Chapter 3. Alternatives

This chapter describes how the project alternatives were identified and evaluated, what conclusions were reached regarding their feasibility, and the basis for the selection of the Bigelow Gulch Road/Forker Road Urban Connector—Havana Street to Sullivan Road (Urban Connector Alignment) as the preferred alternative. The information in this chapter was derived from the January 2006 Environmental Assessment (EA), and from additional engineering analysis.

A large portion of the comments received on the January 2006 EA related to project alternatives and the process for evaluating those alternatives (see Appendix 3, Comments and Responses to January 2006 EA). Many of these comments reflected the opinion that the January 2006 EA did not include a complete analysis of alternatives, particularly the two-lane alternative, and that additional information regarding the screening of alternatives was needed. Some respondents suggested that a two-lane alternative with curve improvements should have been evaluated in the January 2006 EA.

This chapter responds to these comments by providing additional information about the alternatives, the feasibility analysis of a two-lane roadway, and the methods applied in selecting the Urban Connector Alignment.

Two project alternatives are evaluated in this Revised EA:

- The Urban Connector Alignment (proposed action) would consist of widening approximately 5.80 miles of existing Bigelow Gulch Road and Forker Road and constructing 2.46 miles of new roadway at the west and east ends of the alignment. The Urban Connector Alignment would begin just west of the Havana Street/Bigelow Gulch Road intersection and terminate at the Sullivan Road/Wellesley Avenue intersection in the City of Spokane Valley. This
proposed alignment has been modified since the January 2006 EA, as indicated in Chapter 2, *Project Description*.

- Under the No Action alternative, no major transportation improvements would be constructed in the project area, but regular ongoing maintenance activities would be continued.

### 3.1. How were the alternatives developed and analyzed?

As mentioned in Chapter 2 of this Revised EA, the 1998 study titled *Connecting our Community—A Regional Study of Urban Connectors* (Spokane County 1998a), identified Bigelow Gulch Road/Forker Road corridor as one of several existing roadways in Spokane County needing transportation improvements because of increasing traffic congestion, high collision rates, and need for improved freight mobility. Using this guidance, Spokane County developed a project purpose and need (Chapter 2). The process of identifying and analyzing alternatives included the following stages:

- identification and screening of alternatives,
- second-level screening of alternatives,
- analysis of roadway geometry and lanes, and
- analysis of alternatives in the January 2006 EA.

These stages are described in the following sections.

#### 3.1.1. Alternatives Screening

As a part of the public scoping meeting held at the Central Grange on February 2, 2000, Spokane County presented the project as a four-lane roadway with four alternative alignments at its west end (see Chapter 1 for discussion of public involvement). The alternatives were identified as A, B, C, and D. The focus was on establishing alternative routes (from Havana Street to the eastern segment of Weile Avenue), grades no-greater-than 6% and improving, driver sight-distance. These alternatives are shown in Figure 3-1, and the description follows.
Figure 3-1
Initial Bigelow Gulch Road
Alignment Alternatives

- **Alternative A**: Havana Street Cross County to eastern segment of Wiele Rd.
- **Alternative B**: Follows Existing Bigelow Rd alignment
- **Alternative C**: Havana St Cross Country via Lyons Rd
- **Alternative D**: Existing Bigelow Rd to Weille Rd (preferred action)
- **Alternative A.** From Havana Street through open space to the eastern segment of Weile Avenue.
- **Alternative B.** Following the existing alignment of Bigelow Gulch Road with minor modifications to flatten some of the more substantial horizontal and vertical curves.
- **Alternative C.** From Havana Street crossing open space and via Lyons Road.
- **Alternative D.** Following the existing Bigelow Gulch Road to the eastern segment of Weile Avenue.

As a result of public input and additional engineering analysis, Alternatives A, C, and D were carried forward for further analysis.

Alternative B, following the existing alignment of Bigelow Gulch Road, was dropped from further consideration for engineering reasons, including existing substandard curves and safety issues at the intersection with Palmer Road.

