



SH 52 at I-25 Interchange and Parking Traffic Evaluation

August 20, 2007

Introduction

This report describes the existing traffic volumes at the I-25 SH 52 interchange and the adjacent intersections, as well as future traffic conditions with an improved interchange.

Existing Conditions

The SH 52 interchange at I-25 was constructed in 1999. The interchange has a diamond configuration is relatively new compared to other interchanges along the corridor. The interchange area includes the following roadways:

SH 52. SH 52 is an east-west four lane arterial roadway that connects I-25 to the diagonal highway (SH 119) to the west and to the tri-towns of Frederick, Firestone and Dacono to the east. Further east SH 52 connects to Fort Lupton and US 85. Figure 2 summarizes the traffic counts collected in August 2004 at this interchange. As shown, average daily traffic on SH 52 is 20,000 to 25,000 vehicles per day (vpd) east and west of the interchange. The speed limit is 40 mph in the vicinity of the interchange, and all intersections are controlled with a traffic signal.

I-25 Ramp Terminals. Ramps carrying travelers to and from north of SH 52 each carried approximately 4,500 vpd while ramps traveling to and from the south carried about twice as many vehicles daily. This indicates a higher travel demand to and from the metro area. The turning movement counts reveal two dominant travel patterns. The first is AM travelers leaving the tri-town area and heading south toward the metro area and returning in the afternoon; second is a heavy volume of AM travelers arriving from the metro area destined for westbound SH 52.

East Frontage Road. A frontage road is located on the east side of the interchange, approximately 900 feet east of the northbound ramp intersection. It is signalized and has separate left and right turn lanes on all approaches. South of SH 52 the east frontage road carried less than 500 vpd; north of SH 52 it carried nearly 4,000 vpd.

West Frontage Road. The West Frontage Road is located approximately 600 feet west of the southbound ramp intersection. There are no turn lanes at the intersection with SH 52. There are turn lanes on all approaches of this signalized intersection. The West Frontage Road carried less than 2,000 vpd both north and south of SH 52.

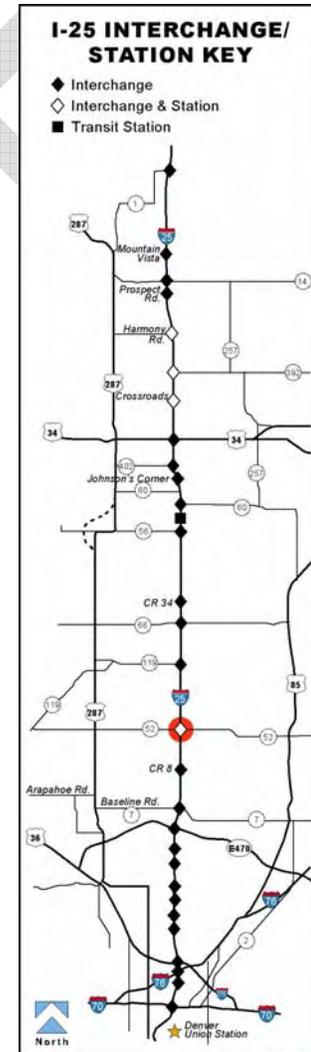


Figure 1. Vicinity Map

Traffic Operations

An operational analysis of the interchange was conducted based on methodology developed in the Highway Capacity Manual (Transportation Research Board, 2000). The result of such analysis is a level of service (LOS) rating. Level of service is a qualitative assessment of the traffic flow based on the average stopped delay per vehicles at controlled intersections (i.e. traffic signal, stop-sign).

Levels of service are described by a letter designation ranging from “A” to “F”, with LOS A representing essentially uninterrupted flow, and LOS F representing a breakdown of traffic flow with excessive congestion and delay. Signalized intersection analyses result in a level of service rating for each movement and for the entire intersection but typically only the level of service for the entire intersection is reported. For unsignalized intersections a level of service rating is determined for each turn movement that must yield to another turn movement but an overall level of service rating is not determined for the entire intersection. The following table shows how average stopped delay at controlled intersections equates to levels of service.

Table 1. Equivalent Level of Service to Average Stopped Delay and Density

Level of Service	Average Delay at Signalized Intersections in (sec./veh.)	Average Delay at Stop-Controlled intersections in (sec./veh.)
A	0 to <=10.	0 to <=10
B	> 10 to <= 20	> 10 to <= 15
C	> 20 to <= 35	> 15 to <= 25
D	> 35 to <= 55	> 25 to <= 35
E	> 55 to <= 80	> 35 to <= 50
F	> 80	> 50

Figure 2 illustrates existing peak period levels of service at the ramp terminals, adjacent intersections and ramp junctions with I-25. Currently, all four signalized intersections operate at LOS C or better during both peak hours.

In addition to the intersection level of service shown in the figure, Table 2 provides additional information for key movements at each intersection to provide further insight into existing operations at the interchange. Key movements are those movements that could have an impact on adjacent intersections or an impact to I-25. For example, east-west movements along SH 52 can queue into adjacent intersections and impede traffic flow at those locations, while vehicles on the ramps could queue back onto the interstate. North-south movements at the east frontage road intersection have not been included in the table because they would not impede traffic flow on SH 52. As shown in the table, the 95th percentile queue lengths for all movements were not greater than the distance between intersections or did not exceed the current storage length provided on the ramps.

