# Chapter 3
# Existing and Future Traffic Conditions

*This chapter describes existing (2004) and future (2030) traffic conditions along the SR 164 corridor including expected increases in traffic volumes and vehicle delay. The chapter also describes how the expected increases will affect the operating condition and travel times at key intersections and various sections of the highway. Current safety conditions and recent SR 164 collision history are also presented in this chapter.*

## 1 What are the population and employment growth trends on the SR 164 corridor?

Washington State Department of Transportation (WSDOT) is the agency charged by the legislature with developing and managing state and federal highways and the ferry system. A significant part of that obligation is responding to demands on the state transportation infrastructure. Traffic volumes increase with new residential and commercial developments that are further from established metropolitan job centers. WSDOT is not the permitting agency for land use decisions. That responsibility is in the hands of local jurisdictions. Therefore, it is important that WSDOT and local jurisdictions work together to address the impacts to the state's transportation system caused by local development.

Property along the SR 164 corridor (see Exhibit 3.1) has experienced population and employment growth during the past twenty-two years. There has been a 58 percent increase in

Exhibit 3.1

**SR 164 Vicinity Map**

*For a larger view of the SR 164 Corridor go to map in Exhibit 2.3, on page 2-10.*

households and a 56 percent increase in jobs.[1] These increases have created additional travel demand on SR 164 and the area's local roadways. As new developments are constructed in Auburn, the Muckleshoot Tribal Reservation, unincorporated King County, and Enumclaw in accordance with local comprehensive plans, the demand placed on the existing highway network will continue to increase.

The current data and the future estimates lead to the conclusion that the SR 164 Corridor will not continue to see significant rises in employment, but will continue to see a steady rise in homes, thus putting more pressure on SR 164 to deliver these suburban workers to their jobs elsewhere in Puget Sound.

## 2 Is there a daily SR 164 traffic pattern?

SR 164, like many highways on the outskirts of metropolitan Puget Sound, has a predominantly heavy traffic flow during the morning toward regional employment centers (westbound on SR 164). During the afternoon commute hours the traffic volumes then reverse and are heavy eastbound toward the more residential areas. The heaviest of these morning and afternoon commute hours are referred to as the AM peak hour and PM peak hour, respectively.

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[1] Source: Puget Sound Regional Council (PSRC) Draft 2006 Sub-County Forecasts for Population and Employment (REVISED Version, Oct 2006). Source data was used for comparison purposes. Data is based on a Forecast Analysis Zone (FAZ). The PSRC prepares small area forecasts of households and employment, in order to meet the requirements of federal legislation and data needs for land use and transportation modeling. Two (2) FAZs were compiled for the data used in these graphs. The two FAZs are the closest FAZs in proximity to the SR 164 corridor. The FAZs are:

- FAZ 3120 - Auburn South
- FAZ 3200 - Enumclaw Plateau

FAZs may have city names, however, they are made up of Census tracts, so they do not exactly follow city boundaries. FAZ map may be found at http://www.psrc.org/datapubs/data/geo/index.htm.

*Traffic Volumes*

## 3 What are the existing traffic volumes on SR 164?

The traffic volumes along SR 164 increase as one travels the corridor from west to east. Predictably the average daily traffic (ADT) volumes are higher within the city limits of Auburn than they are in the rural eastern King County sections of the highway. Exhibit 3.2 below displays the SR 164 ADT ranges for 2004 and the projected future ADT ranges for 2030.

Exhibit 3.2

**Average Daily Traffic Volumes**

(2004 - 2030)

| Highway Segment | Milepost | Number of Traffic Lanes | 2004 ADT Range | 2030 ADT Range | Growth from 2004 to 2030 |
|---|---|---|---|---|---|
| Auburn | 0.31 to 2.79 | 2 to 4 lanes | 30,200 - 41,400 | 35,600 - 59,600 | 18 to 44% |
| Academy | 2.79 to 5.00 | 2 lanes | 22,000 - 22,700 | 33,600 - 34,600 | 52 to 53% |
| Muckleshoot | 5.00 to 8.78 | 2 lanes | 15,700 - 17,400 | 27,000 - 28,500 | 64 to 72% |
| Rural / Agricultural | 8.78 to 12.24 | 2 lanes | 10,800 - 12,500 | 21,900 - 24,500 | 96 to 103 |
| Enumclaw | 12.24 to 15.13 | 2 lanes | 8,400 - 11,700 | 12,800 - 14,900 | 27 to 52% |

The projected future average daily traffic volumes for 2030 were developed using the current King County Travel Demand model (KC model). The KC model projects travel demand based on estimated growth in employment and population.

Adjustments were made to the KC model to incorporate employment growth, population projections, and current land use plans for the jurisdictions along SR 164.

When examined on a segment-by-segment westward basis, the 2004 traffic volumes above display incremental increases. This would indicate commuter travel from more residential areas along the corridor to Auburn and SR 18, which serves as the primary link to other regional employment centers.

## 4 What are the future (2030) traffic volumes on SR 164?

The SR 164 average daily traffic volumes increase in each of the analyzed corridor segments by the future year 2030 (See Exhibit 3.2 on the previous page).[2] The highest projected 2030 daily traffic volumes are in the Auburn segment of SR 164 that currently has four lanes and provides the access point to SR 18. A more detailed look at daily traffic volumes within each analyzed segment for 2004 and predicted 2030 is shown below in Exhibits 3.3 through 3.7 on pages 3-5 through 3-9.

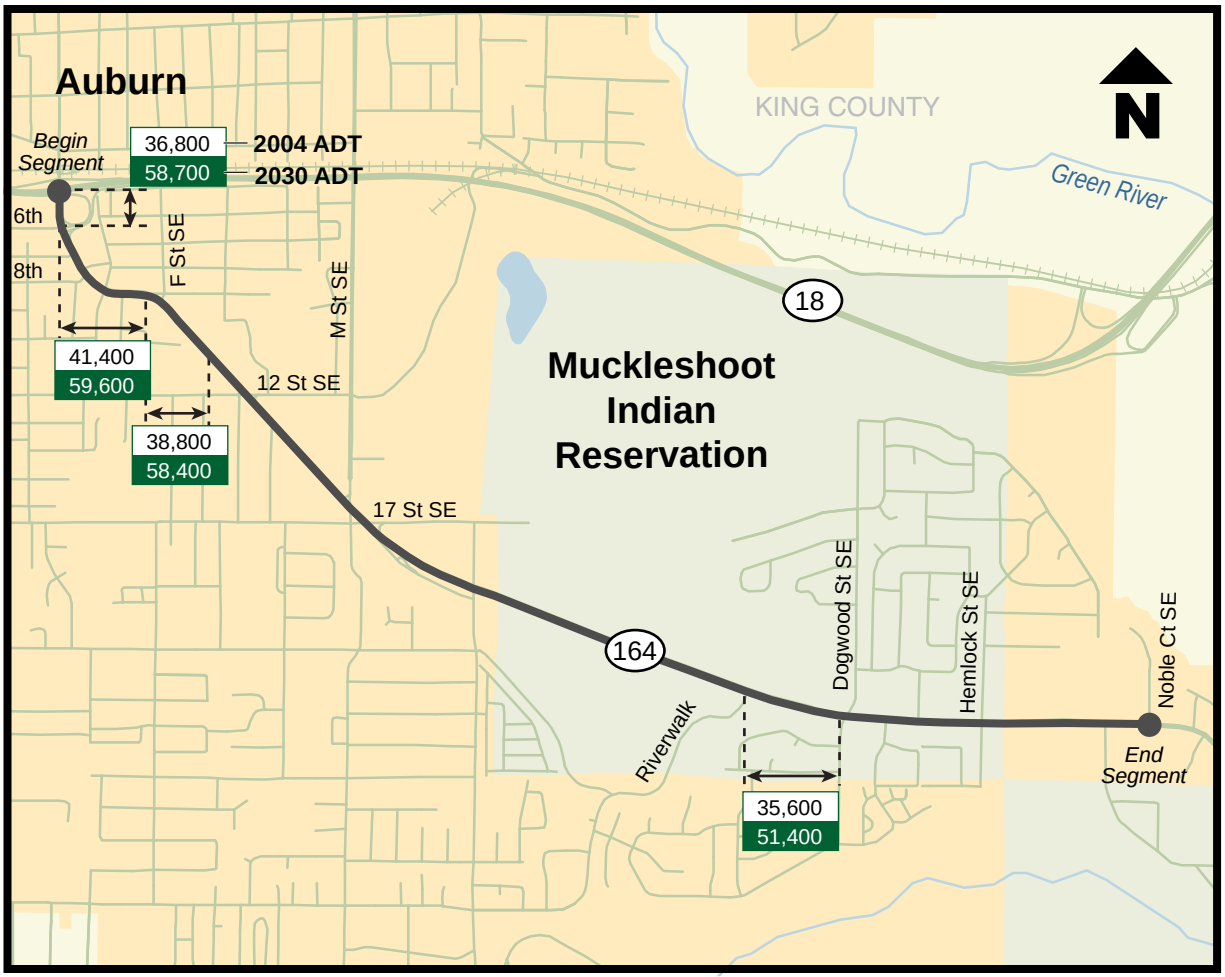
### How do the existing (2004) traffic volumes compare to the future (2030) traffic volumes?

SR 164 average daily traffic volumes are predicted to jump between 18 and 103 percent by the year 2030. The largest percent growth is projected to occur in the Rural / Agricultural (96 to 103%) and the Muckleshoot (64 to 72%) segments. These two segments currently feature predominantly two-lane highway alignments.

[2] The year 2030 was chosen as the future year planning horizon for analysis in this Corridor Planning Study. Year 2030 projections represent a version of the future year 2030 where no new additional capacity improvements would be built other than those that are already funded and slated to be implemented.

Exhibit 3.3

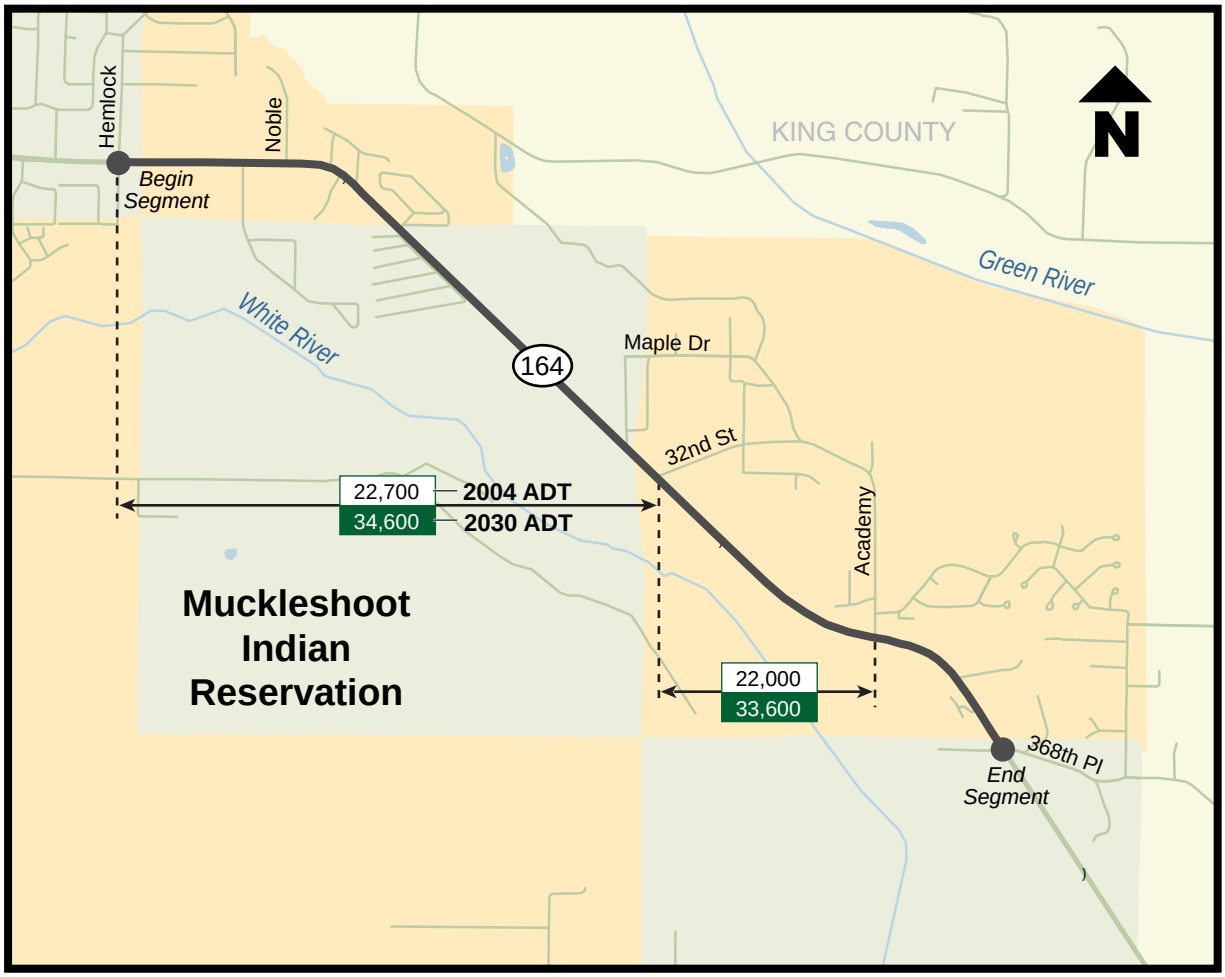
## Auburn Segment - Existing and Future ADT Volumes




**Traffic Volumes shown represent Average Daily Traffic (ADT) for 2004 (existing) and 2030 (future) traffic conditions.*

Exhibit 3.4

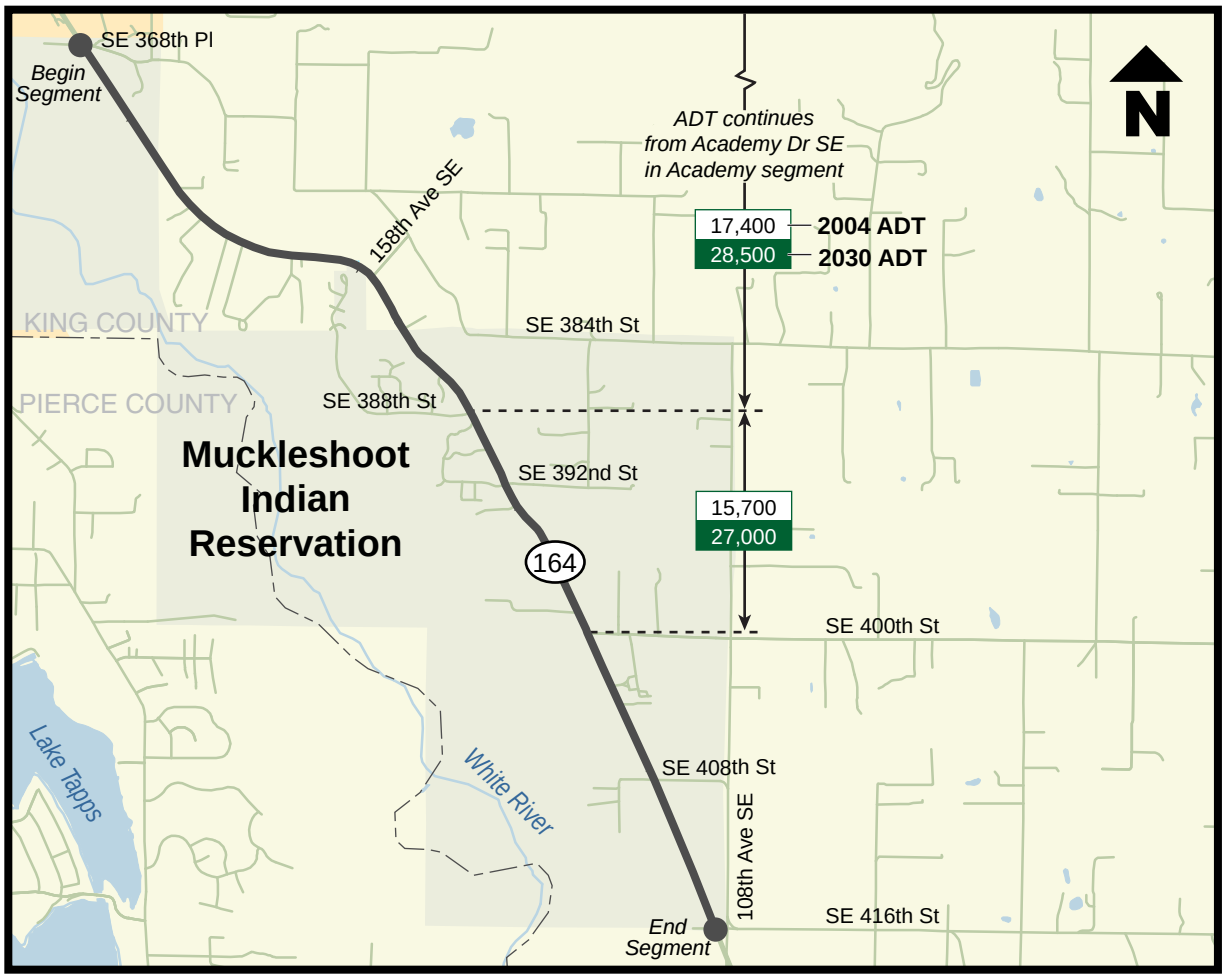
## Academy Segment - Existing and Future ADT Volumes




*Traffic volumes shown represent Average Daily Traffic (ADT) for 2004 (existing) and 2030 (future) traffic conditions.*