### 3.1.2. Second-Level Screening

In addition to eliminating one alternative (Alternative B), the alternatives analysis was expanded to include a series of east and west alternatives, some of which included new alignments in new rights-of-way (ROW). These alternatives were briefly described in Section 3.4 of the January 2006 EA, and are shown here in Figure 3-2.
Figure 3-2
Western and Eastern Alignment Alternatives

Legend
- Alternative WA
- Alternative WB
- Alternative WC
- Alternative WD
- Alternative EC
- Alternative EA
- Alternative EB
- Route Common to Alternatives WA-WD

Map Date: 02/26/2007
A total of eight alignment alternatives were identified, including five western alignments from Havana Street to Argonne Road: WA, WB, WC, WD, and WE; and three eastern alignments from Argonne Road to Wellesley Avenue: EA, EB, and EC.

All eight alignment alternatives were rejected based on the engineering, cost, and environmental factors presented in Table 3-1.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Engineering Factors</th>
<th>Environmental Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>WA</td>
<td>Right-of-way acquisition cost for 44 acres.</td>
<td>Loss or conversion of 66 acres of forest, farmland, and developed land; impacts on central part of Orchard Prairie community.</td>
</tr>
<tr>
<td>WB</td>
<td>Substandard curvature and sight distance; access safety issue at Palmer Road; substandard curvature or sight distance.</td>
<td>Loss or conversion of 52 acres of forest, farmland, and developed land; impacts on central part of Orchard Prairie community.</td>
</tr>
<tr>
<td>WC</td>
<td>Large amount of earthwork required to achieve 6% grade.</td>
<td>Loss or conversion of 73 acres of forest, farmland, and developed land.</td>
</tr>
<tr>
<td>WD</td>
<td>Large amount of earthwork required to achieve 6% grade.</td>
<td>Loss or conversion of 68 acres of forest, farmland, and developed land.</td>
</tr>
<tr>
<td>WE</td>
<td>Bridge structure and full interchange required to cross and access Argonne Road; could not connect to Forker Road due to steep terrain; substandard curvature or sight distance.</td>
<td>Loss or conversion of 73 acres of forest, farmland, and developed land.</td>
</tr>
<tr>
<td>EA</td>
<td>Bridge structure and full interchange required to cross and access Argonne Road; could not connect to Forker Road due to steep terrain; substandard curvature or sight distance.</td>
<td>Loss or conversion of 105 acres of forest, farmland, and developed land.</td>
</tr>
<tr>
<td>EB</td>
<td>Bridge structure and full interchange required to cross and access Argonne Road; could not connect to Forker Road due to steep terrain; substandard curvature or sight distance.</td>
<td>Loss or conversion of 115 acres of forest, farmland, and developed land.</td>
</tr>
<tr>
<td>EC</td>
<td>Bridge structure and full interchange required to cross and access Argonne Road; could not connect to Forker Road due to steep terrain; substandard curvature or sight distance.</td>
<td>Loss or conversion of 109 acres of forest, farmland, and developed land.</td>
</tr>
</tbody>
</table>

As a result of the analysis, five of the alternatives (WB, WE, EA, EB, and EC) were rejected because they could not meet the project purpose and need. The reasons they did not meet purpose and need were due to substandard curvature or sight distance, which affected the ability to meet the safety element of purpose and need, or because they incurred engineering difficulty or complexity and cost associated with bridge or interchange construction (at Argonne Road and Forker Road).

One of the primary reasons for roadway standards is to ensure safety. Alternative WA was dropped because of the potential effects on the central part of the Orchard Prairie community, and the environmental impacts of constructing an alignment with no existing roadway along much of its route (Figure 3-2).

Alternatives WC and WD were dropped because of the large amounts of earthwork
necessary to achieve the less than 6% grade and the impacts of constructing an alignment with no existing roadway along much of their routes (Figure 3-2).