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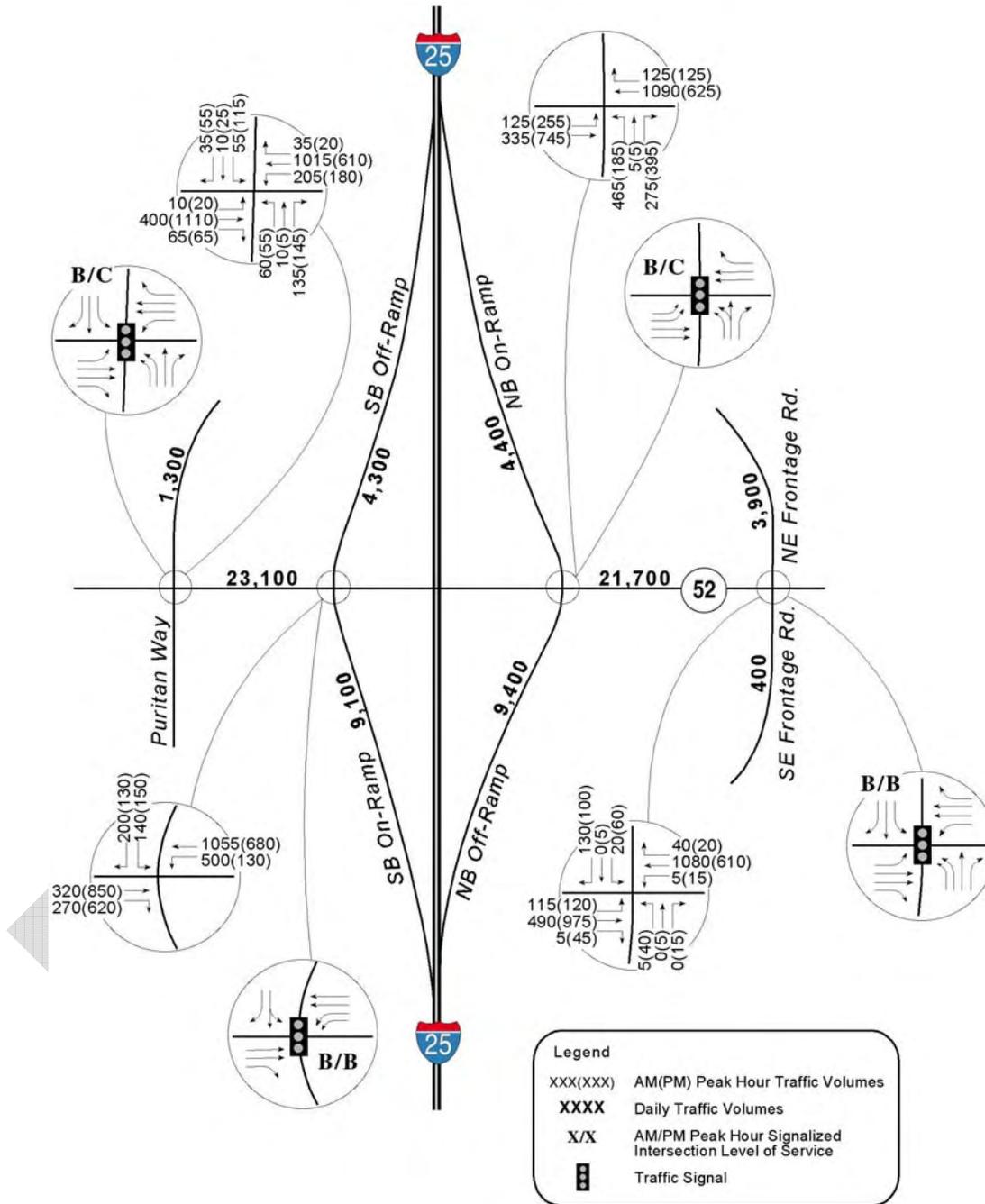


Figure 2. Existing Conditions

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Table 2. Existing Level of Service and Queue Lengths for Key Movements

Intersection / Movement	Level of Service		Estimated 95 th Percentile Queue ¹		Intersection Spacing and Storage Length Provisions
	AM	PM	AM	PM	
West Frontage Road					
WB Left	A	D	100'	170'	Storage Distance Provided – 200'
WB Thru	A	A	320'	160'	Distance to Adjacent Intersection – 600'
WB Right	A	A	0'	0'	Distance to Adjacent Intersection – 600' (continuous lane) -
Southbound Ramp Terminal					
WB Left	C	C	380'	160'	Storage Distance Provided – 600'
WB Thru	A	B	180'	140'	Distance to Adjacent Intersection – 880'
SB Left	D	C	160'	140'	Storage Distance Provided – 340'
SB Right	A	C	Free	Free	Storage Distance Provided – 340'
Northbound Ramp Terminal					
EB Left	D	E	150'	270'	Storage Distance Provided – 760'
EB Thru	A	A	90'	80'	Distance to Adjacent Intersection – 880'
NB Left	D	C	420'	220'	Storage Distance Provided – 440'
NB Right	C	D	10'	60'	Storage Distance Provided – 440'
East Frontage Road Intersection					
EB Left	C	B	110'	100'	Storage Distance Provided – 230'
EB Thru	A	C	110'	200'	Distance to Adjacent Intersection – 800'
EB Right	A	B	0'	0'	Storage Distance Provided – 200'
¹ The queue lengths given in this table primarily come from SimTraffic with some engineering judgment. SimTraffic gives a queue length for each lane. For example, with dual left-turn lanes SimTraffic estimates a queue for each lane. In the table, for thru movements the queue length is the longest queue observed in any through lane. For multiple turn lanes (i.e. dual lefts), the queue length is the sum of the queues in each lane. For a single turn lane (i.e. right turn), the queue is just the queue for that lane.					

