with Alternative #1 is estimated at 13 minutes 20 seconds; the westbound travel time is estimated at 10 minutes 15 seconds.

In the eastbound direction, the estimated travel time savings is 80 person-hours (40%) and in the westbound direction the travel time savings is estimated at 53 person-hours (40%). Using a weighted VTTS of $19.53 for the eastbound direction and $19.62 for the westbound direction (to account for commercial drivers) the total travel time savings value is $2,600 (2021 dollars). Extending this to an annual weekday p.m. total, the value is approximately $675,000 per year. If weekday p.m. peak hour conditions exist daily (including weekends) then the value of the travel time savings is approximately $950,000 per year.

SECTION 4. POLICY AND REGULATORY CONSIDERATION MEMO

LAND USE PLANNING
TRANSPORTATION PLANNING
PROJECT MANAGEMENT

MEMORANDUM

Task 4.1 Final Policy and Regulatory Considerations Memo

City of Sandy Bypass Feasibility Reevaluation

DATE	May 7, 2021
TO	Reah Flisakowski, DKS
FROM	Darci Rudzinski and Emma Porricolo, APG
CC	Kevin Chewuk, and Dock Rosenthal, DKS

INTRODUCTION

This memorandum provides a detailed evaluation of the policy and regulatory considerations associated with a potential bypass of the existing US 26 around the south side of the city of Sandy. A potential US 26 bypass was one of three concepts developed and evaluated during the 2011 Sandy Transportation System Plan (TSP) update to enhance connectivity, provide access to developing lands, and address congestion in the existing US 26 corridor. The bypass option is being reexamined in preparation for the current TSP update as a two-lane facility (one lane in each direction) around the south side of the City with an interchange at the west terminus (a point west of Orient Drive) and an interchange at the east terminus (near Firwood Road). As was the case in the analysis that led to the adoption of the 2011 TSP, a bypass would be part of a package of improvements that would include local system enhancements and highway improvements. The state and local policy and regulatory framework for updating the TSP is reviewed in Technical Memorandum 1: Policy Framework and Code Review. This memorandum is focused only on the additional considerations related to a bypass; the evaluation herein references both the January 2021 Policy Framework and Code Review as well as work developed as part of the 2011 TSP.[1]

As noted in the 2011 transportation analysis, the construction of a US 26 bypass around the city of Sandy represents a significant investment in public infrastructure with the potential to impact transportation, urban and rural lands, Goal 5 resources, and the local and regional economy. Demonstration of compliance with several related policies and regulations will need to be addressed if this alternative is pursued and further developed.

[1] Technical Memorandum #3, Transportation Alternatives and Improvement Strategies, February 25, 2011, City of Sandy TSP Update.

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The applicable state and local policy documents are:

- Oregon Highway Plan (OHP)
- Oregon Statewide Planning Goals
- Transportation Planning Rule (TPR)

POLICY AND REGULATORY REVIEW

Oregon Highway Plan

Planning for a bypass would be undertaken as a new facility plan[2] project, developed in partnership with ODOT, the City of Sandy, and Clackamas County consistent with Oregon Highway Plan (OHP) Policy 2A: Partnerships. Ultimately, a facility plan for a new bypass would be adopted by the Oregon Transportation Commission (OTC) as an amendment to the OHP. Planning for new bypasses is governed by OHP Policy 1G: Major Improvements and Policy 1H: Bypasses.

Policy 1G: Major Improvements

Policy 1G states that existing facilities should be maintained and enhanced to improve performance and safety before adding capacity. When developing transportation solutions, the priority is to maintain the existing system first by improving functionality through means such as access management, transportation demand management, and improved traffic operations. Where this strategy is unable to meet the project objectives, the focus should then shift to improvements to efficiency and capacity of existing facilities, followed by adding capacity to existing facilities, and lastly to constructing new facilities.