In sum, the screening analysis concluded that the above alternatives were rejected due to:

- substandard curvature or sight distance (i.e., safety element of the purpose and need for the project could not be achieved);
- significant loss or conversion of forest and farmland because the alternatives would cross undeveloped land; and
- high engineering costs associated with right-of-way acquisition and construction of bridges and interchanges at Argonne Road and Forker Road.

### 3.1.3. What options were analyzed in the January 2006 EA?

The January 2006 EA included an analysis of a four-lane roadway (an urban connector) with three western alignment options (Options 1, 2, and 3), and No Action. Figure 3-3 shows the three western alignment options. As previously mentioned, these options were three of the four Initial Alternatives (Alternatives A, C, and D became known as Options 2, 3, and 1 respectively in the January 2006 EA) presented to the public during scoping in 2000.

All three alternatives were determined to generally meet the purpose and need for the project (i.e., improve local traveler safety, traffic flow, traffic volumes, and traffic congestion).

The environmental impacts of Options 1, 2, and 3 were assessed in the January 2006 EA. In terms of natural resources, impacts on wetlands, forest (white-tailed deer wintering habitat), and Urban Natural Open Space were all identified as priority habitats of Spokane County (Spokane County Code [SCC] 11.20.060 – Fish, Wildlife Habitat, and Species Conservation Areas). The comparative impacts are summarized below.

- Options 2 and 3 would have slightly more surface water impacts than Option 1;
- Option 1 would have fewer soil and geology impacts than Options 2 and 3 since it would follow existing roadway for much of its length; and
- Option 1 would have significantly fewer visual and vegetation/wildlife impacts than Options 2 and 3 since it would cross less undisturbed habitat.

When considering the combined impacts on natural resources in the project area (surface water, floodplains, forest, Urban Natural Open Space, and white-tailed deer wintering habitat), Option 1, in conjunction with the improvements along the Bigelow Gulch Road and Forker Road right-of-way, would have fewer impacts on natural resources than would Options 2 and 3.
Figure 3-3
Western Alignment Options
Evaluated in the January 2006 EA
Similarly, comparisons of impacts on many of the factors associated with the human environment (air quality, cultural resources, noise, and visual resources) also indicate that Option 1, by using of the existing-right of-way, would have the least overall impact of the three options.

Option 1 would require less new roadway construction and would therefore have fewer impacts on forest (i.e., deer winter range) and farmland, and would require less right-of-way acquisition. Under option 1, 29% (11,752 feet) of the total alignment would involve construction through previously undeveloped alignment, as compared to 38% (15,160 feet) under Option 2 and 38% (15,286 feet) under Option 3.

Section 4(f)
Section 4(f) of the U.S. Department of Transportation Act of 1966 (U.S. Code 303) was found to apply to this project due to the presence of eligible historic properties and recreational resources in the project area. Section 4(f) declares that a special effort be made to public park and recreation lands, wildlife and waterfowl refuges, and historic sites. The use of these sites for a transportation project will be approved only if it is determined that there is no other prudent or feasible alternative.

A two-step Section 4(f) process was conducted for the Bigelow Gulch project. An initial analysis determined that a portion of the historic farmstead on Bigelow Gulch Road and recreational sports fields at the East Valley Middle School would be used by the project as proposed. As a result, Spokane County modified a 0.14-mile section of the right-of-way from west of Jensen Road to just east of Old Argonne Road to avoid the historic farmstead. The right-of-way in that section of the proposed roadway was reduced from 120 feet in width to 80 feet and shifted slightly south to avoid any use of the farmstead property. The width reduction was accompanied by a speed limit reduction from 45 to 35 mph in that section. These changes were incorporated into the proposed action (see description of the Urban Connector Alignment in Section 2.3).

Chapter 5 of this Revised EA includes the identification, evaluation, and comparison of alternatives to avoid or minimize use of the 4(f) properties (i.e., recreational sports fields at the East Valley Middle School). The evaluation concluded that use of the recreational fields could not be avoided. Planning was carried out that identified measures to minimize harm to the resources through a land exchange between Spokane County and the East Valley School District and replacement of the recreational fields.
3.2. How did the engineering analysis determine the number of lanes?

