

Appendix D

Improvement Options Report



IMPROVEMENT OPTIONS REPORT

PREPARED FOR:



PREPARED BY:



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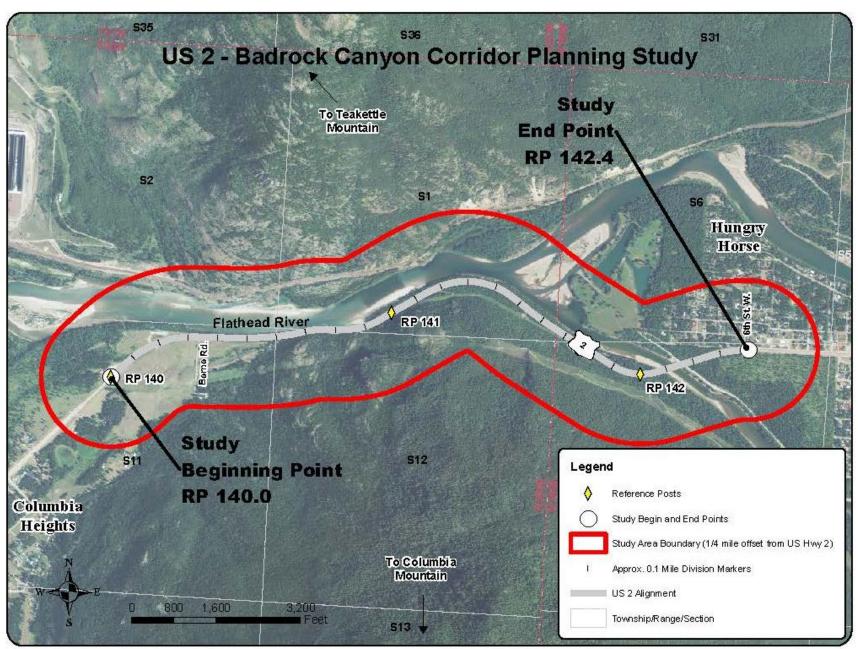
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1.0 INTRODUCTION

The US 2-Badrock Canyon Corridor Planning Study area includes 2.4 miles of US Highway 2 beginning at Reference Post (RP) 140.0 and ending at RP 142.4. The study area is located within Sections 6 and 7, Township 30 North, Range 19 West, Montana Meridian and Sections 1, 2, 11 and 12, Township 30 North, Range 20 West, Montana Meridian, within Flathead County. Figure 1-1 illustrates the study area.

Figure 1-1 Study Area



Source: MDT, 2011; NRIS, 2011; DOWL HKM, 2011.



1.1 Previous Planning Efforts in US 2 – Badrock Canyon Corridor

In 1995, the Columbia Heights-Hungry Horse Final Environmental Impact Statement (FEIS) / Section 4(f) Evaluation was completed to assess the impacts of reconstructing 4.5 miles of US 2 from approximate RP 138.3 to RP 142.7 between Columbia Heights and Hungry Horse in Flathead County, Montana. The Federal Highway Administration (FHWA) signed a Record of Decision (ROD) on the FEIS on December 22, 1995. The ROD approved Alternative 1, which entailed a four- and five-lane design for the reconstruction of US 2. Pursuant to the FEIS, MDT initiated two reconstruction projects within the Columbia Heights-Hungry Horse corridor. The Columbia Heights-East project extended from RP 138.3 to RP 140.1, and the Hungry Horse-West project extended from RP 140.1 to RP 142.7.

In the years following completion of the Columbia Heights-Hungry Horse FEIS and ROD, Flathead County experienced substantial growth, which resulted in the need to update traffic volumes and accident rates. Federal and state regulations relevant to some of the project activities had changed. Additionally, other concerns were identified that required MDT to make minor design modifications or that had the potential to dictate new and more notable project design changes. Some of these design activities resulted in more accurate quantification of the environmental effects disclosed in the FEIS. Lastly, controversy surrounded the alternative approved in the ROD. For these reasons, MDT conducted an Environmental Re-evaluation of the FEIS and Section 4(f) Evaluation in 2002.

The Re-evaluation concluded that the FEIS adequately described the impacts associated with reconstruction of US 2 within the limits of the Columbia Heights-East project. This reconstruction project proceeded and was completed in 2004. The Re-evaluation also concluded the FEIS adequately discussed the environmental effects of building a new bridge across the South Fork of the Flathead River (referred to in this report as the South Fork Flathead River Bridge). The Re-evaluation found that the preferred alternative discussion in the FEIS and ROD did not adequately address environmental effects of reconstructing US 2 through Badrock Canyon (RP 140.1 to RP 141.2) on an alignment that minimized or totally avoided rock excavation near Berne Memorial Park. Since the Re-evaluation, additional information was identified regarding Native American cultural concerns in the area and potential impacts to a natural gas transmission pipeline. The Re-evaluation called for a Supplemental Environmental Impact Statement (SEIS) to be prepared for this segment of the corridor.



In early 2011, members of communities in proximity to Badrock Canyon (broadly referred to in this report as the "canyon community") approached MDT regarding potential improvements to US 2 through Badrock Canyon. In lieu of preparing a SEIS at that time, MDT hosted an informational meeting in May 2011 to identify community concerns within the corridor. Based on comments provided during the meeting as well as written comments submitted during the comment period from May 12 to May 20, 2011, MDT determined there was local interest in pursuing further analysis of the corridor. This effort, referred to as Phase I, was completed in June 2011. Phase II entails completion of the corridor planning study process for the portion of the US 2 corridor between RP 140.0 and RP 142.4.

1.2 Linking Transportation Planning and Environmental Compliance

FHWA guidance on linking transportation planning and environmental analysis notes transportation planning can be used to limit the number of potential solutions evaluated during the National and Montana Environmental Policy Act (NEPA/MEPA) process. A planning study can provide a basis for early screening, allowing exclusive focus on reasonable, feasible alternatives during the NEPA/MEPA process.

This report documents the planning level screening process used in the US 2-Badrock Canyon corridor with the intent of fulfilling future NEPA/MEPA requirements. The report identifies potential improvement options, defines qualitative screening criteria, and presents a planning level evaluation of options in the corridor. The findings and recommendations provided in this report can be used to streamline a future SEIS effort if MDT pursues improvements in the corridor.

1.3 Background

Alternatives identified in the FEIS were used as a starting point for the US 2 – Badrock Canyon Corridor Study. The FEIS initially considered transportation system management (TSM), transit, alternate routes, reconstruction of the existing alignment, tunnel construction, construction of a grade-separated facility, and closing US 2.

The FEIS identified reconstruction of the existing US 2 alignment as the only reasonable alternative. All other alternatives were eliminated from further consideration due to constructability challenges, impracticality, high costs and/or failure to improve conditions in the corridor. The FEIS analyzed several roadway configurations to reconstruct the existing US 2



alignment, including an improved two-lane highway, a two-lane highway with a center left-turn lane, an undivided four-lane highway, and a four-lane highway with a center left-turn lane. A four-lane highway involving rock excavation in Badrock Canyon was recommended throughout the corridor (with a center left-turn lane from Columbia Heights to Berne Road [RP 140.3±]) based on anticipated traffic projections at that time, which indicated four travel lanes would be needed for the highway to operate at an acceptable LOS B in the FEIS design year of 2010.

1.4 Factoring in Corridor Needs and Objectives

Needs and objectives for the US 2 – Badrock Canyon Corridor Planning Study were developed through a review of baseline data provided in the FEIS and Re-evaluation, existing and projected conditions identified through the corridor planning study process, consideration of input from members of the public and resource agencies, and coordination with the study advisory committee, including representatives from the Confederated Salish and Kootenai Tribes (CSKT), Flathead County, City of Columbia Falls, and the canyon community. The corridor planning study team identified a range of potential improvement options to address corridor safety and operational needs and objectives relating to roadway geometry, the South Fork Flathead River Bridge, roadside safety and traffic control devices, drainage conditions, traffic operations, and non-motorized usage in the corridor. The planning team also attempted to identify improvements that would minimize adverse impacts to sensitive resources in the corridor and consider other limiting factors, including utility conflicts, construction feasibility, and funding availability. Needs, objectives, and other considerations are listed below.



<u>Need 1</u>: Improve the safety and operation of the US 2 roadway facility within the study area for all users, where practicable.

Objectives:

- 1.a Improve roadway elements to meet current MDT design standards.
- 1.b Provide a South Fork Flathead River Bridge structure that meets current MDT design standards.
- 1.c Provide appropriate guardrail and signing based on current design guidelines.
- 1.d Provide appropriate drainage facilities throughout the corridor to minimize water and ice on the roadway.
- 1.e Provide desirable Level of Service (LOS) through the planning horizon year of 2035.
- 1.f Provide opportunities for non-motorized usage in the corridor.

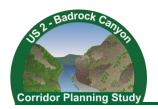
<u>Need 2</u>: Minimize adverse impacts from improvements to the environmental, historic, cultural, scenic and recreational characteristics of the corridor.

Objectives:

- 2.a Minimize adverse impacts to the main stem and South Fork of the Flathead River and fisheries that may result from improvement options.
- 2.b Minimize adverse impacts to historic, cultural, and archaeological resources that may result from improvement options.
- 2.c Strive to maintain the scenic nature of the corridor with respect to view sheds and landscape features.
- 2.d Provide reasonable access to recreational sites in the corridor.
- Minimize conflicts with wild animals and facilitate wildlife movement.

Other issues to be considered as part of the screening process:

- Conflicts with utilities
- Construction feasibility
- Availability and feasibility of funding



2.0 DEVELOPMENT OF IMPROVEMENT OPTIONS

2.1 Alignments

The US 2 – Badrock Canyon corridor is physically constrained and includes a number of sensitive environmental and cultural resources. Within the middle portion of the corridor from RP 140.6± to RP 141.2±, US 2 is directly bordered by culturally sensitive rock outcroppings to the south and the Flathead River to the north, which provides critical habitat for bull trout. Narrow shoulders, sharp curves, limited sight distance, roadway drainage and icing issues, and public access to recreational sites create safety concerns within the corridor, while traffic operations are anticipated to decline within the 2035 planning horizon.

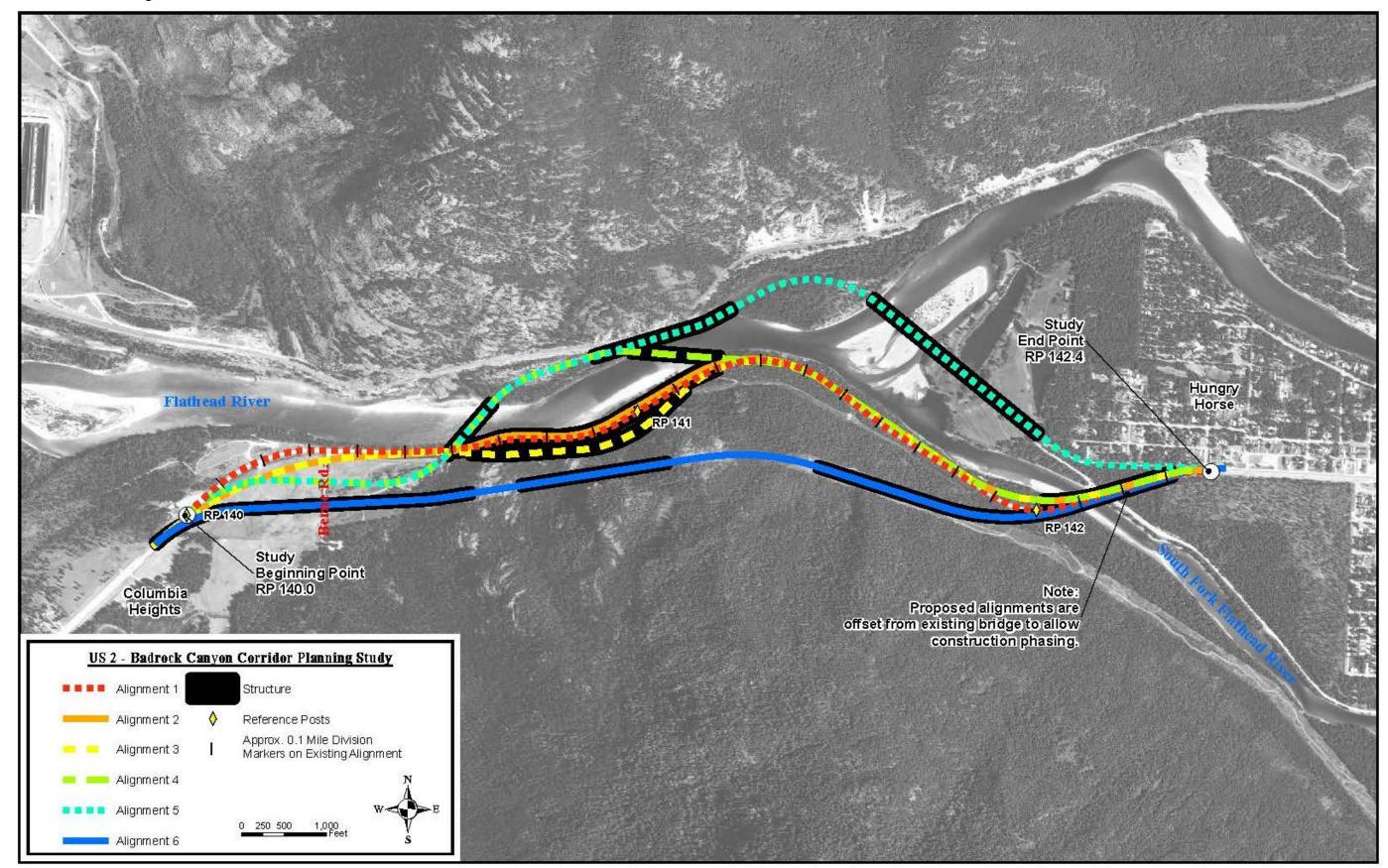
The US 2 – Badrock Canyon planning team identified six potential alignments to improve safety and operations for US 2 corridor users while minimizing impacts to environmental and cultural resources to the extent practicable.

Figure 2-1 illustrates potential alignments, with required structures indicated in black. Appendix 1 includes additional alignment figures. The following sections describe potential alignments in more detail.



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Figure 2-1 Potential Alignments





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2.1.1 Alignment 1 (Existing Alignment)

Alignment 1 would follow the existing US 2 alignment and would involve no modifications to current roadway geometry. Existing horizontal and vertical curves failing to meet current MDT design standards would remain, and the roadway would continue to have two travel lanes with minimal shoulders throughout the corridor. Improvements would be implemented to provide or enhance access management, bicycle/pedestrian facilities, drainage, parking, roadside safety, rockfall prevention, rumble strips, sight distance, traffic control, and wildlife passage. The existing South Fork Flathead River Bridge would be replaced with a new two-lane or fourlane structure due to its classification as functionally obsolete and structurally deficient.

2.1.2 Alignment 2 (Optimized Existing Alignment)

Alignment 2 would generally follow the existing US 2 alignment, although it would include modifications to horizontal/vertical geometry and other roadway elements to meet current MDT design standards where practicable. A new elevated or at-grade structure would be needed in the most constrained portion of the corridor (RP 140.6± to RP 141.2±) to avoid rock excavation. An elevated structure would be constructed above the elevation of the existing US 2 roadway, while an at-grade structure would be constructed at approximately the current roadway elevation. US 2 would be reconstructed as a two-lane facility with shoulders; a combination of two-lane, three-lane, and/or four-lane sections; or a four-lane facility. A new two-lane or four-lane bridge would be constructed to replace the existing South Fork Flathead River Bridge, depending on the lane configuration selected for this alignment.

2.1.3 Alignment 3 (Tunnel Alignment)

Alignment 3 would generally follow the existing US 2 alignment at the western and eastern ends of the corridor (RP 140.0± to RP 140.6± and RP 141.2± to RP 142.4±). It would be reconstructed as a four-lane roadway and would include modifications to horizontal/vertical alignments and other roadway elements to meet current MDT design standards where practicable. A two-lane or four-lane tunnel would extend through the mountain south of US 2 from RP 140.6± to RP 141.2± to bypass the most constrained portion of the corridor. Within this segment, a two-lane tunnel could serve as part of a couplet to accommodate eastbound (EB) volumes with the existing US 2 roadway serving westbound (WB) traffic. For a couplet scenario, a new structure would be needed along the existing US 2 alignment to avoid rock cuts. Alternately, a four-lane tunnel could accommodate EB and WB traffic, and the existing US 2 facility could continue to be maintained as a local roadway to provide access to Berne



Memorial Park (RP 140.9±) and the Flathead River. For both configurations, a new four-lane bridge would be constructed to replace the existing South Fork Flathead River Bridge and tie into the four existing travel lanes in Hungry Horse.

2.1.4 Alignment 4 (Partial Canyon Bypass Alignment)

Alignment 4 would cross to the north side of the main stem of the Flathead River at RP 140.6± and rejoin the existing alignment at RP 141.2±, bypassing the most constrained portion of the existing alignment. Within this segment, the existing US 2 roadway could continue to be maintained as a local roadway to provide access to Berne Memorial Park and the Flathead River. The new four-lane US 2 facility would meet current MDT design standards where practicable. Alignment 4 would include two new four-lane bridges crossing the main stem of the Flathead River, and a new four-lane bridge crossing the South Fork of the Flathead River.

2.1.5 Alignment 5 (Full Canyon Bypass Alignment)

Alignment 5 would cross to the north side of the main stem Flathead River at RP 140.6± and rejoin the existing alignment at the far eastern end of the corridor (RP 142.4±), bypassing the majority of the existing alignment. Within this portion of the corridor, the existing US 2 roadway could continue to be maintained as a local roadway providing access to Berne Memorial Park and the Flathead River. The new four-lane US 2 facility would meet current MDT design standards where practicable. Alignment 5 would include three new four-lane bridges crossing or paralleling the main stem of the Flathead River. The new alignment could tie into the west end of River Junction Road before intersecting the existing US 2 alignment in Hungry Horse.

2.1.6 Alignment 6 (Southern Alignment)

Alignment 6 would depart from the existing alignment at the western end of the corridor (RP 140.0±) to traverse over the mountainous terrain south of US 2, and rejoin the existing alignment at RP 142.4±. Within this portion of the corridor, the existing US 2 roadway could continue to be maintained as a local roadway to provide access to Berne Memorial Park and the Flathead River. The new four-lane US 2 facility would meet current MDT design standards where practicable. Three lengthy elevated structures would be needed to span the steep topography, and a new four-lane bridge would replace the existing South Fork Flathead River Bridge.



