FEHR PEERS

Memorandum

Date: May 17, 2022

To: Valley Regional Transit

From: Chris Breiland, Fehr & Peers
Seishi Yamagata, Fehr & Peers
Mary Sizemore, Fehr & Peers

Subject: State Street Corridor Operational Analysis

UT21-2277

Introduction

In 2011, VRT and ACHD prepared State Street Transit and Traffic Operations Plan (TTOP), which identified a vision for the State Street Corridor in the Treasure Valley. The TTOP included enhanced bus service on State Street and high occupancy vehicle (HOV) lanes on State Street between 23rd Street and Glenwood Street. However, the State of Idaho has not authorized implementing HOV lane operations on the corridor. Given the time it takes to implement major roadway widening projects, the Ada County Highway District (ACHD) is strategically adding the additional lanes, but without the HOV designation.

Fehr & Peers performed a traffic and transit operations analysis to determine potential low-cost and quick build design options that can offer the operational benefits to transit that the TTOP HOV lane concept could offer but without the need to change state law and with minimal impacts to non-transit vehicles.

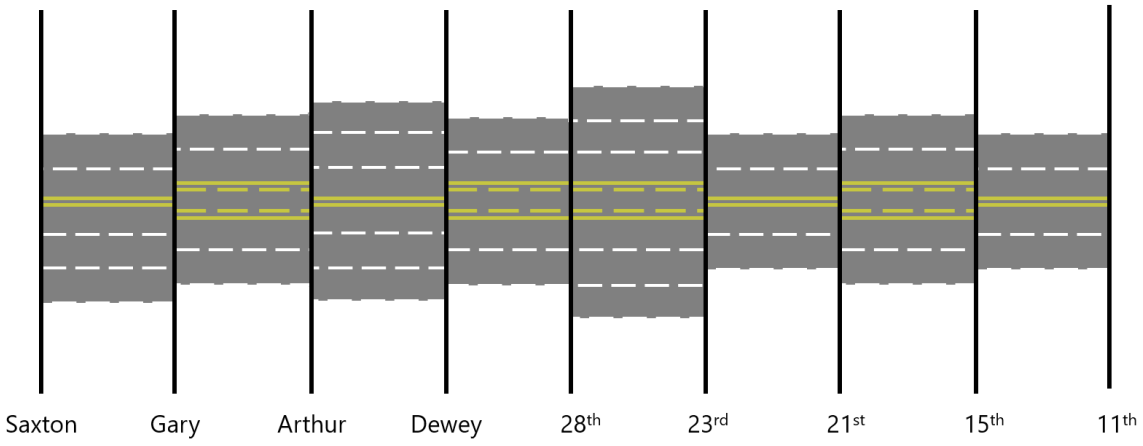
Study Area and Methodology

The study area consists of the following intersections along State Street between Ballantyne Lane and at N 23rd Street.

- 23rd Street
- 27th Street
- Whitewater Park Boulevard / 31st Street
- 33rd Street / Idaho Transportation Department (ITD)
- Dewey Street
- Veteran's Memorial Parkway / 36th Street
- Arthur Street
- Willow Lane
- Wylie Lane
- Collister Drive
- Marketplace Lane
- Plantation River Drive / Bloom Street
- Ellens Ferry Drive
- Pierce Park Lane
- SR-44 / Glenwood Street / Gary Lane

The existing roadway network is shown as **Figure 1** below.

Figure 1. Existing Roadway Network



Currently, the transit stops along State Street are mostly in-lane, with a few stops having bus shelters. **Figure 2** and **Figure 3** show typical bus stop layouts along State Street.

Figure 2. W State Street & N Clover Drive Southeast Corner Stop

In-lane stop with bench and no shelter on State Street (in a bike lane). Source: Google Earth 2021.

Figure 3. W State Street & N Whitewater Park Blvd Southeast Corner Stop

In-lane stop with bench and shelter on State Street. Source: Google Earth 2021.