A key task in developing the alternatives was designing a roadway that would best meet the project purpose and need and the future transportation requirements for the Bigelow Gulch/Forker corridor. The roadway also had to be feasible from an engineering perspective. These questions were addressed in an engineering study of the roadway geometry, conducted by Spokane County, which was presented in Appendix B of the January 2006 EA.

In addition, the Washington State Department of Transportation (WSDOT) requested an analysis, by roadway segment, of the number of through lanes designed for each segment of the project corridor. This analysis used a required traffic model developed by the Spokane Regional Transportation Council to forecast traffic volumes. Other design and safety considerations were included in the analysis.

This section presents a summary of the analysis criteria and conclusions of the roadway geometry report; and specifically, the determination of lane requirements to meet safety standards and projected future traffic volumes.

3.2.1. Analysis Criteria

The analysis of the alternatives focused on four primary elements:

- operation analysis,
- safety assessment,
- auxiliary truck lane assessment, and
- route continuity.

These elements are described as follows.

Operation Analysis

Level of Service (LOS) is typically used to measure the operating quality of a roadway segment or intersection. The quality of traffic conditions is graded into one of six LOS designations, which range from A through F. LOS A and B represent the fewest traffic slow-downs, and LOS C and D represent intermediate traffic congestion. LOS E indicates that traffic conditions are at or approaching urban congestion conditions and LOS F indicates a high level of congestion and unstable traffic flow. For this analysis, a standard of LOS C was defined for Bigelow Gulch Road roadway segments, based on guidelines set forth by the American Association of State Highway Transportation Officials (AASHTO) (2001) and WSDOT (2007b) for a collector roadway. Spokane County Standards for Road and Sewer Construction (Spokane County 2006e) references AASHTO for all design elements.
Alternatives

for county roads not shown in the standards. LOS for roadway segments are not included in the standards; therefore AASHTO LOS criteria would govern LOS on County roads. Assessment methods were also derived from the *Highway Capacity Manual* (Transportation Research Board 2000a) and the *Washington State Department of Transportation Design Manual* (WSDOT 2007a).

**Conclusions for Operation Analysis**

Under the current two-lane, two-way configuration, all roadway segments of Bigelow Gulch corridor are now functioning at LOS D or E, both of which fail to meet the standard of LOS C (Appendix B of January 2006 EA).

It was determined that improvements made to increase passing sight distance, to widen lanes, and to widen shoulders would not be enough to offset the effects of the increase in traffic projected for 2025. Based on projected 2025 traffic volumes, a two-lane Bigelow Gulch Road would operate at LOS E, which does not meet the standard of LOS C established for this roadway.

LOS was calculated under the scenario of reconstructing Bigelow Gulch Road as a two-way, four-lane roadway. The analysis indicates that a multilane roadway would allow Bigelow Gulch Road to operate at an acceptable LOS to the 2025 design year and beyond.

Note that a large gap exists between the capacity of a two-lane roadway, which produces an unacceptable LOS, and the capacity of a four-lane roadway. For example, the capacity of a multilane highway in rolling terrain is 1,250 vehicles per hour (vph) per lane, or 2,500 vph for two lanes going in one direction, compared to a two-lane highway in rolling terrain with a capacity of 950 vph for one lane going in one direction.

The analysis concluded that LOS C on Bigelow Gulch Road would be achieved by constructing a multilane facility (four lanes).

**Safety Assessment**

Safety considerations such as roadside safety, sight distance, and barrier design would be part of the project regardless of the number of lanes or the inclusion of a median or two-way left turn lane. Additional analysis focused on whether or not separating the two directions of traffic, through provision of a median or a two-way left-turn lane, would provide additional significant safety benefit. The safety assessment determined that separating traffic could save an average of $1.5 million per year in societal costs of collisions. Additionally, the benefits of separating traffic far outweigh the costs of implementing and maintaining a median or two-way left-turn lane.
Auxiliary Truck Lane Assessment

Auxiliary lanes for heavy vehicles were investigated due to the steep grades on Bigelow Gulch Road and Forker Road and the anticipated use of the roadway by trucks.