2.2 Alignment Screening

A qualitative screening process was developed to evaluate the range of alignments at a pre-NEPA/MEPA planning level. To be considered viable and pass the screening, an alignment must be reasonable and practicable in terms of cost, constructability, level of community support, degree of impacts to sensitive resources, and right-of-way acquisition requirements. Screening criteria and results are described in more detail below.

2.2.1 Cost

Cost is an important consideration at the pre-NEPA/MEPA planning level. An alignment can be screened from further consideration if it would not be feasible due to excessive costs. An estimated cost may be deemed unreasonable if it is substantially greater than costs for other options that meet corridor needs and objectives. Very high cost projects are not practicable or feasible due to difficulties in securing funding.

Estimated costs include at-grade and elevated structures within the most constrained portion of the corridor (RP 140.6± to RP 141.2±), bridges, and various lane configurations, as well as unknown factors at the planning level stage. Cost estimates include two- and four-lane configurations for Alignment 2 and a four-lane configuration for a new US 2 facility (Alignments 3, 4, 5, and 6). A 20 to 50 percent contingency was included for Alignments 1, 2, 4, 5, and 6 to account for unknown factors over the planning horizon. A 30 to 60 percent contingency was assumed for Alignment 3 due to a higher number of unknown factors associated with excavating a tunnel through the mountain south of the existing alignment. Cost estimates reflect anticipated construction costs only, and do not include potential costs associated with right-of-way acquisition, utility relocation, preliminary engineering, or operations and maintenance.

Estimated costs include replacement of the existing South Fork Flathead River Bridge and construction of new bridges, where appropriate. Bridge widths would vary from two to four travel lanes to match lane configurations associated with each alignment. In coordination with MDT's Bridge Bureau, a conservative estimate of \$175 per square foot was utilized for reconstruction of the South Fork Flathead River Bridge, bridges associated with Alignments 4 and 5, and elevated structures associated with Alignments 2 and 6. An estimate of \$125 per square foot was utilized for construction of a cantilevered deck associated with Alignment 2. Structures could be constructed using methods and structure types commonly used on the



highway system in Montana. Substructures typically consist of pile or drilled shaft foundations supporting cast-in-place concrete pile caps, pier walls, or hammerhead caps. Superstructures range from steel plate girders to pre-stressed concrete I-girders supporting cast-in-place concrete deck slabs. Miscellaneous elements supported by and attached to the bridge deck may include sidewalks, vehicle barriers, pedestrian barriers, and steel bridge railing, as appropriate.

Planning level cost estimates for each alignment are presented in Table 2.1. Appendix 2 includes cost estimate tables.

Table 2.1 Planning Level Cost Estimates – Alignments

Alignment	Planning Level Estimate of Costs ⁽¹⁾			
Alignment 1	Spot Improvements: \$500 to \$6.6M			
(Existing Alignment)	South Fork Flathead River Bridge Reconstruction: \$9.7M to \$27.3M			
Alignment 2 (Optimized Existing Alignment)	US 2 Reconstruction: \$35.9M to \$177.0M			
Alignment 3 (Tunnel Alignment)	US 2 Reconstruction / New Construction: \$399.0M to \$558.0M			
Alignment 4 (Partial Canyon Bypass Alignment)	US 2 Reconstruction / New Construction: \$70.1M to \$86.4M			
Alignment 5 (Full Canyon Bypass Alignment)	US 2 Reconstruction / New Construction: \$89.5M to \$110.0M			
Alignment 6 (Southern Alignment)	US 2 Reconstruction / New Construction: \$307.0M to \$379.0M			

Source: DOWL HKM, 2012.

Alignment 1 (Existing Alignment)

Spot improvements range in cost from \$500 for a new static sign up to \$6.6 million for a dedicated bicycle/pedestrian facility. Reconstruction of the South Fork Flathead River Bridge is estimated to cost from \$9.7 million to \$15.3 million for a two-lane structure and \$19.6 to \$27.3 million for a four-lane structure.

⁽¹⁾ Estimates for Alignment 1 indicate range of costs for potential spot improvements and reconstruction of the South Fork Flathead River Bridge. Estimates for Alignments 2 through 6 encompass reconstruction or construction of new alignments within the corridor, including replacement of the existing South Fork Flathead River Bridge, where appropriate. Cost ranges reflect various spot improvements, structures, lane configurations, and contingencies. Cost estimates are provided in 2012 dollars and reflect anticipated construction costs only. Costs reflect planning level estimates, and should not be considered an actual cost encompassing all scenarios and circumstances. Estimates do not include potential costs associated with right-of-way acquisition, utility relocation, preliminary engineering, or operations and maintenance. Cost estimate tables are provided in Appendix 2.



Alignment 2 (Optimized Existing Alignment)

The planning level cost estimate for Alignment 2 ranges from \$35.9 to \$177.0 million due to the wide variation in potential structure types and lane configurations. The low end of the cost estimate range represents a two-lane configuration with a two-lane cantilevered structure through the most constrained portion of the corridor (RP 140.6± to RP 141.2±) and replacement of the existing South Fork Flathead River Bridge with a new two-lane bridge. The high end of the cost estimate range represents a four-lane configuration with a four-lane elevated structure in the most constrained portion of the corridor and replacement of the existing South Fork Flathead River Bridge with a new four-lane bridge. Alignment 2 structure types and lane configurations are described in more detail in Chapters 4 and 5.

Alignment 3 (Tunnel Alignment)

Construction of Alignment 3 is estimated to range from \$399.0 to \$558.0 million. The low end of this cost range represents a couplet configuration from RP 140.6± to RP 141.2±, with a two-lane EB tunnel through the mountain south of US 2 and a two-lane cantilevered structure for WB traffic generally following the existing alignment. The high end of the cost range represents a four-lane tunnel from RP 140.6± to RP 141.2± to bypass the most constrained portion of the corridor.

Alignment 4 (Partial Canyon Bypass Alignment)

Construction of Alignment 4 is estimated to range from \$70.1 to \$86.4 million. This estimate includes two new four-lane bridges crossing the main stem of the Flathead River and replacement of the existing South Fork Flathead River Bridge with a new four-lane bridge.

Alignment 5 (Full Canyon Bypass Alignment)

The planning level cost estimate for Alignment 5 ranges from \$89.5 to \$110.0 million. This estimate includes three new four-lane bridges crossing or paralleling the main stem of the Flathead River.

Alignment 6 (Southern Alignment)

Alignment 6 is estimated to range from \$307.0 to \$379.0 million, which would include construction of three structures traversing over the mountainous terrain south of US 2 and the South Fork of the Flathead River.



Cost Summary

Alignment 1 is expected to be the least costly alignment. Alignments 2, 4, and 5 are expected to range in cost from \$35.9 million to \$177.0 million, depending on the required number of river crossings, lane configurations, and the types of structures involved in construction or reconstruction of US 2. Alignments 3 and 6 are expected to range in cost from \$307.0 to \$558.0 million, nearly two to more than three times higher than the next most costly alignment. For this reason, Alignments 3 and 6 are considered not feasible from a cost perspective.

2.2.2 Constructability

Alignment 1 (Existing Alignment)

Alignment 1 would involve constructability challenges associated with replacement of the existing South Fork Flathead River Bridge. Measures to protect water quality while installing bridge piers within and adjacent to the river would be required. Reconstruction of the South Fork Flathead River Bridge may require construction of a second parallel bridge, use of the existing bridge, and/or phased construction to maintain traffic during construction.

Construction of spot improvements in the most constrained portion of the corridor (RP 140.6± to RP 141.2±) may require intermittent lane closures, resulting in challenges for emergency vehicle access.

Alignment 2 (Optimized Existing Alignment)

In addition to South Fork Flathead River Bridge challenges mentioned above for Alignment 1, Alignment 2 would involve construction challenges in the most constrained portion of the corridor. Mobilizing construction equipment, maintaining traffic, and providing adequate emergency vehicle access during construction activities would be a challenge given the physical site constraints.

Construction of a cantilevered or elevated structure would require retaining walls or bridge piers within or adjacent to the Flathead River. Foundation construction may be difficult due to geotechnical soil variance. Measures would need to be taken to reduce the likelihood of soil erosion or failure due to construction loads. Environmental permitting requirements may impose construction timing and/or other restrictions.

AT&T owns and operates a fiber optic cable that generally runs along the south side of US 2. NorthWestern Energy owns and operates a 10-inch diameter high pressure natural gas



transmission pipeline that generally runs along the south side of US 2. This is the only natural gas transmission pipeline serving the Flathead Valley area. In some locations where the rock outcroppings encroach upon the roadway, the line may be located directly under the road surface. The exact location and depth of the line in relation to Alignment 2 is not known at this time. The 1995 FEIS disclosed the gas pipeline would be in conflict with proposed highway reconstruction and must be relocated. At a minimum, temporary pipeline relocation during construction activities would have been required for construction of the FEIS preferred alternative. Following roadway reconstruction, the gas transmission pipeline was proposed to be permanently relocated within the highway right-of-way. The 2002 Re-evaluation noted shifting the US 2 alignment to the north to avoid cutting or blasting the rock outcroppings may reduce conflicts with the transmission pipeline and the temporary relocation previously proposed may no longer be required. The Re-evaluation noted the effects of highway reconstruction on the pipeline and the need for relocation cannot be determined until engineering design is completed. The exact location of buried utilities in relation to Alignment 2 and the need for and methods of potential relocation would need to be addressed during project development.

Alignment 3 (Tunnel Alignment)

A tunnel would pose substantial construction challenges. Based on information provided by the MDT Geotechnical Section, rock outcroppings south of US 2 are composed of Precambrian argillite and quartzite. The rock outcroppings exhibit multiple tension cracks, some as wide as two feet running parallel to US 2. Tension cracking along these outcroppings would likely create complications related to tunnel construction. At this planning level stage, no geotechnical engineering was completed to determine the feasibility of excavating the rock in this area to construct a tunnel. Additional geotechnical analysis which could cost up to \$2.0 million would be required to determine the feasibility of this option before engineering design could proceed.

Mobilizing roadway construction equipment within the constrained portion of the corridor would be difficult depending on the tunneling method. If a tunnel alignment were pursued, it may be possible to maintain two-lane traffic on the existing US 2 alignment during portions of construction. At times, traffic flow may need to be restricted to one travel lane serving alternating directions of traffic.



Utility conflicts would need to be addressed during project development, as noted in the discussion for Alignment 2.

Alignment 4 (Partial Canyon Bypass Alignment)

Alignment 4 would require construction of two new bridges crossing the main stem of the Flathead River, in addition to replacement of the existing South Fork Flathead River Bridge. Further analysis of subsurface materials would need to be verified to ensure proper design of the bridges. Measures to protect water quality while installing bridge piers within and adjacent to the river may pose constructability challenges. Construction of Alignment 4 would also be complicated by the proximity of the railroad line across the river north of the existing US 2 alignment.

Alignment 5 (Full Canyon Bypass Alignment)

Alignment 5 would involve all of the construction difficulties mentioned above for Alignment 4. New bridge construction would be required, likely through lowland areas with a high water table in some locations, requiring private access road reconstruction and additional private property impacts. Alignment 5 could tie into the west end of River Junction Road, which is currently a low-volume unpaved roadway within a residential area. Connection with River Junction Road could impact local traffic patterns in Hungry Horse.

Alignment 6 (Southern Alignment)

Substantial challenges would be encountered during construction of Alignment 6 due to the mountainous terrain south of the existing US 2 alignment. No geotechnical engineering has been conducted to determine the feasibility of constructing elevated structures over this steep terrain and would need to be verified at the project level.

Alignment 6 would require considerable quantities of embankment material to bring the proposed roadway structure to grade, specifically on the west end of the project. Substantial quantities of material would also need to be excavated and blasted on the top of the mountain to properly grade the new roadway. New bridges would need to be constructed within these areas, adding complications of soil consolidation and settlement. Settlement issues would likely require construction of embankment materials followed by a settling period, typically one construction season. This process would delay the finish date of construction.



The existing South Fork Flathead River Bridge would need to be replaced with a much longer bridge. The new super structure would tower over the existing roadway on the east end of the project and would create a steep longitudinal grade on the structure for a length of over 4,000 feet. The new bridge would incorporate piers over 100 feet high, overlapping the existing highway.

Constructability Summary

Alignments 3 and 6 are not feasible from a constructability standpoint due to potential geotechnical risks associated with blasting and/or tunneling through unstable rock formations and steep terrain south of the existing alignment.

2.2.3 Potentially Impacted Resources

Alignments were identified to minimize impacts to sensitive environmental and cultural resources and adjacent land areas to the extent practicable. Despite these efforts, replacement of the South Fork Flathead River Bridge, reconstruction of the existing US 2 alignment, and/or construction of new alignments would result in unavoidable impacts within the corridor. Potentially impacted resources are listed below.

- Surface water bodies, including the main stem, Middle Fork, and South Fork of the Flathead River
- Wetland areas
- Floodplains
- Federally and state-listed fish and wildlife species and habitat, including critical habitat for bull trout and Canada lynx
- Wildlife movement corridors
- Farmlands

- Vegetation, including federally and state-listed plant species
- Cultural and archaeological resources, including the Badrock Canyon Cultural Landscape
- Recreational resources, including Berne Memorial Park and Fisherman's Rock
- Geologic features
- Water source at Berne Memorial Park
- Section 4(f) sites
- Visual resources

Section 404 of the Clean Water Act requires permitting through the U.S. Army Corps of Engineers (USACE) prior to discharging dredged or fill material into waters of the United States or adjacent wetlands. A Section 404 permit would be needed for all alignments due to anticipated impacts to the Flathead River. Under Section 404(b)(1) guidelines (40 CFR 230.10), USACE may only permit discharges into waters of the United States that represent the least environmentally damaging practicable alternative (LEDPA), provided the alternative meets the project purpose and does not have other significant adverse environmental consequences. To



be practicable, an alternative must be available and capable of being implemented after taking into consideration cost, existing technology, and logistics in light of the overall project purpose. Technical and logistical factors include access, transportation needs, utilities, topography, and available construction techniques. During an agency meeting conducted on January 9, 2012, USACE indicated culturally significant rock outcroppings and other Tribal concerns would be considered when identifying the LEDPA for this corridor.

Other environmental permits that would be required for all alignments are listed below. Permitting through the Montana Department of Natural Resources and Conservation (DNRC) is discussed in Section 2.2.4.

- Montana Stream Protection Act (SPA 124 Authorization) administered by Montana Fish,
 Wildlife & Parks (FWP)
- Montana Floodplain and Floodway Management Act (Floodplain Development Permit) administered by the Flathead County Floodplain Administrator
- Short-term Water Quality Standard for Turbidity (318 Authorization) administered by the Montana Department of Environmental Quality (DEQ)

Alignment 1 (Existing Alignment)

Alignment 1 would result in potential impacts to the South Fork Flathead River, wetlands, fish and wildlife habitat, and vegetation due to reconstruction of the South Fork Flathead River Bridge and construction of spot improvements. Alignment 1 is expected to be the least impactful alignment.

Alignment 2 (Optimized Existing Alignment)

Alignment 2 would result in potential impacts associated with reconstruction and widening of US 2 and reconstruction of the South Fork Flathead River Bridge. In order to avoid rock cuts, the roadway could be widened to the north, resulting in impacts to the South Fork Flathead River, floodplains, wetlands, and fish and wildlife habitat. Impacts to wildlife movement corridors, farmlands, vegetation, the Badrock Cultural Landscape, Berne Memorial Park, Fisherman's Rock, and visual resources may also occur. The degree of impact would depend on the lane configuration selected for this alignment.

Alignment 3 (Tunnel Alignment)

Alignment 3 would result in potential impacts associated with reconstruction and widening of US 2 and reconstruction of the South Fork Flathead River Bridge as described for Alignment 2.



Tunnel construction would impact geologic features south of US 2. Additional study would be needed to determine if tunneling could impact the water source at Berne Memorial Park.

Alignments 4 and 5 (Partial and Full Canyon Bypass Alignments)

Construction of Alignments 4 and 5 would require new bridge crossings, resulting in impacts to the main stem of the Flathead River, floodplains, wetlands, and fish and wildlife habitat. It may be difficult to permit new bridge crossings if there are less environmentally damaging options that meet corridor needs and objectives. In addition to potential impacts associated with reconstruction and widening of the existing US 2 alignment at the eastern and western ends of the corridor, Alignments 4 and 5 would result in impacts to multiple resources along new alignments north of the Flathead River.

Alignment 6 (Southern Alignment)

Alignment 6 would result in potential impacts to the South Fork Flathead River, floodplains, wetlands, and fish and wildlife habitat due to reconstruction of the South Fork Flathead River Bridge. Alignment 6 would impact multiple resources along a new alignment spanning the mountainous terrain south of the existing US 2 alignment. Additional study would be needed to determine if Alignment 6 could impact the water source at Berne Memorial Park.

Potentially Impacted Resources Summary

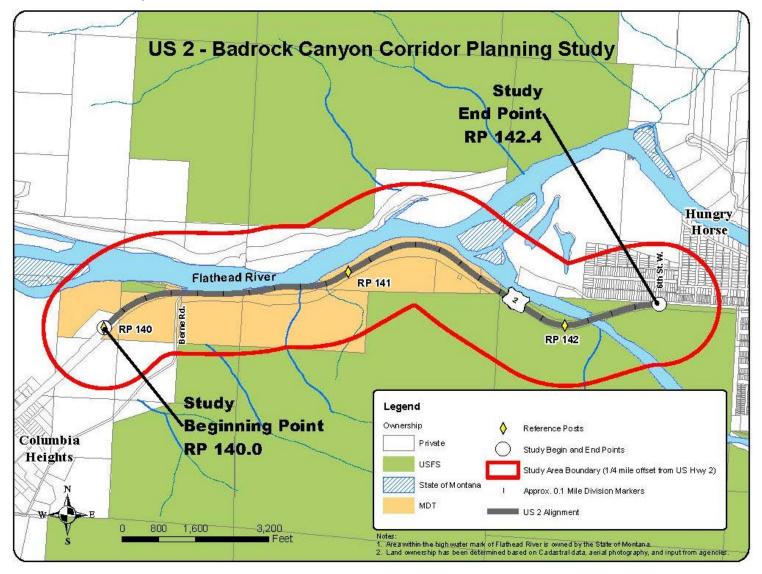
All alignments would result in unavoidable impacts to resources in the corridor. Construction of Alignments 3 and 6 could create a risk of impacting the water source at Berne Memorial Park. Alignments 4 and 5 would require new river crossings, which could result in Flathead River impacts that may be difficult to permit. For these reasons, Alignments 3, 4, 5, and 6 would result in or would create a risk of unreasonable impacts to corridor resources.