Analysis Software

Fehr & Peers used the Synchro traffic operations software to calculate delay and level of service (LOS) for the study intersections under existing (2021) [1] and future (2035) conditions. Per ACHD standards, Section 7100 – General Requirements Procedures for Development states that the minimum acceptable LOS is LOS E for principal arterials (State Street's roadway classification). Intersections that operate at LOS F are considered to operate deficiently.

Due to the software's limitation on transit operations, two intersections (Pierce Park Lane and Veterans Memorial Parkway) were simulated in VISSIM to evaluate effects of deviating from the TTOP design with enhanced transit alternative. The VISSIM results at these two intersections served as surrogates so that the team could post-process the Synchro output and adjust the LOS/delay findings for transit and general purpose traffic across the entire corridor.

Input Data

A data collection firm collected traffic counts for the AM and PM peak periods on Tuesday, May 25, 2021, and Fehr & Peers processed them to establish a baseline of existing conditions and operations for the area. The AM and PM peak periods in this study are from 7:00 AM to 9:00 AM

[1] Based on discussions with VRT and ACHD staff, while 2021 conditions were still impacted somewhat by the COVID-19 pandemic, general purpose traffic was similar to pre-pandemic conditions while transit ridership was still below pre-pandemic levels.

and 4:00 PM to 6:00 PM, respectively. COMPASS provided annual growth rates to compute future traffic volumes. Generally, traffic is estimated to grow on State Street at a rate of about 1.5% between 2021 and 2035, except between Whitewater Parkway and Gary/Glenwood where traffic is estimated to grow at about 2.5% per year. Fehr & Peers used the Highway Capacity Manual 6th Edition (HCM 6th Edition) methodology delay thresholds to compute the LOS at each study intersection for the existing background and future conditions.

Analysis Results

This section of the memorandum summarizes the results of the traffic and transit operations analysis under existing and future year conditions.

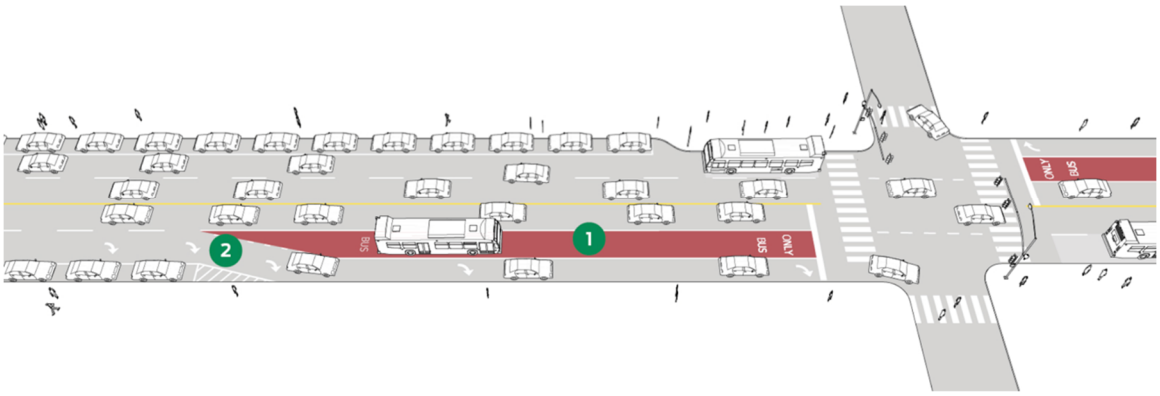
Analysis Scenarios

Three future year scenarios were evaluated to understand the impacts and benefits of different lane configurations and transit speed and reliability options on both general purpose traffic and transit. The scenarios are as follows

- **Future No-Build:** The baseline scenario assumes that no new improvements are built on State Street by 2035.
- **Scenario 1:** Consistent with the TTOP, this scenario assumes two lanes for General Purpose (GP) traffic and one for HOV traffic along State Street between Glenwood and 23rd. New bus stops would be in pull-outs.
- **Scenario 2:** This scenario also assumes widening between Glenwood and 23rd, but instead of HOV lanes, there would be two lanes of GP traffic and an exclusive right-turn lane or bus queue jumps at intersections as described further below.
- **Scenario 3:** This scenario assumes that the State does not allow HOV lanes, but ACHD proceeds with widening State Street to include three lanes of GP traffic between Glenwood and 23rd. Under this scenario all bus stops would be in-lane between Glenwood and 23rd.