2030 Conditions

2030 traffic projections were developed for the three alternatives being considered:

- 1) No-Action Alternative
- 2) Package A: GPL + CR + CB 85
- 3) Package B: TEL+ BRT

These three packages are illustrated in Figures 3 through 5. In developing peak hour turning movements at the ramp terminals and the nearest adjacent intersections, model results were calibrated against existing traffic counts to derive an adjusted model forecast. These adjusted forecasts along with existing turning movement data were used in the NCHRP 255 balancing procedure to develop 2030 peak hour turning movement forecasts. These forecasts were further adjusted, as necessary, to balance between intersections and for reasonableness.

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Figure 3. No Action Alternative

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LEGEND

- 1 New General Purpose Lane (GPL) in Each Direction
- ▤ 1 New General Purpose Lane (GPL) + Auxiliary Lane in Each Direction
- Commuter Rail (CR)
- Commuter Bus (CB) Service on US 85
- Feeder Bus Service
- ◆ Interchange Upgrades
- X Number of Lanes
- Commuter Bus Station / Stop
- Commuter Rail Station
- FasTracks Rail Line
- FasTracks / RTD Transit Station
- Potential Commuter Rail Operational & Maintenance Facility
- Potential Commuter Bus Operational & Maintenance Facility

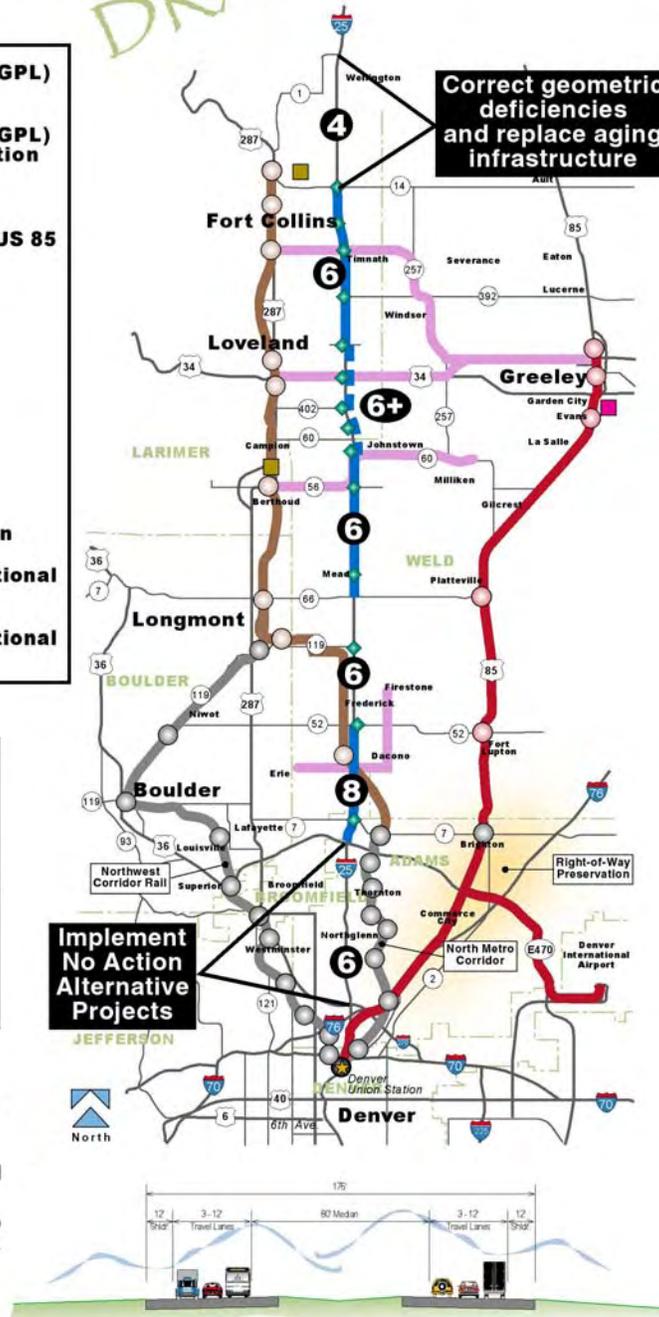
Congestion Management Measures include:

- Enhanced carpool lot parking capacity and amenities
- Courtesy patrol (incident management) from SH 14 to SH 7
- Variable messaging signs at all transit stations
- Automated Vehicle Locators on all transit vehicles - "next bus" technology
- Links to local bike and pedestrian systems at station areas
- Support for development of Transportation Management Organization (TMO)

NOTE:

- Select sections of I-25 would require auxiliary lanes and / or an additional through lane in addition to this 6-lane cross section.
- Where widening is needed between SH 66 and SH 7, the median would be used.
- Commuter Rail Service without a Longmont to North Metro connection will also be evaluated.