2.2.4 Right-of-Way Acquisition / Easements

Following completion of the FEIS, MDT purchased additional right-of-way from RP 140.0± to RP 141.7± adjacent to the existing US 2 facility in anticipation of a future project to widen the roadway. Figure 2-2 illustrates land ownership within the corridor.



Figure 2-2 Land Ownership





The State of Montana holds ownership of the land and minerals located below navigable rivers, streams, and lakes and related acreage as established in the Equal Footing Doctrine and Montana statutes. DNRC administers these lands on behalf of the state. DNRC considers navigable waterways to be those for which it has historical documentation of commercial use. The portions of the main stem and south fork of the Flathead River within the corridor study area are considered navigable. A land use license or easement is required from DNRC for any construction or improvement of a structure within or over a navigable water body.

Alignment 1

No new right-of-way would be needed for spot improvements on the existing US 2 alignment. A DNRC land use license or easement would be required for replacement of the South Fork Flathead River Bridge. A US Forest Service (USFS) easement would be required at the eastern end of the corridor on either side of the South Fork Flathead River Bridge and at the fishing access site near RP 140.2±.

Alignment 2

No new right-of-way would be needed for reconstruction of US 2 along Alignment 2 from RP 140.3± to RP 141.7±. A small amount of right-of-way may need to be acquired from private landowners near RP 140.0±. A USFS easement would be required at the eastern end of the corridor from RP 141.7± to RP 142.4 and possibly near RP 140.2± where roadway widening and modifications to horizontal and vertical elements would extend outside existing MDT rights-of-way onto USFS land. Replacement of the South Fork Flathead River Bridge would require a land use license or easement from DNRC.

Alignment 3

Tunnel construction and widening/modification of the US 2 alignment would generally occur within existing MDT rights-of-way. A USFS easement would be required at the eastern end of the corridor from RP 141.7± to RP 142.4 and possibly near RP 140.2± where roadway widening and modifications to horizontal and vertical elements would extend outside existing MDT rights-of-way. Replacement of the South Fork Flathead River Bridge would require a land use license or easement from DNRC.

Alignment 4

New right-of-way on the north side of the river would need to be acquired from private landowners from RP 140.6± to RP 141.2±. Alignment 4 would be in close proximity to existing



railroad rights-of-way on the north side of the river. Coordination with the railroad would be required to avoid impacts to rail operations. New river crossings and replacement of the South Fork Flathead River Bridge would require a land use license or easement from DNRC. A USFS easement would be required at the eastern end of the corridor from RP 141.7± to RP 142.4 where roadway widening and modifications to horizontal and vertical elements would extend outside the existing MDT rights-of-way.

Alignment 5

New right-of-way would need to be acquired from private landowners from RP 140.6± to 142.4±. Coordination with the railroad would be required to avoid impacts to rail operations. New river crossings and replacement of the South Fork Flathead River Bridge would require a land use license or easement from DNRC. Alignment 5 would enter Hungry Horse from the northwest, and may impact buildings and require modifications to existing private access roads.

Alignment 6

A USFS easement would be required from RP 141.1± to RP 142.4 where roadway widening and modifications to horizontal and vertical elements would extend outside the existing MDT rights-of-way. Replacement of the South Fork Flathead River Bridge would require a land use license or easement from DNRC. Coordination with utilities may be required.

Right-of-Way Acquisition / Easements Summary

All alignments would require USFS easements and/or DNRC land use licenses or easements. Alignments 4, 5, and 6 would require unreasonable quantities of new right-of-way from private landowners and coordination with the railroad and utilities.

2.2.5 Community Support

During the Phase I and Phase II corridor planning study efforts, community members and CSKT representatives expressed support for maintaining or generally following the existing alignment (Alignments 1 and 2). Support was expressed for spot improvements, replacement of the South Fork Flathead River Bridge, and roadway reconstruction to improve corridor safety and operations, while minimizing impacts to sensitive environmental and cultural resources. There was some interest in tunnel options and potential alignments to the north and south of the existing US 2 roadway (Alignments 3, 4, 5, and 6), although community members and CSKT representatives were generally less supportive of new alignments.



2.2.6 Screening Summary - Alignments

Alignments 1 and 2 are advanced, with additional discussion in Chapter 3. Based on failure to meet criteria relating to cost, constructability, resource impacts, right-of-way acquisition / easements, and community support, Alignments 3, 4, 5 and 6 are eliminated from further consideration and will not be discussed further in this report. Table 2.2 summarizes the alignment screening. Orange shading indicates failure to pass a screening criterion, with specific failing elements highlighted in black.

Table 2.2 Screening Summary – Alignments

Criteria	Alignment 1 Existing	Alignment 2 Optimized Existing	Alignment 3 Tunnel	Alignment 4 Partial Canyon Bypass	Alignment 5 Full Canyon Bypass	Alignment 6 Southern Alignment
Planning Level Estimate of Costs ⁽¹⁾	Spot Improvements \$500 to \$6.6M South Fork Flathead River Bridge Reconstruction \$9.7 to \$27.3M	<u>US 2 Reconstruction</u> \$35.9M to \$177.0M	US 2 Reconstruction / New Construction \$399.0M to \$558.0M	US 2 Reconstruction / New Construction \$70.1M to \$86.4M	US 2 Reconstruction / New Construction \$89.5M to \$110.0M	US 2 Reconstruction / New Construction \$307.0M to \$379.0M
Constructability Challenges ⁽²⁾	 South Fork Flathead River Bridge reconstruction Traffic delays during construction 	 South Fork Flathead River Bridge reconstruction Mobilization of materials and equipment into constrained area Traffic delays during construction Conflicts with utilities 	 Geotechnical risks South Fork Flathead River Bridge reconstruction Mobilization of materials and equipment into constrained area Traffic delays during construction Conflicts with utilities 	 New river crossings South Fork Flathead River Bridge reconstruction Mobilization of materials and equipment into constrained area Traffic delays during construction 	New river crossings Mobilization of materials and equipment into constrained area Traffic delays during construction	 Steep terrain Geotechnical risks South Fork Flathead River Bridge reconstruction Mobilization of materials and equipment into constrained area Conflicts with utilities
Potentially Impacted Resources ⁽²⁾	Impacts to multiple resources adjacent to existing alignment	Impacts to multiple resources adjacent to existing alignment	 Risk of impacts to water source at Berne Memorial Park Impacts to multiple resources adjacent to existing alignment 	 New river crossings Impacts to multiple resound alignment Impacts to multiple resound alignment 	,	 Risk of impacts to water source at Berne Memorial Park Impacts to multiple resources adjacent to existing bridge and along new alignment
Right-of-Way (RW) Acquisition / Easements	much DNRC easement at river crossing USFS easement at RP 140.2± and at eastern end of corridor much Railro DNRC river cr USFS			 New RW throughout much of corridor Railroad involvement DNRC easements at river crossings USFS easement at eastern end of corridor 	 New RW throughout majority of corridor Railroad involvement DNRC easements at river crossings 	 New RW throughout majority of corridor Utility involvement DNRC easement at river crossing USFS easement at eastern end of corridor
Community Support ⁽³⁾	More Support	More Support	More Support	Less Support	Less Support	Less Support
Recommendation	Advance	Advance	Eliminate from Further Consideration	Eliminate from Further Consideration	Eliminate from Further Consideration	Eliminate from Further Consideration

Source: DOWL HKM, 2012. Note: Shading indicates failure to meet criteria.

⁽¹⁾ Estimates indicate capital construction costs for spot improvements; reconstruction of existing alignment, including existing South Fork Flathead River Bridge; and/or construction of new alignment. Alignment 1 includes a two-lane configuration (with a two-lane South Fork Flathead River Bridge). Alignment 2 includes two-, three-, and four-lane configurations (with a two- or four-lane South Fork Flathead River Bridge). Alignments 3 through 6 include a four-lane configuration (with a four-lane South Fork Flathead River Bridge, where appropriate). Planning level estimates should not be considered an actual cost encompassing all scenarios and circumstances. Estimates do not include potential costs associated with right-of-way acquisition, utility relocation, preliminary engineering, or operations and maintenance. Cost estimate tables are provided in Appendix 2.

Planning level summary does not provide a comprehensive list of issues. Further analysis would be required during project development.

(3) Indication of community support is based on feedback provided during informational meetings held in Columbia Falls and Hungry Horse and written comments submitted during the study.



3.0 ALIGNMENTS ADVANCED

3.1 Alignment 1

This section identifies potential improvements that could be implemented along the existing US 2 alignment (Alignment 1) before roadway reconstruction throughout the corridor.

3.1.1 Access Management

Berne Memorial Park attracts members of the public and visitors wishing to access picnic areas and the Flathead River. Safety improvements at Berne Memorial Park could include vehicle turn lanes or median treatments to limit turning movements into and out of the park. A median barrier could be constructed at Berne Memorial Park that would only allow EB right-in and right-out movements and eliminate safety issues associated with left-turn movements. Concrete barrier could also be placed adjacent to the Berne Memorial Park parking area to designate a single point of access.

Potential Locations

RP 140.8± to RP 141.0± (South Side of US 2)

Planning Level Cost Estimate

\$100,000 to \$150,000

Recommended Implementation Timeframe

Short-term

Potentially Impacted Resources and Right-of-Way Requirements

Impacts to Section 4(f) recreational resources may occur. Additional study would be needed to quantify specific impacts.

3.1.2 Bicycle/Pedestrian Facilities

Community members expressed support for improved pedestrian and bicycle access within the study corridor. Currently, the roadway's narrow or non-existent shoulders do not encourage non-motorized use. A bi-directional path could be constructed near or immediately adjacent to the existing roadway, providing a dedicated facility for non-motorized users. The facility could be constructed to the north or south of the existing roadway, although a facility to the south may minimize the need for crossings by providing access to Berne Memorial Park and connecting to existing trail systems. Portions of the dedicated facility could be implemented before roadway reconstruction throughout the corridor. Due to physical constraints including the Flathead River and rock outcroppings, a dedicated facility within the most constrained



portion of the corridor would need to be designed and implemented in coordination with roadway reconstruction.

An elevated pedestrian bridge could be constructed to allow access across US 2. The structure would need to incorporate ramps and landings in compliance with the Americans with Disabilities Act (ADA). The required ramp and landing dimensions may be difficult to accommodate given physical constraints within the corridor.

The specific location of a dedicated bicycle/pedestrian facility, the potential need for crossings in the corridor, and compatibility with roadway reconstruction would need to be determined during project development.

Potential Locations

Dedicated Bicycle/Pedestrian Facility: Throughout Corridor (North or South Side of US 2) Bicycle/Pedestrian Overcrossing: RP 140.8± (North & South Sides of US 2)

Planning Level Cost Estimate

Dedicated Bicycle/Pedestrian Facility: \$3.6 million to \$6.6 million (entire corridor) Bicycle/Pedestrian Overcrossing: \$1.0 million to \$2.5 million per location

Recommended Implementation Timeframe

Mid- to long-term

Potentially Impacted Resources and Right-of-Way Requirements

Impacts to the Flathead River, wetland areas, floodplains, fish and wildlife species and habitat, farmlands, vegetation, Section 4(f) cultural/archaeological resources and recreational resources, geologic features, and visual resources may occur. Additional study would be needed to quantify specific impacts. Environmental permitting would be required.

3.1.3 Drainage

Based on field observations and previous reports, there are a number of drainage issues within the constrained portion of the corridor. Surface water ponding occurs seasonally near Berne Memorial Park due to a flat roadway cross slope, the lack of drainage ditches, and plugged or buried culverts. One of the areas of concern lies east of the park, directly below the east rock overhang. This area frequently collects water from melting ice and snow on the rock ledge, at times creating icy conditions on the roadway below.



Plugged or buried culverts could be replaced to improve drainage conditions in the canyon. New ditches or concrete valley gutters could be constructed adjacent to the edge of pavement on US 2 at the Berne Memorial Park parking lot to maximize the amount of collected surface water. Additional drainage features could also be incorporated along the east rock overhang to remove standing water from the roadway.

Potential Locations

Install Culverts: RP 140.8±, RP 141.1±, RP 141.2±, and RP 142.0± (North & South Sides of

US 2)

Re-grade Ditches: RP 140.8±, RP 140.9±, and RP 141.8± (South Side of US 2)

Install Valley Gutter: RP 141.0± (South Side of US 2)

<u>Planning Level Cost Estimate</u>

Install Culverts: \$4,000 to \$10,000 per location Re-grade Ditches: \$1,000 to \$15,000 per location

Install Valley Gutter: \$3,000 to \$5,000

Recommended Implementation Timeframe

Short-term

Potentially Impacted Resources and Right-of-Way Requirements

None

3.1.4 Parking

The parking area at the existing fishing access site at RP 140.2± could be further developed to provide additional parking opportunities and river access within the corridor. The parking area could be linked to the dedicated bicycle/pedestrian facility discussed above to allow non-motorized users to park their vehicles at the western end of the corridor and walk or bicycle through the corridor. Coordination with USFS would be required.

Potential Location

RP 140.2± (North Side of US 2)

Planning Level Cost Estimate

\$400,000 to \$500,000

Recommended Implementation Timeframe

Short-term

Potentially Impacted Resources and Right-of-Way Requirements

Impacts to vegetation, Section 4(f) recreational resources, and visual resources may occur. Additional study would be needed to quantify specific impacts.



3.1.5 Roadside Safety

Guardrail issues were observed during the field investigation conducted for this study. W-beam guardrail is the primary guardrail style used in the corridor. Some end treatments were observed with one-way departure terminal sections adjacent to two-lane traffic. These end sections could be updated to standard terminal sections, reducing the severity of possible crashes.

Potential Locations

RP 140.3±, RP 141.9±, and RP 142.3± (North & South Sides of US 2)

Planning Level Cost Estimate

\$3,000 to \$5,000 per location

Recommended Implementation Timeframe

Short-term

Potentially Impacted Resources and Right-of-Way Requirements

None

3.1.6 Rockfall Prevention

Community members and MDT maintenance personnel have described incidents involving rocks and debris falling onto the roadway from adjacent rock outcroppings. Two possible rockfall prevention options were considered for this study. Additional options could be considered at the project level.

Wire mesh netting could be installed on rock outcroppings south of US 2 at RP 140.7± (west of Berne Memorial Park) and RP 141.1± (east of Berne Memorial Park). The netting would provide protection from rocks and debris that may fall onto the roadway. Alternately, rock bolts could be installed in the areas noted above. Rock bolts could be drilled into the rock outcroppings and backfilled with grout to secure the rock face, reducing the likelihood of falling rocks while minimizing visual impacts. Additional geotechnical investigations may be needed during the project development process to determine the feasibility of these options. Potential cultural or visual mitigation measures are not included in the planning level cost estimate listed below.

Potential Locations

RP 140.7± and RP 141.1± (South Side of US 2)

Planning Level Cost Estimate

\$200,000 to \$1.0 million per location



Recommended Implementation Timeframe

Short-term

Potentially Impacted Resources and Right-of-Way Requirements

Impacts to Section 4(f) cultural/archaeological resources, geologic features, and visual resources would occur. Additional study would be needed to quantify specific impacts.

3.1.7 Rumble Strips

Application of shoulder and centerline rumble strips on two-lane highways has been shown to reduce the incidence and severity of roadway departure crashes. Shoulder and centerline rumble strips commonly consist of parallel grooves cut into the roadway. Shoulder and centerline rumble strips in combination with appropriate pavement markings can alert drowsy, inattentive, or impaired drivers who unintentionally stray across the roadway centerline or off the edge of the roadway. The audible sound and physical vibration alert drivers, improving driver reaction and increasing the likelihood for a safe return to the travel lane. Centerline rumble strips can also assist drivers in identifying lane delineations during low visibility conditions. Continuous application of shoulder and centerline rumble strips is recommended within the US 2 corridor.

Potential Locations

Throughout corridor

Planning Level Cost Estimate

\$2,100 to \$2,700 per mile

Recommended Implementation Timeframe

Short-term

Potentially Impacted Resources and Right-of-Way Requirements

None

3.1.8 Sight Distance

Trees and shrubs limit sight distance for motorized users in several locations within the corridor. Clearing, grubbing, and tree trimming could improve safety by increasing sight distance around tight horizontal curves.

Potential Locations

RP 140.9±, RP 141.3±, and RP 142.0± (North & South Sides of US 2)

Planning Level Cost Estimate

\$9,000 to \$30,000 per location



Recommended Implementation Timeframe

Short-term

Potentially Impacted Resources and Right-of-Way Requirements

Impacts to the wetland areas, wildlife species and habitat, vegetation, and visual resources may occur. Additional study would be needed to quantify specific impacts.

3.1.9 South Fork Flathead River Bridge

The South Fork Flathead River Bridge is classified as functionally obsolete and structurally deficient. In the interim period before roadway reconstruction occurs in the corridor, MDT could pursue bridge replacement to provide a safe and functional structure crossing the South Fork of the Flathead River. As supported by future NEPA/MEPA efforts, MDT could initially replace the existing South Fork Flathead River Bridge with a new two-lane bridge. Ultimately, a single four-lane bridge or dual two-lane bridges are recommended to transition into the four existing travel lanes in Hungry Horse and allow flexibility during the design life of the structure. A four-lane bridge (or two two-lane structures) would allow MDT to consider roadway widening within the corridor without the need to replace the bridge(s). A dedicated bicycle/pedestrian facility on the north or south side of the bridge could tie into existing trail systems and a new dedicated non-motorized facility throughout the corridor. Compatibility with other corridor improvements would need to be considered during project development.

Potential Location

RP 142.1±

Plannina Level Cost Estimate

\$9.7 million to \$27.3 million depending on lane configuration

Recommended Implementation Timeframe

Short- to mid-term

Potentially Impacted Resources and Right-of-Way Requirements

Impacts to the Flathead River, wetland areas, floodplains, fish and wildlife species and habitat, farmlands, vegetation, cultural/archaeological resources, recreational resources, and visual resources may occur. Additional study would be needed to quantify specific impacts. Environmental permitting would be required.