Scenario 2 implements transit enhancements that are less common in the Boise area, but are used on other similar arterial corridors throughout the country. Under this scenario, intersections that have a right turn pocket are assumed to have a short queue jump lane at the intersection (in the segment of the third lane from the median that is between the intersection crosswalk and the beginning of the turn lane (see **Figure 4**). For intersections that have a shared through/right-turn movement, the assumed transit enhancement is a right-turn (except bus) lane that allows buses and bikes to travel straight through the intersection while all other vehicles must turn right. The intersection of State Street and 26th/27th Street has this style lane treatment in the eastbound direction today (see **Figure 5**) with a sign at the signal that requires right turns.

Figure 4. Enhanced Transit Queue Jump Lane Example



Source: NACTO

Figure 5. Right-Turn Only (Except Bus) Lane Example

Source: Google Maps

Error! Not a valid bookmark self-reference. reports the results of the LOS analysis for the AM and PM peak hours for each scenario. The focus for Table 1 is in the proposed TTOP widening area between Glenwood and 23rd. The focus of the LOS analysis is on general purpose traffic and the benefits to transit operations are analyzed later in this section.

Table 1. Level of Service Summary – Intersections between Glenwood and 23rd

Intersection			Existing	Future No-Build	Scenario 1	Scenario 2	Scenario 3
ID	Location	Period	LOS / Delay (s)[2]	LOS / Delay (s)[2]	LOS / Delay (s)[2]	LOS / Delay (s)[2]	LOS / Delay (s)[2]
1	23rd & State[1]	AM	A / 8	A / 9	A / 9	B / 12	A / 9
		PM	A / 8	B / 11	B / 11	B / 14	B / 11
2	27th & State[1]	AM	C / 20	C / 28	D / 36	C / 29	C / 25
		PM	C / 32	D / 44	**F / 86**	**F / 117**	D / 43
3	Whitewater Park /31st & State	AM	B / 11	B / 13	B / 13	B / 13	B / 13
		PM	C / 22	E / 72	D / 45	E / 57	C / 31
4	ITD HQ/33rd & State	AM	A / 6	B / 10	A / 6	A / 8	A / 5
		PM	A / 5	A / 5	A / 5	A / 5	A / 4
5	Dewey & State[1]	AM	A / 1	A / 1	A / 1	A / 1	A / 1
		PM	A / 1	A / 2	A / 1	A / 3	A / 2
6	VMP/36th & State	AM	D / 47	D / 42	D / 45	D / 44	D / 42
		PM	D / 35	D / 51	D / 54	D / 38	C / 31
7	Arthur & State[1]	AM	A / 5	A / 2	A / 3	A / 7	A / 4
		PM	A / 3	A / 2	A / 2	A / 2	A / 3
8	Willow & State	AM	A / 3	A / 10	A / 2	A / 8	A / 2
		PM	A / 6	B / 15	A / 6	B / 13	A / 4
9	Wylie & State[1]	AM	A / 3	A / 2	A / 3	A / 2	A / 4
		PM	A / 6	A / 8	A / 3	A / 8	A / 5
10	Collister & State[1]	AM	B / 11	B / 12	A / 10	B / 11	B / 10
		PM	B / 12	B / 16	B / 13	E / 55	C / 22
11	Marketplace & State	AM	A / 3	A / 3	A / 3	A / 3	A / 3
		PM	A / 7	B / 12	A / 8	B / 12	A / 6
12	Plantation /Bloom & State	AM	A / 8	C / 26	B / 11	C / 25	B / 10
		PM	A / 7	D / 51	B / 11	D / 50	A / 10
13	Kessinger /Ellens Ferry & State	AM	A / 5	A / 5	A / 5	A / 5	A / 5
		PM	A / 4	A / 4	A / 9	D / 48	A / 7
14	Pierce Park & State	AM	B / 15	B / 15	B / 14	B / 14	B / 13
		PM	C / 22	E / 66	B / 18	D / 43	B / 16