Climbing Lanes

A climbing lane is an additional lane provided to permit the passing of slow-moving traffic in the uphill direction. AASHTO presents four criteria for the justification of climbing lanes:

- upgrade traffic volume exceeds 200 vph;
- upgrade truck volume exceeds 20 vph;
- either the gradient causes a speed reduction of at least 10 miles per hour (mph), or the roadway is operating at LOS E or F; and
- LOS designation decreases by two levels when moving from the approach segment to the climbing grade (AASHTO 2001).

The first two criteria are met for all segments of the Bigelow Gulch /Forker corridor. Projected vehicular and truck traffic exceeds the justification criteria. The LOS was analyzed for all upgrades on Bigelow Gulch Road and the results are presented in Appendix B of the January 2006 EA.

Crawl (Downgrade) Lanes

The criteria for justifying for a crawl lane on a downgrade are similar to those applied to the climbing lane analysis (AASHTO 2001).

The Highway Capacity Manual (Transportation Research Board 2000a) states that any grade greater than 3% and longer than 0.6 mile must be analyzed as a specific downgrade. Some specific downgrades are long and steep enough that some heavy vehicles must travel at crawl speeds to avoid loss of control. This in turn impedes other vehicles, increases percent time spent following, and decreases average travel speed.

Commercial vehicle drivers are trained to slow down below the speed of other traffic in order to maintain an appropriate speed on a downgrade. Additionally, commercial drivers are trained to use lower gears on downgrades, which lower the travel speed of the heavy vehicle. Two factors that are important in evaluating specific downgrades are the proportion of heavy vehicles and the proportion of heavy vehicles that are tractor-trailer combinations. The proportion of each type of heavy vehicle is used in the calculations to determine the LOS on the downgrade. Without crawl lanes, as heavy vehicles slow down for the downgrade, lighter vehicles platoon behind these heavy vehicles. The passing opportunities are limited due to the substantial opposing traffic volumes and the geometry of the horizontal and vertical alignments that limit
sight distance. Considering these factors, significant lengths of Bigelow Gulch Road would require additional lanes in both the uphill and downhill directions.

**Route Continuity**

Analysis shows that climbing and/or crawl lanes are required through approximately 4.5 miles of the 8.26-mile Bigelow Gulch/Forker corridor. Transitioning back and forth between four-lane and two-lane roadways violates driver expectancy and creates roadway inconsistencies (Wilson 2000). The following is an excerpt from the WSDOT Design Manual that supports route continuity:

> Keep the basic number of lanes constant over a highway route, or a significant portion thereof, regardless of changes in traffic volume. (Note: See Chapter 440 of the Design Manual for the minimum number of lanes for each functional class of highway). Change the basic number of lanes only for general changes in traffic volume over a substantial length of the route. The recommended location for a reduction in the basic number of lanes is on a tangent section between interchanges or intersections. To accommodate high traffic volumes for short distances, such as between adjacent interchanges, use auxiliary lanes. When consecutive sections between interchanges require auxiliary lanes, consider increasing the basic number of lanes through the entire length (WSDOT 2007a).

Once it was established that four lanes are justified for many segments of the roadway, it was determined that four lanes should be consistently implemented throughout the Bigelow Gulch/Forker corridor, to ensure route continuity and safety.

### 3.2.2. Roadway Geometry Options

Prior to development of this Revised EA, an analysis of roadway options was conducted to identify the option that would best meet future design needs for the Bigelow Gulch/Forker corridor, based on the criteria previously described. These options are summarized below.