3.1.10 Traffic Control

Community members expressed support for additional static warning signs and/or variable message signs (VMS). Static signage could include miscellaneous warning signs such as turning roadway signs and share the road signs installed adjacent to the edge of the travel way or on



overhead poles. Overhead static signs could also include warning beacons to further warn travelers. Permanent or temporary VMS could warn motorists of safety concerns, such as falling rocks, icy roads, or accidents and inform motorists of bicycle/pedestrian use in the canyon. Two VMS styles currently utilized on Montana highways include small temporary signs mounted on portable trailers and larger permanent signs on metal poles, both placed adjacent to the roadway. A third VMS style incorporates overhead metal pole structures spanning the roadway. The overhead style is typically used on Interstate or multi-lane facilities, but could be adjusted to fit a narrower roadway. All three VMS systems are capable of being controlled via manual entry or via remote radio connectivity.

Potential Locations

Static sign: RP 140.0±, RP 140.2±, RP 140.4±, RP 140.6±, RP141.0±, RP 141.1±, and RP

142.4± (North & South Sides of US 2)

Variable message sign: RP 140.0±, RP 142.3± (North & South Sides of US 2)

Planning Level Cost Estimate

Static sign: \$500 to \$1,000 per location

Variable message sign: \$20,000 to \$250,000 per location

Recommended Implementation Timeframe

Short-term

Potentially Impacted Resources and Right-of-Way Requirements

None

3.1.11 Wildlife Passage

The US 2 corridor lies in proximity to national forest land and the Flathead River. Wildlife species migrate between mountain ranges to the north and south, creating potential safety issues for motorized vehicles. In a written comment submitted to MDT, U.S. Fish and Wildlife Service (USFWS) noted Badrock Canyon is a known wildlife movement area. USFWS requested consideration of measures to facilitate wildlife movement while improving highway safety.

In an effort to reduce animal-vehicle conflicts, wildlife crossing options were evaluated to determine the appropriate type and location within the corridor. Based on known wildlife movements, a crossing would likely provide the greatest benefit at the western end of the corridor (RP 140.0± to RP 140.4±) before the corridor narrows. At-grade, elevated, and belowgrade concepts were analyzed. At-grade fencing could be used to direct wildlife to a designated below-grade crossing point. A below-grade crossing would be preferred over an elevated option



due to lower anticipated costs and reduced visual impacts. A preliminary analysis of survey data collected for the FEIS effort indicates a wildlife undercrossing could be constructed at the western end of the corridor without altering the current roadway grade. Planning level cost estimates do not reflect roadway grade alterations. This planning level determination would need to be confirmed during the project development phase.

Potential Location

RP 140.2± (North & South Sides of US 2)

Planning Level Cost Estimate

\$920,000 to \$1.1 million

Recommended Implementation Timeframe

Short- to mid-term

Potentially Impacted Resources and Right-of-Way Requirements

Impacts to floodplains, farmlands, vegetation, and visual resources may occur. Additional study would be needed to quantify specific impacts.

3.2 Alignment 2

3.2.1 Structure Types

Alignment 2 would widen the existing US 2 roadway to meet current MDT design standards where practicable. This would entail, at a minimum, shoulders. Alignment 2 improvements could also include additional travel lanes and a dedicated left-turn bay at Berne Memorial Park. The need for a structure within the most constrained portion of the corridor (140.6± to RP 141.2±) was identified in an effort to accommodate roadway widening while avoiding cutting or blasting the face of rock outcroppings.

Rock cutting/blasting activities are undesirable for several reasons. First, the rock in Badrock Canyon is known to be unstable. The Badrock outcroppings exhibit multiple tension cracks, some as wide as two feet running parallel to US 2. The MDT Geotechnical Section has noted these tension cracks increase the potential for large scale failure if the rock face is cut or blasted.

Secondly, the CSKT consider the entire Badrock Canyon to have special historical and cultural significance, and the canyon cliffs are extremely important to CSKT members. In part due to new information about historical/archaeological and Section 4(f) resources identified after



completion of the FEIS, the Re-evaluation found the FEIS did not adequately assess an alignment that would minimize or totally avoid rock excavation near Berne Memorial Park.

Lastly, community members and CSKT representatives have expressed strong support for maintaining the water feature at Berne Memorial Park. In their comments provided to MDT, USACE noted springs are an important aquatic resource in the state of Montana. Additional study would be needed to determine if cutting or blasting the rock would result in impacts to the water source at Berne Memorial Park.

For these reasons, at-grade and elevated structure options were identified to allow roadway widening while avoiding impacts to the canyon rock face. These options are described in more detail below.

Cantilevered Structure

A cantilevered structure could be used to widen the roadway without impacting the rock outcrops within Badrock Canyon. Roadway widening could occur in the direction of the Flathead River, with the cantilevered structure extending over the water body. The structure would require retaining walls or pile walls within the floodplain to support traffic loads and a thickened reinforced concrete slab serving as the road surface. The roadway would remain at or close to its existing grade. Access to Berne Memorial Park could be maintained, although access to the Flathead River may be restricted where the cantilevered structure would extend over the existing river bank.

A transition from the at-grade roadway typical section to the cantilevered section would be required. The cantilevered section would incorporate concrete barrier rail adjacent to the Flathead River, matching new metal guardrail adjacent to the pavement section.

The cantilevered structure would vary in width depending on the number of travel lanes associated with Alignment 2. An example of a two-lane cantilevered structure is illustrated in Figure 3-1. Figures illustrating additional cantilevered structure variations are included in Appendix 3.



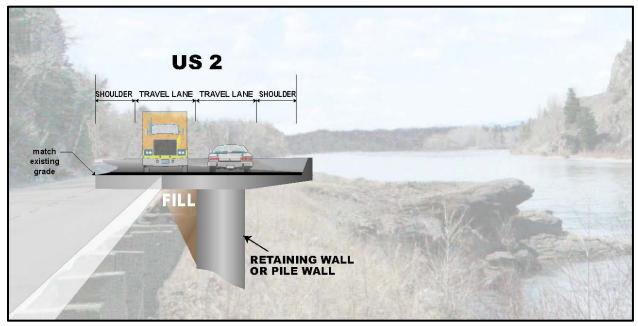


Figure 3-1 Two-Lane Cantilevered Structure

Source: DOWL HKM, 2012.

Elevated Structure

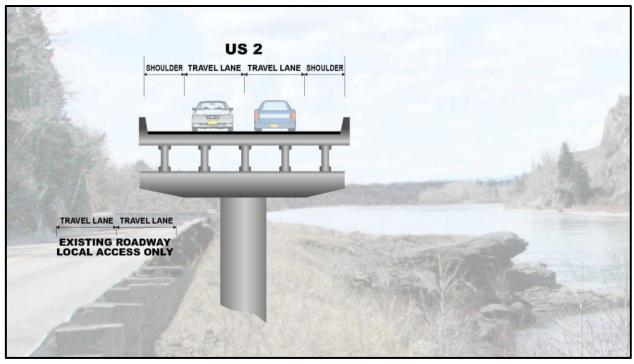
An elevated structure could be constructed above the current US 2 roadway grade to avoid impacting the rock outcrops. The elevated structure could be constructed using precast concrete decking sitting atop concrete piers. Piers would be placed north of the existing US 2 roadway within the floodplain. The existing US 2 roadway could remain in place to provide local access to Berne Memorial Park and the Flathead River.

A transition from the at-grade roadway typical section to the elevated section would be required. Retaining walls could be used to raise the paved section and transition to the elevated structure while minimizing the footprint at ground level. The existing roadway profile drops in elevation through the constrained portion of the corridor at the point closest to the Flathead River. This would allow shorter transitions from the existing profile to the finished raised profile of the elevated structure.

The elevated structure would vary in width depending on the number of travel lanes. An example of a two-lane elevated structure is illustrated in Figure 3-2. Figures illustrating additional elevated structure variations are included in Appendix 3.



Figure 3-2 Two-Lane Elevated Structure



Source: DOWL HKM, 2012.

3.2.2 Structure Screening

Cost

Table 3.1 presents planning level cost estimate ranges for cantilevered and elevated structures. Based on guidance provided by the MDT Bridge Bureau, conservative unit costs of \$125 and \$175 per square foot were assumed for cantilevered and elevated structures, respectively.

Table 3.1 Planning Level Cost Estimates –Structures

Structure Type	Planning Level Estimate of Costs ⁽¹⁾
Cantilevered Structure & Transition Sections	\$22.0M to \$63.9M
Elevated Structure & Transition Sections	\$71.5M to \$138.0M

Source: DOWL HKM, 2012.

⁽¹⁾ Cost estimates are provided in 2012 dollars and reflect anticipated construction costs only. Costs reflect planning level estimates, and should not be considered an actual cost encompassing all scenarios and circumstances. Cost estimates do not include potential costs associated with right-of-way acquisition, utility relocation, preliminary engineering, or operations and maintenance. Cost estimate tables are provided in Appendix 2.



The planning level cost estimate for a cantilevered structure and transition sections within the most constrained portion of the corridor (140.6± to RP 141.2±) ranges from \$22.0 million for a two-lane structure to \$63.9 million for a four-lane structure.

By comparison, an elevated structure and transition sections within the most constrained portion of the corridor (140.6± to RP 141.2±) is estimated to range from \$71.5 million for a two-lane structure to \$138.0 million for a four-lane structure, two to three times the low and high cost estimates for a cantilevered structure, respectively. For this reason, the cost of an elevated structure is not considered practicable.

Community Support

Community members were somewhat supportive of a cantilevered structure that would maintain access to Berne Memorial Park. Less support was expressed for an elevated structure as it would eliminate direct access to Berne Memorial Park from US 2. Concern was also expressed that an elevated structure would block views of the canyon and create wintertime maintenance difficulties.

Screening Summary – Alignment 2 Structures

Table 3.2 summarizes the structure screening. Orange shading indicates failure to pass a screening criterion. Based on failure to meet criteria relating to cost and community support, elevated structure options are eliminated from further consideration and will not be discussed further in this report. A cantilevered structure is advanced, with additional discussion of potential Alignment 2 options provided later in this chapter.



Table 3.2 Screening Summary –Structures (Alignment 2)

	Alignment 2						
Criteria	Cantilevered Structure (RP 140.6± to RP 141.2±)	Elevated Structure (RP 140.6± to RP 141.2±)					
Planning Level Estimate of Costs ⁽¹⁾	\$22.0M to \$63.9M	\$71.5M to \$138.0M					
Community Support ⁽²⁾	More Support	Less Support					
Recommendation	Advance	Eliminate from Further Consideration					

Source: DOWL HKM, 2012.

Note: Shading indicates failure to meet criteria.

(2) Indication of community support is based on feedback provided during informational meetings held in Columbia Falls and Hungry Horse and written comments submitted during the study.

3.2.3 Lane Configurations

Lane configurations considered for Alignment 2 are presented in the following sections. Configurations include two-lane, three-lane, and four-lane segments.

All options would include shoulders in accordance with current MDT and American Association of State Highway and Transportation (AASHTO) guidelines. Shoulder width has also been shown to affect safety performance. Shoulders allow errant vehicles to correct their path and return to the travel lane without leaving the paved surface. Shoulders provide an opportunity for vehicles to pull over in emergency situations and enable speed limit enforcement by providing locations for law enforcement officers to pull over speeding drivers. A wider top width can also improve sight distance, allowing drivers to detect objects and animals in the roadway.

A dedicated WB left-turn bay at Berne Memorial Park (RP 140.9±) could be incorporated in any of the lane configurations. A left-turn bay would allow upstream traffic to continue without delay and provide an exclusive lane from which to wait for a gap in opposing traffic to safely execute a left turn.

A dedicated bicycle/pedestrian facility could also be incorporated with any of the lane configurations. The facility could be constructed to the north or south of the existing roadway,

⁽¹⁾ Estimates indicate capital construction costs for cantilevered and elevated structures within the most constrained portion of the corridor (RP 140.6± to RP 141.2±). Costs reflect planning level estimates, and should not be considered an actual cost encompassing all scenarios and circumstances. Estimates do not include potential costs associated with right-of-way acquisition, utility relocation, preliminary engineering, or operations and maintenance. Cost ranges include two-lane, three-lane, and four-lane structures and transitions sections only and do not include costs for reconstruction of the entire corridor. Cost estimate tables are provided in Appendix 2.



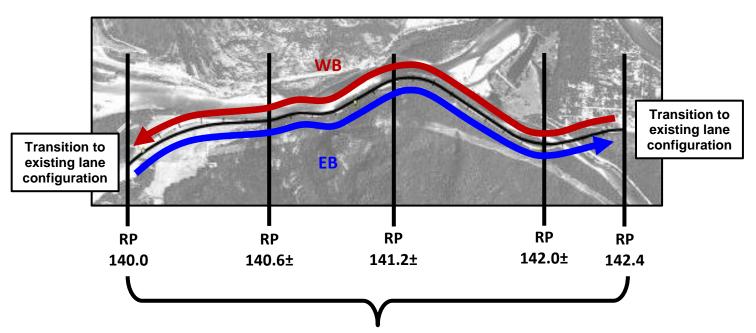
although a facility to the south may minimize the need for crossings by providing access to Berne Memorial Park and connecting to the existing trail systems.

Appropriate transitions would be needed at both ends of the corridor to tie into existing lane configurations in Columbia Heights and Hungry Horse.

Two-Lane Configuration

The US 2 facility could be reconstructed along Alignment 2 with a single travel lane in each direction through the corridor, as is currently provided. The reconstructed roadway would meet current MDT design standards where practicable, including shoulders throughout the study area and a new two-lane bridge replacing the existing South Fork Flathead River Bridge. Figure 3-3 illustrates a two-lane configuration. Typical section figures are provided in Appendix 3.

Figure 3-3 Two-Lane Configuration



2 Travel Lanes Throughout Corridor

(One Travel Lane in Each Direction; $\it Cantilevered Structure$ from RP 140.6 \pm to RP 141.2 \pm ; Two-Lane South Fork Flathead River Bridge)

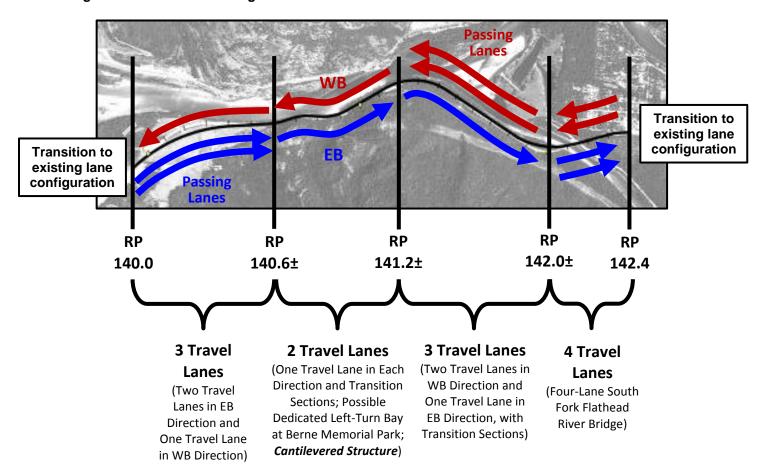


Three-Lane / Two-Lane Configuration with Four-Lane South Fork Flathead River Bridge

A combination of three-lane and two-lane sections was identified to improve passing opportunities while minimizing potential impacts. Passing opportunities (two travel lanes in the same direction) would be provided before traffic enters the most constrained portion of the corridor (RP 140.6± to RP 141.2±). Passing lanes would be provided in the EB direction from RP 140.0 to RP 140.6± and from RP 141.2± to RP 142.0± in the WB direction. A single travel lane would be provided in the opposing direction of travel in these locations. One travel lane in each direction (with transition sections) would be provided to minimize the roadway footprint from RP 140.6± to RP 141.2±.

A new four-lane South Fork Flathead River Bridge would connect to the four existing travel lanes within Hungry Horse. A four-lane bridge would allow MDT to consider further roadway widening within the corridor during the design life of the structure without the need to replace the bridge. Figure 3-4 illustrates the 3-2-3-4 configuration.

Figure 3-4 3-2-3-4 Configuration



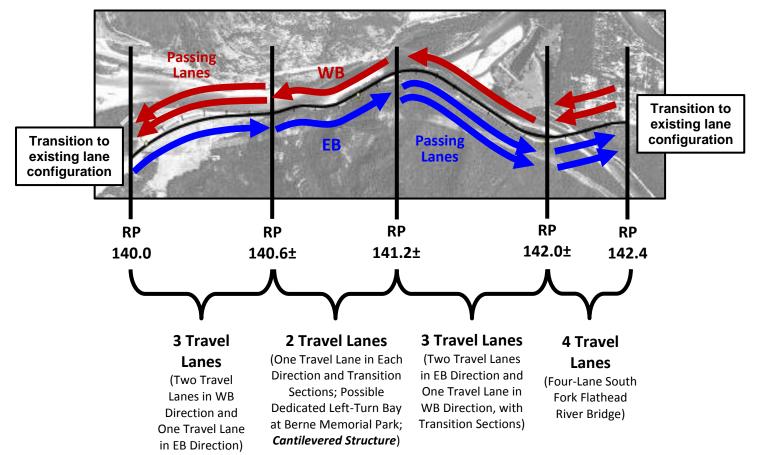


Reverse Three-Lane / Two-Lane Configuration with Four-Lane South Fork Flathead River Bridge

A reverse 3-2-3-4 configuration was identified that would provide passing lanes after traffic volumes exit the most constrained portion of the corridor (RP 140.6± to RP 141.2±). Passing lanes would be provided from RP 140.0 to RP 140.6± in the WB direction and from RP 141.2± to RP 142.0± in the EB direction. All other features of the 3-2-3-4 configuration would remain the same. This configuration would provide passing lanes after (i.e., heading away from) the most constrained portion of the corridor with the intent of potentially providing safer transitions from one-lane to two-lane sections.

As with the 3-2-3-4 configuration, a new four-lane South Fork Flathead River Bridge would be constructed to allow flexibility during the design life of the structure. Figure 3-5 illustrates the reverse 3-2-3-4 configuration.