Intersection			Existing	Future No-Build	Scenario 1	Scenario 2	Scenario 3
15	Glenwood /Gary & State	AM	**F / 86**	**F / 111**	**F / 111**	**F / >150**	**F / 111**
		PM	E / 77	**F / 124**	**F / 113**	**F / >150**	**F / 113**

1. Intersection analyzed with HCM 2000 due to signal phasing limitations.
2. LOS highlighted in **bold** indicate a deficient LOS.

As shown in **Table 1**, several intersections are forecast to operate at LOS F for general purpose traffic under 2035 conditions under the different scenarios:

- 27th Street & State Street would operate at LOS F in the PM peak hour under Scenarios 1 and 2 because the HOV lane or the right-turn (except buses) (in the case of Scenario 2) would reduce the capacity of the road compared to either the Future No-Build Scenario[2] and Scenario 3.
- Glenwood Street/Gary Lane & State Street operates at LOS F in the AM peak hour under existing conditions and is forecast to continue to operate deficiently in the 2035 future conditions no matter which scenario is considered. However, operations under Scenario 2 have the highest future delays.

All other intersections operate well under 2035 conditions regardless of which scenario is considered.

Our team also analyzed traffic operations outside of the TTOP widening area. However, in this part of the corridor, different 2035 scenarios were not tested since there is no current plan to widen or change the operations of this segment of State Street/Highway 44. As shown in **Table 2**, the Highway 44 & Eagle Road intersection is forecast to operate at LOS F conditions in 2035, which is a degradation of the current LOS E operations.

All other intersections operate at acceptable levels of delay in existing and future analysis conditions.

[2] Under the 2035 No-Build condition, there is a right-turn only lane except buses on State Street headed eastbound, but not westbound, which is the busier direction in the PM and is what is causing the high delays and degraded LOS.

Table 2. Level of Service Summary – Intersections between Eagle and Saxton

Intersection			Existing	2035 Future No-Build
ID	Location	Period	LOS / Delay (s)[2]	LOS / Delay (s)[2]
16	Wal-Mart /Saxton & State[1]	AM	B / 14	B / 16
		PM	C / 29	C / 31
17	Bogart & State	AM	B / 14	C / 24
		PM	C / 24	E / 56
18	Horseshoe Bend & State	AM	B / 15	D / 36
		PM	C / 20	C / 25
19	Eagle Promenade & State[1]	AM	A / 2	A / 1
		PM	A / 9	A / 9
20	HWY 55 & State	AM	C / 35	D / 53
		PM	B / 16	C / 24
21	Edgewood & HWY 44/State Street	AM	C / 26	C / 35
		PM	D / 35	D / 46
22	Eagle & HWY 44	AM	E / 66	**F / 109**
		PM	E / 76	**F / 126**

1. Intersection analyzed with HCM 2000 due to signal phasing limitations.
2. LOS highlighted in **bold** indicate a deficient LOS.

An overall finding from the Synchro analysis is that overall general purpose vehicle operations are comparable between Scenarios 1 and 3 (the TTOP and widened with general purpose lanes) under 2035 conditions. Only 27th Street & State Street sees a notable difference in delay, which could be addressed through some lane configuration changes or minor widening. Scenario 2 (full-corridor with right-turn only [except bus] lane or queue jump lanes) shows slightly more delay for general purpose vehicles the other scenarios, but most intersections operate with an acceptable level of delay, particularly in the AM peak hour. In summary, other than a handful of intersections in the PM peak hour (27th and Glenwood), most motorists are not likely to notice a significant difference in operations between the different State Street 2035 scenarios.