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NOT TO SCALE

TYPICAL I-25 CROSS SECTION - 6 GENERAL PURPOSE LANES

Figure 4. Package A

SH 52 at I-25 Interchange and Parking Traffic Evaluation

LEGEND

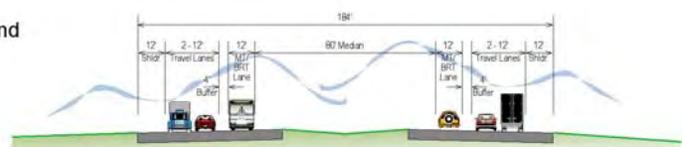
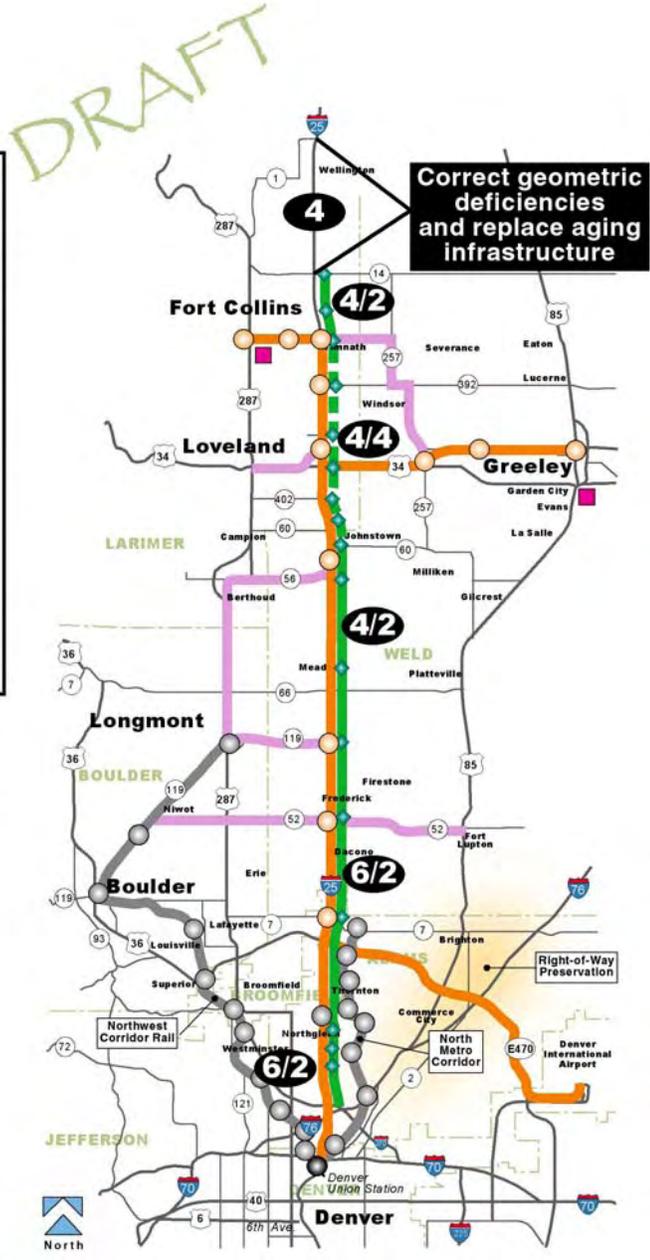
- 1 Buffer-Separated Tolled Express Lane (TEL) in Each Direction**
- 2 Barrier-Separated Tolled Express Lanes (TEL) in Each Direction**
- Bus Rapid Transit (BRT) Route (Uses TELs on I-25)**
- Feeder Bus Service**
- Interchange Upgrades**
- X **Number of Lanes: General Purpose/Tolled Express Lanes**
- Bus Rapid Transit Station**
- FasTracks Rail Line**
- FasTracks / RTD Transit Station**
- Potential Commuter Bus Operational & Maintenance Facility**

Congestion Management Measures include:

- Enhanced carpool lot parking capacity and amenities
- Courtesy patrol (incident management) from SH 14 to SH 7
- Variable messaging signs at all transit stations
- Automated Vehicle Locaters on all transit vehicles - "next bus" technology
- Links to local bike and pedestrian systems at station areas
- Support for development of Transportation Management Organization (TMO)

NOTE:

- A wider barrier and express lanes cross section is included between SH 60 and Harmony Road.
- BRT stations located within an expanded median area.
- Where widening is needed between SH 66 and SH 7, the median would be used.



NOT TO SCALE

TYPICAL I-25 CROSS SECTION - BUFFERED SEPARATED TOLLED EXPRESS LANES

Figure 5. Package B

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2030 No Action Traffic Volumes

Figure 6 depicts 2030 daily and peak hour No Action traffic projections for the SH 52 interchange and adjacent intersections. As shown, daily volume projections on SH 52 are approximately twice those of today at nearly 50,000 vpd both east and west of the interchange. The dominant travel pattern continues to be to and from south of SH 52.

2030 Package A Traffic Volumes

Figure 7 depicts 2030 daily and peak hour Package A traffic projections for the SH 52 interchange and adjacent intersections. Daily volume projections on SH 52 are only slightly higher than those in the No Action Alternative. Ramp volumes and travel patterns are also similar to those in the No Action Alternative.

2030 Package B Traffic Volumes

Figure 8 depicts 2030 daily and peak hour Package B traffic projections for the SH 52 interchange and adjacent intersections. Generally, daily volume projections on SH 52 are somewhat lower than those in the No Action Alternative. Ramp volumes and travel patterns are also similar to those in the No Action and Package A alternatives.