Figure 3-5 Reverse 3-2-3-4 Configuration

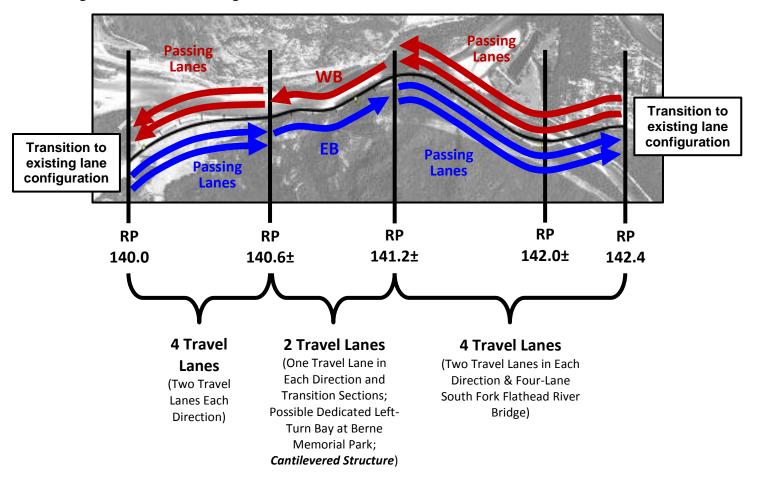




Four-Lane / Two-Lane Configuration

A 4-2-4 configuration was identified to improve passing opportunities while minimizing potential resource impacts. A 4-2-4 would provide four travel lanes on the western end (140.0 to 140.6±) and eastern end (RP 141.2± to RP 142.4) of the corridor, while providing two travel lanes through the most constrained portion of the corridor (RP 140.6± to RP 141.2±). A fourlane South Fork Flathead River Bridge would be provided with this configuration. Figure 3-6 illustrates the 4-2-4 configuration.

Figure 3-6 4-2-4 Configuration

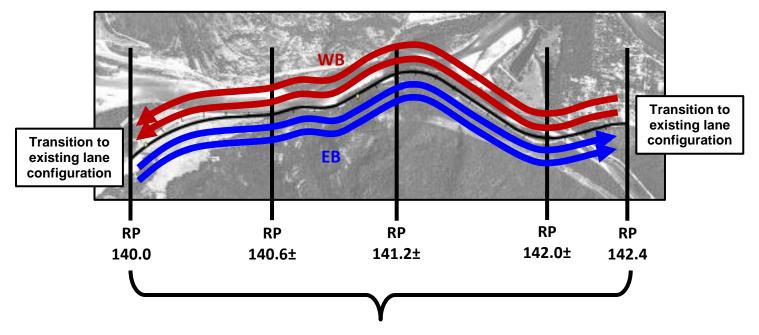


Four-Lane Configuration

A configuration with four travel lanes throughout the corridor was identified to provide corridor-wide safety and operational improvements. Figure 3-7 illustrates a four-lane configuration.



Figure 3-7 Four-Lane Configuration



4 Travel Lanes Throughout Corridor

(Two Travel Lanes in Each Direction; *Cantilevered Structure* from RP 140.6± to RP 141.2±; Four-Lane South Fork Flathead River Bridge)

3.2.4 Lane Configuration Screening

Cost

Table 3.3 provides planning level cost estimates for each lane configuration. All estimates include a cantilevered structure within the most constrained portion of the corridor (RP 140.6± to RP 141.2±).



Table 3.3 Planning Level Cost Estimates for Alignment 2 Lane Configurations

Configuration ⁽¹⁾	Planning Level Estimate of Costs ⁽²⁾
Two-Lane Configuration	\$35.9M to \$59.1M
3-2-3-4 Configuration	\$48.0M to \$86.8M
Reverse 3-2-3-4 Configuration	\$48.0M to \$86.8M
4-2-4 Configuration	\$57.2M to \$90.9M
Four-Lane Configuration	\$65.0M to \$110.2M

Source: DOWL HKM, 2012.

Operations

Traffic conditions on transportation facilities are commonly evaluated using the Level of Service (LOS) concept. The Highway Capacity Manual (HCM) 2010 defines LOS as a classification of performance measured on an A to F scale, with LOS A representing the best operating conditions from the traveler's perspective and LOS F representing the worst. Within the study corridor, US 2 falls under the HCM classification of a Class II two-lane highway. Class II two-lane highways commonly pass through rugged or scenic areas where motorists do not necessarily expect to travel at high speeds. The HCM defines LOS for Class II two-lane highway on the basis of the "percent time-spent-following" (PTSF) concept. PTSF represents the freedom to maneuver and the comfort and convenience of travel. It reflects the average percentage of time that vehicles must travel in platoons behind slower vehicles due to an inability to pass. As more drivers are caught in a platoon behind a slow-moving vehicle, they will desire to make more passing maneuvers. The two major factors affecting PTSF include passing capacity and passing demand. The concept of passing capacity for a two-lane highway reflects that the ability to pass is limited by the opposing traffic flow rate and the distribution of gaps within the opposing flow. The concept of passing demand reflects that the desire or demand to pass increases as the platoon of cars lengthens behind a slow-moving vehicle (i.e., as PTSF increases in a given direction). Both passing capacity and passing demand are related to flow rates. When traffic flow in both directions increases, passing demand increases and passing capacity

⁽¹⁾ Cantilevered structure assumed within most constrained portion of corridor (RP 140.6± to RP 141.2±).

⁽²⁾ Estimates indicate capital construction costs for roadway reconstruction, including replacement of the existing South Fork Flathead River Bridge and construction of a dedicated bicycle/pedestrian facility. Costs reflect planning level estimates, and should not be considered an actual cost encompassing all scenarios and circumstances. Estimates do not include potential costs associated with right-of-way acquisition, utility relocation, preliminary engineering, or operations and maintenance. Cost estimate tables are provided in Appendix 2.



decreases. The entire study corridor is currently striped as a no passing zone, eliminating passing opportunities and negatively affecting LOS.

For a Class II two-lane highway, six LOS categories ranging from A to F are used to describe traffic operations, with LOS A representing the best conditions and LOS F representing the worst. LOS F exists whenever demand flow in one or both directions exceeds the capacity of the segment, operating conditions are unstable, and heavy congestion exists.

Table 3.4 presents LOS criteria for Class II two-lane highway segments.

Table 3.4 LOS Criteria for Class II Two-lane Highways

Level of Service	Class II Two-lane Highways PTSF ⁽¹⁾ (%)
Α	≤40.0
В	>40.0 to 55.0
С	>55.0 to 70.0
D	>70.0 to 85.0
E	>85
F	Demand Exceeds Capacity

Source: HCM 2010, Exhibit 15-3 Automobile LOS for Two-lane Highways.

Highway Capacity Software (HCS) Version 2010 was used to analyze LOS for a Class II two-lane highway in the corridor. Appendix 4 includes HCS analysis worksheets.

The percentage of heavy vehicles in the traffic stream was considered as part of the HCS analysis. The HCM defines heavy vehicles as vehicles that have more than four tires touching the pavement. Trucks, buses and recreational vehicles (RVs) are examples of heavy vehicles. Trucks cover a wide range of vehicles, from lightly loaded vans and panel trucks to the most heavily loaded haulers.

The entry of heavy vehicles into the traffic stream affects the number of vehicles that can be served in two ways. They are larger than passenger cars and occupy more roadway space and they also have poor operating capabilities compared to passenger cars, particularly with respect to acceleration, deceleration, and the ability to maintain speed on upgrades. The inability of heavy vehicles to keep pace with passenger cars in many situations creates large gaps in the

⁽¹⁾ Percent time-spent-following



traffic stream. The resulting inefficiencies in the use of roadway space may be especially pronounced in the study corridor due to the absence of passing opportunities.

Table 3.5 presents the predicted results of the Class II two-lane highway operational analysis for peak season and adjusted annual average (2035) conditions for an average week (Monday – Sunday). Analysis results assume the entire corridor would remain striped as a no passing zone. Results for morning, evening, and off-peak hours are reported.

Table 3.5 Class II Two-lane Highway Operational Analysis Results (2035)

		Existing 2-La	ane Section			
	Analysis Period	RP 140.0 to RP 142.4				
		PTSF(1) (%)	LOS			
	AM Peak Hour EB	84.4	D			
	AM Peak Hour WB	71.6	D			
Peak	Median Off-Peak Hour EB	81.9	D			
Season	Median Off-Peak Hour WB	77.2	D			
	PM Peak Hour EB	75.4	D			
	PM Peak Hour WB	89.4	Е			
	AM Peak Hour EB	69.8	С			
	AM Peak Hour WB	57.8	С			
Adjusted Annual	Median Off-Peak Hour EB	69.1	С			
Annual	Median Off-Peak Hour WB	65.1	С			
	PM Peak Hour EB	60.0	С			
	PM Peak Hour WB	75.5	D			

Source: DOWL HKM, 2011.

(1) Percent time-spent-following

The MDT Traffic Engineering Manual identifies the minimum desirable LOS for a principal arterial facility in rolling terrain as LOS B. Using this criterion, the US 2 corridor is predicted to operate at an undesirable LOS C to LOS E by 2035, depending on the hour, direction, and season.

The capacity of a highway corridor is governed by its narrowest cross section. Passing lanes provided at regular intervals in each direction of travel can improve LOS by decreasing PTSF. PTSF is improved by allowing platoons in the direction of the passing lane to disperse through unrestricted passing for the length of the passing lane. Passing lanes can eliminate the formation of long platoons behind a slower-moving vehicle and provide operational benefits for



some distance downstream before PTSF returns to its former level (without the passing lane). This is described as the downstream effect. Passing lanes currently exist outside the study area at both ends of the corridor, however their downstream effect is partially negated due to slower speed limits within the communities of Columbia Heights and Hungry Horse.

Another method to improve LOS in the corridor is to provide additional capacity by widening the facility from a two-lane highway to a four-lane highway with two travel lanes in each direction.

The HCM defines LOS for multilane highways on the basis of density. Density is defined as the proximity to other vehicles and is related to the freedom to maneuver within the traffic stream (or the number of passenger cars per mile per lane). Table 3.6 presents LOS criteria for multilane highway segments.

Table 3.6 LOS Criteria for Multilane Highways

Level of Service	Density (pc/mi/ln) ⁽¹⁾
Α	>0 to 11.0
В	>11.0 to 18.0
С	>18.0 to 26.0
D	>26 to 35
E	>35 to 45
F	Demand Exceeds Capacity

Source: HCM 2010, Exhibit 14-4 Automobile LOS for Multilane Highway Segments. (1) pc/mi/ln: passenger cars per mile per lane

LOS F occurs when the demand flow rate exceeds capacity. In such cases, density values will be above the threshold shown for LOS E, although specific values cannot be determined.

The following sections discuss predicted operations for each lane configuration. A dedicated WB left-turn bay at Berne Memorial Park (RP 140.9±) could be incorporated with any of the lane configurations. A left-turn bay would provide incremental operational improvements only for WB traffic volumes. Appendix 4 includes HCS analysis worksheets indicating predicted operations with and without a WB left-turn bay at Berne Memorial Park.



Two-Lane Configuration

A two-lane configuration with shoulders in accordance with current MDT design standards would provide no improvement in LOS compared to the existing two-lane configuration. Although shoulders would likely improve safety in the corridor, they would not improve passing conditions, PTSF, or LOS values.

Three-Lane / Two-Lane Configuration with Four-Lane South Fork Flathead River Bridge
Table 3.7 presents the predicted operations of a 3-2-3-4 configuration in 2035. A 3-2-3-4
configuration would improve corridor operations by at least one LOS value in both directions
during peak and off-peak hours of the day. The corridor is generally predicted to operate at an
acceptable LOS A or B during most times of the year, and narrowly exceed the LOS C threshold
in the peak season during the AM peak hour in the EB direction and the PM peak hour in the
WB direction by 2035.

A 3-2-3-4 configuration would result in an improvement over the existing two-lane configuration by providing passing lanes in each direction before traffic volumes enter the most constrained portion of the corridor, allowing vehicle queues to disperse. The portion of the corridor from RP 140.0 to RP 142.0± can be assessed as a single segment due to the downstream effect created by the passing lanes in the 3-2-3-4 configuration.



Table 3.7 Projected Operational Analysis Results: 3-2-3-4 Configuration (2035)

		Existing 2-l Section		3-2-3-4 Configuration					
	Analysis Period	RP 140.0 RP 142.		RP 140.0 RP 142.0		RP 142.0± to RP 142.4			
		PTSF ⁽¹⁾ (%)	LOS	PTSF ⁽¹⁾ (%)	LOS	Density (pc/mi/ln) ⁽²⁾	LOS		
	AM Peak Hour EB	84.4	D	57.0	С	8.0	Α		
	AM Peak Hour WB	71.6	D	45.2	В	5.4	Α		
Peak	Median Off-Peak Hour EB	81.9	D	54.8	В	7.3	Α		
Season	Median Off-Peak Hour WB	77.2	D	48.9	В	6.5	Α		
	PM Peak Hour EB	75.4	D	49.3	В	6.0	Α		
	PM Peak Hour WB	89.4	Е	58.8	С	10.1	Α		
	AM Peak Hour EB	69.8	С	45.0	В	4.0	Α		
	AM Peak Hour WB	57.8	С	34.5	Α	2.7	Α		
Adjusted Annual	Median Off-Peak Hour EB	69.1	С	44.5	В	3.6	Α		
Armuai	Median Off-Peak Hour WB	65.1	С	40.8	В	3.2	Α		
	PM Peak Hour EB	60.0	С	38.0	Α	3.1	Α		
	PM Peak Hour WB	75.5	D	47.6	В	5.1	Α		

Source: DOWL HKM, 2011.

(1) Percent time-spent-following

Reverse Three-Lane / Two-Lane Configuration with Four-Lane South Fork Flathead River Bridge
Table 3.8 presents the predicted operations of a reverse 3-2-3-4 configuration in 2035. A
reverse 3-2-3-4 configuration would improve corridor operations by at least one LOS value
where passing locations are provided after traffic volumes leave the most constrained portion
of the corridor (RP 140.0 to 140.6± in the WB direction and RP 141.2± to 142.4 in the EB
direction). No improvement over the existing two-lane configuration would be provided before
(i.e., headed into) or within the canyon. The location of the passing lanes in the reverse 3-2-3-4
configuration creates a downstream effect extending outside the study corridor. The portion
of the corridor from RP 140.0 to RP 142.0± is assessed as three separate segments due to the
three distinct operational conditions created by the passing lane locations.

⁽²⁾ pc/mi/ln: passenger cars per mile per lane

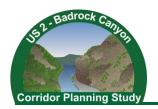


Table 3.8 Projected Operational Analysis Results: Reverse 3-2-3-4 Configuration (2035)

Analysis Period		Existi 2-Lar Secti RP 140	ne on .0 to		Reverse 3-2-3-4 Configuration RP 140.0 to RP 140.6± to RP 141.2± to RP 142.0± to							
		RP 14 PTSF ⁽¹⁾ (%)	LOS	RP 140 PTSF ⁽¹⁾ (%)	LOS	RP 14 ⁻ PTSF ⁽¹⁾ (%)	LOS	RP 14 PTSF ⁽¹⁾ (%)	LOS	RP 142. Density (pc/mi/ln) ⁽²⁾	LOS	
	AM Peak Hour EB	84.4	D	84.4	D	84.4	D	52.3	В	8.0	Α	
	AM Peak Hour WB	71.6	D	43.7	В	71.6	D	71.6	D	5.4	Α	
Peak	Median Off-Peak Hour EB	81.9	D	81.9	D	81.9	D	50.8	В	7.3	Α	
Season	Median Off-Peak Hour WB	77.2	D	47.1	В	77.2	D	77.2	D	6.5	Α	
	PM Peak Hour EB	75.4	D	75.4	D	75.4	D	46.0	В	6.0	Α	
	PM Peak Hour WB	89.4	Е	55.4	С	89.4	Е	89.4	Е	10.1	Α	
	AM Peak Hour EB	69.8	С	69.8	С	69.8	С	42.6	В	4.0	Α	
	AM Peak Hour WB	57.8	С	34.7	Α	57.8	С	57.8	С	2.7	Α	
Adjusted	Median Off-Peak Hour EB	69.1	С	69.1	С	69.1	С	42.2	В	3.6	Α	
Annual Average	Median Off-Peak Hour WB	65.1	С	39.7	Α	65.1	С	65.1	С	3.2	Α	
	PM Peak Hour EB	60.0	С	60.0	С	60.0	С	36.0	Α	3.1	Α	
	PM Peak Hour WB	75.5	D	46.1	В	75.5	D	75.5	D	5.1	Α	

Source: DOWL HKM, 2011.

(1) Percent time-spent-following
(2) pc/mi/ln: passenger cars per mile per lane



Four-Lane / Two-Lane Configuration

Table 3.9 presents the predicted operations of a 4-2-4 configuration in 2035. The four-lane portions at both ends of the corridor would provide substantial operational benefits by giving vehicles an opportunity to pass slower vehicles in both the WB and EB directions. Additionally, a 4-2-4 configuration would provide a downstream effect that would carry throughout the study corridor, resulting in improved LOS within the two-lane section from RP 140.6± to RP 141.2±. The corridor is generally predicted to operate at an acceptable LOS A or B during most times of the year, and narrowly exceed the LOS C threshold in the peak season during the PM peak hour in the WB direction by 2035.

Table 3.9 Projected Operational Analysis Results: 4-2-4 Configuration (2035)

				4-2-	-4 Conf	figuration	
Analysis Period			Existing 2-Lane Section		RP 140.0 to RP 140.6± & RP 141.2± to RP 142.4		± to 2±
			LOS	Density (pc/mi/ln) ⁽²⁾	LOS	PTSF ⁽¹⁾ (%)	LOS
	AM Peak Hour EB	84.4	D	8.0	Α	53.4	В
	AM Peak Hour WB	71.6	D	5.4	Α	44.3	В
Peak	Median Off-Peak Hour EB	81.9	D	7.3	Α	51.7	В
Season	Median Off-Peak Hour WB	77.2	D	6.5	Α	47.8	В
	PM Peak Hour EB	75.4	D	6.0	Α	46.7	В
	PM Peak Hour WB	89.4	Е	10.1	Α	56.7	С
	AM Peak Hour EB	69.8	C	4.0	Α	43.1	В
	AM Peak Hour WB	57.8	C	2.7	Α	35.0	Α
Adjusted Annual	Median Off-Peak Hour EB	69.1	С	3.6	Α	42.7	В
Armuai	Median Off-Peak Hour WB	65.1	C	3.2	Α	40.1	В
	PM Peak Hour EB	60.0	С	3.1	Α	36.4	Α
	PM Peak Hour WB	75.5	D	5.1	Α	46.6	В

Source: DOWL HKM, 2012.