VISSIM Analysis of Key Transit Enhancements

As described in the methodology section, we used VISSIM to perform detailed modeling of the transit and general purpose travel time benefits and impacts of the transit enhancements related to each of the scenarios at two prototypical intersections. **Table 3.** shows the changes in travel

time relative to Scenario 1 (TTOP with HOV lanes and bus stops in pullouts). The analysis was performed under 2035 PM peak hour conditions which allows us to generalize to both AM and PM peak hours in both inbound and outbound directions.

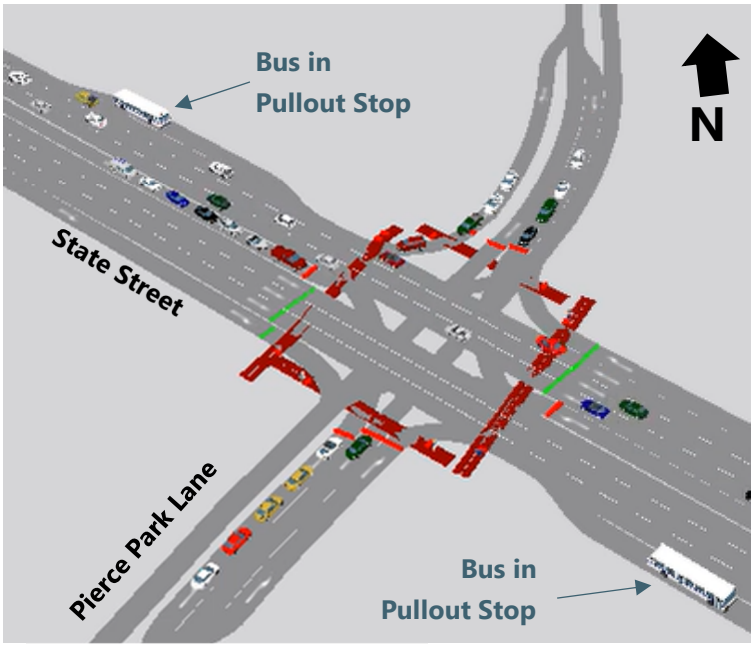
Table 3. PM Peak Hour Westbound Travel Time Difference for Key Transit Enhancements Compared to Scenario 1

Lane Designation	Travel Time Difference (seconds)			
	Smaller Intersection (Pierce Park)		Larger Intersection (VMP)	
	Bus	GP	Bus	GP
Right-Turn Lane Except Bus	-15 to -25	-5 to +5	-5 to -15	0 to +10
Queue Jump	-15 to -25	-5 to +5	0 to -10	0 to +10
All GP Lanes – In-Lane Stops	-30 to -40	-5 to -15	0 to -20	0 to -10

These travels time savings are examined further in the section below.

TTOP HOV Lane Pullouts

Figure 6. Pullout Bus Stops at Pierce Park Lane & State Street



HOV lanes with bus pullout stops consist of a dedicated HOV lane for both transit and GP traffic, and a pullout bus stop. This configuration is the default design for all new sections widened as part of the TTOP. Because pullout stops require buses to merge back into general traffic flow, there is a potential for transit delay. The VISSIM analyses on State Street indicated that for most bus trips, merging back into the HOV lane can be accomplished with relatively minor delay to bus operations. This is particularly true in the AM when traffic volumes on State Street are lower. However, for some higher-volume segments of State Street during the PM peak hour, bus delays of up to 40 seconds were observed. These delays were particularly notable on the western end of the TTOP corridor (between Pierce Park and Glenwood

Road) and in the unwidened section of State Street farther west toward Eagle. **Figure 6** shows a simulated bus at Pierce Park waiting to exit the pullout stop and merge into westbound traffic.