The construction of a new facility such as a bypass is categorized under the lowest level of priority under this policy. Therefore, the planning process must demonstrate that alternatives that do not include a bypass cannot adequately support safety, growth management, and other livability and economic objectives. As identified in a previous analysis,[3] this would include demonstrating that:

- The improvement is needed to satisfy a state transportation objective or objectives.
- The scope of the project is reasonably identified, considering the long-range projection of need.
- The improvement is identified through a planning process that includes:
    - A robust public involvement process;
    - An evaluation of reasonable transportation and land use alternatives including measures for managing the existing transportation system and for reducing demands for highway capacity; and
    - Sufficient environmental analysis at the fatal flaw analysis level.

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[2] Facility plans are defined as plans developed by ODOT for state highway facilities and include corridor facility plans and transportation refinement plans.
[3] The list is from OHP Action 1G.2 and has been modified slightly, both from the OHP source document and from items originally included in Technical Memorandum #3, Transportation Alternatives and Improvement Strategies.

- The plan includes measures to manage the transportation system, and demonstrates that these measures will not satisfy identified highway needs during the planning period or there is a need to preserve a future transportation corridor for future needs beyond the planning period.
- The improvement would be a cost-effective means to achieve the objective(s).
- The proposed timing of the improvement is consistent with priorities established in corridor plans and regional transportation plans.
- Funding for the project can reasonably be expected at the time the project is ready for development and construction.
- Local street improvements proposed as part of the major improvement would be funded through the local transportation financing program.
- The plan includes policies and implementing measures that protect the corridor and its intended function.

Also, Policy 1G: Major Improvements calls for the implementation of a cost-sharing agreement where major improvements benefit the local system.

Policy 1H: Bypasses

Bypasses are highways designed to maintain or increase statewide or regional mobility and they generally divert pass through vehicle trips around a downtown, or an urban or metropolitan area. If a bypass were constructed around Sandy, it is likely to be designed as a limited access facility to protect its functional life as an alternate route around Sandy.

The objectives of the Bypass Policy are:

- To maintain and enhance the utility of the state highway investment,
- To assure land uses that are consistent and compatible with Oregon statewide land use goals,
- To identify the appropriate function of bypasses in the transportation system, and
- To guide the long-term operation of bypasses through agreement on land use and transportation management actions.

In addition, there are actions included in the policy which require:

- ODOT and the affected local governments to identify the need for a bypass in a Transportation System Plan and/or Corridor Plan in a manner consistent with Oregon Highway Plan Policy 1G.
- ODOT and the affected local governments to use a refinement plan and/or a NEPA process to consider alternatives and assess potential impacts.
- Establishment of management agreements between ODOT and the affected local governments to protect the facility investment.
- Design for moderate to high-speed travel, consistent with freeway or expressway facilities.
- Prohibition of direct private property access and a limited number of public access points.
- Development of management plans for new interchanges and other bypass elements.

- Adoption of an acknowledged TSP that incorporates the Oregon Highway Plan Bypass policies.
- Adoption of local ordinances that provide for adequate connectivity to complement the bypass.
- Consideration of re-zoning properties that could adversely impact the facility.
- Consideration of potential local participation in financing.
- Consideration of a jurisdictional transfer of the bypassed highway.

The first bullet in the list above dictates that ODOT, Sandy, and Clackamas County would identify the need for a bypass in a facility plan and/or adopted local transportation system plans (see *Steps to Adoption* in this memorandum). Subsequent steps move into the National Environmental Policy Act (NEPA) process, with decisions becoming more refined as the facility's location and design become more specific. A demonstration of the purpose and need for a US 26 bypass around Sandy would not only provide a basis for studying such an improvement, it is a critical first step in the decision-making process of evaluating alternatives in a manner that complies with NEPA requirements.

As the last bullet in the list implies, a possible outcome of a future bypass would be jurisdictional transfer of the existing US 26 corridor that runs through Sandy from ODOT control to the City. This would shift maintenance responsibilities to the City and future improvements and access would be consistent with a local street functional classification and its associated standards.