Exhibit 3.5

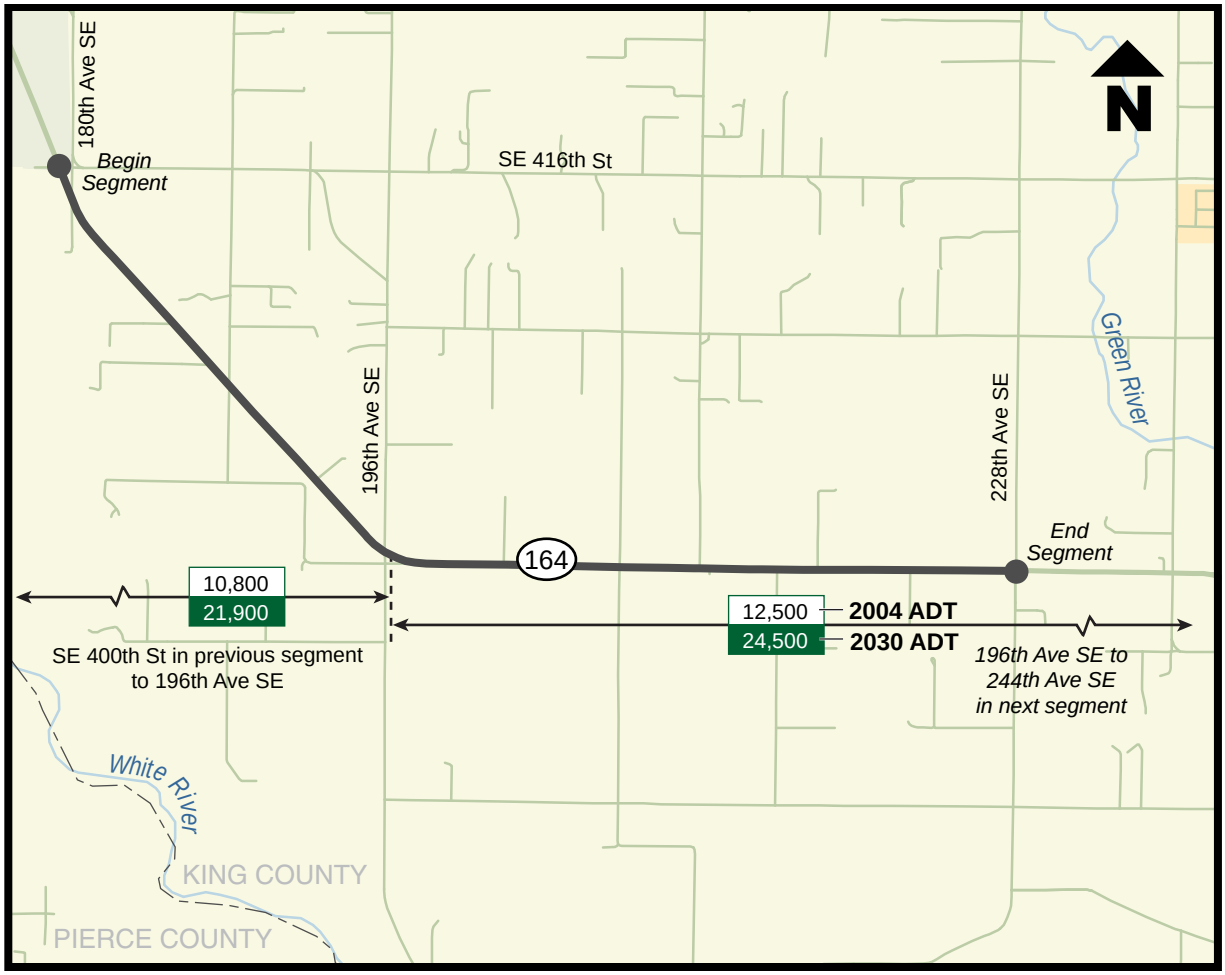
## Muckleshoot Segment - Existing and Future ADT Volumes




*Traffic volumes shown represent Average Daily Traffic (ADT) for 2004 (existing) and 2030 (future) traffic conditions.*

Exhibit 3.6

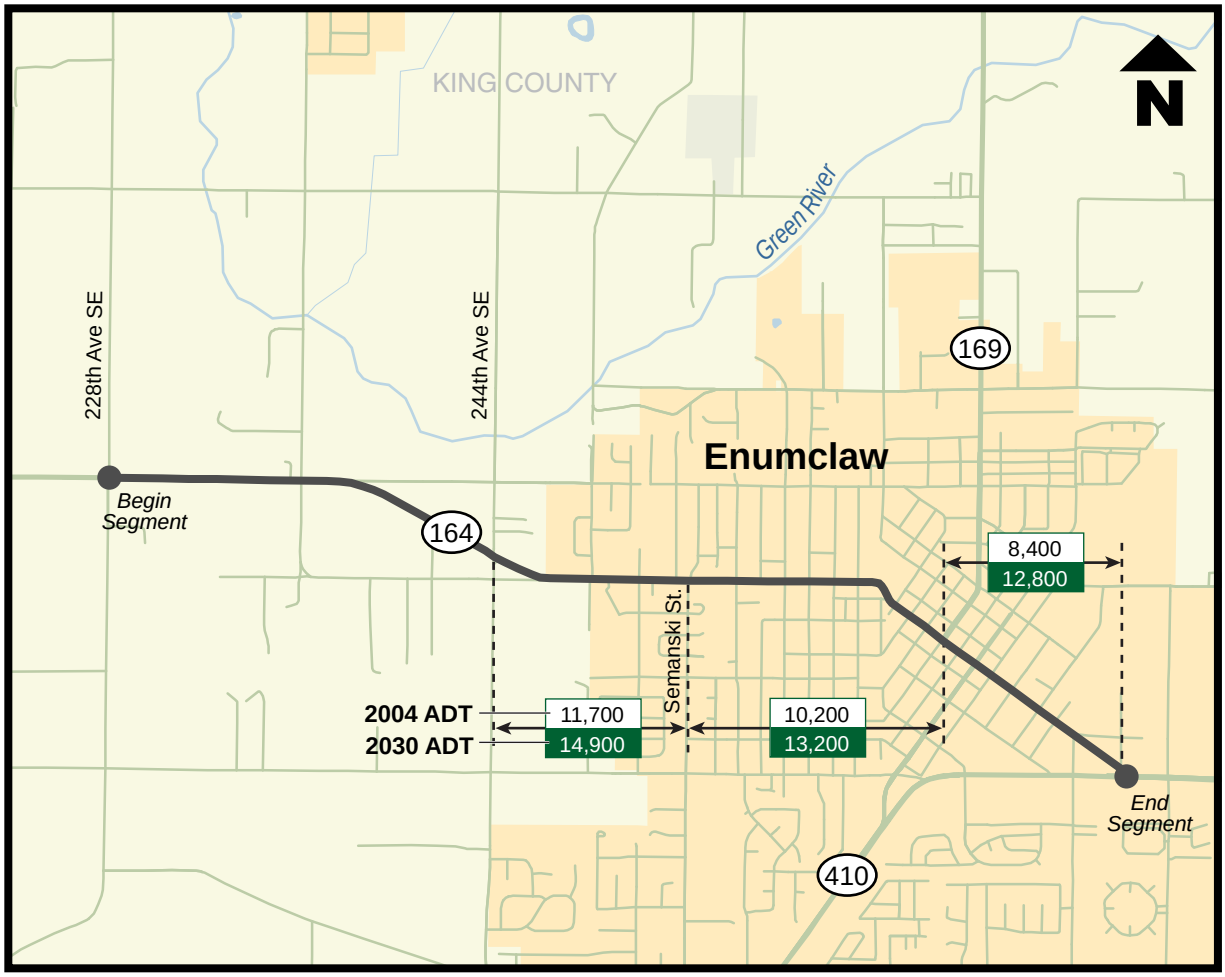
## Rural / Agricultural Segment - Existing and Future ADT Volumes




*Traffic volumes shown represent Average Daily Traffic (ADT) for 2004 (existing) and 2030 (future) traffic conditions.*

Exhibit 3.7

## Enumclaw Segment - Existing and Future ADT Volumes




*Traffic volumes shown represent Average Daily Traffic (ADT) for 2004 (existing) and 2030 (future) traffic conditions.*

*Intersection Level-of-Service*

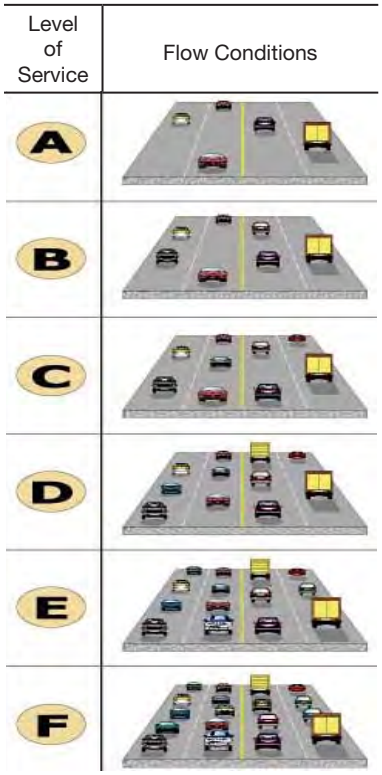
## 5 How is the traffic operational analysis performed and what is LOS?

Traffic operational analysis uses six grades of level-of-service (LOS). Each grade is designated a letter in the range of A through F, with "LOS A" representing the best operating conditions and "LOS F" the worst (See Exhibit 3.8 to the right). Each specific level-of-service definition varies based on service measures such as speed, travel time, freedom to maneuver, traffic interruptions, and convenience on the measured facility. Each level-of-service represents a range of operating conditions and the driver's perception of those conditions. Safety is not included in the measures that establish service levels. In general, "LOS A" describes a free-flowing condition in which individual vehicles are not affected by the presence of other vehicles. At the other end of the spectrum, "LOS F" describes a breakdown in operations when traffic arriving at a point is greater than the facility's capacity to process the traffic flow; vehicles begin to back up and clog the system.

Depending on the facility, WSDOT LOS standards are LOS C or LOS D on state highway facilities. In new construction or major reconstruction projects where geometric design can be addressed, a level-of-service of at least "D" in urban locations and "C" in rural areas is desirable on state highways[3].

Exhibit 3.8

**Level-of-Service & Flow Conditions**




Source: 2004 Highway Capacity Manual

### What was the LOS methodology?

Level-of-service is analyzed for highway intersections and segments of highway. This section of the report discusses intersection LOS. Level-of-service of various highway sections is discussed later in this chapter.

The analysis in this report yields a level-of-service for each intersection based on the calculated delay an average driver would experience at each intersection. The LOS methodology was based on procedures identified in the Highway Capacity Manual (2000), and the intersections were evaluated using Synchro 6.0 software.

[3] Washington State Department of Transportation Design Manual, page 610-3, section 610.06 Traffic Analysis; and page 850-5, section 850 Traffic Control Signals May 2006. (http://www.wsdot.wa.gov/publications/manuals/fulltext/m22-01/design.pdf)

LOS at the SR 164 analyzed intersections is displayed in Exhibit 3.10 on page 3-14. The calculated delay of an average driver at those intersections is displayed in Exhibit 3.36 on page 3-36. Exhibit 3.9 displays the existing and future intersection vehicle delay and levels-of- service for all the analyzed intersections on SR 164. Exhibit 3.35 on page 3-35 displays the vehicle delay for a single trip through the SR 164 corridor.

#### How do intersections affect delay?

During the AM and PM peak hours, there are certain areas along the corridor that begin to slow down, causing traffic back-up and delay. Often it is not just the traffic on the corridor itself, but the vehicles entering the highway at intersections along the corridor that greatly contribute to this delay. Contributing factors to delay at intersections may include:

- Is the intersection signalized?
- How much traffic is going through or turning at the intersection?
- Does the intersection have channelization for a dedicated turn lane?
- What is the volume of traffic entering SR 164 from the intersecting street?

### 6 What are the existing SR 164 intersection levels-of-service?

Seventeen intersections along SR 164 were analyzed to determine the operational efficiency of the corridor for both existing and future conditions. For comparison in this report, the PM peak hour was calculated, as it is the heavier of the peak hours.

The 2004 data in Exhibit 3.9 to the right reveals that 13 (76 percent) of the 17 analyzed intersections are operating at LOS D or better.

Four intersections in 2004 operated below the LOS D standard. These four intersections are all in the Auburn segment which experiences the highest traffic volumes along the corridor (See Exhibits 3.3 through 3.7 for each segment's existing and future traffic volumes).

Exhibit 3.9

**Existing SR 164 Intersection Level-of-Service**

(17 Analyzed intersections - 2004)

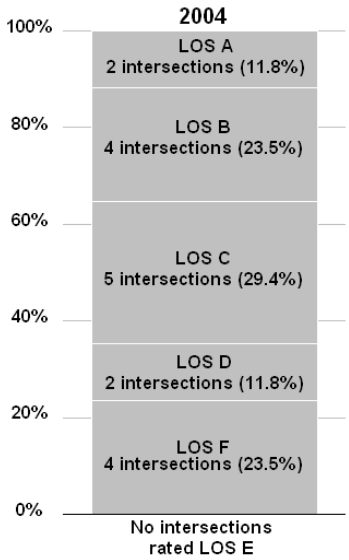


Exhibit 3.10 (on the next page) summarizes the existing and future LOS per intersection. Intersection LOS that does not meet (or will not meet) the LOS D standard, are displayed in **bold text**.

The existing PM peak hour level-of-service at most of the analyzed intersections is performing adequately. A few critical intersections located in the western portion of the corridor in the city of Auburn are performing inefficiently.

### Is level-of-service measured the same at signalized and unsignalized intersections?

By design a signalized intersection and an unsignalized intersection operate differently. A signalized intersection will stop through traffic to allow the side street traffic to cross or access the main highway. At an unsignalized two-way stop controlled intersection, through traffic is not stopped and cross traffic is required to wait for a gap in mainline traffic in order to cross or merge onto the main highway.

At the same time, a signalized intersection may allow cross traffic a shorter delay than an unsignalized intersection. Because of these differences, the measured level-of-service at signalized and unsignalized intersections is a bit different.

The Enumclaw Comprehensive Plan noted that the Harding Street, Blake Street, and SR 410 intersections will degrade to LOS F by 2022 if no improvements are completed (Enumclaw Comp Plan, Chapter 5, Page 19).

Exhibit 3.10

## Existing and Future Level-of-Service at SR 164 Intersections (2004 - 2030)

| | | PM Peak Hour LOS[1] | |
|---|---|---|---|
| **Milepost** | **Intersection** | **2004** | **2030** |
| **AUBURN SEGMENT** | | | |
| 0.31 | SR 18 Westbound Ramps (SIG) | C | **F** |
| 0.38 | 6th Street SE (SIG) | **F** | **F** |
| 0.66 | F Street SE (SIG) | **F** | A |
| 0.91 | 12th Street SE (SIG) | B | C |
| 1.20 | M Street SE (SIG) | **F** | **F** |
| 2.07 | Riverwalk Drive SE / Casino Drive (SIG) | C | D |
| 2.28 | Dogwood Street SE (SIG) | B | C |
| 2.54 | Hemlock Street SE (UNSIG) | **F** | **F** |
| **ACADEMY SEGMENT** | | | |
| 3.82 | 32nd Street SE (UNSIG) | C | **F** |
| 4.37 | Academy Drive SE (SIG) | A | C |
| **MUCKLESHOOT SEGMENT** | | | |
| 6.65 | SE 388th Street / 158th Avenue SE (UNSIG) | D | **F** |
| 7.51 | SE 400th Street (UNSIG) | B | C |
| **RURAL / AGRICULTURAL SEGMENT** | | | |
| 10.23 | 196th Avenue SE (UNSIG) | C | **F** |
| **ENUMCLAW SEGMENT** | | | |
| 13.30 | 244th Avenue SE (SIG) | B | **F** |
| 13.81 | Semanski Street (UNSIG) | D | **F** |
| 14.52 | SR 164 / SR 169 junction (SIG) | A | B |
| 15.13 | SR 164 / SR 410 junction (SIG) | C | E |

**NOTE:** SIG = Signalized; UNSIG = Unsignalized

Intersection LOSs that do not meet (or will not meet) the LOS D standard are displayed in bold.

LOS determination based on methodology from Highway Capacity Manual and intersection evaluations with Synchro software.

*Improvements in LOS between 2004 and 2030 are the result of funded improvements noted in Chapter 2, section 18 in Exhibit 2.27 on pages 2-58 through 2-60.*

1. Level-of-service

Exhibit 3.11 below displays the different levels-of-service for signalized and unsignalized intersections as set out in the Highway Capacity Manual 2000. Each level-of-service is based on an increasing level of vehicle delay through the intersection.

Exhibit 3.11

**Signalized vs. Unsignalized Intersections Seconds of Vehicle Delay & Levels-of-Service**

| | Seconds of Vehicle Delay | |
|---|---|---|
| **Level of Service** | **Signalized Intersections** | **Unsignalized Intersections** |
| A | 0 - 10 | 0 - 10 |
| B | 11 - 20 | 11 - 15 |
| C | 21 - 35 | 16 - 25 |
| D | 36 - 55 | 26 - 35 |
| E | 56 - 80 | 36 - 50 |
| F | > 80 | > 50 |

Source: Highway Capacity Manual 2000

Typically, LOS for signalized intersections is based on the average delay for the whole intersection. Unsignalized intersection LOS is different in that LOS is based on the average delay for the worst approach. But for comparison purposes in this document average vehicle delay and LOS were used for both signalized and unsignalized intersections. The delay differences between a signalized and an unsignalized intersection begin to be more evident as the levels-of-service change from LOS A toward LOS F.