In-Lane Stops

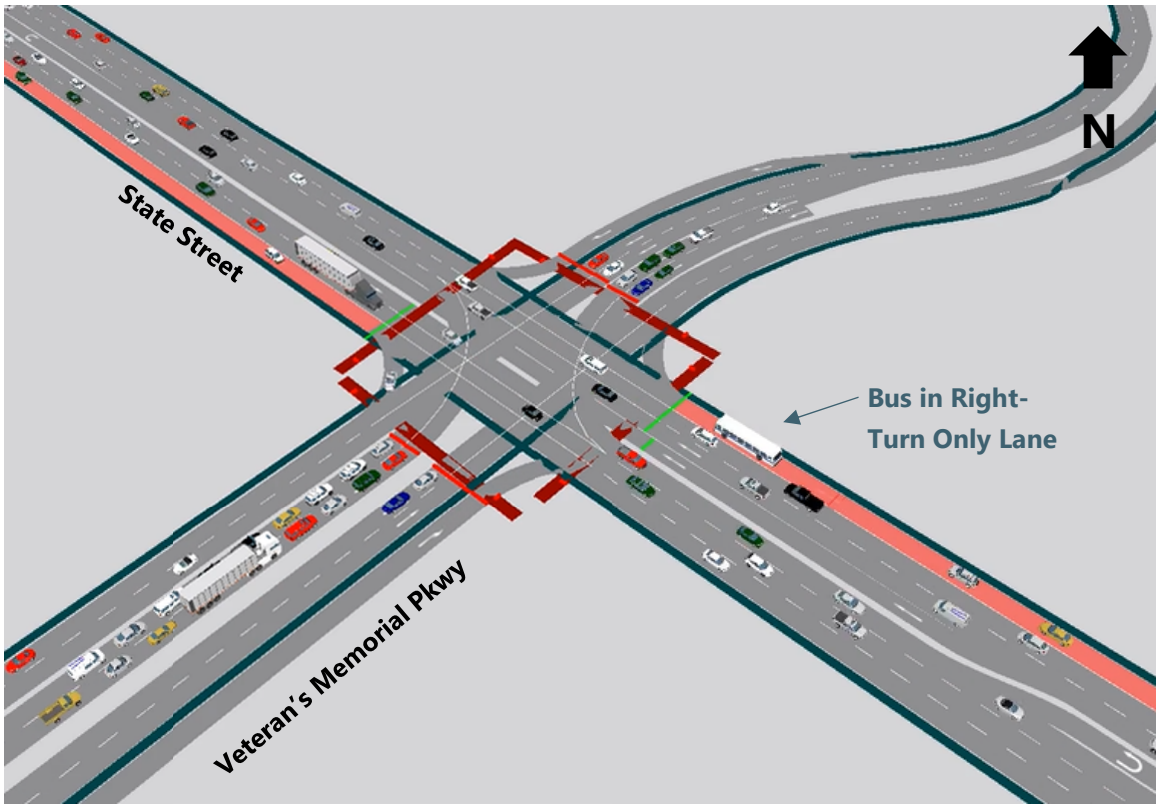
In-lane stops are bus stops located in the outermost GP lane of a roadway. Most bus stops along State Street are currently in-lane stops. Benefits to in-lane stops include lower infrastructure costs and right-of-way needs and bus travel time savings when compared to pullouts. However, a frequent concern raised by the public is that in-lane stops will cause excessive delays to GP vehicles. The results of the VISSIM analysis indicate that in-lane stop vehicle delays are minor compared to intersection control delay. When comparing the TTOP HOV configuration with pullouts and GP configuration with in-lane stops, any GP vehicle delays caused by buses are more than offset by the additional travel time savings from the additional capacity.

Given the relatively good operations (i.e., low vehicle delays) on the State Street corridor forecast under 2035 conditions, the transit travel time benefits from the HOV lanes are not substantial compared to GP lane operations with in-lane stops. Note that if there were pullouts with GP lane operations, the HOV lane with pullouts would operate far better for buses since buses would have a hard time merging back into busy GP lane traffic. Therefore, the bus travel times are likely similar between HOV lanes with pullout stops and GP lanes with in-lane stops.