Oregon Statewide Planning Goals

Goal 3 and Goal 4

Findings of consistency with the Statewide Planning Goals would need to support the adoption of a bypass facility plan and associated recommended changes to local plans. At least portions of a proposed bypass would be located in the rural lands of Clackamas County. Land south of the City of Sandy, outside the City’s urban growth boundary (UGB), would likely include parcels zoned for exclusive farm use (EFU) and forest use (Timber District, TBR). EFU is a state regulated designation that is intended to preserve land for farm- and forest-related uses.

Statewide Planning Goal 3, to preserve and maintain agricultural lands, is implemented by the Oregon Administrative Rule (OAR) 660-033. OAR 660-033-0012, Table 1, identifies transportation facilities and improvements that are permitted on Agricultural lands. Included in the Uses Authorized on Agricultural Lands are transportation improvements on rural lands allowed by OAR 660-012-0065. This is a subsection of the Oregon Transportation Planning Rule (TPR) that identifies transportation improvements that may be allow on rural lands, consistent with Goal 3 and Goal 4, Forest Lands.

Forest lands are also considered a resource land designation and have specific state protections that are implemented through local ordinances. Pursuant to OAR chapter 660, Division 6, the County may allow transportation-related uses in the TBR zone designated lands, including road widening within existing rights-of-way in conformance with the transportation element of acknowledged comprehensive plans and public road and highway projects as described in ORS 215.213(1) and 215.283(1).[4]

A new four-lane bypass alignment that impacted EFU or Forest (Timber) lands would require a goal exception. The goal exception would be a reasons exception with findings pursuant to ORS 197.732.[5] Clackamas County would be the approving body for a goal exception, which would need to be supported by findings of fact and "reasons" statements documenting why state policy – in this case Goal 3 Agricultural Lands and/or Goal 4 Forest Lands, depending on the parcel's zoning – should not apply.

A reasons exception needs to document that there is no alternative area that could reasonably accommodate the improvement and that the long term environmental, economic, social and energy (ESEE) consequences have been evaluated and the proposed roadway and its interchanges have been designed to reduce adverse impacts and, to the extent possible, is compatible with adjacent uses. That analysis must include showing that the solutions to the defined problem cannot be accommodated in any areas that wouldn't require a goal exception, that the proposed improvements' impact on the subject goal exception area are not any worse than those associated with other alternatives, and that the improvements can be designed to minimize adverse impacts. In other words, the proposed transportation improvement must be shown to be compatible with other adjacent uses or will be made so through specified measures to reduce adverse impacts. The County and City may need to show how the adoption of a facility design and associated land use measures minimize the accessibility of rural lands from the proposed bypass and that adoption also supports the continued use of surrounding rural lands.

Goal 5

Goal 5, Natural Resources, Scenic and Historic Areas, and Open Spaces, states that local governments shall "adopt programs that will protect natural resources and conserve scenic, historic, and open space resources for present and future generations." Cities and counties are to maintain inventories for the following:

- Riparian corridors (including water and riparian areas and fish habitat)
- Wetlands
- Wildlife habitat
- Federal wild and scenic rivers
- State scenic waterways
- Groundwater resources
- Approved Oregon recreation trails
- Natural areas
- Wilderness areas

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[4] ORS 215.213(1) and 215.283(1) address uses permitted in exclusive farm use zones; transportation improvements are basically limited on EFU lands to modification, improvement, or realignment of existing roadways and highways.
[5] https://www.oregonlaws.org/ors/197.732

- Mineral and aggregate
- Energy sources
- Cultural areas

Analysis supporting the 2011 TSP identified constraints to land and public infrastructure development related to Sandy's location at the base of Mt. Hood and the foothills terrain. Environmental and topographic constraints limit options to provide an effective transportation network in specific areas. Constraints include, but are not limited to:

- steep slopes in the northeast that severely limit the feasible expansion of transportation facilities to provide alternate routes to US 26 east of Bluff Road and Tickle Creek; and
- salmon-bearing streams and wetlands running parallel to US 26 along the southern end of the City.