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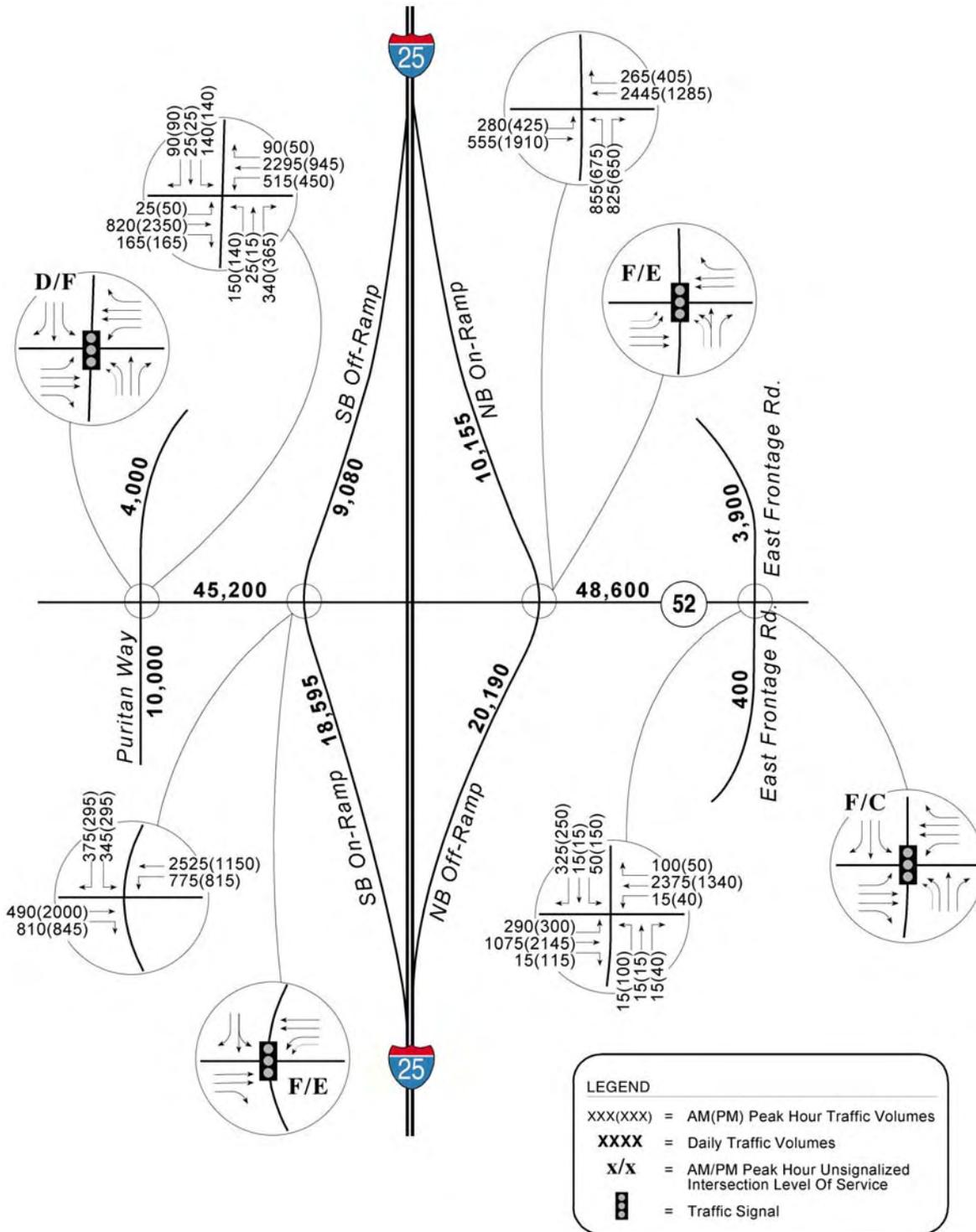


Figure 6. No Action Forecasts and Levels of Service

SH 52 at I-25 Interchange and Parking Traffic Evaluation

2030 No Action Traffic Operations

Figure 6 shows the projected levels of service at the frontage road and ramp intersections on SH 52 under the No Action scenario. As the figure indicates, the ramp terminal intersections approach movements operate at LOS E and F in both peak hours. Table 3 shows the projected queuing for key movements at the interchange and further underscores that the existing interchange would be over capacity with the projected traffic volumes. As shown, the westbound through movement exceed the available storage at the West Frontage Road and the southbound ramp terminal during both peak hours. The eastbound turning movements at the East Frontage Road also exceed the available storage. These queues would block the adjacent ramp terminal interchanges and result in poor traffic operation. In addition, queues on both ramps exceed the available storage during one or both of the peak hours. As a result these queued vehicles utilize the 1600 foot ramp for additional storage.

Table 3. 2030 No Action Level of Service and Queue Lengths for Key Movements

Intersection / Movement	Level of Service		Estimated 95 th Percentile Queue ¹		Intersection Spacing and Storage Length Provisions
	AM	PM	AM	PM	
West Frontage Road					
WB Left	B	F	270'	230'	Storage Distance Provided – 200'
WB Thru	D	A	930'	810'	Distance to Adjacent Intersection – 600'
WB Right	A	A	160'	670'	Distance to Adjacent Intersection – 600' (continuous lane) -
Southbound Ramp Terminal					
WB Left	F	F	660'	710'	Storage Distance Provided – 600'
WB Thru	F	A	1,170'	1240'	Distance to Adjacent Intersection – 880'
SB Left	F	F	470'	560'	Storage Distance Provided – 340'
SB Right	A	A	290'	450'	Storage Distance Provided – 340'
Northbound Ramp Terminal					
EB Left	F	E	650'	320'	Storage Distance Provided – 760'
EB Thru	A	D	310'	220'	Distance to Adjacent Intersection – 880'
NB Left	E	C	1060'	1130'	Storage Distance Provided – 440'
NB Right	F	F	280'	570'	Storage Distance Provided – 440'
East Frontage Road Intersection					
EB Left	F	C	280'	250'	Storage Distance Provided – 230'
EB Thru	A	A	380'	330'	Distance to Adjacent Intersection – 800'
EB Right	A	A	0'	80'	Storage Distance Provided – 200'
¹ The queue lengths given in this table primarily come from SimTraffic with some engineering judgment. SimTraffic gives a queue length for each lane. For example, with dual left-turn lanes SimTraffic estimates a queue for each lane. In the table, for thru movements the queue length is the longest queue observed in any through lane. For multiple turn lanes (i.e. dual lefts), the queue length is the sum of the queues in each lane. For a single turn lane (i.e. right turn), the queue is just the queue for that lane.					