(1) Percent time-spent-following
(2) pc/mi/ln: passenger cars per mile per lane

Four-Lane Configuration

Table 3.10 presents the predicted operations of a four-lane configuration in 2035. Constructing a four-lane highway would provide LOS A throughout the entire corridor within the 2035 planning horizon.



Table 3.10 Projected Operational Analysis Results: Four-Lane Configuration (2035)

Analysis Period		Existing 2 Secti	on	4-Lane Section Throughout Corridor RP 140.0 to RP 142.4		
		RP 140.0 to PTSF ⁽¹⁾ (%)	LOS	Density (pc/mi/ln) ⁽²⁾	LOS	
	AM Peak Hour EB	84.4	D	8.0	Α	
	AM Peak Hour WB	71.6	D	5.4	Α	
Peak	Median Off-Peak Hour EB	81.9	D	7.3	Α	
Season	Median Off-Peak Hour WB	77.2	D	6.5	Α	
	PM Peak Hour EB	75.4	D	6.0	Α	
	PM Peak Hour WB	89.4	Е	10.1	Α	
	AM Peak Hour EB	69.8	С	4.0	Α	
	AM Peak Hour WB	57.8	С	2.7	Α	
Adjusted	Median Off-Peak Hour EB	69.1	С	3.6	Α	
Annual Average	Median Off-Peak Hour WB	65.1	С	3.2	Α	
	PM Peak Hour EB	60.0	С	3.1	Α	
	PM Peak Hour WB	75.5	D	5.1	Α	

Source: DOWL HKM, 2012.

(1) Percent time-spent-following
(2) pc/mi/ln: passenger cars per mile per lane

Summary

Table 3.11 presents a summary of operational analysis results for all lane configurations in 2035.



Table 3.11 Summary of Projected Operational Analysis Results (2035)

Analysis Period		2-Lane Configuration ⁽¹⁾	3-2- Configu		Reverse 3-2-3-4 Configuration ⁽²⁾				4-2-4 Configuration ⁽²⁾		4-Lane Configuration
		RP 140.0 to RP 142.4	RP 140.0 to RP 142.0±	RP 142.0± to RP 142.4	RP 140.0 to RP 140.6±	RP 140.6± to RP 141.2±	RP 141.2± to RP 142.0±	RP 142.0± to RP 142.4	RP 140.0 to RP 140.6± & RP 141.2± to RP 142.4	RP 140.6± to RP 141.2±	RP 140.0 to RP 142.4
	AM Peak Hour EB	D	С	Α	D	D	В	Α	Α	В	Α
	AM Peak Hour WB	D	В	Α	В	D	D	Α	Α	В	Α
Peak	Median Off-Peak Hour EB	D	В	Α	D	D	В	Α	Α	В	Α
Season	Median Off-Peak Hour WB	D	В	Α	В	D	D	Α	Α	В	Α
	PM Peak Hour EB	D	В	Α	D	D	В	Α	Α	В	Α
	PM Peak Hour WB	Е	С	Α	С	E	Е	Α	Α	С	Α
	AM Peak Hour EB	С	В	Α	С	С	В	Α	Α	В	Α
	AM Peak Hour WB	С	Α	Α	Α	С	С	Α	Α	Α	Α
Adjusted	Median Off-Peak Hour EB	С	В	Α	С	С	В	Α	Α	В	Α
Annual Average	Median Off-Peak Hour WB	С	В	Α	Α	С	С	Α	Α	В	Α
	PM Peak Hour EB	С	Α	Α	С	С	Α	Α	Α	Α	Α
	PM Peak Hour WB	D	В	Α	В	D	D	Α	Α	В	Α

Source: DOWL HKM, 2012.

⁽¹⁾ Analysis results for two-lane configuration assume the entire corridor would remain striped as a no passing zone.

⁽²⁾ For 3-2-3-4, Reverse 3-2-3-4, and 4-2-4 configurations, range of LOS values indicates variance depending on number of lanes within each corridor segment.

Note: LOS values indicate predicted operations without a WB left-turn bay at Berne Memorial Park (RP 140.9±). A left-turn bay would provide marginal operational improvements only for WB traffic volumes. Appendix 4 includes HCS analysis worksheets indicating projected operations with and without a WB left-turn bay at Berne Memorial Park.



Level of Anticipated Impact

A two-lane configuration would provide the smallest footprint and would result in the least impacts throughout the corridor. The 3-2-3-4 and reverse 3-2-3-4 configurations would be more impactful than a two-lane configuration, although the roadway would still be limited to two travel lanes to minimize impacts in the most constrained portion of the corridor. Similarly a 4-2-4 configuration would be slightly more impactful, while still minimizing impacts within the narrowest part of the corridor. A four-lane configuration throughout the corridor would have the widest footprint and would result in the greatest level of impact.

Community Support

Two-Lane Configuration

Community members were supportive of a two-lane configuration throughout the corridor, noting this configuration would result in the fewest impacts and maintain the existing corridor character. Some concerns were expressed that a two-lane configuration with shoulders may not sufficiently improve corridor operations. Other community members noted shoulders would improve safety, and were less concerned with improving corridor operations.

3-2-3-4 and Reverse 3-2-3-4 Configurations

Community members were somewhat supportive of three-lane / two-lane configurations as these could provide operational and safety benefits while minimizing impacts within the most constrained portion of the corridor. Some community members perceived a three-lane / two-lane combination may be an appropriate compromise given the competing environmental, cultural/historical, safety, and operational issues and concerns in the corridor.

4-2-4 and Four-Lane Configurations

Less community support was expressed for a 4-2-4 configuration or a four-lane configuration throughout the corridor. Potential improvements in corridor safety and operations provided by four-lane sections were not perceived to justify the additional impacts to environmental and cultural/historical resources that would result from a wider footprint. Four travel lanes throughout the corridor received the least support.

Screening Summary

Table 3.12 summarizes the lane configuration screening. Orange shading indicates failure to pass a screening criterion. Based on failure to meet criteria relating to cost, operations, anticipated level of impact, and community support, the two-lane, reverse 3-2-3-4, and four-



lane configurations are eliminated from further consideration and will not be discussed further in this report. 3-2-3-4 and 4-2-4 lane configurations are advanced.

Table 3.12 Screening Summary – Lane Configurations (Alignment 2)

	Alignment 2 ⁽¹⁾									
Criteria	2 Lanes Throughout Corridor	3-2-3-4	Reverse 3-2-3-4	4-2-4	Four Lanes Throughout Corridor					
Planning Level Estimate of Costs ⁽²⁾	\$35.9M to \$59.1M	\$48.0M to \$86.8M	\$48.0M to \$86.8M	\$57.2M to \$90.9M	\$64.6M to \$110.2M					
Operations Anticipated Level of Service - 2035 ⁽³⁾	C to E	A to C ⁽⁴⁾	A to E ⁽⁵⁾	A to C ⁽⁴⁾	А					
Level of Anticipated	Least		Moderate Impacts							
Impact ⁽⁶⁾	Impacts	Le	ess	More	Impacts					
Community Support ⁽⁷⁾	Most Support	Some Support	Some Support	Some Support	Least Support					
Recommendation	ommendation Further Advance		Eliminate from Further Consideration	Advance	Eliminate from Further Consideration					

Source: DOWL HKM, 2012.

Note: Shading indicates failure to meet criteria.

⁽¹⁾ Cantilevered structure included within the most constrained portion of corridor (RP 140.6± to RP 141.2±).

⁽²⁾ Estimates indicate capital construction costs for roadway reconstruction, including replacement of the existing South Fork Flathead River Bridge and construction of a dedicated bicycle/pedestrian facility. Costs reflect planning level estimates, and should not be considered an actual cost encompassing all scenarios and circumstances. Estimates do not include potential costs associated with right-of-way acquisition, utility relocation, preliminary engineering, or operations and maintenance. Cost estimate tables are provided in Appendix 2.

⁽³⁾ LOS ranges reflect values within the AM and PM peak hour and median off-peak hour during peak season and adjusted annual average conditions. Additional detail is provided in Appendix 4.

⁽⁴⁾ Configurations narrowly exceed the LOS C threshold during the peak hour of the peak season; LOS A and B are anticipated throughout the rest of the year.

⁽⁵⁾ Reverse 3-2-3-4 improves LOS for the direction of travel outside of and heading away from the most constrained portion of the corridor (as indicated by LOS A), but does not improve LOS before or within the most constrained portion of the corridor (as indicated by LOS E).

⁽⁶⁾ Level of anticipated impact is based on lane configuration footprint. Further analysis would be required during project development to identify specific impacts.

⁽⁷⁾ Indication of community support is based on feedback provided during informational meetings held in Columbia Falls and Hungry Horse and written comments submitted during the study.



4.0 SUMMARY OF RECOMMENDED IMPROVEMENT OPTIONS

The US 2 – Badrock Canyon Corridor Planning Study has confirmed FEIS findings that construction of a grade-separated structure, a tunnel, and new alignments north and south of the existing US 2 alignment are not reasonable options based on cost, constructability, impacts, right-of-way, and community support screening criteria.

The planning study recommends reconstruction of the corridor along Alignment 2 (Optimized Existing Alignment) with either a 3-2-3-4 or 4-2-4 configuration, using a two-lane cantilevered structure within the most constrained portion of the corridor (RP 140.6± to RP 141.2±) and a four-lane South Fork Flathead River Bridge. A two-lane cantilevered structure could be used to avoid rock excavation and minimize the roadway footprint within the narrowest part of the corridor. Shoulders and improved geometry are expected to reduce safety concerns throughout the corridor. A dedicated bicycle/pedestrian facility would improve non-motorized access in the corridor. A four-lane South Fork Flathead River Bridge would provide flexibility during the design life of the structure to allow future roadway widening if necessary through the corridor. The three- or four-lane sections at the eastern and western ends of the corridor would provide passing opportunities and allow vehicle queues to disperse before entering the most constrained area. The corridor is generally predicted to operate at an acceptable LOS A or B during most times of the year, narrowly exceeding the LOS C threshold during the peak hour of the peak season by 2035. Although this planning study confirms FEIS findings that a fourlane configuration is needed to provide LOS B or better at all times of the day and year, a design exception could be considered to balance the need to improve corridor safety and operations with the need to minimize adverse impacts to resources in the corridor.

Full reconstruction of the corridor is recommended for long-term consideration within the 2035 planning horizon. Phasing may be appropriate to allow funding identification for construction of shorter segments within the corridor. Replacement of the existing South Fork Flathead River Bridge with a new four-lane bridge could be pursued first, followed by reconstruction of the western (RP 140.0 to RP 140.6±) and eastern (141.2± to RP 142.0±) ends of the corridor with three-lane sections. The most constrained portion of the corridor (RP 140.6± to RP 141.2±) could be addressed last using a two-lane cantilevered structure.



In the interim period before corridor wide reconstruction (Alignment 2), other short-, mid-, or long-term, options could be implemented along the existing US 2 alignment (Alignment 1) to provide incremental improvements in safety and corridor access. Several Alignment 1 improvements, including parking, rockfall prevention and a new South Fork Flathead River Bridge, are considered stand-alone options that would remain if Alignment 2 reconstruction is pursued at a later date. All other Alignment 1 options may need to be modified or replaced if Alignment 2 roadway reconstruction is pursued. Some of the identified Alignment 1 improvements represent substantial transportation system investments. If Alignment 1 improvements are forwarded from this study, compatibility with future corridor reconstruction should be considered.

Implementation of corridor improvement options is dependent on funding availability and other system priorities. Recommended timeframes for implementation are defined as follows:

- Short-term: Implementation recommended within 1- to 5-year period
- Mid-term: Implementation recommended within 6- to 10-year period
- Long-term: Implementation recommended within 11- to 20-year period

Table 4.1 provides a menu of recommended improvements for consideration in the corridor. Implementation of all options is not anticipated. Selection of some options may preclude implementation of others.

Table 4.1 Menu of Recommended Improvements

Recommended Improvement		ed Improvement	Possible Locations	Planning Level Estimate of Costs ⁽⁴⁾	Recommended Implementation Timeframe ⁽⁵⁾	Potentially Impacted Resources / RW Requirements
ments	Access Management ⁽¹⁾	Install Concrete Barrier	RP 140.8± to RP 141.0± (South Side of US 2)	\$100,000 to \$150,000	Short-term	No
	Bicycle/ Pedestrian Facilities ⁽¹⁾	Construct Dedicated Bicycle/Pedestrian Facility	Throughout Corridor (North Side of US 2)	\$3.6M to \$6.6M	Mid-term to long-term	Yes
		Construct Bicycle/Pedestrian Overcrossing	RP 140.8± (North & South Sides of US 2)	\$1.0M to \$2.5M		Yes
	Drainage ⁽¹⁾	Install Culverts	RP 140.8±; RP 141.1±; RP 141.2±; RP 142.0± (North & South Sides of US 2)	\$4,000 to \$10,000 per location	Short-term to mid-term	No
		Re-grade Ditches	RP 140.8±; RP 140.9±; RP141.8± (South Side of US 2)	\$1,000 to \$15,000 per location		No
		Install Valley Gutter	RP 141.0± (South Side of US 2)	\$3,000 to \$5,000		No
	Parking ⁽²⁾	Construct Parking Lot	RP 140.2± (North Side of US 2)	\$400,000 to \$500,000		Yes
prove	Roadside Safety ⁽¹⁾	Install Guardrail with End Treatments	RP 140.3±; RP 141.9±; RP 142.3±(North & South Sides of US 2)	\$3,000 to \$5,000 per location		No
Alignment 1 Improvements	Rockfall Prevention ⁽¹⁾	Install Wire Mesh Stabilization Fence	RP 140.7±; RP 141.1± (South Side of US 2)	\$200,000 to \$1.0M per location		Yes
	Rumble Strips ⁽¹⁾	Install Shoulder and Centerline Rumble Strips	Throughout Corridor	\$2,100 to \$2,700 per mile		No
	Sight Distance ⁽¹⁾	Remove Vegetation	RP 140.9±; RP 141.3±; RP 142.0± (North & South Sides of US 2)	\$9,000 to \$30,000		Yes
	South Fork Flathead River Bridge ⁽²⁾	Reconstruct South Fork Flathead River Bridge	RP 142.1	\$9.7M to \$27.3M		Yes
	Traffic Control ⁽¹⁾	Install Static Sign	RP 140.0±; RP 140.2±; RP 140.4±; RP 140.6±; RP 141.0±; RP 141.1±; RP 142.4± (North & South Sides of US 2)	\$500 to \$1,000 per location		No
		Install Variable Message Sign	RP 140.0±; RP 142.3± (North & South Sides of US 2)	\$20,000 to \$250,000 per location		No
	Wildlife Passage ⁽¹⁾	Wildlife Undercrossing	RP 140.2± (North & South Sides of US 2)	\$920,000 to \$1.1M		Yes
Roadway Reconstruction ⁽³⁾ (Alignment 2)		Construct 3-2-3-4 Configuration	Throughout Corridor	\$48.0M to \$86.8M	Long-term	Yes
		Construct 4-2-4 Configuration	Throughout Corridor	\$57.2M to \$90.9M	Long-term	Yes

Source: DOWL HKM, 2012. ¹Improvements may need to be modified or replaced if Alignment 2 reconstruction is pursued at a later date.

⁽²⁾ Stand-alone improvements could remain if Alignment 2 reconstruction is pursued at a later date.

⁽³⁾ Roadway reconstruction costs include replacement of the existing South Fork Flathead River Bridge with a new four-lane structure. Roadway reconstruction would be less costly if the South Fork Flathead River Bridge is replaced separately as part of an Alignment 1 improvement.