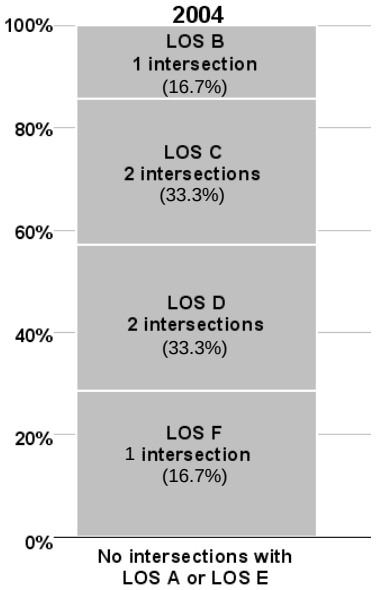
### What are the existing SR 164 unsignalized intersection levels-of-service?

The six existing SR 164 unsignalized intersections are found throughout the corridor with at least one intersection in each corridor segment. Five of the six unsignalized intersections are operating at or above the LOS D standard (See Exhibit 3.12 to the right). The intersection that is operating worse than LOS D is located in the Auburn Segment:

Hemlock Street SE (LOS F)

The other five existing SR 164 unsignalized intersections are located in other corridor segments at intersections with lower traffic volumes.

**Exhibit 3.12**
**Existing SR 164 Unsignalized Intersection Level-of-Service**
(6 Analyzed Intersections – 2004)




### What are the existing SR 164 signalized intersection levels-of-service?

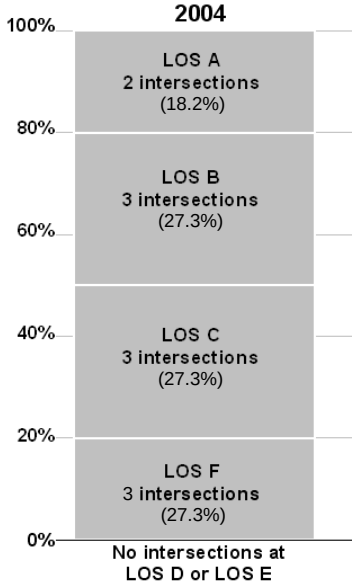
The eleven existing SR 164 signalized intersections are found in the more urbanized areas of the corridor primarily in the Auburn and Enumclaw segments. The one exception is the signal at milepost 4.37 at Academy Drive SE. There is also a new signal at SE 392 Street that was installed after this study's data was collected. Eight of the eleven signalized intersections are operating above the LOS D standard (See Exhibit 3.13 to the right). The three intersections that are operating worse than LOS D are located in the Auburn Segment:

6th Street SE (LOS F)

F Street SE (LOS F)

M Street SE (LOS F)

**Exhibit 3.13**
**Existing SR 164 Signalized Intersection Level-of-Service**
(11 Analyzed Intersections – 2004)



## 7 What are the future (2030) SR 164 intersection levels-of-service?

The seventeen future (2030) SR 164 intersections are estimated to range from LOS A to LOS F. But LOSs A, B, D, and E are only represented by one intersection each (see Exhibit 3.14 to the right). Most of the intersections (10 intersections - 58.8%) are calculated to operate at a level-of-service worse than the LOS D standard.

Each of the SR 164 corridor segments is predicted to include at least one of the nine intersections that will operate at LOS F; with the Auburn Segment home to four of those LOS F intersections:

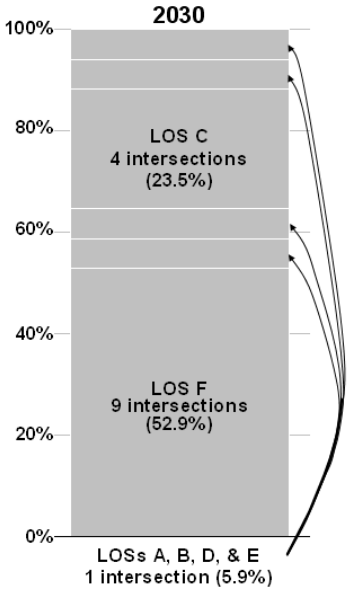
SR 18 WB Ramps

6th Street SE

M Street SE

Hemlock Street SE

**Exhibit 3.14**
**Future SR 164 Intersection Level-of-Service**
(13 Analyzed Intersections – 2030)

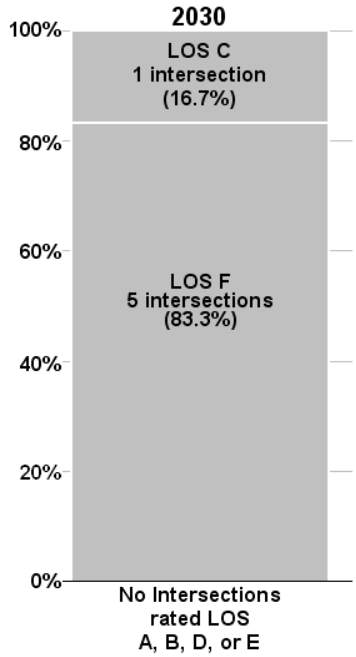



### What are the future (2030) SR 164 unsignalized intersection levels-of-service?

Six of the seventeen analyzed intersections are projected to be unsignalized in the future.[4] Five of those future unsignalized intersections are estimated to provide LOS F service in 2030. Each segment is likely to contain at least one LOS F unsignalized intersection.

Each segment is expected to include at least one of the intersections rated LOS F by 2030. Most of these LOS F intersections are expected to experience high enough traffic volumes along SR 164 during the peak hour that there will be few gaps for the vehicles along the minor streets to turn onto or cross SR 164. This will substantially increase the delay along the side streets, negatively affecting the LOS of the intersections. The one unsignalized intersection that is not predicted to provide LOS F service is located in the Muckleshoot Segment (SE 400th Street providing LOS C service).

**Exhibit 3.15**
**Future SR 164 Unsignalized Intersection Level-of-Service**
(6 Analyzed Intersections – 2030)



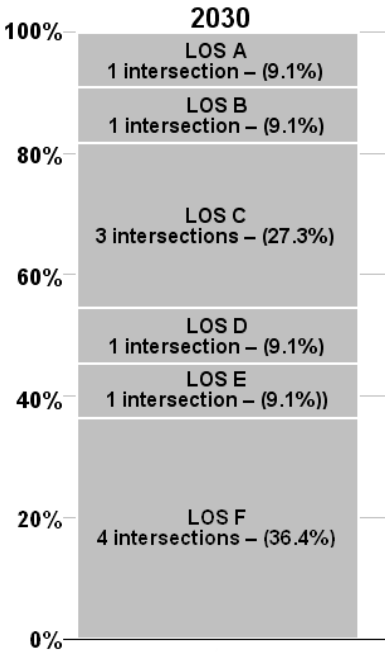

[4] There are 6 existing (2004) unsignalized intersections and there are projected to be 6 future (2030) unsignalized intersections.

### What are the future (2030) SR 164 signalized intersection levels-of-service?

Eleven of the seventeen analyzed intersections are projected to be signalized in 2030.[5] The north end of the SR 164 corridor is expected to include mostly signalized intersections. Four of the Auburn Segment signalized intersections degrade to a PM peak hour LOS F by 2030. Two 2030 LOS F intersections are estimated to be located at the very busy SR 164 / SR-18 interchange.

The other 2030 signalized LOS F intersection (M Street SE) is estimated to experience much the same delay issues as the unsignalized intersections mentioned above. Through traffic on SR 164 is projected to be so heavy that it will likely get the majority of the "green time" from the traffic signals, resulting in significant delay on the minor streets. Even though the minor street delay is projected to be worse at this intersection, the intersection approaches on SR 164 itself will most likely also be at LOS F due to the significant increase in traffic volumes between 2004 and 2030.

**Exhibit 3.16**
**Future SR 164 Signalized Intersection Level-of-Service**
(11 Analyzed Intersections – 2030)




### How do the existing (2004) intersection levels-of-service compare to the future (2030) intersection levels-of-service?

By 2030, the projected growth in traffic volumes and the accompanied delays along the corridor are estimated to push more intersections beyond their current capacity. While only four of the seventeen intersections failed to meet the LOS D standard in 2004, by 2030 nine intersections are projected to be worse than the LOS D standard for the PM peak hour. As displayed in Exhibit 3.10 (page 3-13) and Exhibit 3.17, between 2004 and 2030 there will be a drop in the level-of-service at most of the intersections on the corridor.

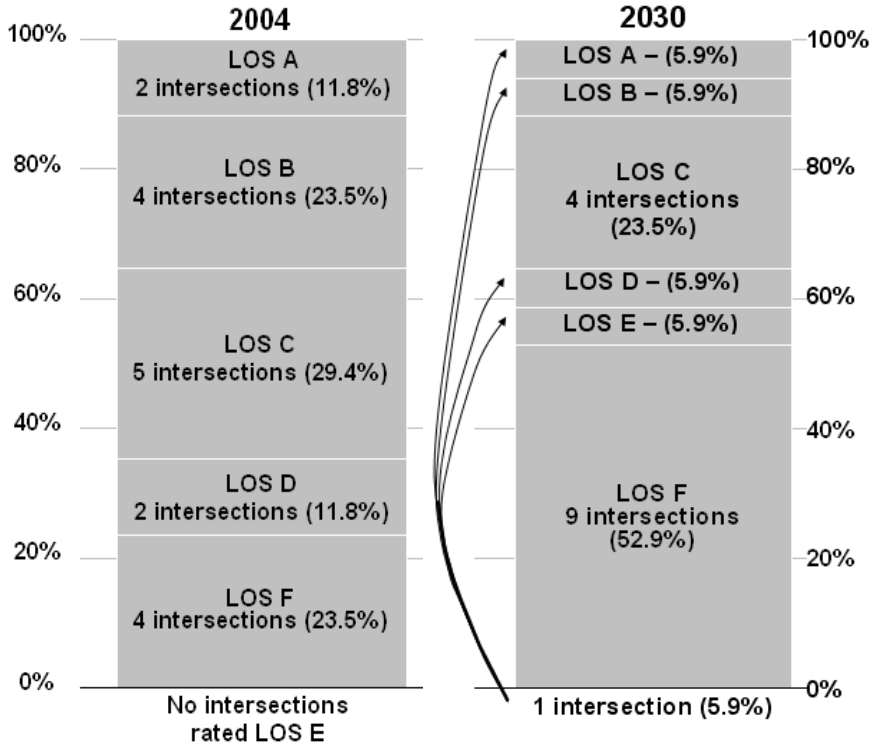
- In 2004, four intersections (23.5%) were designated as worse than LOS D.
- By 2030, the percent of intersections now predicted to be worse than LOS D will more than double to 58.8% (10 intersections).

[5] There are 11 existing (2004) signalized intersections and there are projected to be 10 future (2030) signalized intersections.

Exhibit 3.17

## Existing vs. Future SR 164 Intersection Levels-of-Service

2004 to 2030



### How do the existing (2004) unsignalized intersection levels-of-service compare to the future (2030) unsignalized intersection levels-of-service?

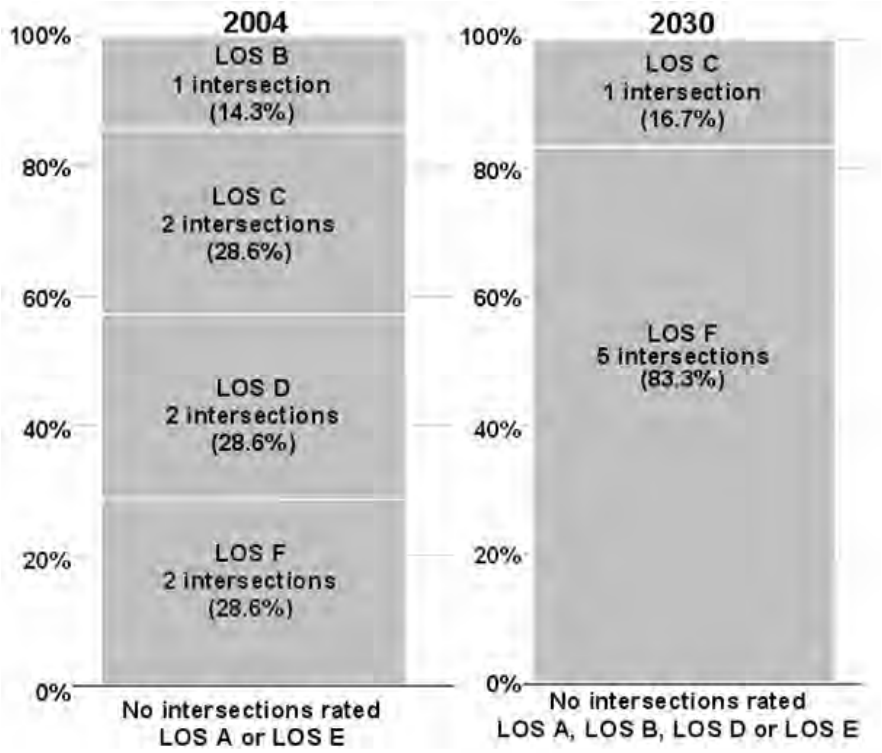
As displayed in Exhibit 3.18 (below) there is estimated to be a drop in the level-of-service at most of the intersections on the corridor.

- In 2004, two intersections (28.6%) were operating at LOS F.
- By 2030, the intersections predicted to operate at LOS F will increase to 5 intersections (83.3%).

Exhibit 3.18

**Existing vs. Future SR 164 Unsignalized Intersection Levels-of-Service**

2004 (7 intersections) to 2030 (6 intersections)[6]




[6] There are 7 existing (2004) unsignalized intersections and there are projected to be 6 future (2030) unsignalized intersections.

### How do the existing (2004) signalized intersection levels-of-service compare to the future (2030) signalized intersection levels-of-service?

Exhibit 3.19 (below) displays the differences at signalized intersections between existing LOSs in 2004 and predicted LOSs in 2030.

- In 2004, two intersections operated at LOS F (20.0%).
- By 2030, five intersections will operate at LOS F (45.5%).

Exhibit 3.19

### Existing vs. Future SR 164 Signalized Intersection Levels-of-Service

2004 (10 intersections) to 2030 (11 intersections)[7]

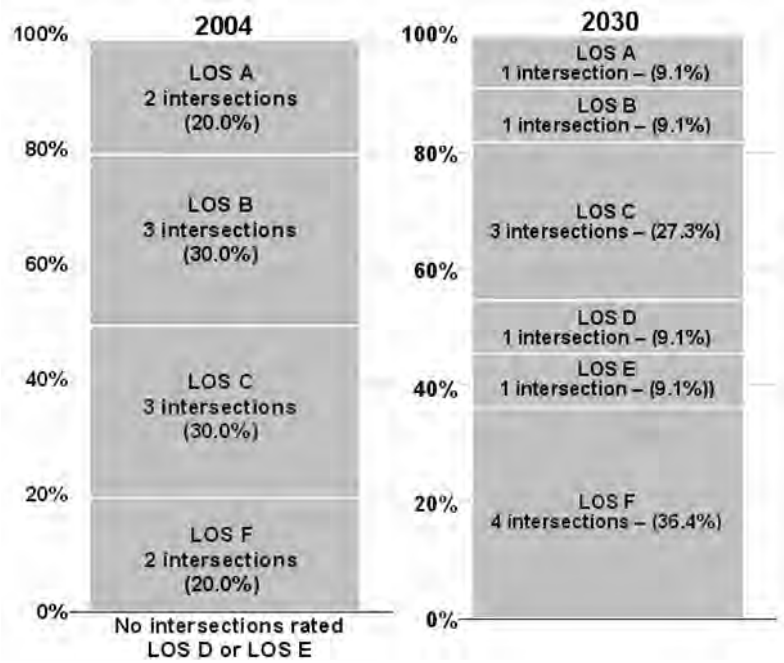
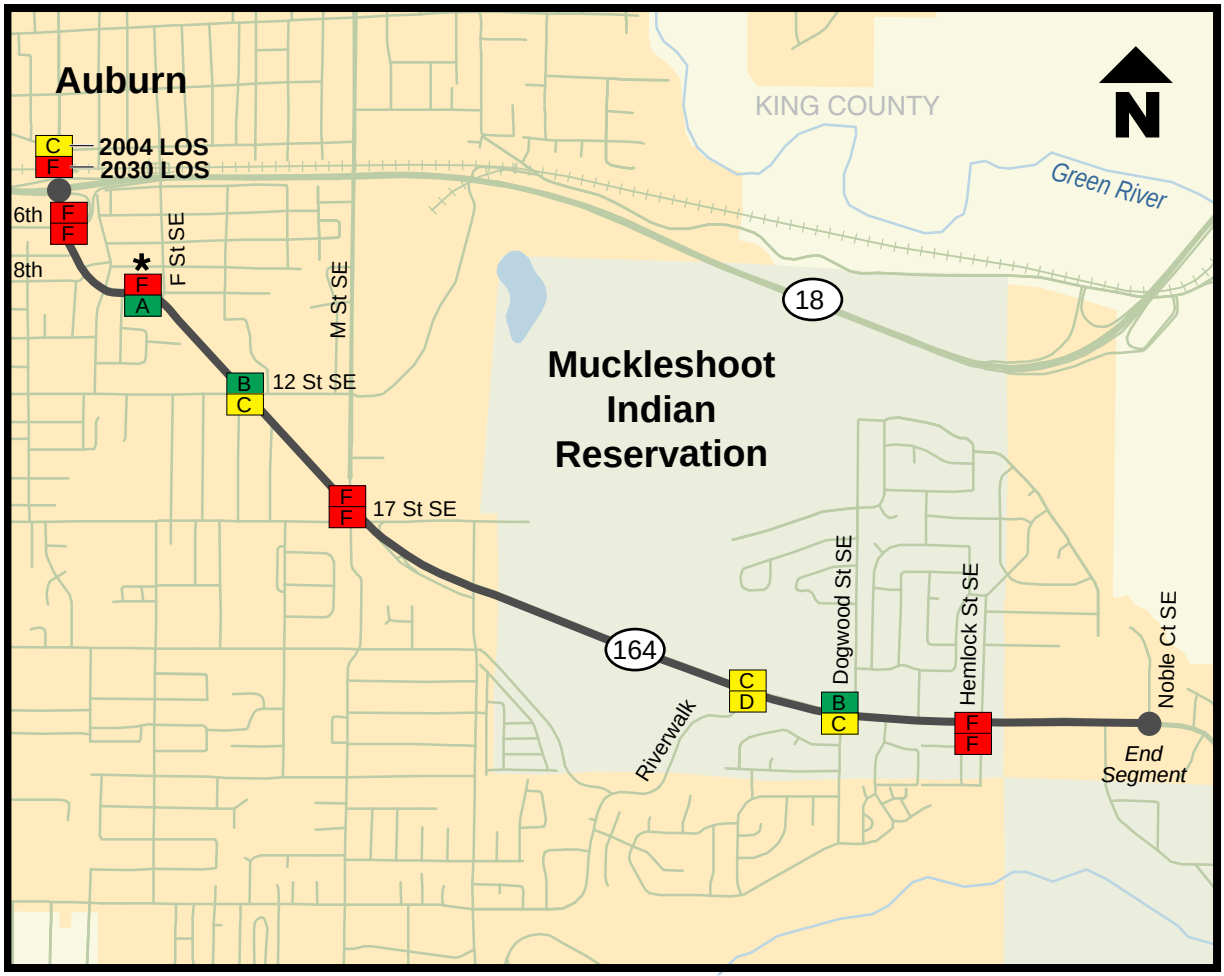



Exhibit 3.20 through Exhibit 3.24 on pages 3-21 through 3-25 display maps of each corridor study segment's existing and future PM peak hour intersection level-of-service.