2030 Package A Traffic Operations

Interchange Configuration

The proposed configuration for the SH 52 DEIS interchange evaluation is a diamond configuration (Figure 7) with a wider bridge to accommodate future volumes. The existing bridge would be widened at the interchange to eight lanes to accommodate side by side dual left-turn lanes and two through lanes east and westbound. One westbound lane would be extended back 200 feet east of the northbound ramp terminal to provide additional storage. In addition, the westbound approach to the West Frontage Road and the eastbound approach to the East Frontage Road would be widened to accommodate three approach lanes. These would be tapered back to two lanes in each direction after the signal.

Carpool Lot Location

Package A also includes an existing 90-space carpool lot located in the northwest quadrant of the interchange. Access to the lot is located off the east side of the west frontage road.

Interchange Operations

Figure 7 also shows the levels of service for the ramps and frontage road intersections, along with recommendations for laneage at each location. As shown, all four intersections in the vicinity of the ramps are anticipated to operate at LOS D or better with the forecasted traffic volumes and the enhancements identified.

Table 4 summarizes the levels of service, queue lengths, intersection spacing and designed storage lengths for key movements at the interchange. As shown in the table, specific movement levels of service at this interchange range from LOS A to LOS F. The eastbound left turn at the northbound ramp terminal operates at LOS F during the AM peak hour, but queues are well within the available storage distance.

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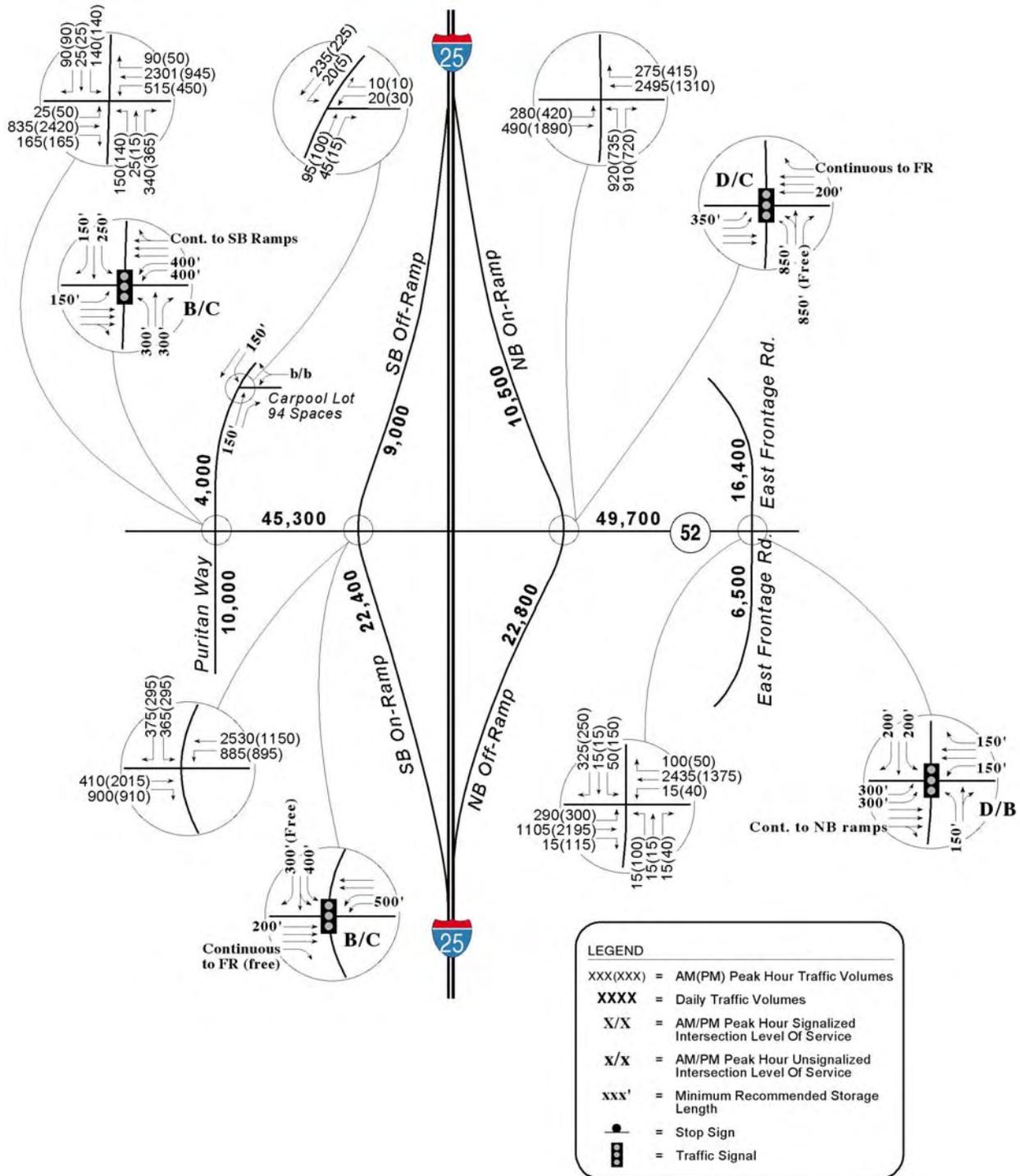


Figure 7. Package A Forecasts and Levels of Service

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Table 4 also compares SimTraffic estimates of the 95th percentile queue length for key movements to the storage distance available for each. For turning movements, the distance listed is the planned turn lane storage length, while for through movements the length listed is the distance between intersections. The queuing analysis shows that most queuing can be accommodated in the interchange complex. While, the northbound and southbound left turn ramp movements exceed the storage length provided, the 1600 foot ramp provides additional storage and does not result in queues extending into the mainline.