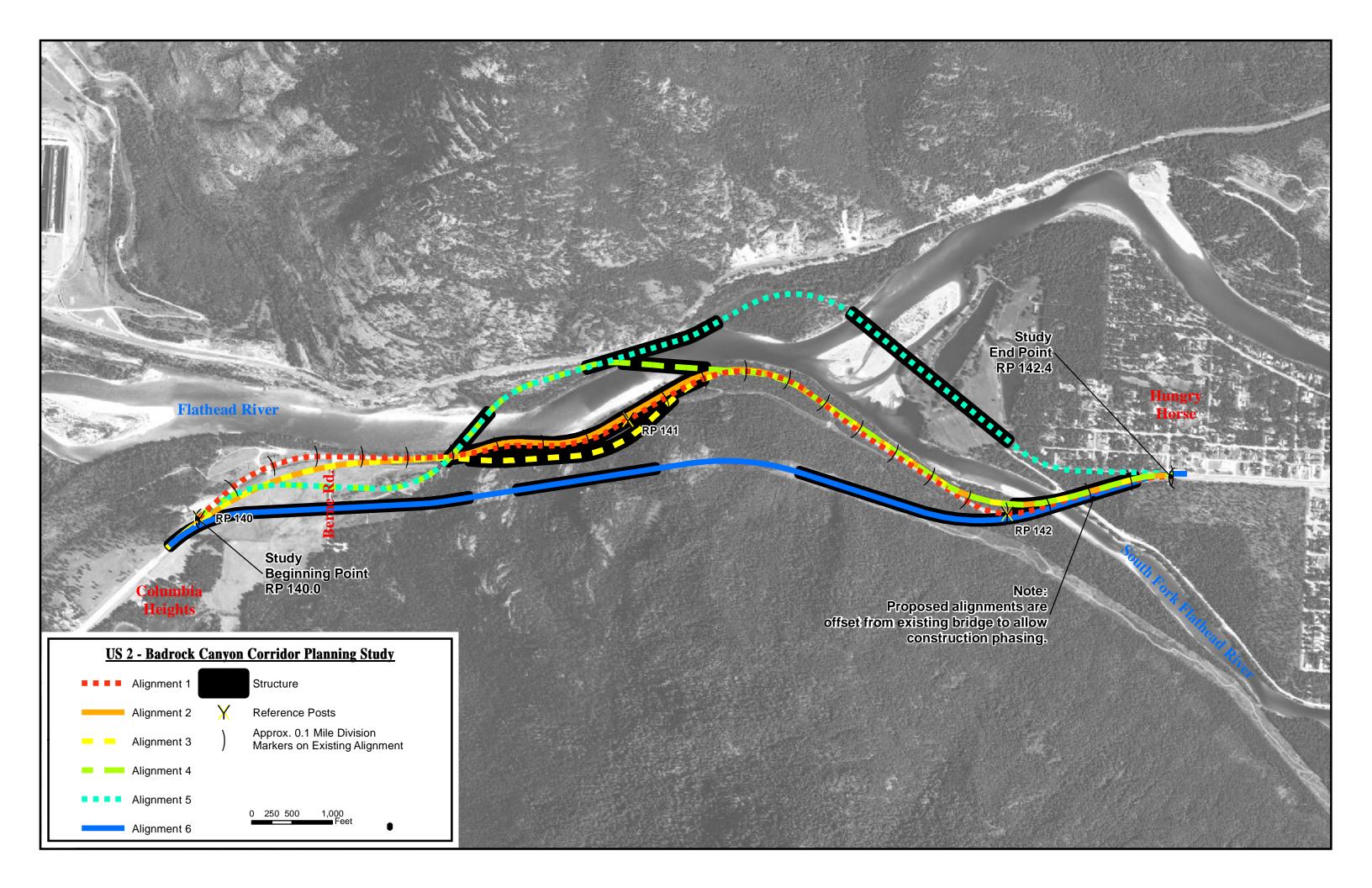
Improvement Options Report

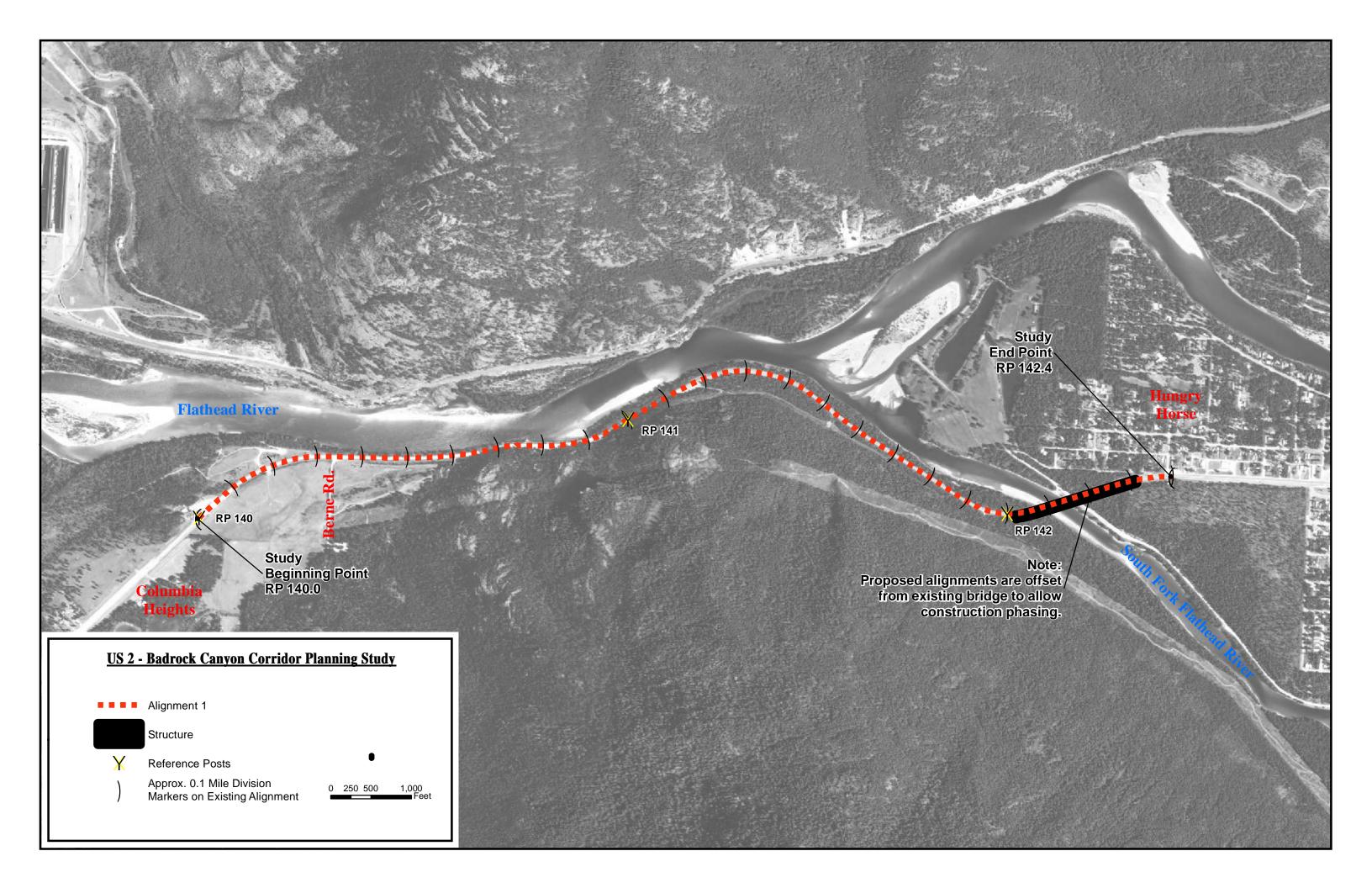
(4) Costs reflect planning level estimates, and should not be considered an actual cost encompassing all scenarios and circumstances. Estimates do not include potential costs	
associated with right-of-way acquisition, utility relocation, preliminary engineering, or operations and maintenance. Cost estimate tables are provided in Appendix 2. (5)	
Recommended implementation timeframe does not indicate when projects will be programmed or implemented. Project programming is based on available funding and oth	ər
system priorities. Short-term: Implementation is recommended within a 1- to 5-year period; Mid-term: Implementation is recommended within a 6- to 10-year period; Long-te	rm
Implementation is recommended within a 11- to 20-year period.	