[7] There are 11 existing (2004) signalized intersections and there are projected to be 10 future (2030) signalized intersections.

Exhibit 3.20

## Auburn Segment - Existing and Future PM Peak Hour Intersection LOS




*LOS improvement at F Street SE from 2004 to 2030 is result of signal installation.

*PM Peak Hour LOS is shown for 2004 (existing) and 2030 (future) traffic conditions*

### Levels of Service - A through F

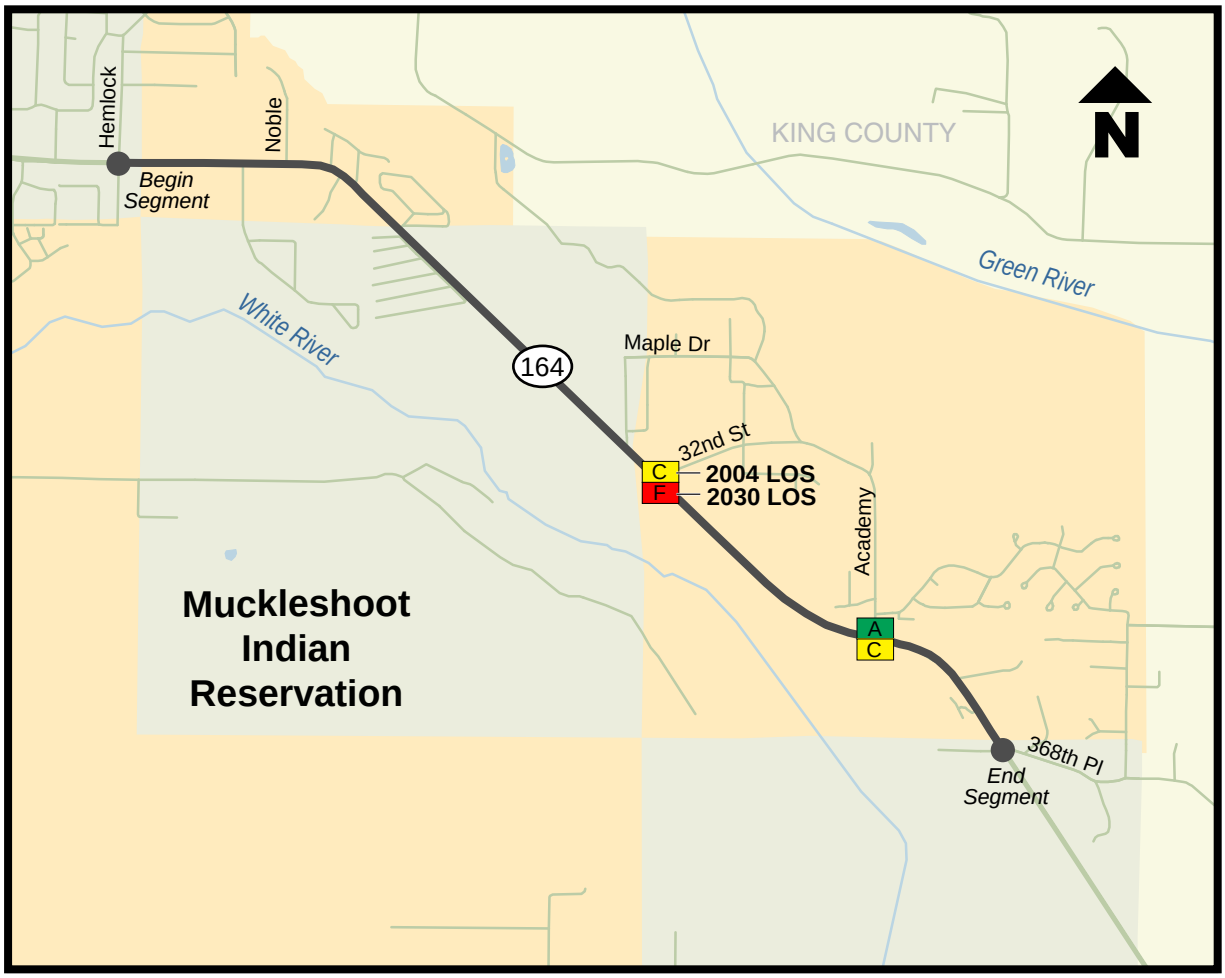
A B LOS A and B better than state standard

C D LOS C better than state standard
LOS D state standard

E F LOS E and F worse than state standard

Exhibit 3.21

## Academy Segment - Existing and Future PM Peak Hour Intersection LOS




*PM Peak Hour LOS is shown for 2004 (existing) and 2030 (future) traffic conditions.*

### Levels of Service - A through F

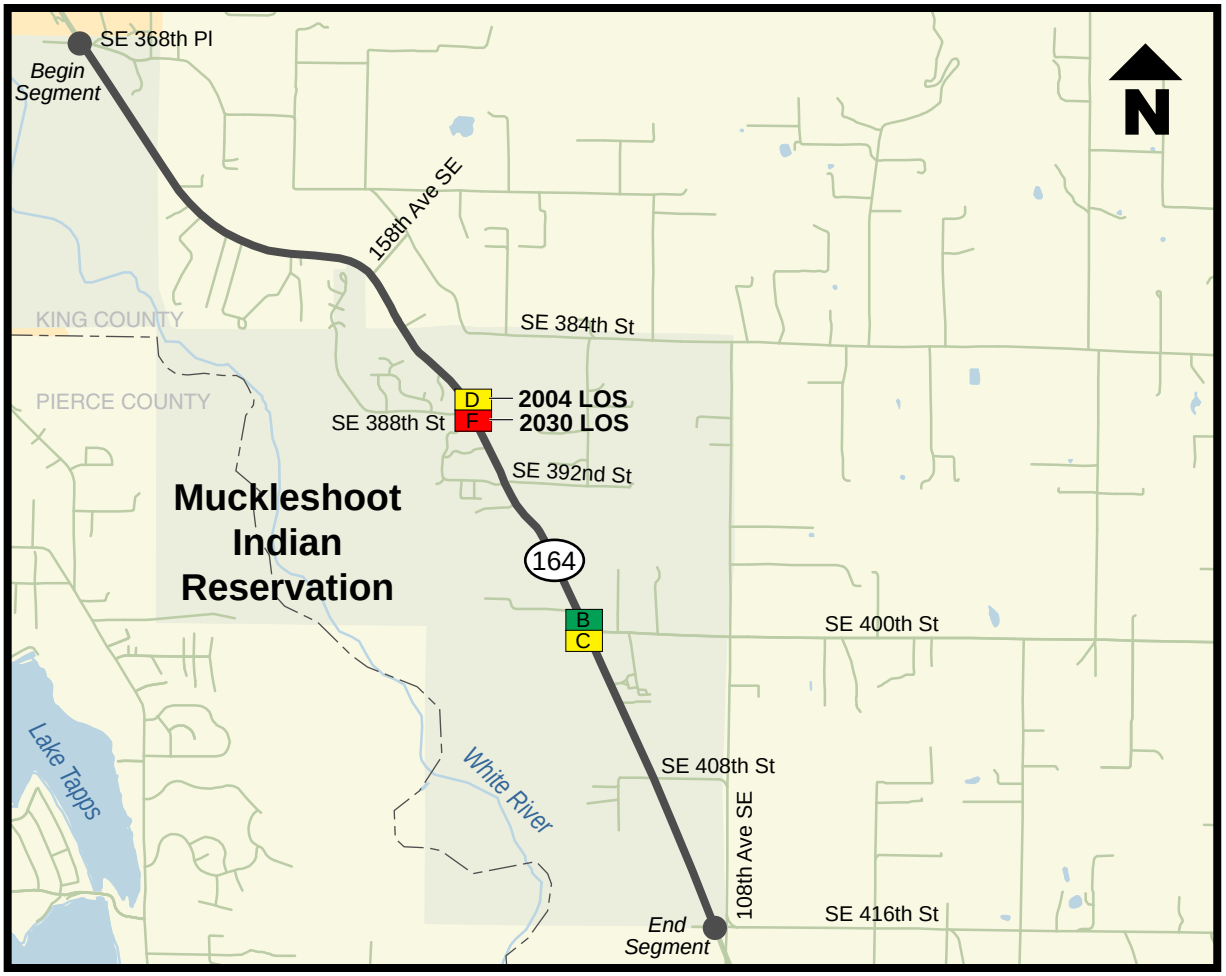
A B LOS A and B better than state standard

C D LOS C better than state standard
LOS D state standard

E F LOS E and F worse than state standard

Exhibit 3.22

## Muckleshoot Segment - Existing and Future PM Peak Hour Intersection LOS




*PM Peak Hour LOS is shown for 2004 (existing) and 2030 (future) traffic conditions.*

### Levels of Service - A through F

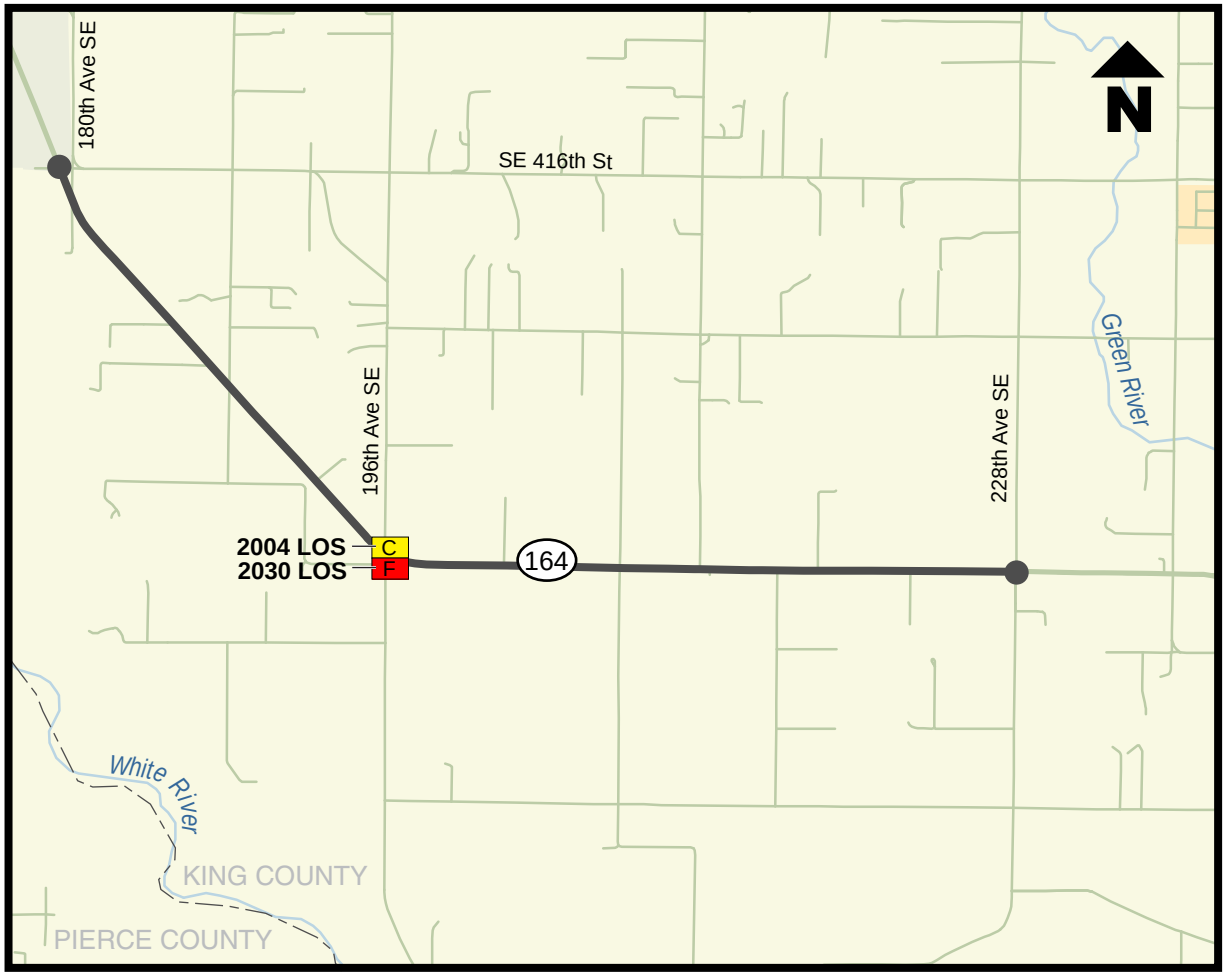
A B LOS A and B better than state standard

C D LOS C better than state standard
LOS D state standard

E F LOS E and F worse than state standard

Exhibit 3.23

## Rural / Agricultural Segment - Existing and Future PM Peak Hour Intersection LOS




*PM Peak Hour LOS is shown for 2004 (existing) and 2030 (future) traffic conditions.*

### Levels of Service - A through F

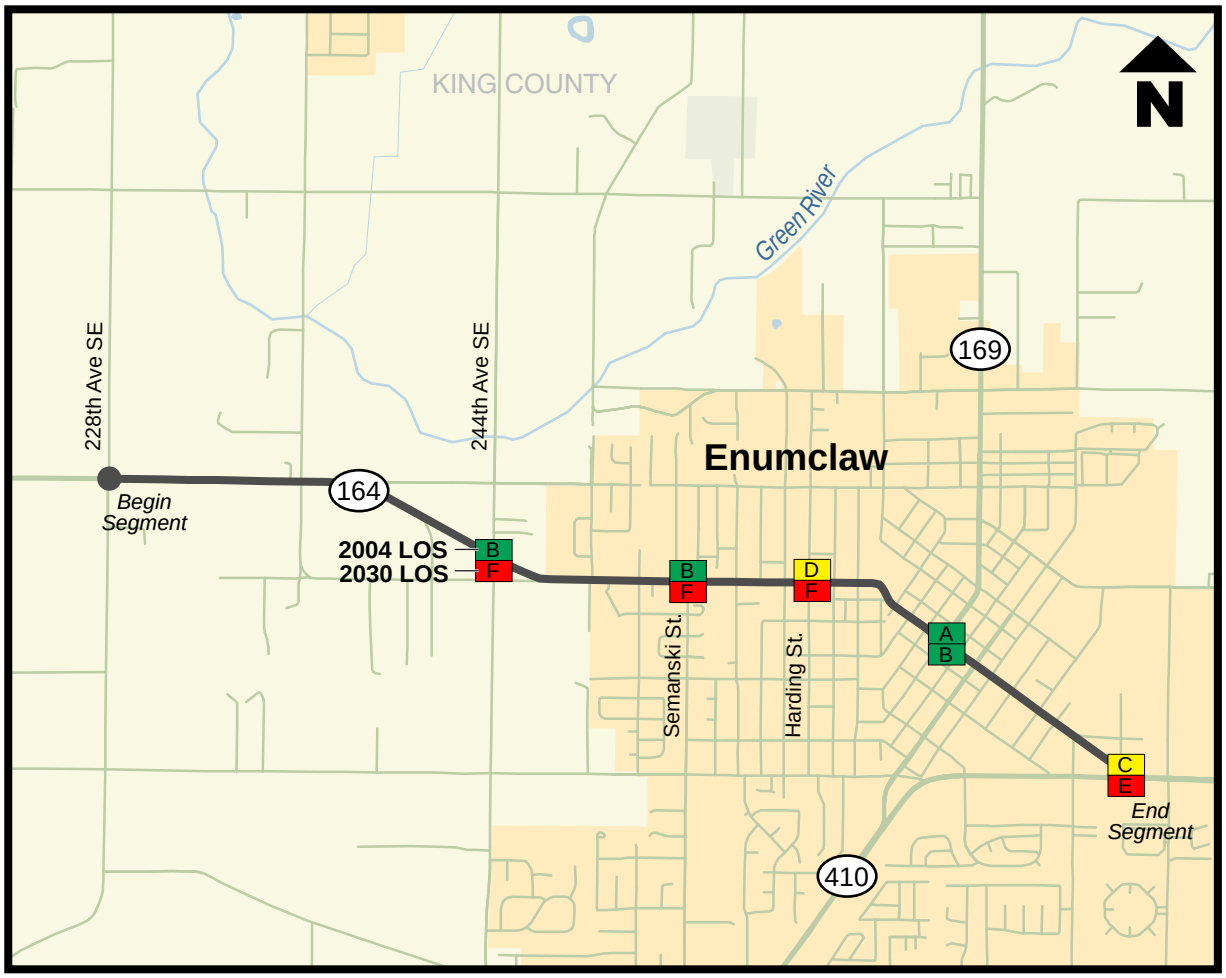
A B LOS A and B better than state standard

C D LOS C better than state standard
LOS D state standard

E F LOS E and F worse than state standard

Exhibit 3.24

## Enumclaw Segment - Existing and Future PM Peak Hour Intersection LOS




*PM Peak Hour LOS is shown for 2004 (existing) and 2030 (future) traffic conditions.*

### Levels of Service - A through F

A B LOS A and B better than state standard

C D LOS C better than state standard
LOS D state standard

E F LOS E and F worse than state standard

*Intersection Vehicle Delay*

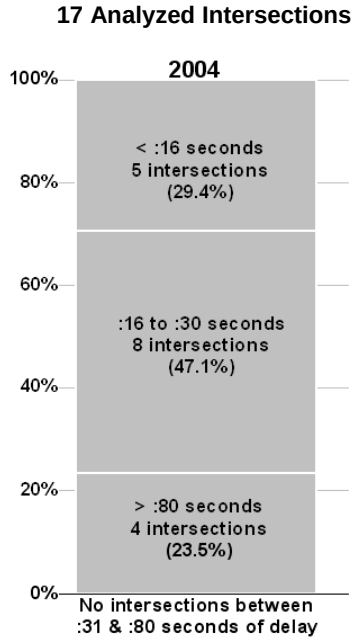
## 8 What are the existing (2004) SR 164 intersection vehicle delays?