**Summary of Capacity Analysis**

**Two-Lane Two-Way Roadway**

Bigelow Gulch Road is currently configured as a two-lane, two-way roadway, and under future conditions is considered the No Action Alternative. This option was rejected for the following reasons:

- It fails segment and intersection LOS.
- It delays traffic on upgrades due to the absence of climbing lanes for heavy vehicles and delays traffic on downgrades due to the absence of crawl lanes for heavy vehicles.

- Reconstruction of Bigelow Gulch Road as a two-lane two-way roadway would fail to address safety deficiencies and therefore purpose and need.

**Super-Two Roadway**

A super-two roadway incorporates extra wide lanes, wide shoulders, and 100% passing zones. Super-two roadways are generally feasible only in level or gently rolling terrain (Institute of Transportation Engineers 2003a). This option was rejected for the following reason:

- The steep grades and curvature of the Bigelow Gulch/Forker corridor would not allow the ability to achieve 100% passing zones that is a requirement for the use of this design.

**Two-Lane Two-Way Roadway with Passing Lanes**

The projected 2025 traffic volumes justify passing lanes for all segments of Bigelow Gulch Road in both directions (WSDOT 2007a). However, passing lanes are intended for long stretches of two-lane roadways with minimal passing opportunities. For example, research has recommended a passing lane length of 1.5 to 2 miles and spacing such lanes at 3.5 to 4 miles apart (Texas Transportation Institute 2002). Passing lanes are preferably implemented in four-lane sections (WSDOT 2007a). Transitioning back and forth between two-lane and four-lane facilities causes route continuity problems. If passing lanes were to be used in both directions, a median should be considered on roadways carrying 500 or more vph (all segments of Bigelow Gulch exceed 500 vph in the peak hour), particularly if the roadway is ultimately to be converted to four-lane divided cross section (AASHTO 2001). This option was rejected for the following reasons:

- All segments for both directions justify passing lanes.

- Adding passing lanes does not allow for the separation of traffic with a median, which is an important safety benefit.

- Reconstruction of portions Bigelow Gulch Road as a two-lane roadway would fail to address safety deficiencies and therefore purpose and need.

- Segments that were not built with passing lanes would not meet LOS standards.

- Transitioning back and forth between two-lane and three-lane facilities creates driver expectation and route continuity problems (see route continuity discussion above).
Two-Lane Two-Way Roadway with Climbing Lanes
Climbing lanes reduce the delay to standard vehicles on upgrades. Large trucks slow down to climb upgrades; climb lanes provide an opportunity to pass the slower moving vehicle. This configuration would construct climbing lanes (three-lane roadway) on the segments with upgrades and two-lane two-way roadway for the remaining segments. A total of 4.5 miles of the 8.26-mile corridor met requirements for climbing lanes. This option was rejected for the following reasons:

- Transitioning back and forth between two-lane and three-lane facilities creates driver expectation and route continuity problems (see route continuity discussion above).
- This configuration does not address the LOS and safety deficiencies on the two-lane, two-way segments without climbing lanes.
- Adding crawl lanes does not allow for the separation of traffic with a median, which is an important safety benefit.
- LOS calculations for upgrades with climbing lanes did not result in an acceptable improvement in LOS, as the LOS designations for the climbing lanes were E and F.

Two-Lane Two-Way Roadway with Climbing Lanes and Crawl Lanes
Crawl lanes reduce the delay to non-heavy vehicles on downgrades. Heavy truck drivers are trained to use lower gears on downgrades. Lower gears lower the speed of the vehicle. Crawl lanes provide an opportunity to pass the slower moving vehicle. This configuration would construct climbing lanes and crawl lanes (four-lane roadway) on the segments with upgrades/downgrades and two-lane two-way roadway for the remaining segments. A total of 2 miles of the 8.26-mile corridor met requirements for crawl lanes and 4.5 miles for climbing lanes (see above). One additional mile of the corridor could not be analyzed due to proximity to the Argonne Road/ Bigelow Gulch Road signalized intersection. This option was rejected for the following reasons:

- This configuration does not address the LOS and safety deficiencies on the two-lane, two-way segments without climbing and crawl lanes.
- As previously stated, transitioning back and forth between a two-lane and four-lane facilities creates driver expectation and route continuity problems.