Table 4. 2030 Package A Level of Service and Queue Lengths For Key Movements

Intersection / Movement	Level of Service		Estimated 95 th Percentile Queue ¹		Intersection Spacing and Storage Length Provisions
	AM	PM	AM	PM	
West Frontage Road Intersection					
WB Left	B	E	440'	520'	Storage Distance Provided – 800'
WB Thru	A	A	190'	280'	Distance to Adjacent Intersection – 600'
WB Right	A	A	20'	20'	Distance to Adjacent Intersection – 600' (continuous lane) -
Southbound Ramp Terminal					
WB Left	B	D	820'	1260'	Storage Distance Provided – 1960'
WB Thru	A	A	330'	230'	Distance to Adjacent Intersection – 880'
SB Left	E	D	460'	350'	Storage Distance Provided – 340'
SB Right	A	A	Free	Free	Storage Distance Provided – 340'
Northbound Ramp Terminal					
EB Left	F	C	490'	520'	Storage Distance Provided – 1760'
EB Thru	C	A	210'	120'	Distance to Adjacent Intersection – 880'
NB Left	E	E	1,120'	770'	Storage Distance Provided – 440'
NB Right	A	A	260'	0'	Storage Distance Provided – 440'
East Frontage Road Intersection					
EB Left	E	C	530'	370'	Storage Distance Provided – 600'
EB Thru/Right	B	A	310'	500'	Distance to Adjacent Intersection – 800'
¹ The queue lengths given in this table primarily come from SimTraffic with some engineering judgment. SimTraffic gives a queue length for each lane. For example, with dual left-turn lanes SimTraffic estimates a queue for each lane. In the table, for thru movements the queue length is the longest queue observed in any through lane. For multiple turn lanes (i.e. dual lefts), the queue length is the sum of the queues in each lane. For a single turn lane (i.e. right turn), the queue is just the queue for that lane.					

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2030 Package B Traffic Operations

Interchange Configuration

The proposed configuration for the SH 52 DEIS interchange evaluation is the same as that described in Package A.

BRT Station Location

Package B includes a 290-space BRT station located approximately six-tenths of a mile north of SH 52 on the west side of I-25. The station would be accessed via the West Frontage Road.

Interchange Operations

Figure 8 shows the levels of service for the ramps and frontage road intersections, along with recommendations for laneage at each location. As shown, all four intersections in the vicinity of the ramps are anticipated to operate at LOS D or better with the forecasted traffic volumes and the enhancements identified.

Table 5 summarizes the levels of service, queue lengths, intersection spacing and designed storage lengths for key movements at the interchange. As shown in the table, specific movement levels of service at this interchange range from LOS A to LOS F. The eastbound left turn at the northbound ramp terminal operates at LOS F during the AM peak hour but queues are well within the available storage distance.

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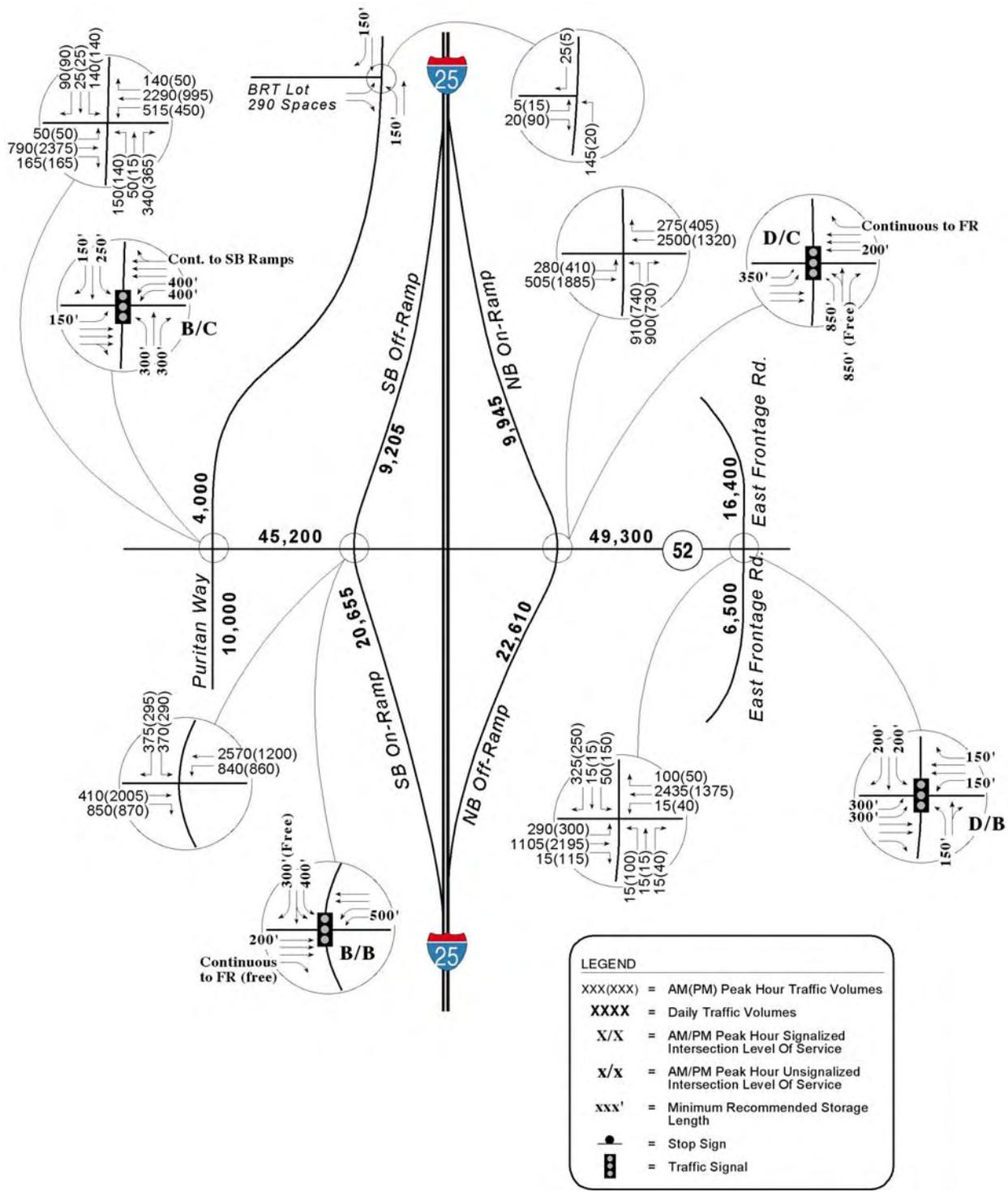