All of the 17 analyzed intersections on SR 164 currently experience some PM peak hour delay, although significant delay is not widespread. Presently, four intersections are operating with more than 80 seconds of vehicle delay.[8] See Exhibit 3.28 on page 3-28 for vehicle delay at each of the 17 analyzed intersections.

The measured delay at all the analyzed intersections is displayed in Exhibit 3.25 on the right and provides the following:

- Most of the intersections (13 intersections - 76.5%) experience less than 31 seconds of vehicle wait time.
- More intersections (8 intersections - 47.1%) experience between 16 and 30 seconds of delay than any other level of delay.

**Exhibit 3.25**
**SR 164 Existing Intersection Vehicle Delays**
2004 (in seconds)




[8] As discussed above (Exhibit 3.11, page 3-14), signalized and unsignalized intersections are designed differently and delay can be different depending on the minor street cross traffic. The LOS D standard for the 6 existing (2004) unsignalized intersections is between 26 and 35 seconds, while the LOS D standard for the 11 existing (2004) signalized intersections is 36 to 55 seconds.

## What are the existing (2004) SR 164 unsignalized intersection vehicle delays?[9]

Each segment of the corridor contains at least one of the 7 unsignalized intersections. As seen in Exhibit 3.26 to the right, only two intersections experienced a delay worse than the unsignalized standard of LOS D (26-35 seconds). These two unsignalized intersections are F Street SE and Hemlock Street SE.

Both of these intersections are in the more urbanized Auburn segment. Three of the remaining five unsignalized intersections operated at delays between 16 and 30 seconds (LOS C and LOS D).

## What are the existing (2004) SR 164 signalized intersection vehicle delays?

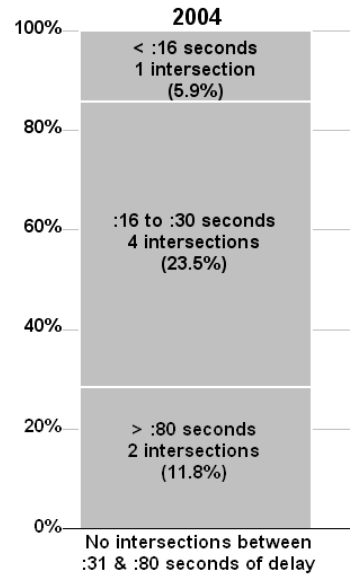
The 10 SR 164 existing signalized intersections that were analyzed in 2004 are dispersed in the more urban Auburn, Academy, and Enumclaw segments. As seen in Exhibit 3.26 to the right, only two intersections experienced a delay worse than the signalized standard of LOS D (36-55 seconds). These two signalized intersections are 6th Street SE and M Street SE.

Four of the signalized intersections experienced a delay less than 16 seconds. Another four signalized intersections experienced a delay between 16 and 30 seconds.

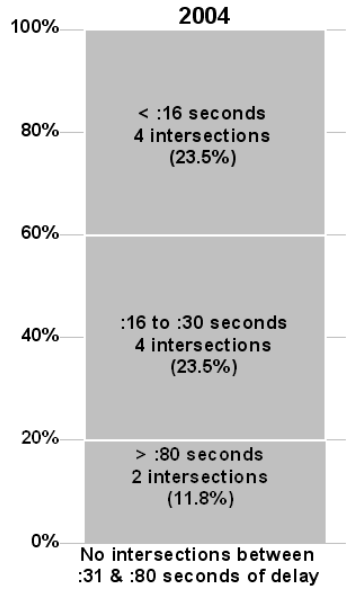
For 2004, Exhibit 3.27 on the following page shows a vehicle's PM peak hour single trip delay at these SR 164 intersections.

**Exhibit 3.26**
**SR 164 Existing Intersection Vehicle Delays**
2004 (in seconds)

**7 Unsignalized Intersections**




**10 Signalized Intersections**




**17 total analyzed intersections**

[9] Existing condition intersection delay was measured in December of 2004.

Exhibit 3.27

**What is one vehicle's existing SR 164 PM peak hour single trip delay? (in minutes)**

| | 2004 |
|---|---|
| All Intersections: | 6.4 min |
| Unsignalized intersections: | 4.3 min |
| Signalized intersections: | 2.1 min |

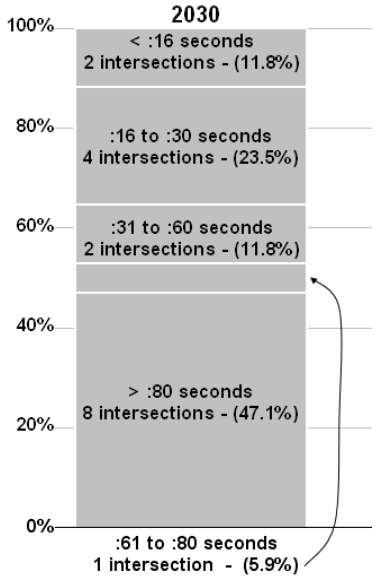
## 9 What are the future (2030) SR 164 intersection vehicle delays?

All of the 17 analyzed intersections on SR 164 are projected to experience some PM peak hour delay. Analysis later in this section will discuss which intersections are predicted to be worse than the unsignalized or signalized intersection vehicle delay service standard by 2030.[10]

Exhibit 3.28 to the right displays nine intersections expected to exceed 60 seconds of vehicle delay by 2030. The exhibit to the right provides the following:

- Most of the intersections (11 intersections - 64.8%) are predicted to experience more than 31 seconds of vehicle delay.
- Eight intersections (47.1%) are expected to experience greater than 80 seconds of delay. Four of these eight intersections are in the Auburn segment.

**Exhibit 3.28**
**SR 164 Future (2030) Intersection Vehicle Delays**
(in seconds)




[10] See Exhibit 3.11, page 3-14. LOS D standard for the unsignalized intersections is between 26 and 35 seconds of vehicle wait time. The LOS D standard for the signalized intersections is 36 to 55 seconds of vehicle delay.

**How does existing (2004) intersection vehicle delay compare to future (2030) intersection vehicle delay?**

Exhibit 3.29 on the right compares the existing intersection vehicle wait time in 2004 and the future intersection vehicle delay in 2030 for all of the 17 analyzed intersections on SR 164.

Between 2004 and 2030, intersection delay along SR 164 is forecasted to deteriorate. Delay is not only estimated to become worse at the intersections already experiencing long vehicle wait times, but delay is also expected to increase at other intersections currently operating with acceptable levels-of-service.

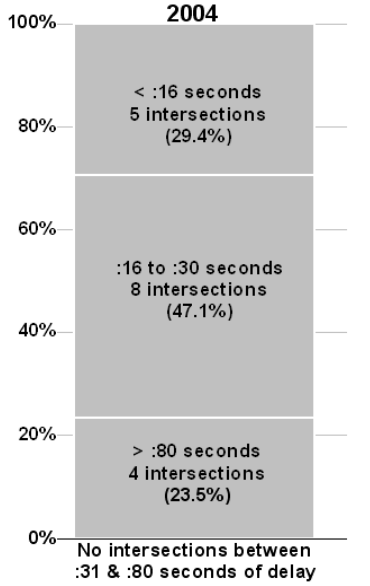
- In 2004, thirteen intersections (76.5%) had less than 31 seconds delay.

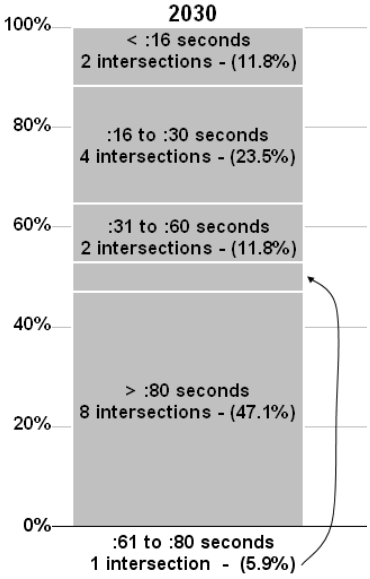
  By 2030, only six intersections (35.3%) are estimated to experience less than 31 seconds delay.

- In 2004, only four intersections (23.5%) experienced more than 60 seconds of vehicle wait time.

  By 2030, nine intersections (53%) will experience more than 60 seconds of vehicle delay.

**Exhibit 3.29**
**SR 164 Existing and Future Intersection Vehicle Delay**
(in seconds)



### What are the future (2030) SR 164 unsignalized intersection vehicle delays?[11]

Six of the seventeen analyzed intersections are projected to be unsignalized in the future.[12] Those intersections are:

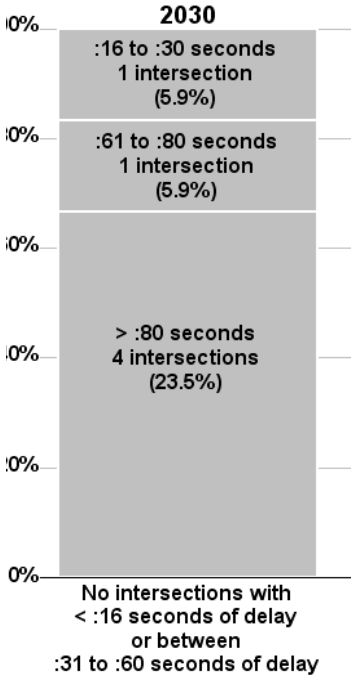
- Auburn Segment -
  Hemlock Street SE (> :80 seconds delay)
- Academy Segment -
  32nd Street SE (> :80 seconds delay)
- Muckleshoot Segment -
  SE 388th Street / 158th Avenue SE
  (> :80 seconds delay)
  SE 400th Street (:19 seconds delay)
- Rural / Agricultural Segment -
  196th Avenue SE / SE 436th Street
  (:67 seconds delay)
- Enumclaw Segment -
  Semanski Street (> :80 seconds delay)

Exhibit 3.30, to the right, displays the future intersection vehicle delay in seconds for the SR 164 unsignalized intersections. The level-of-service standard for unsignalized intersections is LOS D with a range of 26 to 35 seconds of vehicle delay. Five of those future unsignalized intersections are estimated to exceed 35 seconds and provide LOS F service in 2030. Each segment is expected to include at least one of the intersections rated LOS F by 2030.

Exhibit 3.30

**Future SR 164 Unsignalized Intersection Vehicle Delays**

(6 Analyzed Intersections - 2030)




[11] Existing condition intersection delay was measured in December of 2004.

[12] There are 6 existing (2004) unsignalized intersections and there are projected to be 6 future (2030) unsignalized intersections.

### How do the existing (2004) unsignalized intersection vehicle delays compare to the future (2030) unsignalized intersection vehicle delays?

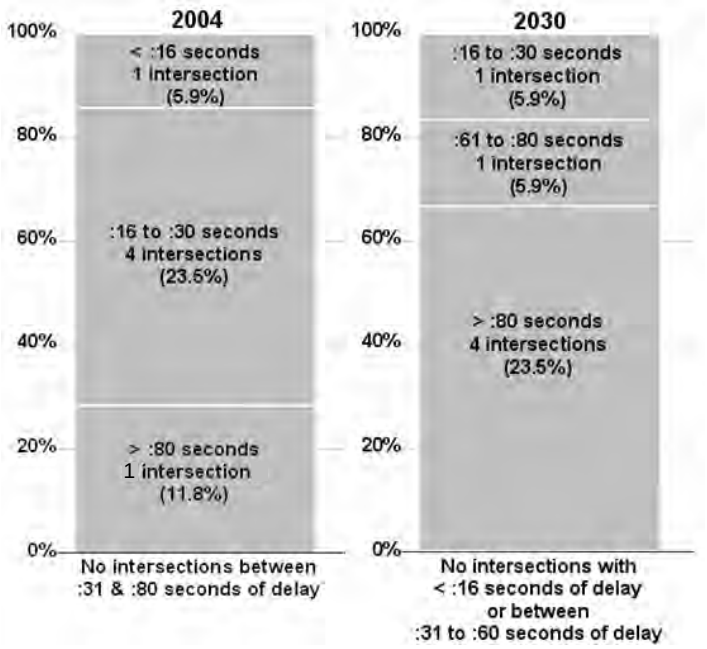
As displayed in Exhibit 3.31 (below) there is estimated to be an increase in the vehicle wait times at the unsignalized intersection on the corridor between 2004 and 2030.

- In 2004, only 1 intersection (11.8%) was found to experience PM peak hour vehicle delays over the unsignalized level-of-service standard of LOS D (26-35 seconds).[13] The intersection is located in the urbanized area of Auburn (Hemlock Street SE).
- By 2030, five intersections (83.3%) are predicted to have intersection vehicle delays worse than the unsignalized intersection standard of LOS D.

Exhibit 3.31

## Existing vs. Future SR 164 Unsignalized Intersection Vehicle Delays

2004 (6 intersections) to 2030 (6 intersections)[14]




[13] See Exhibit 3.11, page 3-14. LOS D standard for the unsignalized intersections is between 26 and 35 seconds of vehicle wait time.

[14] There were 6 existing (2004) unsignalized intersections and there are projected to be 6 future (2030) unsignalized intersections.

### What are the future (2030) SR 164 signalized intersection vehicle delays?

Ten of the seventeen analyzed intersections are now signalized.[15] Those intersections are listed in Exhibit 3.32 below.

Exhibit 3.32

**Future SR 164 Signalized Intersection Vehicle PM Peak Hour Delays**

(2030)

| Milepost | Intersection | PM Peak Hour Delay[1] (in seconds) |
|---|---|---|
| **Auburn Segment** | | |
| 0.31 | SR 18 Westbound Ramps | > 80 |
| 0.38 | 6th Street SE | > 80 |
| 0.91 | 12th Street SE | 28 |
| 1.20 | M Street SE | > 80 |
| 2.07 | Riverwalk Drive / Casino Drive | 54 |
| 2.28 | Dogwood Street SE | 26 |
| **Academy Segment** | | |
| 4.37 | Academy Drive SE | 30 |
| **Muckleshoot Segment** | | |
| | No Signalized Intersections | |
| **Rural / Agricultural Segment** | | |
| | No Signalized Intersections | |
| **Enumclaw Segment** | | |
| 13.30 | 244th Avenue SE | > 80 |
| 14.52 | SR 169 | 11 |
| 15.13 | SR 410 | 57 |

1 Average vehicle delay per intersection in seconds.

Exhibit 3.33 (on the next page) displays the future intersection vehicle delay in seconds for the SR 164 signalized intersections. The level-of-service standard for signalized intersections is LOS D (36 to 55 seconds of vehicle delay). Five of the ten future signalized intersections are estimated to exceed 55 seconds in 2030.

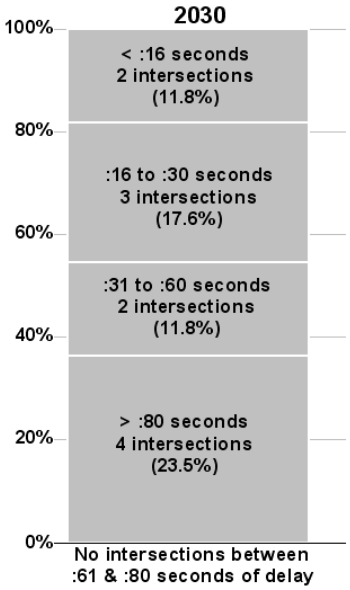
[15] There are 10 existing (2004) signalized intersections and there are projected to be 11 future (2030) signalized intersections.

One other signalized intersection (Riverwalk Drive / Casino Drive) is predicted to experience 54 seconds of vehicle delay and be two seconds away from exceeding the LOS D standard.

- By 2030, three signalized intersections in the Auburn Segment and one signalized intersection in the Enumclaw Segment degrade to a PM peak hour LOS F. The intersections are:
- SR 18 Westbound Ramps — Auburn Segment
- 6th Street SE — Auburn Segment
- M Street SE — Auburn Segment
- 244th Avenue SE — Enumclaw Segment

The urbanized Auburn and Enumclaw segments include all but one of the signalized intersections on the corridor. The other signalized intersection that will degrade to an LOS F intersection is located in Enumclaw at the SR 164 / SR 410 intersection. The only other analyzed signalized intersection on the corridor is in the Academy Segment at Academy Drive.[16]

**Exhibit 3.33**
**Future SR 164 Signalized Intersection Vehicle Delays**
(11 Analyzed Intersections – 2030)




### How do the existing (2004) signalized intersection vehicle delays compare to the future (2030) signalized intersection vehicle delays?