In addition to required Goal 5 inventories, local governments are encouraged to inventory:

- Historic resources
- Open spaces
- Scenic views and sites

The City's TSP supports environmental resource protection through the following adopted Environmental Goal: "Avoid or mitigate transportation project impacts to environmental resources including creeks and wetlands, cultural resources, and wildlife corridors." The TSP also includes protection of scenic resources and the City's historic character under "Community Goals."

Impacts to Goal 5 resources, in particular to those that are mapped and associated with specific County or City protection or mitigation requirements, would be a criterion by which to evaluate proposed bypass alignments. Where mapped Goal 5 lands are impacted, a goal exception may be needed to support the bypass "preferred alternative" - the selected bypass alignment and associated project improvements. The preferred alternative would then be further studied for refinements that could mitigate or minimize any potential impact to Goal 5 resources.

Goal 12, Transportation

Goal 12, Transportation, is implemented by OAR 660 Division 12, known as the Transportation Planning Rule or "TPR." The Clackamas County TSP and the Sandy TSP must be consistent with each other, and both have to be consistent with adopted elements of the state TSP, including the OHP. Cities and counties adopt regional and local TSPs required by the TPR as part of their comprehensive plans.

Transportation Planning Rule (OAR 660-012)

The Transportation Planning Rule (TPR) identifies transportation facilities, services, and improvements that may be permitted on rural lands consistent with Goals 3, 4, 11, and 14 without a goal exception (Transportation Improvements on Rural Lands **660-012-0065**). As described in the Goal 3 and Goal 4 section of this memorandum, transportation improvements on rural resource lands are largely limited to modifications, improvements, or realignments of existing roadways and highways. In order to plan for and adopt elements of a bypass facility plan, in the case that the preferred alignment impacts EFU or Forest lands, Clackamas County will need to support adoption with goal exception findings.

STEPS TO ADOPTION

As discussed earlier in this memorandum, a preferred bypass alternative would be documented in a facility plan. Pursuant to OAR 734-051-7010, the OTC ultimately adopts facility plans, thereby amending the OHP. Prior to adoption by the OTC, ODOT, the City of Sandy, and Clackamas County would work collaboratively on developing any amendments to local comprehensive plans and TSPs and local land use and subdivision codes that are necessary to support the plan for the proposed bypass and to ensure that its recommendations are consistent with local plans and codes. While both the state and the local governments adopt the facility plan, or elements thereof, the adoption processes are different and the roles and responsibilities of the different levels of government are not the same.

Both the City of Sandy and Clackamas County would amend their respective TSPs to incorporate elements of the facility plan. In addition to adopting planned improvements on the local systems associated with the bypass and interchanges, local approval may require the adoption of new transportation-related policies, consistent with the findings and supportive of the recommendations of the facility plan. In addition, new ordinances or amendments to existing ordinances, resolutions, and Inter-Governmental Agreements (IGA) may be necessary to ensure that access management, land use management, and coordination elements of the facility plan are achieved. The approval process would include Planning Commission/City Council hearings with the City of Sandy and Planning Commission/County Commission hearings with Clackamas County. As discussed in the previous section, if the preferred bypass alignment impacts County land designated for EFU or Forest use, the County would need to support adoption with goal exception findings.[6] Following successful local adoption by the City and County, the facility plan can be presented to the OTC for its review and approval.

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[6] Note that the adoption action is an amendment to the TSP, the transportation element of the local Comprehensive Plan. The comprehensive plan amendment becomes acknowledged after the 21-day appeal period and no appeals have been filed (see https://www.oregonlaws.org/ors/197.625.)