Right-Turn Only Lane Except Bus

Right-Turn Only (Except Bus) lanes allow transit through movements as well as right-turning movements into business driveways or minor streets for GP traffic. This lane configuration provides a lower-volume traffic lane for the transit vehicle to proceed quicker through the signalized intersection than it would in a typical GP traffic lane. Because a right-turn only (except bus) lane utilizes an existing receiving lane, GP through traffic must merge from three to two lanes before the right-turn lane begins – this results in additional GP delay of up to 10 seconds for each vehicle on the approach to the intersection. While the transit vehicles proceed quicker through the signalized intersection, there is some bus delay in the weaving/merging area as the lane approaches the intersection and GP vehicle position in the correct lane. Overall, however, right-turn only (except bus) lanes generally would save 5-25 seconds of bus travel time compared to the HOV or GP lane configuration. Error! Reference source not found. shows a simulated bus at VMP using this lane configuration to proceed through the intersection.

Figure 7. Right-Turn Only Lanes Except Bus at Veterans Memorial Parkway & State Street

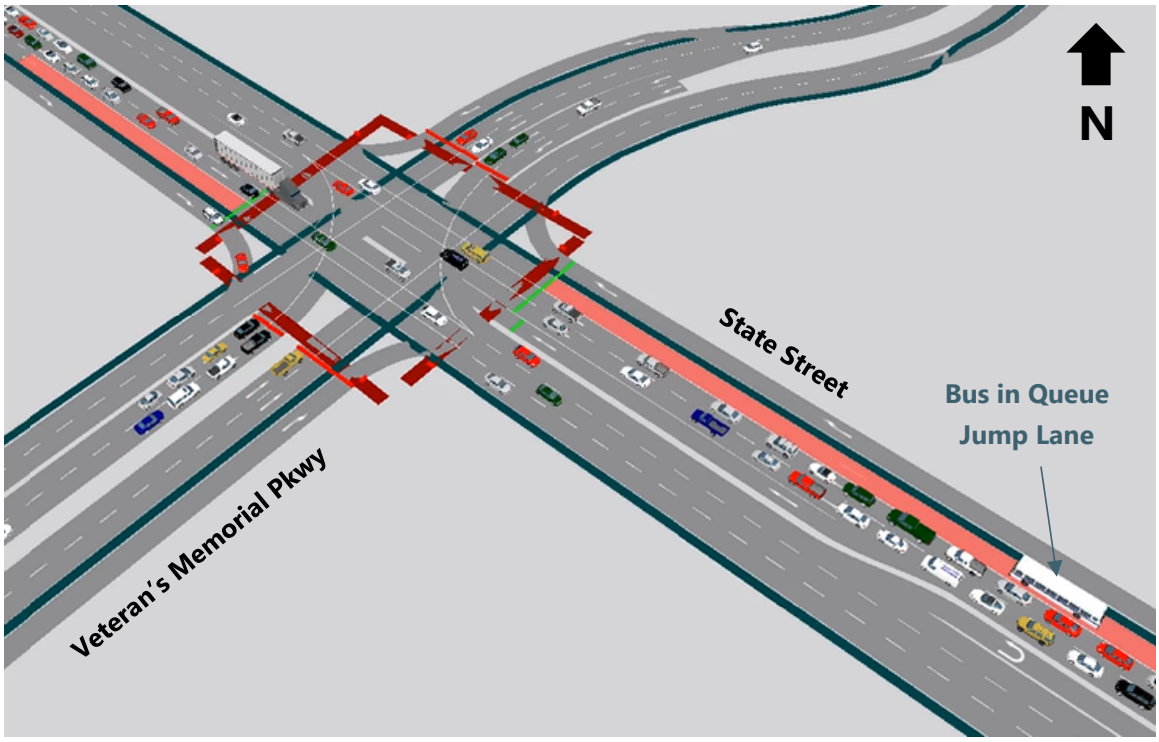


Queue Jump Lanes

Queue Jump Lanes are an added lane at traffic signal approaches (typically between the through lanes and the right-turn lane) that allow transit vehicles to "jump" the queue of GP traffic during a red signal phase. Similar to a right-turn only (except bus) lane, a queue jump lane utilizes an existing receiving lane and GP traffic must merge from three to two lanes (or one could consider that the outside GP lane is "trapped" into a right turn only lane). Similar to the right-turn only (except bus) lanes lane, there is some bus delay caused by GP cars positioning into the correct lane, but the VISSIM analysis indicated that queue jumps could save up to 25 seconds in travel time for each bus, similar to right-turn only (except bus) lanes. Also similar to right-turn only (except bus) lanes, the VISSIM analysis indicated that approach delays for vehicles could be up to 10 seconds higher per vehicle because of the reduced capacity.[3] **Figure 8** shows a simulated bus at VMP using a queue jump lane to bypass a GP traffic queue from a recent red signal phase.

[3] Note that Synchro has some ability to model Right-Turn Only (Except Bus) lanes and Queue Jump lanes as well. While the VISSIM results were generally found to be consistent with Synchro, the Synchro analysis presented in Table 1 found higher GP vehicle delays at several intersections with the Right-Turn Only (Except Bus) lanes or Queue Jump configurations, as described earlier.

Figure 8. Queue Jump Lanes at Veterans Memorial Parkway & State Street



Conclusion

The Treasure Valley region has developed a long-range vision for a vibrant transit corridor along State Street that includes transit-oriented development anchored by frequent and reliable transit service. To make this vision a reality, it is important to consider a set of improvements to State Street that can balance background traffic growth with the needs of a modern frequent transit service.