As displayed in Exhibit 3.34 (on the next page) from 2004 to 2030 there is an estimated increase in the vehicle wait times at the signalized intersection on the corridor.

- In 2004, only 2 signalized intersections (11.8%) were found to experience PM peak hour vehicle delays over the signalized level-of-service standard of LOS D (36-55 seconds).[17] Those intersections are located in the urbanized area of Auburn (6th Street SE and M Street SE).

[16] Editor's note: Two signalized intersections were added to the corridor after the data analysis for this Corridor Planning Study was completed.

1) In the Muckleshoot Segment at milepost 6.92 - SE 392nd Street; and
2) In the Auburn Segment at milepost 1.85 - Muckleshoot Plaza.

[17] See Exhibit 3.11, page 3-14. LOS D standard for the signalized intersections is between 36 and 55 seconds of vehicle wait time.

– By 2030, five signalized intersections (45.5%) are predicted to have intersection vehicle delays worse than the signalized intersection standard of LOS D. Those intersections are located in the urbanized area of Auburn and Enumclaw. They are:

| | |
|---|---|
| SR 18 Westbound Ramps | Auburn Segment |
| 6th Street SE | Auburn Segment |
| M Street SE | Auburn Segment |
| 244th Avenue SE | Enumclaw Segment |
| SR 164 / SR 410 intersection | Enumclaw Segment |

Exhibit 3.35 below compares 2004 and 2030 PM peak hour single vehicle trip delays for the above mentioned intersections.

Exhibit 3.35

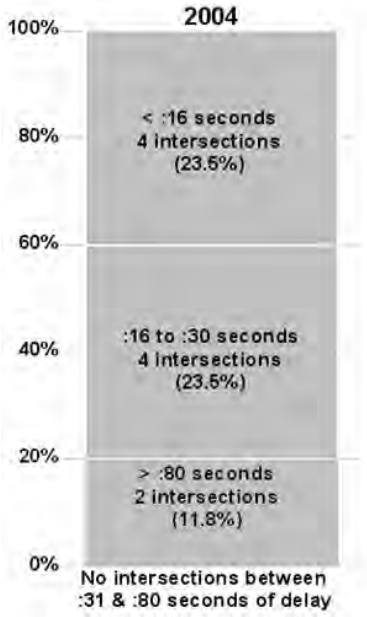
### What is one vehicle's existing and future SR 164 PM peak hour single trip delay?

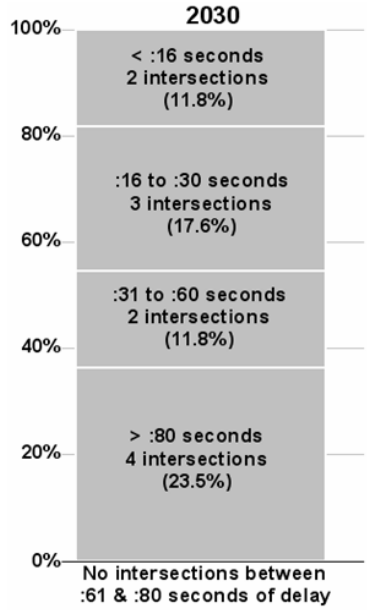
(in minutes)

| | 2004 | 2030 |
|---|---|---|
| **All Intersections:** | 6.4 min | 21.7 min |
| **Unsignalized Intersections:** | 4.3 min | 4.1 min* |
| **Signalized Intersections:** | 2.1 min | 4.9 min |

* One potential explanation for the decrease in delay from 2004 to 2030 for unsignalized intersections is the fact that one unsignalized intersection (F Street SE) with over :80 seconds of delay in 2004 became a signalized intersection with only :07 estimated seconds of delay in 2030.

**Exhibit 3.34**
**Existing vs. Future SR 164 Signalized Intersection Vehicle Delays**
(10 Intersections – 2004 to 11 intersections – 2030)[15]




[18] There were 10 existing (2004) signalized intersections and there are projected to be 11 future (2030) signalized intersections.

Exhibit 3.36 below displays the existing and future intersection vehicle delay and levels of service for all the analyzed intersections on SR 164.

Exhibit 3.36

## SR 164 Existing & Future Intersection Vehicle Delay & Level-of-Service

(2004 - 2030)

| | | | PM Peak Hour | | | | |
|---|---|---|---|---|---|---|---|
| | | | 2004 | | 2030 | | Change in Delay |
| Milepost | Intersection | SIG / UNSIG[1] | Delay[2] (in seconds) | LOS[3] | Delay[2] (in seconds) | LOS[3] | 2004 to 2030 |
| **Auburn Segment** | | | | | | | |
| 0.31 | SR 18 Westbound Ramps | SIG | 21 | C | > 80 | **F** | > - 59 |
| 0.38 | 6th Street SE | SIG | > 80 | **F** | > 80 | **F** | -- |
| 0.66 | F Street SE | SIG | > 80 | **F** | 7 | A | > - 73 |
| 0.91 | 12th Street SE | SIG | 12 | B | 28 | C | - 16 |
| 1.20 | M Street SE | SIG | > 80 | **F** | > 80 | **F** | -- |
| 2.07 | Riverwalk Drive / Casino Drive | SIG | 23 | C | 54 | D | - 31 |
| 2.28 | Dogwood Street SE | SIG | 17 | B | 26 | C | - 09 |
| 2.54 | Hemlock Street SE | UNSIG | > 80 | **F** | > 80 | **F** | -- |
| **Academy Segment** | | | | | | | |
| 3.82 | 32nd Street SE | UNSIG | 16 | C | > 80 | **F** | > - 64 |
| 4.37 | Academy Drive SE | SIG | 7 | A | 30 | C | - 23 |
| **Muckleshoot Segment** | | | | | | | |
| 6.65 | SE 388th Street / 158th Avenue SE | UNSIG | 27 | D | > 80 | **F** | - 5 |
| 7.51 | SE 400th Street | UNSIG | 13 | B | 19 | C | - 6 |
| **Rural / Agricultural Segment** | | | | | | | |
| 10.23 | 196th Avenue SE / SE 436th Street | UNSIG | 18 | C | 67 | **F** | - 49 |
| **Enumclaw Segment** | | | | | | | |
| 13.30 | 244th Avenue SE | SIG | 13 | B | > 80 | **F** | > - 67 |
| 13.81 | Semanski Street | UNSIG | 26 | B | > 80 | **F** | > - 54 |
| 14.52 | SR 169 | SIG | 9 | A | 11 | B | - 2 |
| 15.13 | SR 410 | SIG | 23 | C | 57 | E | - 34 |

1 SIG = Signalized Intersection; UNSIG = Unsignalized Intersection -- Typically, LOS for signalized intersections is based on the average delay for the whole intersection. At the same time unsignalized intersection LOS is based on the average delay for the worst approach. But for comparison purposes in this document average vehicle delay and LOS was used for both signalized and unsignalized intersections.

2 Average vehicle delay per intersection in seconds.

3 Level-of-Service

**NOTE:** Intersection LOSs that do not meet (or will not meet) the LOS D standard, are displayed in bold
Improvements in Delay and LOS between 2004 and 2030 are the result of funded improvements noted in Chapter 2, Section 18 in Exhibit 2.25 starting on page 2-56.

*Highway Section Levels-of-Service*

## 10 What was the highway section level-of-service methodology?

In addition to intersection level-of-service, existing (2004) and future (2030) highway section LOS was analyzed. Highway segment LOS was determined in accordance with the Highway Capacity Manual 2000 methodology using both Synchro 6.0 and the Highway Capacity Software 2000. Similar to intersection LOS analysis, traffic operations for highway sections are also described alphabetically using LOS A through LOS F, with LOS A indicating free-flowing traffic and LOS F indicating extreme congestion and long vehicle delays (see Exhibit 3.37 to the right).

For this analysis, SR 164 was divided into 7 highway sections of different highway types (rural and urban), as shown in Exhibit 3.38 on the next page and in Exhibit 3.39 on page 3-38. These highway sections were evaluated as follows:

**Rural - Two-Lane Highway (3 sections):**

These sections are usually a rural roadway with a two-lane cross section, one lane for each direction of flow, on which passing maneuvers must be made in the opposing lane.[19]

Passing a slower vehicle requires use of the opposing lane as sight distance and gaps in the opposing traffic stream permit. As traffic volumes and roadway obstructions increase, ability to pass is restricted. Levels-of-service on these types of highway are based on the ability to pass another vehicle and the average speed of traffic.

Exhibit 3.37

**Level-of-Service & Flow Conditions**

| Level of Service | Flow Conditions |
|---|---|
| A | |
| B | |
| C | |
| D | |
| E | |
| F | |

Source: 2004 Highway Capacity Manual

[19] Source: Highway Capacity Manual 2000

Two-lane highways can be analyzed either as two-way segments obtaining traffic performance measures for both directions of travel combined or as directional segments with each direction of travel considered separately. Separate analysis by direction is appropriate for steep grades.[20]

The three rural sections are located along portions of the corridor leading into and out of urban areas. These segments were analyzed using two-way, two-lane highway methodology. These segments were analyzed using the 2000 Highway Capacity Software.

Exhibit 3.38

## SR 164 Highway Segment Evaluation Type

| Milepost | Segment | Highway Evaluation Type |
|---|---|---|
| **Auburn Segment** | | |
| 0.31 - 2.49 | EB Auburn Urban Area | Arterial - Urban Street[2] |
| 0.31 - 2.49 | WB Auburn Urban Area | Arterial - Urban Street[2] |
| **Academy Segment** | | |
| 2.49 - 4.71 | EB / WB Auburn East | Two-way, Two-lane Highway[1] |
| **Muckleshoot Segment** | | |
| 4.71 - 8.73 | Muckleshoot / King County | Two-way, Two-lane Highway[1] |
| **Rural / Agricultural Segment** | | |
| 8.73 - 12.24 | Enumclaw Rural Area | Two-way, Two-lane Highway[1] |
| **Enumclaw Segment** | | |
| 12.24 - 15.13 | EB Enumclaw Urban Area | Arterial - Urban Street[2] |
| 12.24 - 15.13 | WB Enumclaw Urban Area | Arterial - Urban Street[2] |

1 Two-way, Two-lane Highway (TWTL): refers to a two-lane highway evaluated as two-way segments obtaining traffic performance measures for both directions of travel combined.

2 Arterial - Urban Street (Art - Urb St): refers to an urban street arterial evaluated as potentially a multi-lane divided facility segment, a multi-lane undivided facility segment; or a two-lane facility segment with shoulders obtaining traffic performance measures for both directions of travel combined.

[20] Ibid.

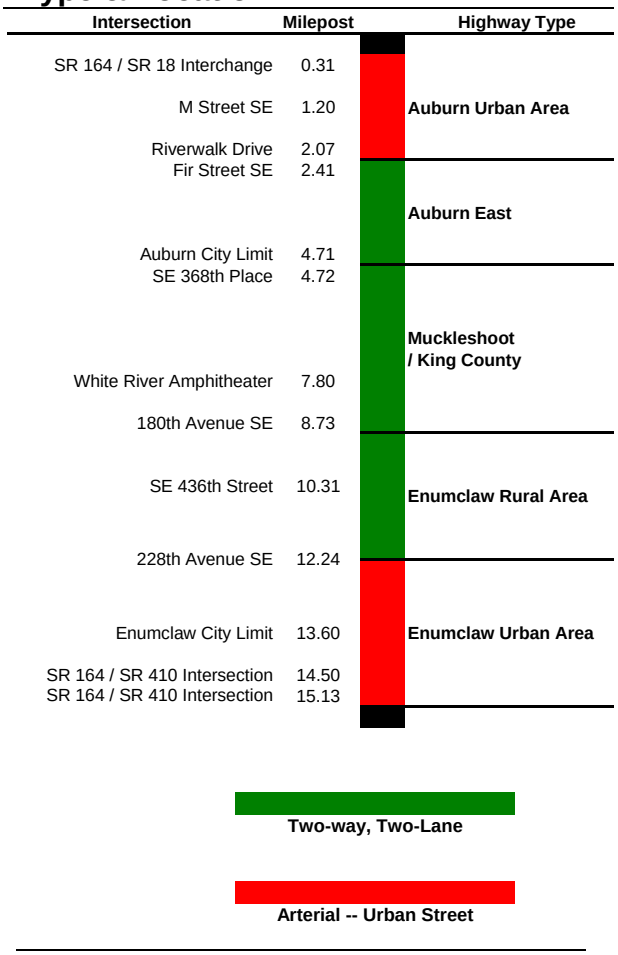
### Urban - Arterial Urban Street (4 sections):

These sections are highway segments with at least two lanes for the exclusive use of traffic in each direction, with no control or partial control of access. But this type of highway may have periodic interruptions to flow at signalized intersections no closer than 2 miles.[21] The arterial urban street differs from the two-lane highway primarily because a driver on a multilane highway is able to pass slower-moving vehicles without using lanes designated for oncoming traffic.

An arterial urban street is also influenced both by the number of signals per mile and by the intersection control delay. Levels-of-service on these types of highway are typically based on the average speed and density of traffic. These four SR 164 urban sections are located between the SR 164 / SR 18 interchange and just east of Fir Street SE (MP 0.31 to MP 2.49). These segments were analyzed using the HCM arterial LOS methodology Synchro.

**Exhibit 3.39**

**SR 164 Highway Segment Evaluation Type & Location**




### What are the service criteria for urban and rural sections?

Factors influencing highway LOS include traffic volumes, percentage of heavy vehicles (large trucks), design speed of the highway, number of passing zones, shoulder and lane widths, grade, and directional distribution of traffic.[22]

The measurement criteria for urban and rural highway segment level-of-service are different. Direct comparisons between the two are not useful. Steep grades, frequent trucks, and lack of passing lanes make the rural two-lane highway sections function at lower levels-of-service at fairly low volumes compared to the urban multilane volumes.

[21] Ibid.

[22] The specific methods for calculating LOS can be found in the Transportation Research Board's (TRB) Highway Capacity Manual (HCM) 2000.

### What are the existing (2004) SR 164 rural highway section levels-of-service?

Current peak hour LOS along the rural highway sections of SR 164 are operating at or worse than the state standard of LOS D. The Auburn East section operates at LOS E in the PM peak hour in both the eastbound and westbound directions. Exhibit 3.40 on page 3-41 lists the existing and future highway section levels-of-service and average speeds.

Any mention of average travel speed in these tables discussing highway segment level-of-service should also consider the posted speed limit's impact. A listing of the posted speed limits is in Exhibit 2.12 on page 2-35 earlier in this document.

### What are the future (2030) SR 164 rural highway section levels-of-service?

The future conditions of the rural two-lane highway segment fail to meet the regional LOS D standard in 2030. This is not only due to the high volume of traffic, but the condition of the roadway itself. Uncontrolled traffic movements onto and off of the highway can diminish the corridor's traffic flow. Channeled access to the roadway can improve the highway level-of-service and minimize traffic conflicts.

The narrow shoulders and winding curves make passing difficult. Exhibit 3.40 on page 3-41 lists the existing and future highway section levels-of-service and average speeds.

### What are the existing (2004) SR 164 urban highway section levels-of-service?

As discussed earlier, the arterial urban street differs from the two lane highway because of the ability to pass without facing oncoming traffic and the number of signals per mile. The western section of SR 164 is made up of mostly multilane urban arterial street sections. The existing PM peak hour level-of-service for the eastbound Auburn Urban Area of SR 164 is operating worse than the LOS D standard. The westbound Auburn Urban Area (LOS C) and both eastbound and westbound Enumclaw Urban Areas (LOS B) are operating better than the LOS D standard.

Exhibit 3.40 on page 3-41 lists the existing and future highway section levels-of-service and average speeds. Any mention of average travel speed in these tables discussing highway segment level-of-service should also consider the posted speed limit's impact. The posted speed limit varies from 25 to 45 miles per hour within the Enumclaw Urban Area section. A listing of the posted speed limits is in Exhibit 2.13 on page 2-36 earlier in this document.

### What are the future (2030) SR 164 urban highway section levels-of-service?

The eastbound direction of SR 164 (toward Enumclaw) is the peak direction during the PM peak hour. The Auburn Urban Area is expected to experience the highest traffic volumes along the corridor and is also where a majority of the traffic on SR 164 enters the corridor. Projects listed later in this SR 164 CPS are recommended to address this travel deficiency.

The eastbound Auburn urban highway section of SR 164 corridor is currently operating worse than the LOS D standard. Without any additional operational or capacity improvements, this operational condition is expected to continue in the future and travel speeds are expected to decrease in most areas as traffic volumes increase by 2030.

Exhibit 3.40 (below) lists the existing and future highway section levels-of-service and average speeds analyzed.