Four-Lane Roadway Segments Where Capacity Issues Are Identified, Two-Lane Remainder
A configuration of building four-lane segments to address capacity issues, with two lanes for the remainder of the Bigelow Gulch/Forker corridor was rejected for the following reasons:
Projected traffic volumes (projected VISUM 2025) indicate unsatisfactory LOS designations on the segments analyzed as two-lane roadways.

Such a configuration would not fully address safety since transitioning back and forth between two- and four-lane facilities creates driver expectation and route continuity problems.

**Four-Lane Undivided Roadway for Whole Corridor**

A four-lane undivided roadway configuration would also not fully address safety if traffic separation measures are not implemented. Additionally, the LOS analysis was based on a divided four-lane facility. An undivided facility has lower per-lane vehicle capacity than a divided facility. Thus, LOS for the undivided roadway could potentially be lower than LOS calculated for the divided roadway.

**Four-Lane Roadway Divided for Whole Corridor**

This facility configuration meets the project purpose and need with respect to safety and LOS objectives. This configuration provides clearer driver expectations and route continuity, and safety is greatly improved by a reduced collision rate. It is typical in modern practice to design multilane roadways in rural areas as divided facilities.

3.2.3. **Conclusion of Engineering Analysis**

The engineering analysis concluded that the preferred configuration for the Bigelow Gulch/Forker corridor would be a four-lane divided roadway. This configuration most effectively addresses the issues of operations (LOS), safety, and need for auxiliary truck lanes route continuity (i.e., driver expectation). Therefore, the four-lane divided roadway was defined as the recommended configuration (i.e., preferred alternative).

3.3. **How does the preferred alternative meet the project requirements?**

The previous section reviewed the analysis that resulted in the determination of a four-lane divided facility for the whole corridor as the preferred alternative. This section provides a more detailed analysis of elements specific to the preferred alternative.

3.3.1. **Operation (LOS) Analysis and Auxiliary Truck Lane Assessment**

This analysis includes a combined discussion of the operation (LOS) and auxiliary truck lane assessment criteria presented previously in Section 3.2.
Corridorwide

Under the current two-lane roadway, the projected traffic volumes would result in an unacceptable segment LOS for the 2025 design year. Transportation planning criteria indicate that when the design hourly volumes exceed 900, a multilane roadway should be considered. Projected design hourly volumes for the Bigelow Gulch/Forker corridor range from 1,250 to 2,120, far exceeding the threshold for multilane consideration.

By Segment

**Havana Street to the Urban Boundary.** This segment fails the LOS standard for two lanes, and projected traffic volumes indicate that capacity is deficient. The LOS, number of lanes and capacity deficiency apply to the total segment from Havana Street to Argonne Road.

**Urban Boundary to Thierman Road.** The criteria for climbing and crawl lanes are met in this segment.

**Thierman Road to Jensen Road.** The vertical alignment of this segment does not allow eastbound heavy vehicles to accelerate to an acceptable operating speed (34 mph). Therefore, the climbing lane criteria are satisfied for the segment from Palmer to Jensen.

**Jensen Road to Argonne Road.** Due to the signal at Argonne/Bigelow Gulch, westbound heavy vehicles can only achieve 23 mph before entering the 5% grade. The 5% grade is approximately 1,900 feet in length. This is above the minimum design criterion of 1,000 feet. Therefore, climbing lanes are justified for this segment. There is inadequate distance to transition from a two lanes to one lane eastbound before reaching the signal at the intersection of Argonne Road and Bigelow Gulch Road.

**Argonne Road to Lehman Road.** Eastbound heavy vehicles can only achieve 27 mph before entering the 5.35% grade. The 5.35% grade is approximately 3,900 feet in length, and therefore, above the minimum design criterion of 1,000 feet. Therefore, climbing lanes are justified for this segment. This segment fails the LOS standard for two-lane roadways. The LOS standard applies to the total segment from Argonne Road to Forker Road.