Based on the analysis summarized in this memo, the long-term 2035 transit vision for State Street could be achieved by widening the corridor to three GP travel lanes in each direction between 23rd Street and Glenwood Road. Critical to this transit vision would be the use of in-lane bus stops that are strategically positioned to align with transit-oriented development and signalized pedestrian crossings of State Street. Features like Transit Signal Priority, off-board fare payment, near-level boarding, routing of bikes behind bus stops, and strategic stop consolidation could all leverage the corridor design and result in a strong transit corridor. The analysis in this memo indicated a strong transit travel time benefit of in-lane versus pullout stops, on the order of several minutes of time savings per bus trip. The companion Case Studies Memo that researched and interviewed peer transit agencies corroborates the importance of in-lane stops and identifies no substantial traffic operations or safety issues with in-lane stops on corridors similar to State Street. This configuration would provide similar bus operations performance to the TTOP's concept of full-corridor HOV lanes with pull-out stops.[4]

Phasing

A full-scale widening of State Street will take many years to complete. Today, portions of the corridor are built to the six-lane cross section, while others retain the legacy four-lane section. In this interim condition, there are additional ways to leverage the relatively sparse GP vehicle use of the additional lanes that drop outside of the widened section. Specifically, the analysis performed for this memo found that strategically implemented treatments like right-turn only (except bus) lanes and queue jump lanes could benefit transit operations without any substantial degradation to GP traffic operations. This finding is because current traffic volumes are not at 2035 levels and because drivers tend to position themselves to avoid the lane drops so there is extra capacity that can be utilized by VRT buses. The right-turn only (except bus) lanes and queue jump lanes, along with stop enhancements (off-board fare payment, near-level boarding, routing of bikes behind

[4] It should be noted that while our team did not specifically analyze this condition, full corridor HOV lanes with in-lane bus stops would offer the best bus operations. However, the idea of HOV lanes with in-lane bus stops was not part of the finalized TTOP. Traffic operations would not be substantially impacted by the HOV lane with in-lane stops.

bus stops, and strategic stop consolidation) could enhance the transit experience on State Street corridor and generate new ridership that can be sustained over the long-term.

In summary, this traffic and transit operations analysis supports a phased approach to building out the State Street corridor that takes advantages of the sporadic widening of the corridor over time to implement innovative transit enhancements while eventually building toward a six-lane corridor with in-lane bus stops and other bus stop enhancements.