Exhibit 3.40

## SR 164 Rural & Urban Highway Segments Existing vs. Future Level-of-Service and Average Speed

(2004 and 2030)

| | | | | 2004 PM Peak Hour | | 2030 PM Peak Hour | |
|---|---|---|---|---|---|---|---|
| **Milepost** | **Segment** | **Rural/ Urban[1]** | **Highway Type[1]** | **LOS[2]** | **Average Speed[3]** | **LOS** | **Average Speed** |
| **Auburn Segment** | | | | | | | |
| 0.31 - 2.40 | EB Auburn Urban Area | Urban | Art - Urb St | E | 13.0 | F | 7.0 |
| 0.31 - 2.40 | WB Auburn Urban Area | Urban | Art - Urb St | C | 21.9 | D | 15.2 |
| **Academy Segment** | | | | | | | |
| 2.40 - 4.72 | EB Auburn East | Rural | TWTL | E | 27.7 | F | 19.1 |
| 2.40 - 4.72 | WB Auburn East | Rural | TWTL | E | 27.7 | F | 19.1 |
| **Muckleshoot Segment** | | | | | | | |
| 4.72 - 8.73 | Muckleshoot Segment | Rural | TWTL | D | 41.2 | E | 32.8 |
| **Rural / Agricultural Segment** | | | | | | | |
| 8.73 - 12.24 | Enumclaw Rural Area | Rural | TWTL | D | 40.4 | E | 35.2 |
| **Enumclaw Segment** | | | | | | | |
| 12.24 - 15.13 | EB Enumclaw Urban Area | Urban | Art - Urb St | B | 22.8 | C | 18.8 |
| 12.24 - 15.13 | WB Enumclaw Urban Area | Urban | Art - Urb St | B | 19.3 | C | 20.5 |

1. HCM LOS methodology used:
   TWTL = two-way, two-lane highway;
   Art - Urb St = arterial (urban street).

2. Level-of-service.

3. Average speed per vehicle in miles per hour.

**NOTE:** Posted speed limits on SR 164 are listed in Exhibit 2.13 on page 2-36.

*Segment Travel Times*

## 11 What was the segment travel time analysis methodology?

Average free flow and congested travel times were developed for each corridor segment using traffic modeling software. Travel times for the urban portions of the corridor (Auburn and Enumclaw) were developed using the Synchro traffic model. The model is based on average delay per vehicle at intersections plus travel time between intersections. The travel time methodology accounted for delays observed at congested signalized intersections along the urban segments. For the remaining non-urban segments of the corridor, the 2000 Highway Capacity Software was used to develop free flow and congested travel times.

Travel times are based upon the capacity of a two-lane rural highway, posted speed limits, and the average time spent following slower vehicles. All travel times are expressed in minutes. The travel times were developed primarily for the purpose of comparison of each segment over time. It is important to note that each segment has a different distance, configuration, density, and traffic volumes. Comparison between segments would not be valid or appropriate. Examining the difference in percent change in travel times between segments would be valid and appears later in this section. Travel times for the 2030 No Build option, compared with the existing (2004) PM peak period travel times are shown in Exhibit 3.41 on the next page.

Exhibit 3.41

## SR 164 Existing and Future Travel Time Comparison

(2004 and 2030 Average PM Peak Period)

| Segment | Distance (miles) | Average Free Flow[1] Travel Time (minutes) | 2004 Existing Average PM Travel Time (minutes) | 2030 Future No Build Average PM Travel Time (minutes) | Percent Change:[2] 2004 to 2030 Travel Time (minutes) |
|---|---|---|---|---|---|
| Auburn | 2.09 | 3.1 | 9.6 | 17.9 | 85.7% |
| Academy | 2.32 | 3.3 | 5.0 | 7.3 | 45.0% |
| Muckleshoot | 4.01 | 4.4 | 5.8 | 7.3 | 25.6% |
| Rural / Agricultural | 3.51 | 3.9 | 5.2 | 6.0 | 14.8% |
| Enumclaw | 2.89 | 5.1 | 7.6 | 9.2 | 21.3% |
| **Totals:** | 14.82 | 19.8 | 33.3 | 47.7 | 43.2% |

1 Free Flow Travel refers to the time it would take to travel the whole corridor at the posted speed limits and unrestricted by other traffic.

2 The percent change in travel times from 2004 to 2030 all increase travel times.

### What are the existing (2004) SR 164 highway segment travel times?

The Existing (2004) travel times are displayed in Exhibit 3.41 above. The travel time for the Auburn segment is longer than the other segments although the Auburn segment is a shorter distance than the others. The total existing travel time for one PM peak period trip along the corridor is 33.3 minutes.

The travel times were developed primarily for the purpose of comparison of each segment over time. It is important to note that each segment has a different distance, configuration, density, and traffic volumes. Comparison between segments would not be valid or appropriate.

### What are the future (2030) SR 164 highway segment travel times?

The 2030 PM peak period travel time for each segment is longer than their current travel times. The predicted travel time for the 2.1 mile Auburn segment would be almost 18 minutes. Even travel time in the rural areas would increase. The total for one PM peak trip along the corridor is predicted to increase to 47.7 minutes to travel the SR 164 corridor in 2030.

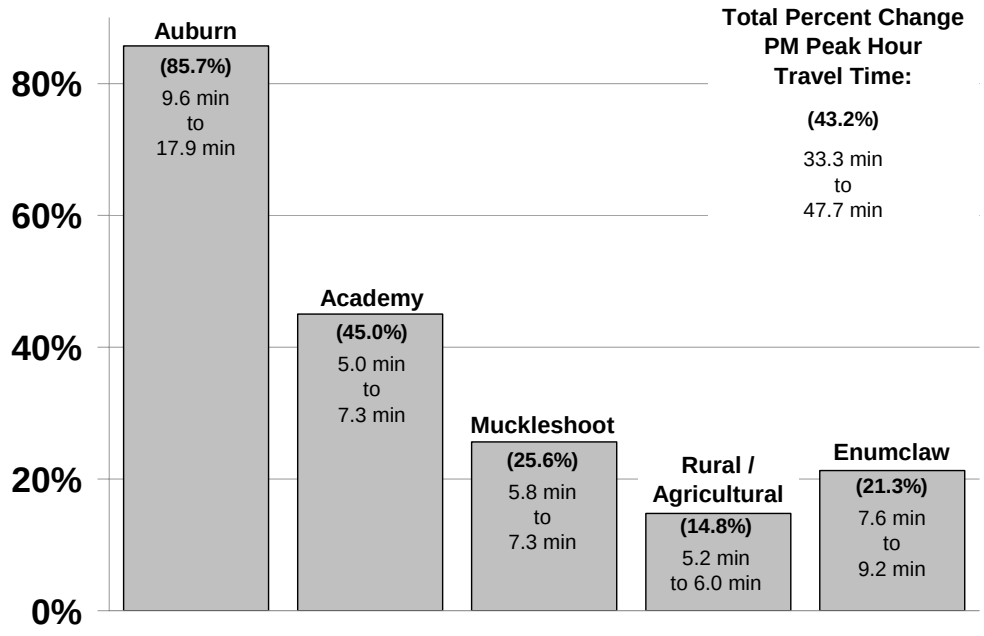
### How do the existing (2004) highway segment travel times compare to the future (2030) highway segment travel times?

The segment with the largest percent increase in travel time is expected to be the Auburn segment, where the PM peak travel time is projected to increase from 9.6 minutes to nearly 18 minutes (17.9 minutes - 85.7 percent increase). This percent increase almost doubled the segment with the next highest increase, the Academy segment (45.0 %). One reason for this increase is probably due to the anticipated increase in vehicle trips between 2004 and 2030 concentrated in this segment. The relative percent change in segment travel time between 2004 and 2030 can be seen in Exhibit 3.42 below.

Exhibit 3.42

**SR 164 Average PM Peak Hour Travel Times**

Percent Change 2004 to 2030



The PM peak hour intersection level-of-service analysis, the highway segment level-of-service analysis, and the average travel time analysis all show that the existing corridor has capacity deficiencies which are anticipated to worsen during the next 20 years. Operational improvements to the entire corridor will be necessary to bring the SR 164 corridor level-of-service up to the state standard of level-of-service D or better.

## *Safety Conditions*

### 12 What are the existing SR 164 safety conditions?

Safety is a top priority on all our state highways. The growth of communities along SR 164 has changed the use of the highway from a small two-lane, rural farm road to a small, mostly two-lane, commuter and freight highway. The safety problems listed below are exacerbated by the volume of traffic now using the highway:

- Multiple uncontrolled driveways with direct access to SR 164
- Intersections that meet the roadway at awkward angles
- Narrow travel lanes and shoulders (in some locations shoulders are inadequate width for pedestrians)
- Sharp curves, steep roadside embankments, and foliage that obstruct drivers' and pedestrians' ability to clearly see the entire roadway
- No turning lanes or turn pockets for vehicles to slow down and turn while others continue without stopping
- Large trucks that block the roadway while making left turns
- Disabled vehicles (which block the shoulders and/or traffic lanes)
- Lack of sidewalks in developed areas and near school zones
- Sight distance inadequate for several KC Metro bus stops

- Numerous and frequent school bus stops of Auburn School District buses that stop in traffic to load and off-load children, which impede the flow of traffic within the Auburn, Academy, and Muckleshoot sections
- Inadequate safe walking routes for children along the route with a lack of safe pedestrian crossings for children at bus stops

These conditions listed above can reduce roadway safety and contribute to vehicle collisions. The recent history of collisions is discussed on the next page. The Corridor Working Group has developed recommendations that, when implemented, will help improve safety along SR 164 (See Chapter 5).

## *Collision History*

### 13 What is the recent SR 164 collision history?

Collision data for SR 164 is summarized in the following pages by roadway segment and collision type. The data comes from the 2006 Washington State Collision Data Summary (found on the WSDOT website: http://www.wsdot.wa.gov/mapsdata/tdo/PDF_and_ZIP_Files/2006_Annual_Collision_Data_Summary_-_All_Roads.pdf).[23]

The data reflects those collisions reported during the analysis period from 2002 through 2004. The total number of collisions for each year during the analysis period was nearly the same. A reportable collision is defined as: "An unintended event on a public roadway involving at least one motor vehicle or pedal-cyclist, consisting of at least $700 worth of damage to any one person's property, or else injury or death to any person involved in the collision."[24]

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[23] Federal law 23 United States Code Section 409 governs use of the data contained in above mentioned Summary. Under this law data maintained for purposes of evaluating potential highway safety enhancements: ". . . Shall not be subject to discovery or admitted into evidence in a federal or state court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data." If anyone attempts to use this data in an action for damages against WSDOT, the State of Washington, or any other jurisdiction involved in the locations mentioned in the data, these entities expressly reserve the right, under Section 409, to object to the use of the data, including any opinions drawn from the data.

[24] Washington State Highway Annual Collision Data Summary, 2006.

The Washington State Collision Data Summary includes various types of collisions. The segment analysis below covers the most prevalent types of collisions. These main collision types are:

- Rear-end collisions (collisions where contact is first made to the back of one vehicle)
- Opposite direction collisions (vehicles collide while headed in opposite directions
- Fixed object (stationary structure or substantial vegetation attached to the terrain)
- "Other" (Other collision types are combined together and displayed as "other" in the discussions below. Other includes pedestrian, pedestrian and bicycle, and various other smaller category of collisions such as vehicles entering the highway at an angle or overturned vehicles.)

It is important to distinguish between collision types and other contributing circumstances to collisions that may also occur. Driver contributing circumstances in collisions can be driver under the influence; driver exceeding a safe speed; driver over the center line; driver did not grant right-of-way to vehicle; driver distraction; driver disregard for stop sign or flashing red signal; or driver apparently asleep.

As a further note, the reader is advised to be aware, throughout the Report, of the distinction between the number of collisions and the number of people injured or who die in the collision; for example, one fatal collision may have three fatalities (i.e., number of deaths).

### Auburn Segment Collision Analysis

The Auburn segment is the segment with the largest number of collisions along SR 164 (57% of all highway collisions). The breakdown of collision types on the Auburn segment is displayed in Exhibit 3.43 on page 3-49. As stated above, most of the collisions are rear-enders. Some contributing factors to the high number of rear end collisions are:

- several traffic signals in this area cause free flow speeds to suddenly stop
- varying speed limits ranging from 35 mph to 45 mph throughout the segment
- a large increase in traffic volume when compared to the southern end of the SR 164 corridor
- several uncontrolled commercial driveways that do not have left turn (or refuge) lanes to accommodate left turning vehicles entering the roadway during congested periods.

SR 164 had a total of 12 pedestrian collisions during the 2002 to 2004 time period. The Auburn segment included 8 of those 12 pedestrian collisions. The collision data shows that four of the pedestrian collisions in the Auburn segment occurred at intersections closer to the SR 18 interchange. The other four collisions occurred at intersections in the Muckleshoot Casino vicinity.

Collisions in the Auburn segment make up 57% of all collisions along the entire SR 164 highway during the study period. The breakdown of collision types on the Auburn segment are displayed in Exhibit 3.43 on the next page. Rear-end collisions not only represent the most frequent collisions in this segment (38.4%), they also accounted for almost a quarter (21.9%) of the total collisions on the SR 164 corridor during the study period.

One contributor to this type of collision is the presence of several uncontrolled driveways. Collisions may occur because turning vehicles leaving and entering the roadway during congested periods do not have left turn (refuge) lanes or right turn pockets to accommodate their maneuver.

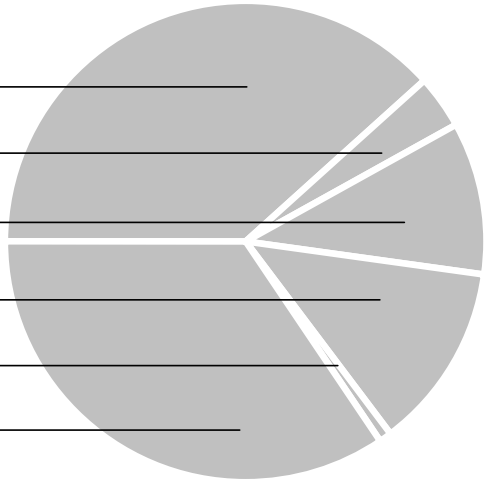
The Auburn segment also experienced a large number of “Other” collisions during the analysis years (161 collisions - 34.5%). See the note above defining “other” collisions at the top of page 3-47.

Exhibit 3.43

## Types of Collisions on SR 164 Auburn Segment[25]

(2002 - 2004)

| | | |
|---|---|---|
| **Rear Ends:** | **179** | **(38.4%)** |
| **Fixed Object:** | **17** | **(3.6%)** |
| **Opposing Direction:** | **47** | **(10.1%)** |
| **Enter at Angle:** | **59** | **(12.7%)** |
| **Overturn:** | **3** | **(0.6%)** |
| **Other*:** | **161** | **(34.5%)** |



Source: WSDOT 2002-2004 Collision Data
* Includes: pedestrian and bicycle collisions
466 total collisions includes: 1 fatality and 25 alcohol-related collisions

### Academy Segment Collision Analysis

Similarly to the Auburn segment, rear-end collisions made up slightly more than half of this segment's collisions during the analysis period - 30 collisions - 51.7% of the segment's 58 total collisions.

One contributor to this type of collision is the presence of several uncontrolled driveways. Collisions may occur when turning vehicles leaving and entering the roadway during congested periods do not have left-turn (refuge) lanes or right-turn pockets to accommodate their maneuver.

[25] Federal law 23 United States Code Section 409 governs use of the data contained in the Exhibit above. Under this law data maintained for purposes of evaluating potential highway safety enhancements: ". . . Shall not be subject to discovery or admitted into evidence in a federal or state court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data." If anyone attempts to use this data in an action for damages against WSDOT, the State of Washington, or any other jurisdiction involved in the locations mentioned in the data, these entities expressly reserve the right, under Section 409, to object to the use of the data, including any opinions drawn from the data.

The representation of collision types on the Academy segment are displayed in Exhibit 3.44 below.

The collision type distribution is rather even in the Academy segment. There was not a single collision type that had a significantly larger occurrence over any other collision type.

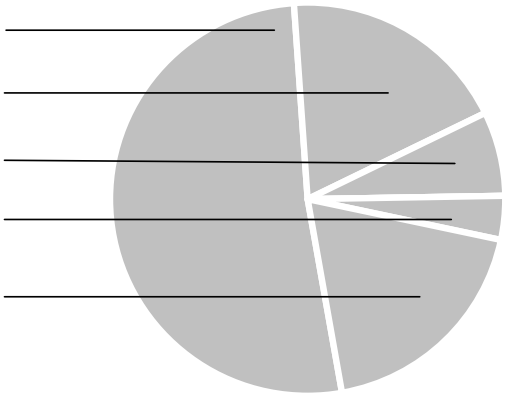
The total collisions in this segment make up 7.1% of the total collisions along the highway. The Academy segment has the second smallest number of collisions per segment along the corridor. One explanation for this statistic is that the Academy segment is the smallest segment by distance but has the second highest vehicle miles traveled.

Exhibit 3.44

**Types of Collisions on SR 164 Academy Segment[26]**

(2002 - 2004)

| | | |
|---|---|---|
| **Rear Ends:** | **30** | **(51.7%)** |
| **Fixed Object:** | **11** | **(19.0%)** |
| **Opposing Direction:** | **4** | **(6.9%)** |
| **Overturn:** | **2** | **(3.4%)** |
| **Other*:** | **11** | **(19.0%)** |
| **Enter at Angle:** | **0** | **(0.0%)** |



Source: WSDOT 2002-2004 Collision Data
* Includes: pedestrian and bicycle collisions
58 total collisions includes: 1 fatality and 4 alcohol-related collisions

[26] Ibid.

### Muckleshoot Segment Collision Analysis

Most of the Muckleshoot segment collisions were either rear ends, fixed object, or "other" collision types. As stated previously, a high number of rear-end collisions can coincide with the presence of uncontrolled access to the highway, traffic congestion, and a lack of turning lanes. The breakdown of collision types on the Muckleshoot segment is displayed in Exhibit 3.45 on the following page.

The total collisions in this segment make up 13.7% of the total collisions along the highway (112 segment collisions). This segment has a higher number of fixed-object collisions than any other segment on the corridor (27 collisions). The fixed-object collisions made up 24.1% of the Muckleshoot segment total collisions.