Figure 8. Package B Forecasts and Levels of Service

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Table 5 also compares SimTraffic estimates of the 95th percentile queue length for key movements to the storage distance available for each. For turning movements, the distance listed is the planned turn lane storage length, while for through movements the length listed is the distance between intersections. The queuing analysis shows that most queuing can be accommodated in the interchange complex. While, the northbound and southbound left turn ramp movements exceed the storage length provided, the 1600 foot ramp provides additional storage and the queues would not result in vehicles extending into the mainline.

Table 5. 2030 Package B Level of Service and Queue Lengths for Key Movements

Intersection / Movement	Level of Service		Estimated 95 th Percentile Queue ¹		Intersection Spacing and Storage Length Provisions
	AM	PM	AM	PM	
West Frontage Road Intersection					
WB Left	B	E	490'	220'	Storage Distance Provided – 800'
WB Thru	A	A	240'	320'	Distance to Adjacent Intersection – 600'
WB Right	A	A	50'	30'	Distance to Adjacent Intersection – 600' (continuous lane) -
Southbound Ramp Terminal					
WB Left	B	D	910'	1250'	Storage Distance Provided – 1960'
WB Thru	B	A	260'	380'	Distance to Adjacent Intersection – 880'
SB Left	E	D	530'	390'	Storage Distance Provided – 340'
SB Right	A	A	Free	Free	Storage Distance Provided – 340'
Northbound Ramp Terminal					
EB Left	F	C	400'	570'	Storage Distance Provided – 1760'
EB Thru	C	A	230'	110'	Distance to Adjacent Intersection – 880'
NB Left	E	E	1040'	760'	Storage Distance Provided – 440'
NB Right	A	A	210'	0'	Storage Distance Provided – 440'
East Frontage Road Intersection					
EB Left	E	C	370'	350'	Storage Distance Provided – 600'
EB Thru/Right	B	A	340'	480'	Distance to Adjacent Intersection – 800'
¹ The queue lengths given in this table primarily come from SimTraffic with some engineering judgment. SimTraffic gives a queue length for each lane. For example, with dual left-turn lanes SimTraffic estimates a queue for each lane. In the table, for thru movements the queue length is the longest queue observed in any through lane. For multiple turn lanes (i.e. dual lefts), the queue length is the sum of the queues in each lane. For a single turn lane (i.e. right turn), the queue is just the queue for that lane.					

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Traffic Operational Analysis

Table 6 compares the levels of service and delay at the SH 52 interchange for the three packages. As the table indicates without improvements at this location, the ramp terminal intersections with SH 52 would operate at LOS E or F during both peak hours. Widening the SH 52 bridge to provide additional capacity improves operation to LOS D or better during both peak hours.

Table 6. Intersection Level of Service and Delay

Intersection	No Action		Package A		Alternative B	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
West Frontage Road	LOS D (45 sec.)	LOS F (>80 sec.)	LOS B (19 sec.)	LOS C (32 sec.)	LOS B (19 sec.)	LOS C (30 sec.)
Southbound Ramp Intersection	LOS E (73 sec.)	LOS E (61 sec.)	LOS B (13 sec.)	LOS C (21 sec.)	LOS B (14 sec.)	LOS B (19 sec.)
Northbound Ramp Intersection	LOS F (>80 sec.)	LOS E (58 sec.)	LOS D (36 sec.)	LOS C (22 sec.)	LOS D (35 sec.)	LOS C (24 sec.)
East Frontage Road	LOS F (>80 sec.)	LOS C (24 sec.)	LOS D (39 sec.)	LOS B (17 sec.)	LOS D (39 sec.)	LOS B (15 sec.)

LOS X – Level of service

##.# - Average delay in seconds per vehicle