**Lehman Road to Forker Road.** The climbing lane justification ends near the intersection with Lehman Road. This segment fails the LOS standard for two-lane roadways. The capacity of a two-lane, two-way roadway may be adequate for the existing traffic volumes; however this segment shows the most projected traffic growth. Rebuilding the roadway as a two-lane two-way roadway would not provide enough future capacity and would have the appearance of forcing traffic through the segment, thus disrupting route continuity. The passing lane analysis completed for
this segment determined that a passing lane would not improve LOS to the required standard of LOS C. The analysis was completed for both eastbound and westbound directions. Both meet the criteria for passing lanes, therefore making this segment a four-lane roadway.

**Forker Road to the Urban Boundary.** This segment fails the LOS standard for a two-lane roadway from Forker Road to Wellesley Avenue. Both climbing and crawl lanes showed are justified in this segment. This is further supported by the projected LOS F designation for the upward grade portion of this segment.

**Urban Boundary to Wellesley Avenue.** This segment fails the LOS standard for a two-lane roadway. This segment is in the urban boundary, therefore; it will be designed to principal urban arterial standards. The LOS C service flow rate for a one-lane urban roadway is 480 vph; the directional design hour volume is 1,020 vph. Therefore, two lanes will be required each direction.

### 3.3.2. **Safety Assessment**

A four-lane divided roadway is considered the safest of the alternatives. Spokane County believes this preferred alternative would incorporate the maximum safety into the roadway, thus fulfilling the safety mandate by the U.S. Congress (AASHTO 2001). Following is a summary of the safety benefits of the preferred alternative:

- Four lanes would allow for separation of traffic with a median, which would result in a lower crash rate, separate opposing traffic, provide for recovery of out-of-control vehicles, reduce head-on collisions, provide an area for emergency parking, allow space for left turns, minimize headlight glare, allow for future widening, and control access.
- Two lanes in each direction would increase safety on the long steep hills located on the corridor.
- Four lanes would significantly reduce the fatalities from vehicle crashes due to violation of traffic control devices (signals or stop signs) compared to two-lane facilities.
- Converting a two-lane roadway to a divided four-lane roadway could result in a crash reduction of between 40% and 60%.
- Climbing and crawl lanes would support safer interactions between cars and large trucks.
- Converting a two-lane roadway to a divided four-lane roadway would reduce road departure fatalities, which include run-off-the-road, head-on, and opposite direction sideswipes.
- Converting a two-lane roadway to a divided four-lane roadway could save from $1.2 to $1.8 million per year in societal costs.
- Adding a two-way left-turn lane would significantly improve the benefit/cost ratio for this project.
- Converting a two-lane roadway to a divided four-lane roadway historically could save six lives over the design life of the project.

### 3.3.3. Route Continuity

Climbing and/or crawl lanes are required through approximately 4.5 miles of the 8-mile Bigelow Gulch Road/Forker corridor.

Transitioning from a four-lane roadway to a two-lane roadway would violate driver expectancy and create roadway inconsistencies (Wilson 2000). Constructing a four-lane facility for the entire Bigelow Gulch/Forker corridor would provide roadway continuity. A short portion of Bigelow Gulch could be two-way and two-lane if the roadway was designed on capacity alone (see previous LOS section). However, this short portion of two-lane would be located after and before significant sections of four-lane divided roadway. Driver expectations are to continue on a four-lane facility and not to transition into and out of a two-lane section. Lane transition areas are typically locations of driver confusion and have a higher collision potential. The basic number of lanes should be constant over a significant portion of the corridor and should not be changed regardless of changes in traffic volume (WSDOT 2007a).

### 3.4. Conclusion

The analysis of the initial and expanded alternatives was based on an assessment of engineering feasibility, safety, LOS, climbing lane and crawl lane justification, and route continuity. This analysis concludes that the appropriate roadway geometry for the Bigelow Gulch/Forker corridor would be a divided four-lane roadway.