Also highly represented in this segment of the corridor were:

- **Fixed-object collisions**
  Corridor Total: 78 Segment Total: 27
  Percent of segment collisions: 24.1%
  Percent of fixed-object collisions: 34.6%

- **Disabling-injury collisions**
  Corridor Total: 34 Segment Total: 9
  Percent of segment collisions: 8.0%
  Percent of disabling-injury collisions: 26.5%

- **Alcohol-related collisions**
  Corridor Total: 69 Segment Total: 22
  Percent of segment collisions: 19.6%
  Percent of alcohol-related collisions: 31.9%

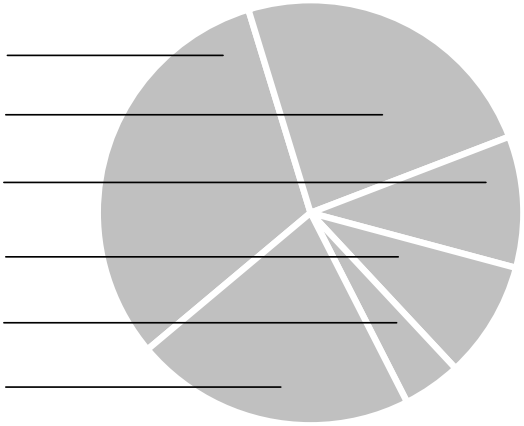
- **Fatal collisions**
  Corridor Total: 5 Segment Total: 3
  Percent of segment collisions: 2.7%
  Percent of fatal collisions: 60.0%

Exhibit 3.45

## Types of Collisions on SR 164 Muckleshoot Segment[27]

(2002 - 2004)

| | | |
|---|---|---|
| **Rear Ends:** | **35** | **(31.3%)** |
| **Fixed Object:** | **27** | **(24.1%)** |
| **Opposing Direction:** | **11** | **(9.8%)** |
| **Enter at Angle:** | **10** | **(8.9%)** |
| **Overturn:** | **5** | **(4.5%)** |
| **Other*:** | **24** | **(21.4%)** |



Source: WSDOT 2002-2004 Collision Data
* Includes: pedestrian and bicycle collisions
112 total collisions includes: 3 fatalities and 22 alcohol-related collisions

### Rural / Agricultural Segment Collision Analysis

The Rural / Agricultural segment had the lowest number of collisions along SR 164 (50 collisions or 6.1% of all highway collisions). The breakdown of collision types on the Rural / Agricultural segment are displayed in Exhibit 3.46 on the next page. Most of the collisions were fixed-object collisions. Some contributing factors to the high number of fixed-object collisions are:

- Signs or objects too close to the roadway
- Driver inattention
- Driver impairment
- Driver asleep at the wheel.

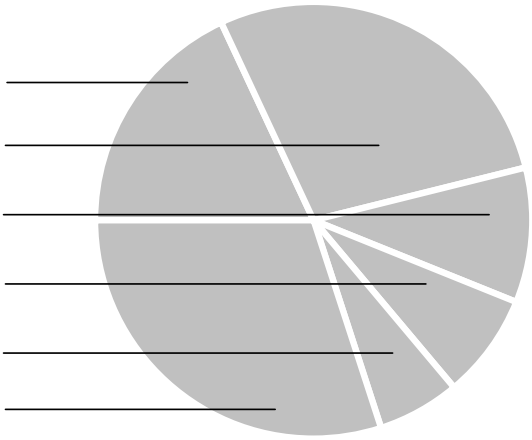
[27] Ibid.

Exhibit 3.46

## Types of Collisions on SR 164 Rural / Agricultural Segment[28]

(2002 - 2004)

| | | |
|---|---|---|
| **Rear Ends:** | **9** | **(18.0%)** |
| **Fixed Object:** | **14** | **(28.0%)** |
| **Opposing Direction:** | **5** | **(10.0%)** |
| **Enter at Angle:** | **4** | **(8.0%)** |
| **Overturn:** | **3** | **(6.0%)** |
| **Other*:** | **15** | **(30.0%)** |



Source: WSDOT 2002-2004 Collision Data
* Includes: pedestrian and bicycle collisions
50 total collisions includes: 0 fatalities and 5 alcohol-related collisions

### Enumclaw Segment Collision Analysis

The majority of the collisions in the Enumclaw segment were rear-end collisions. Contributors to this type of collision can be the presence of uncontrolled driveways into residential or commercial areas. Collisions may occur when left-turning vehicles leaving and entering the roadway during congested periods do not have left-turn (refuge) lanes to accommodate their maneuvers.

The total collisions in this segment make up about 16.0% of the total collisions along the highway. The breakdown of collision types on the Enumclaw segment are displayed in Exhibit 3.47 on the next page.

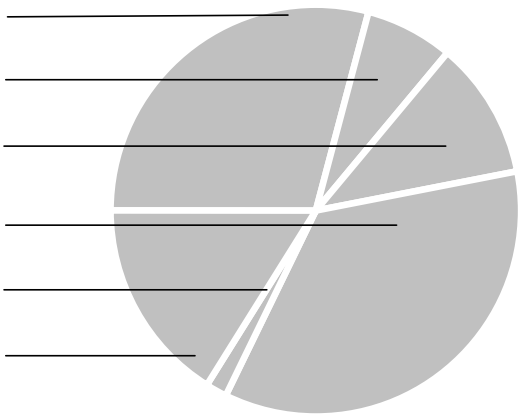
[28] Ibid.

Exhibit 3.47

## Types of Collisions on SR 164 Enumclaw Segment[29]

(2002 - 2004)

| | | |
|---|---|---|
| **Rear Ends:** | **38** | **(29.0%)** |
| **Fixed Object:** | **9** | **(6.9%)** |
| **Opposing Direction:** | **14** | **(10.7%)** |
| **Enter at Angle:** | **46** | **(35.1%)** |
| **Overturn:** | **2** | **(1.5%)** |
| **Other*:** | **22** | **(16.8%)** |



Source: WSDOT 2002-2004 Collision Data
* Includes: pedestrian and bicycle collisions
131 total collisions includes: 5 fatalities and 69 alcohol-related collisions

Exhibit 3.48 below lists the SR 164 collision types by segment in one table.

Exhibit 3.48

## SR 164 Collision Type by Segment

(2002 - 2004)

| Segment | Rear End | Fixed Object | Opposite Direction | Enter at Angle | Overturn | Other* | Total Collisions |
|---|---|---|---|---|---|---|---|
| Auburn | 179 | 17 | 47 | 59 | 3 | 161 | **466** |
| Academy | 30 | 11 | 4 | 0 | 2 | 11 | **58** |
| Muckleshoot | 35 | 27 | 11 | 10 | 5 | 24 | **112** |
| Rural / Agricultural | 9 | 14 | 5 | 4 | 3 | 15 | **50** |
| Enumclaw | 38 | 9 | 14 | 46 | 2 | 22 | **131**** |
| | **291** | **78** | **81** | **119** | **15** | **233** | **817** |

Source: WSDOT 2002 - 2004 Collision Data
* Includes: pedestrian (12) and pedestrian/cycle (6) collisions
** Includes: 5 fatalities and 69 alcohol-related collisions

[29] Ibid.

*Collision Locations*

## 14 Where are many of the collision locations on SR 164?

There are eight SR 164 roadway sections that had a higher number of collisions from 2002-2004 when compared to other similar type highways[22] as shown in Exhibit 3.49 below and Exhibit 3.50 on the next page. Some of these roadway sections overlap and create three long sections of highway (as displayed in the map on Exhibit 3.50) that had a higher than average number of collisions during the study period.

Exhibit 3.49

### SR 164 Collision Locations

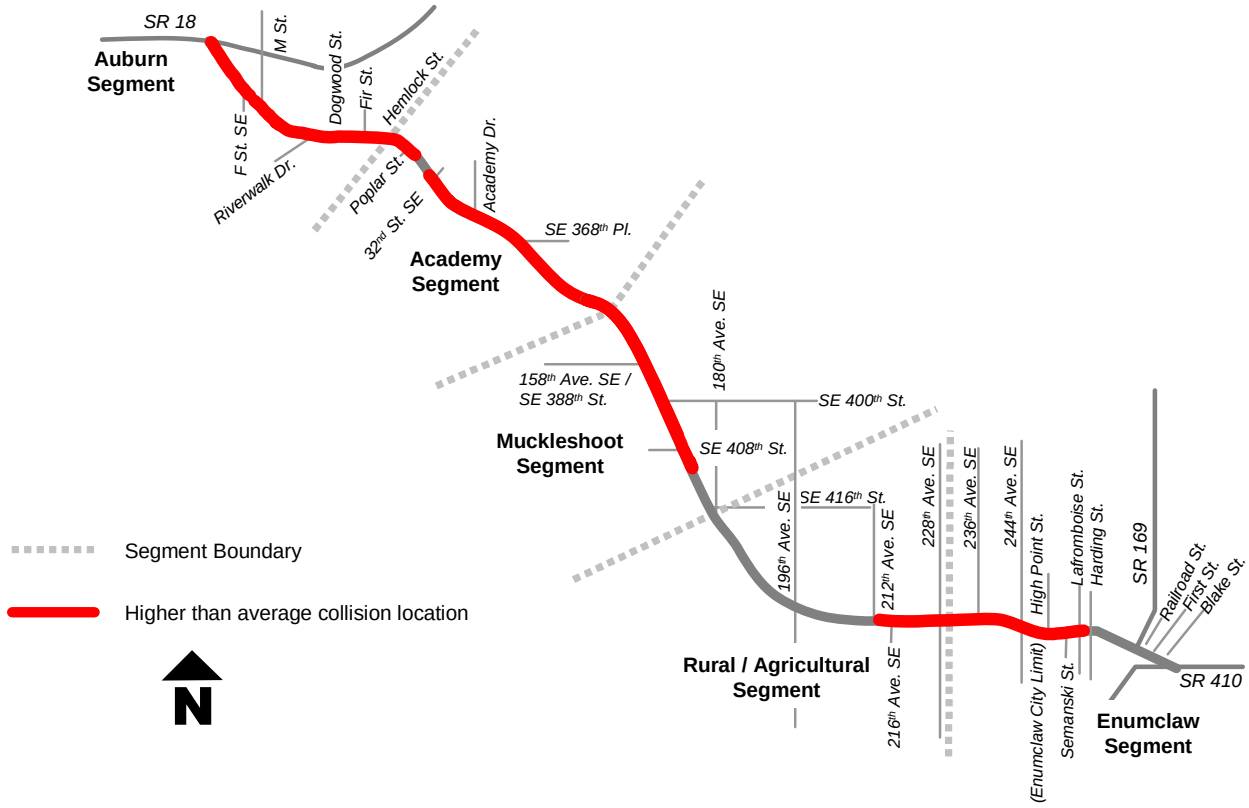
(2002 - 2004)

| Milepost | Approximate Location | Segment | Jurisdiction |
|---|---|---|---|
| 0.32 to 0.72 | SR 18 to East of F Street SE | Auburn | City of Auburn |
| 1.11 to 1.30 | West of M Street SE to East of 17th Street SE | Auburn | City of Auburn |
| 1.31 to 3.30 | East of 17th Street SE to East of Poplar Street SE | Auburn | City of Auburn / Muckleshoot Indian Tribe |
| 1.90 to 2.14 | Riverwalk Drive SE vicinity | Auburn | City of Auburn / Muckleshoot Indian Tribe |
| 2.19 to 2.54 | Dogwood Street vicinity to Hemlock Street | Auburn | City of Auburn / Muckleshoot Indian Tribe |
| 3.81 to 8.30 | 32nd Street SE to East of SE 408th Street (east of the White River Amphitheatre) | Auburn / Academy / Muckleshoot/ | City of Auburn / Muckleshoot Indian Tribe / King County |
| 6.65 to 6.65 | 158th Avenue SE | Muckleshoot | Muckleshoot Indian Tribe |
| 11.31 to 14.30 | West of 216th Avenue SE to East of Lafromboise Street | Rural / Agricultural / Enumclaw | King County / City of Enumclaw |

Information Source for Exhibit: 2004 WSDOT Collision Analysis.
See SR 164 Recommended projects (Chapter 5 of this CPS) for proposed improvements to these issues areas.
Recommendations are also available on the WSDOT SR 164 web page: http://www.wsdot.wa.gov/Projects/SR164/RDP/

Exhibit 3.50

## SR 164 Collision Locations




Federal law 23 United States Code Section 409 governs use of the data contained in the Exhibit above. Under this law data maintained for purposes of evaluating potential highway safety enhancements: ". . . Shall not be subject to discovery or admitted into evidence in a federal or state court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data." If anyone attempts to use this data in an action for damages against WSDOT, the State of Washington, or any other jurisdiction involved in the locations mentioned in the data, these entities expressly reserve the right, under Section 409, to object to the use of the data, including any opinions drawn from the data

## 15 Where are the recent pedestrian or bicycle collision locations on SR 164?

There were two locations on SR 164 that had a higher than average number of pedestrian collisions from 2002 to 2004 when compared to other similar type highways.[23] Those locations were:

- Auburn Segment
  SR 164 & 6th Street SE in Auburn
  (SR 164 & SR 18 access ramps)

- Auburn Segment
  SR 164 & Riverwalk Drive in Auburn at the Muckleshoot Casino.

There were a total of 12 pedestrian collisions along the corridor with the most (8 collisions) occurring in the Auburn segment. The 12 collisions represented about 1.5% of the total collisions along SR 164 during the study period. There were another 7 collisions which involved a pedestrian or a bicyclist (3 each in the urban segments of Auburn and Enumclaw).

The bicycle and pedestrian collisions occurred on or near the locations shown in Exhibit 3.51 on the following page.

Exhibit 3.51

## SR 164 Recent Pedestrian & Bicycle Collision Locations

| Milepost | Approximate Location | Segment | Bicyclist / Pedestrian Collision |
|---|---|---|---|
| 0.38 | 6th Street SE Ramps to SR 18 | Auburn | 2 Pedestrian<br>1 Bicyclist |
| 0.91 | 12th Street SE | Auburn | Pedestrian |
| 1.23 | 17th Street SE | Auburn | 1 Pedestrian<br>1 Bicyclist |
| 1.89 | West of Muckleshoot Plaza | Auburn | Pedestrian |
| 2.03 | West of Riverwalk Drive SE | Auburn | Pedestrian |
| 2.07 | Riverwalk Drive SE | Auburn | Bicyclist |
| 2.28 | Dogwood Street SE | Auburn | Pedestrian |
| 2.36 | West of Fir Street SE | Auburn | Pedestrian |
| 2.41 | Fir Street SE | Auburn | Bicyclist |
| 5.07 | East of SE 368th Place | Muckleshoot | Pedestrian |
| 6.65 | 158th Avenue SE | Muckleshoot | Pedestrian |
| 6.92 | SE 392nd Street | Muckleshoot | Pedestrian |
| 14.25 | Lafromboise Street | Enumclaw | Bicyclist |
| 14.52 | SR 164 / SR 169 Intersection | Enumclaw | Pedestrian |
| 14.68 | Railroad Street | Enumclaw | Bicyclist |
| 14.75 | First Street | Enumclaw | Bicyclist |

Information Source for Exhibit: 2004 WSDOT Collision Analysis.

See SR 164 Recommended projects (Chapter 5 of this CPS) for proposed improvements to these issues areas. Recommendations are also available on the WSDOT SR 164 web page: http://www.wsdot.wa.gov/Projects/SR164/RDP/

An updated collision summary for the five corridor segments for the years 2005 through 2007 is included in Appendix F.

## 16 Where are the safety and mobility issue locations on SR 164?

Based on the data described in this chapter, the following areas discussed in Exhibit 3.52 on the next page are known or are predicted to have mobility problems and safety issues on SR 164.

Exhibit 3.52

## SR 164 Mobility and Safety Problems by Segment[30]

| Segment | Problem Statement |
|---|---|
| **Auburn** | **Safety:**<br>- Narrow shoulders create the potential for conflicts between moving vehicles and cars parked on the shoulder.<br>- Vehicles stopping to make left turns at points on the highway without left turn lanes can create safety concerns.<br>- There is insufficient street lighting and poor visibility along this portion of the highway.<br>- Unmarked crosswalks, children walking to and from the school bus, and narrow shoulders also create vehicle / pedestrian safety concerns. |
| | **Congestion:**<br>- Heavy peak commute period traffic delay. Additional delay results when vehicles stop to make left turns at points on the highway without left turn lanes. |
| **Academy** | **Safety:**<br>- School buses making frequent stops to pick up and drop off school children create vehicle backup and delay.<br>- Unmarked crosswalks and children walking to and from the school bus also create vehicle / pedestrian safety issues.<br>- Vehicles stopping to make left turns at points on the highway without left turn lanes can create safety concerns.<br>- There is insufficient street lighting and poor visibility along this portion of the highway. |
| | **Congestion:**<br>- Vehicles stopping to make left turns at point on the highway without left turn lanes create traffic backups and vehicle delays. |
| **Muckleshoot** | **Safety:**<br>- Unmarked crosswalks and children walking to/from the school bus also create vehicle/ pedestrian safety concerns.<br>- Tight roadway curves, awkward angled intersections, and roadside vegetation can create safety concerns.<br>- Vehicles stopping to make left turns at points on the highway without left turn lanes can create safety concerns.<br>- There is insufficient street lighting and poor visibility along this segment. |
| **Rural / Agricultural** | **Safety:**<br>- Unmarked crosswalks and children walking to and from the school bus also create vehicle / pedestrian safety concerns.<br>- Vehicles stopping to make left turns at points on the highway without left turn lanes can create safety concerns.<br>- There is insufficient street lighting and poor visibility along this segment. |
| **Enumclaw** | **Safety:**<br>- There are some awkward angled intersections that can create safety concerns for vehicles entering and exiting the highway.<br>- There is insufficient street lighting and poor visibility along this segment.<br>- Unmarked crosswalks and children walking to and from the school bus also create vehicle / pedestrian safety concerns. |
| | **Congestion:**<br>- During peak hour travel there is frequent truck traffic on this segment. |

[30] Ibid.