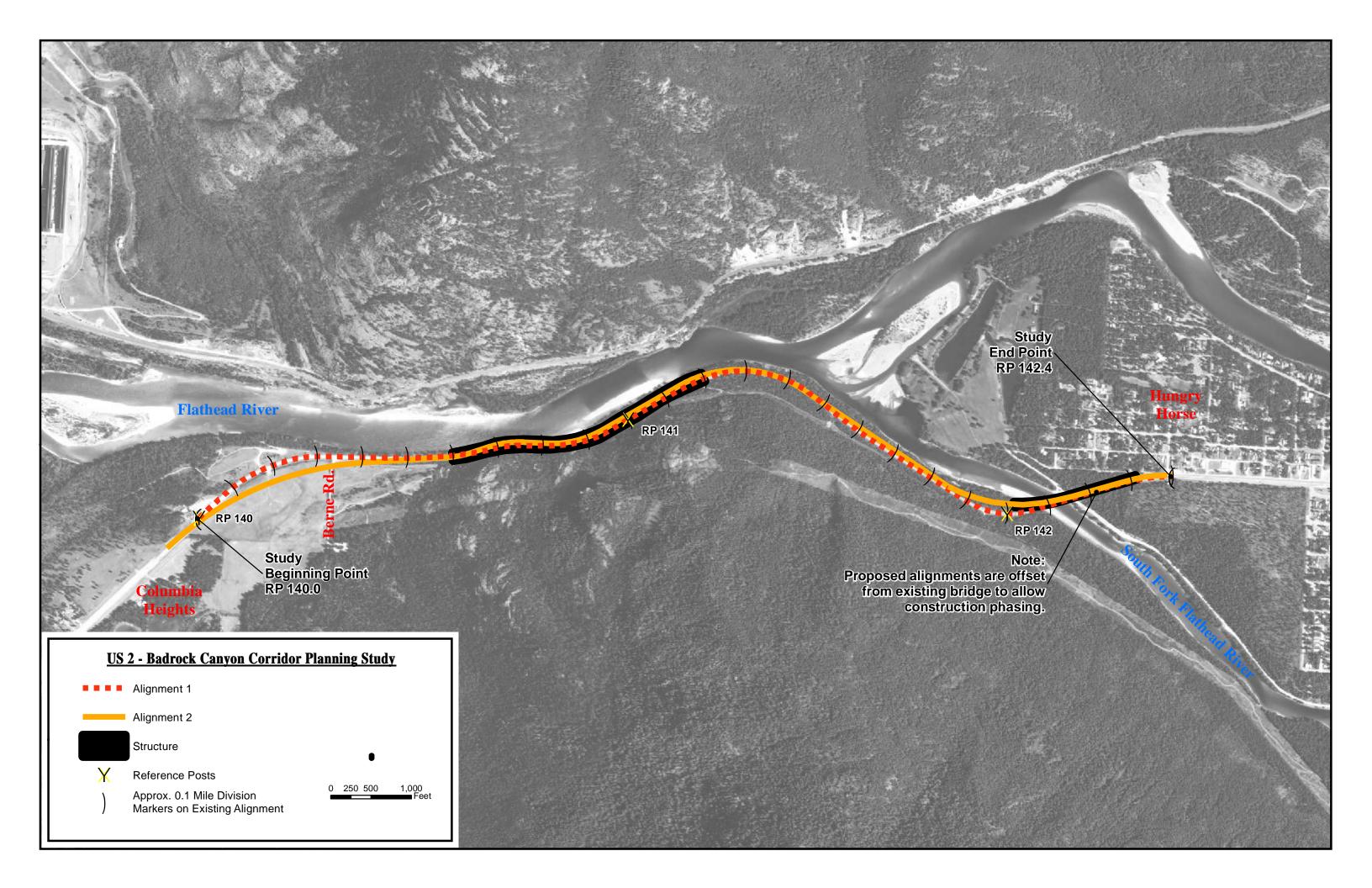


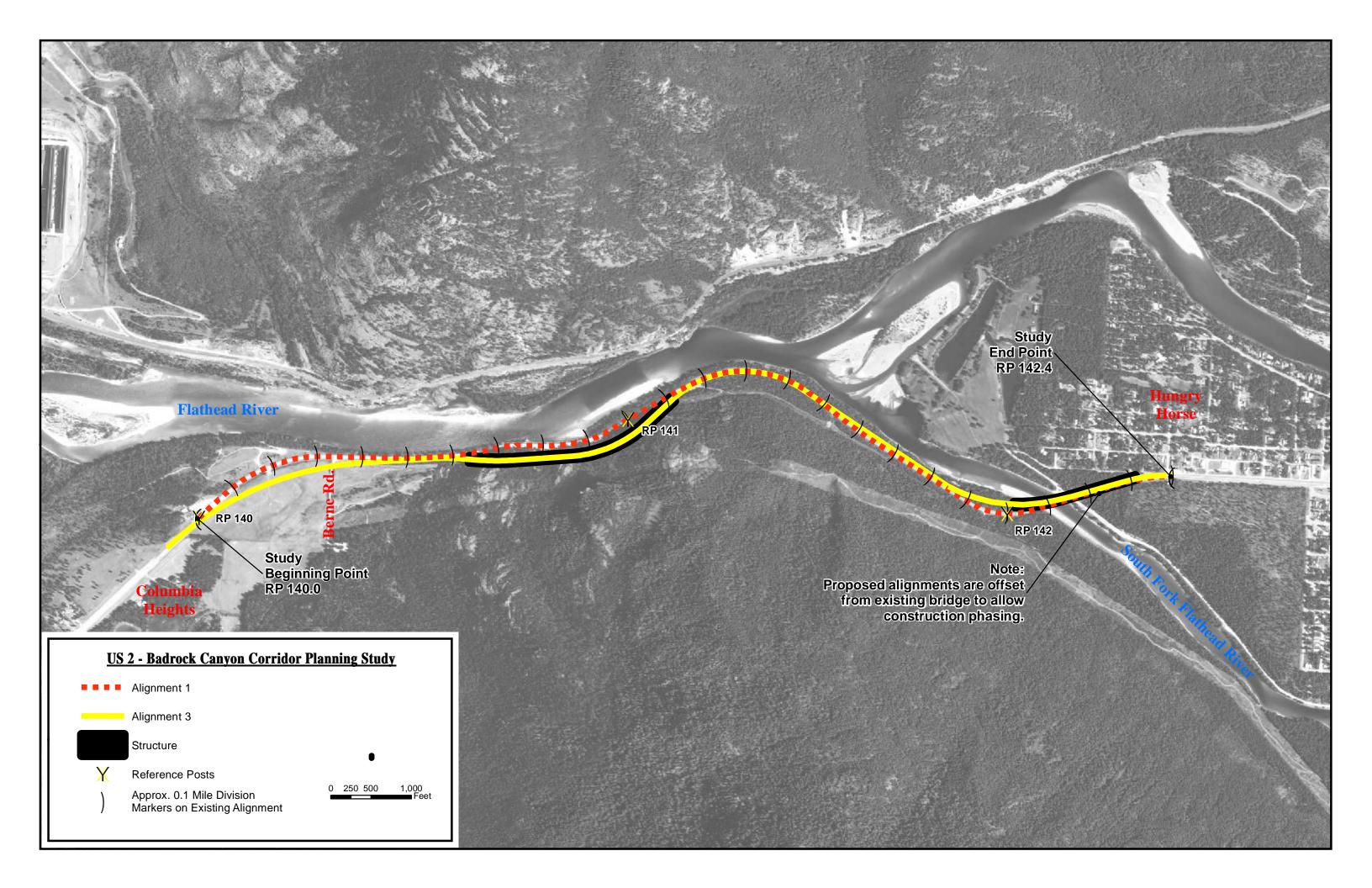
Appendix 1

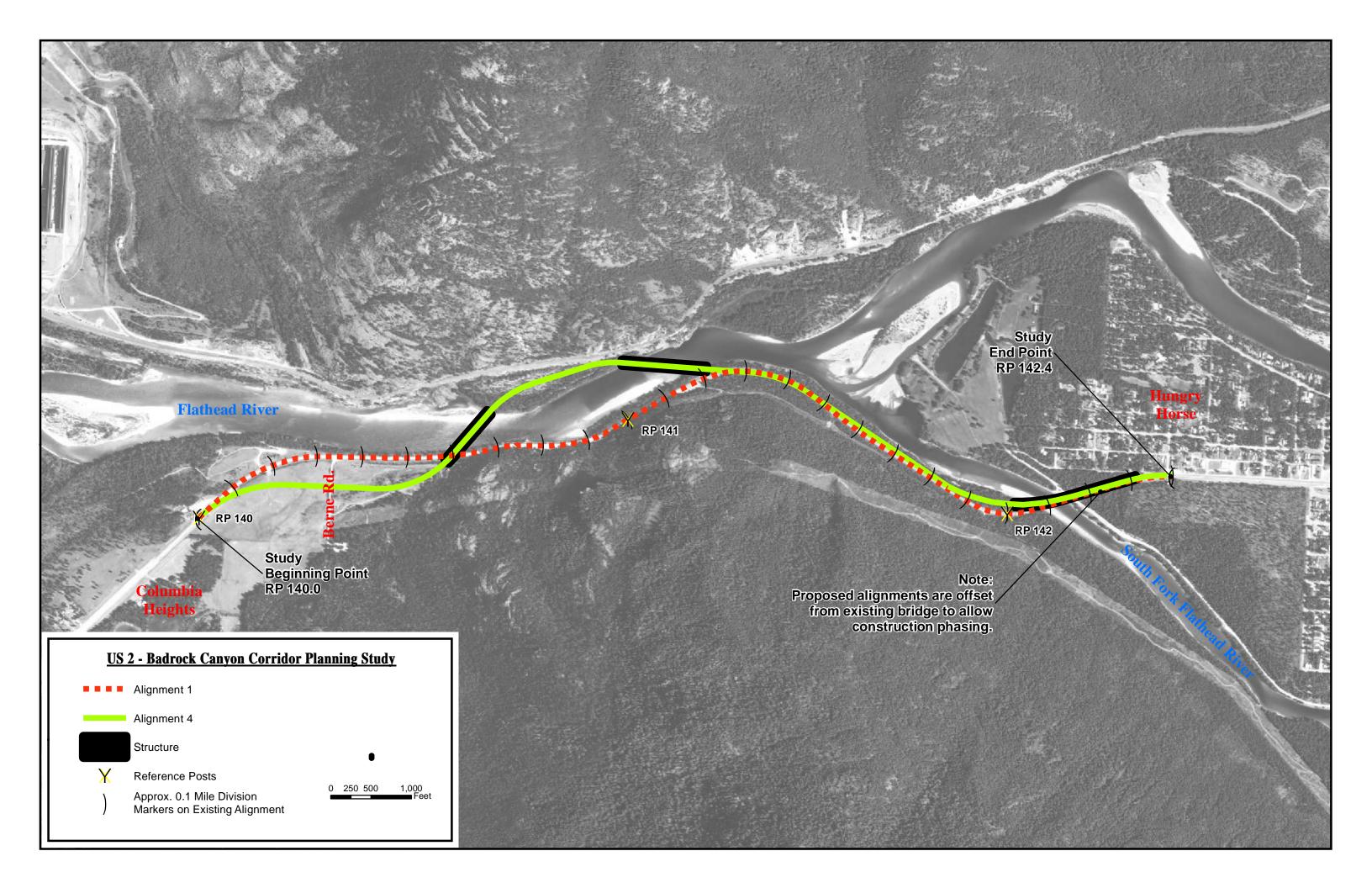
Alignment Figures

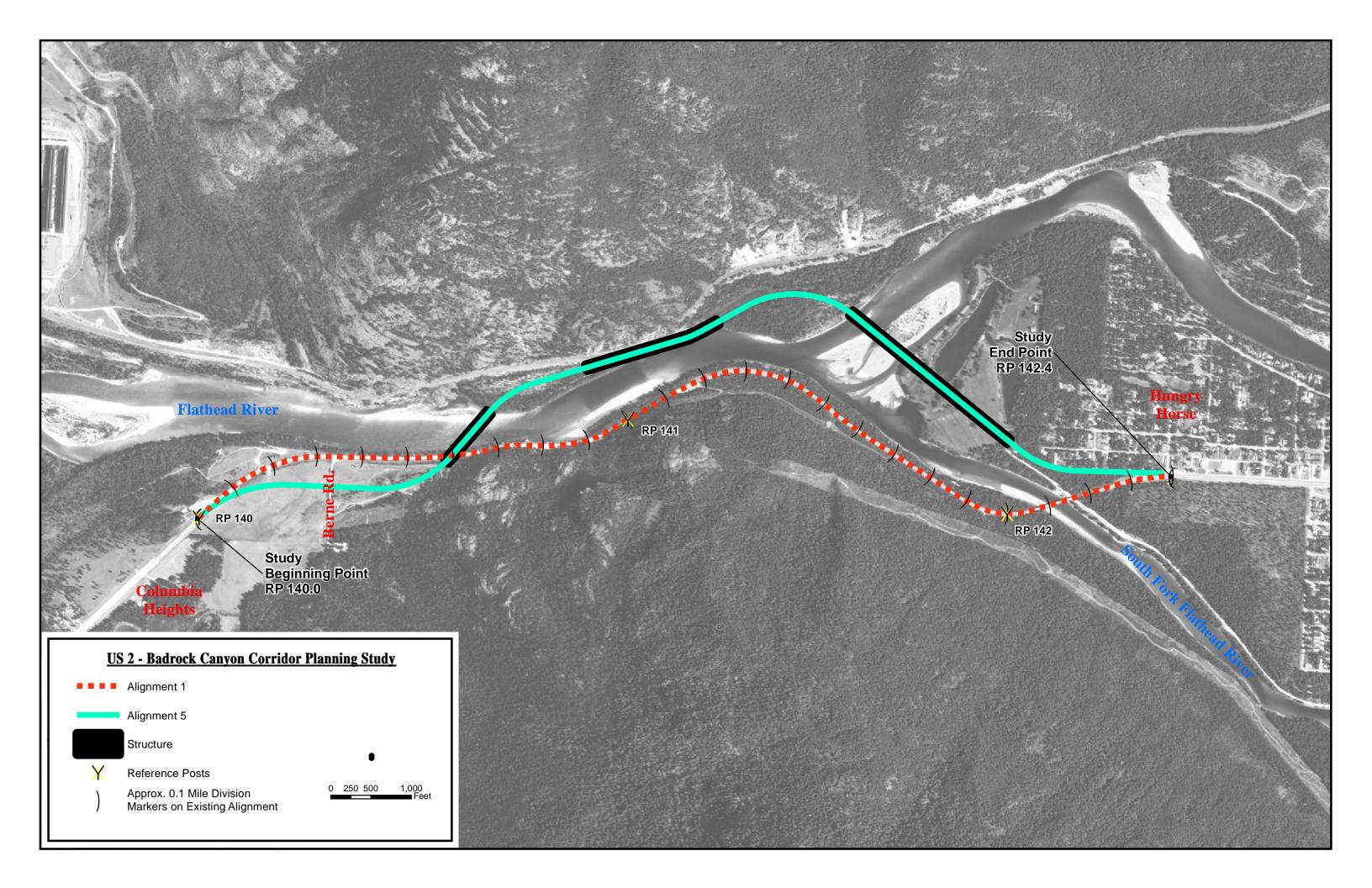


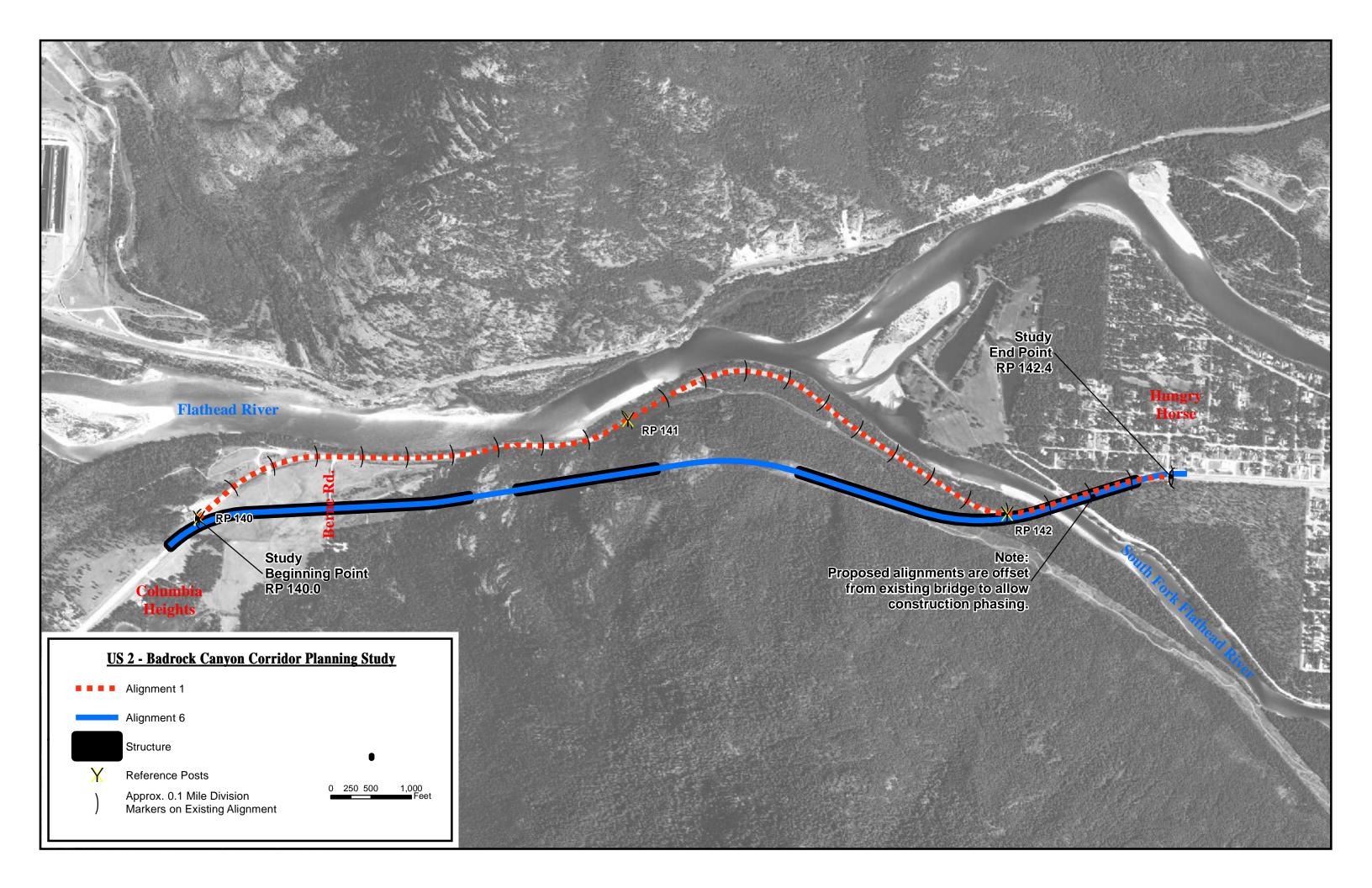














Appendix 2

Cost Estimate Spreadsheets



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 TWO LANES THROUGHOUT CORRIDOR

	Approx. Quantity		Average Bid Prices ²		Adjusted Unit Prices	
Item Description		Unit	Unit Price	Amount	Unit Price	Amount ³
	(Per Station) 1	-	Dollars	Dollars	Dollars	Dollars
TWO-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	515.00	CUYD	\$4.67	\$2,405.00		\$2,405.00
EMBANKMENT IN PLACE	160.00	CUYD	\$6.83	\$1,093.00		\$1,093.00
CRUSHED AGGREGATE COURSE	345.00	CUYD	\$18.79	\$6,483.00		\$6,483.00
COVER - TYPE 2	445.00	SQYD	\$0.51	\$227.00		\$227.00
DUST PALLIATIVE	1.00	TON		\$0.00	\$120.00	\$120.00
PLANT MIX BIT SURF GR S-3/4 IN	125.00	TON	\$25.37	\$3,171.00		\$3,171.00
ASPHALT CEMENT PG 64 64-28	7.00	TON	\$674.59	\$4,722.00		\$4,722.00
EMULS ASPHALT CRS-2P	1.00	TON	\$578.92	\$579.00		\$579.00
STRIPING-WHITE EPOXY	1.00	GAL	\$61.96	\$62.00		\$62.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
TWO-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$18,805.00		\$18,925.00
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00
CATEGORY	LENGTH (STA.)	COST PER STATION			SUBTOTAL	
TWO-LANE ROAD (FULL RECONSTRUCT)	112.70	\$18,925.00		\$2,100,000		
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQUARE FOOT 4		SUBT	OTAL
CANTILEVER CONSTRUCTION (TWO-LANE)	1,850.00	41.50	\$125.00		\$9,600,000	
	APPROX. QUANTITY	UNIT	UNIT PRICE			
EXCAVATION-UNCLASS BORROW	11,000.00	CUYD	\$4.67		\$51,400.00	
EMBANKMENT IN PLACE	2,665.00	CUYD	\$6.8	33	\$18,200.00	
RETAINING WALL	28,710.00	SQFT	\$50.	00	\$1,400,000.00	
CANTILEVER CONSTRUCTION (TWO-LANE) SUBTOTAL					\$11,100,000.00	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	JARE FOOT 5	SUBTOTAL	
SOUTH FORK BRIDGE CONSTRUCTION						
STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	0.000
STRUCTURE COST SUBTOTAL			· · ·		\$16,00	
STREETORE COST SOSTOTAL				SUBTOTAL 1	\$18,10	·
	ADDIT	IONAL COSTS		SOBIOTALI	710,110	0,000
	ADDIT		LLANEOUS @ 20% O	E SURTOTAL 1 6	20%	\$3,600,000
			ILIZATION @ 18% O	_	18%	\$3,300,000
	CON		GINEERING @ 15%		15%	\$2,700,000
	COI	ISTROCTION EN	IGHTELINING @ 13/8 (SUBTOTAL 2	15/0	\$27,700,000
	INDIRECT COST	(IDC) - CONSTR	UCTION @ 9.64% O		9.64%	\$2,700,000
	HADIRECT COST	(IDC) - CONSTR		JUDIUIALZ	20%	\$5,500,000
		CONTINGEN	ICY @ 20% & 50% O	F SUBTOTAL 2 ⁹	50%	\$13,900,000
	TOTAL IMPI	ROVEMENT OPT	TION COST @ 20% CO	ONTINGENCY 10	\$35,90	
			TION COST @ 20% CO		\$44,30	
	TOTAL IMP	AUVEIVIENT OPT	ION COST @ 50% CC	JINTINGENCY	344,3U	0,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

⁵ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for this structure.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

7 The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁹ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this

planning level cost estimate.

10 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 TWO LANES THROUGHOUT CORRIDOR WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY **Planning Level Estimate of Costs**

	Annroy Quartity		Average Bid Prices ²		Adjusted l	Jnit Prices
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ³
	(Per Station) 1	-	Dollars	Dollars	Dollars	Dollars
TWO-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	515.00	CUYD	\$4.67	\$2,405.00		\$2,405.00
EMBANKMENT IN PLACE	160.00	CUYD	\$6.83	\$1,093.00		\$1,093.00
CRUSHED AGGREGATE COURSE	345.00	CUYD	\$18.79	\$6,483.00		\$6,483.00
COVER - TYPE 2	445.00	SQYD	\$0.51	\$227.00		\$227.00
DUST PALLIATIVE	1.00	TON		\$0.00	\$120.00	\$120.00
PLANT MIX BIT SURF GR S-3/4 IN	125.00	TON	\$25.37	\$3,171.00		\$3,171.00
ASPHALT CEMENT PG 64 64-28	7.00	TON	\$674.59	\$4,722.00		\$4,722.00
EMULS ASPHALT CRS-2P	1.00	TON	\$578.92	\$579.00		\$579.00
STRIPING-WHITE EPOXY	1.00	GAL	\$61.96	\$62.00		\$62.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
TWO-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$18,805.00		\$18,925.00
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBT	OTAL
TWO-LANE ROAD (FULL RECONSTRUCT)	111.10		\$18,925.00			0,000
DEDICATED BICYCLE/PEDESTRIAN FACILITY	11.20	\$2,767.00			\$31,000	
CONCRETE BARRIER RAIL	126.72	\$7,060.00			\$895	,000
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT 4			SUBT	OTAL
CANTILEVER CONSTRUCTION (TWO-LANE)	1,975.00	53.50 \$125.00		\$13,21	10,000	
	APPROX. QUANTITY	UNIT				
EXCAVATION-UNCLASS BORROW	14,000.00	CUYD	\$4.6	57	\$65,400.00	
EMBANKMENT IN PLACE	7,200.00	CUYD	\$6.8	33	\$49,200.00	
RETAINING WALL	30,200.00	SQFT	\$50.0	00	\$1,500,000.00	
CANTILEVER CONSTRUCTION (TWO-LANE) SUBTOTAL					\$14,800	,000.00
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT 5	SUBT	OTAL
SOUTH FORK BRIDGE CONSTRUCTION						
STRUCTURE (TWO-LANE)	655.00	55.00	\$175.	.00	\$6,30	0,000
STRUCTURE COST SUBTOTAL					\$21,10	00,000
				SUBTOTAL 1	\$24,20	00,000
	ADDIT	IONAL COSTS				
		MISCEI	LLANEOUS @ 20% OF	SUBTOTAL 1 6	20%	\$4,800,000
		МОВ	SILIZATION @ 18% OF	SUBTOTAL 1 7	18%	\$4,400,000
	COI	NSTRUCTION EN	IGINEERING @ 15% C	OF SUBTOTAL 1	15%	\$3,600,000
				SUBTOTAL 2		\$37,000,000
	INDIRECT COST	(IDC) - CONSTR	RUCTION @ 9.64% OF		9.64%	\$3,600,000
		-		_	20%	\$7,400,000
		CONTINGEN	NCY @ 20% & 50% OF	SUBTOTAL 2 9	50%	\$18,500,000
	TOTAL IMP	ROVEMENT OPT	TION COST @ 20% CC	ONTINGENCY 10	\$48,00	
			TION COST @ 50% CO		\$59,10	
	TOTAL IIVIF	NO VENTENTI OF	CO31 @ 30% CC	ZIT I I TOLITCI	733,10	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

⁵ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for this structure.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations. ⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.
9 A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

¹⁰ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 TWO LANES THROUGHOUT CORRIDOR, ELEVATEDTWO LANE ROADWAY STRUCTURE RP 140.6 - RP 141.2 Planning Level Estimate of Costs

	Anney Quantity		Average Bi	d Prices ²	Adjusted Unit Prices	
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ³
	(Per Station) ¹		Dollars	Dollars	Dollars	Dollars
TWO-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	515.00	CUYD	\$4.67	\$2,405.00		\$2,405.00
EMBANKMENT IN PLACE	160.00	CUYD	\$6.83	\$1,093.00		\$1,093.00
CRUSHED AGGREGATE COURSE	345.00	CUYD	\$18.79	\$6,483.00		\$6,483.00
COVER - TYPE 2	445.00	SQYD	\$0.51	\$227.00		\$227.00
DUST PALLIATIVE	1.00	TON		\$0.00	\$120.00	\$120.00
PLANT MIX BIT SURF GR S-3/4 IN	125.00	TON	\$25.37	\$3,171.00		\$3,171.00
ASPHALT CEMENT PG 64 64-28	7.00	TON	\$674.59	\$4,722.00		\$4,722.00
EMULS ASPHALT CRS-2P	1.00	TON	\$578.92	\$579.00		\$579.00
STRIPING-WHITE EPOXY	1.00	GAL	\$61.96	\$62.00		\$62.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
TWO-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$18,805.00		\$18,925.00
CATEGORY	LENGTH (STA.)	COST PER STATION		SUBTOTAL		
TWO-LANE ROAD (FULL RECONSTRUCT)	85.11	\$18,925.00		\$1,600	0,000	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT 4		SUBTO	OTAL
ELEVATED STRUCTURE (TWO-LANE)	4,800.00	43.00	\$175	.00	\$36,10	0,000
SOUTH FORK BRIDGE CONSTRUCTION						
STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,900,000	
STRUCTURE COST SUBTOTAL					\$41,00	0,000
				SUBTOTAL 1	\$42,60	0,000
	ADDIT	IONAL COSTS		-		
		MISCEI	LLANEOUS @ 20% OI	SUBTOTAL 1 5	20%	\$8,500,000
		МОВ	ILIZATION @ 18% OI	SUBTOTAL 1 ⁶	18%	\$7,700,000
	CON	ISTRUCTION EN	IGINEERING @ 15% (OF SUBTOTAL 1	15%	\$6,400,000
				SUBTOTAL 2		\$65,200,000
	INDIRECT COST	(IDC) - CONSTR	RUCTION @ 9.64% OI	SUBTOTAL 2 7	9.64%	\$6,300,000
		CONTINCES	ICY @ 20% & 50% OI	SUPTOTAL 3.8	20%	\$13,000,000
		CONTINGEN	NCY @ 20% & 50% OF	- SORIGIAL 5	50%	\$32,600,000
	TOTAL IMP	ROVEMENT OP	TION COST @ 20% C	ONTINGENCY 9	\$84,50	0,000
	TOTAL IMP	ROVEMENT OP	TION COST @ 50% C	ONTINGENCY 9	\$104,10	00,000

 $^{^{\}rm 1}$ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁵ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁶ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁷ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁸ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁹ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 TWO LANES THROUGHOUT CORRIDOR,

ELEVATEDTWO LANE ROADWAY STRUCTURE RP 140.6 - RP 141.2 WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY

			Average Bio	d Prices ²	Adjusted Unit Prices	
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ³
·	(Per Station) 1		Dollars	Dollars	Dollars	Dollars
TWO-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	515.00	CUYD	\$4.67	\$2,405.00		\$2,405.00
EMBANKMENT IN PLACE	160.00	CUYD	\$6.83	\$1,093.00		\$1,093.00
CRUSHED AGGREGATE COURSE	345.00	CUYD	\$18.79	\$6,483.00		\$6,483.00
COVER - TYPE 2	445.00	SQYD	\$0.51	\$227.00		\$227.00
DUST PALLIATIVE	1.00	TON		\$0.00	\$120.00	\$120.00
PLANT MIX BIT SURF GR S-3/4 IN	125.00	TON	\$25.37	\$3,171.00		\$3,171.00
ASPHALT CEMENT PG 64 64-28	7.00	TON	\$674.59	\$4,722.00		\$4,722.00
EMULS ASPHALT CRS-2P	1.00	TON	\$578.92	\$579.00		\$579.00
STRIPING-WHITE EPOXY	1.00	GAL	\$61.96	\$62.00		\$62.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
TWO-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$18,805.00		\$18,925.00
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBTOTAL	
TWO-LANE ROAD (FULL RECONSTRUCT)	85.11		\$18,925.00		\$1,600,000	
DEDICATED BICYCLE/PEDESTRIAN FACILITY	8.40	\$2,767.00			\$23,200	
CONCRETE BARRIER RAIL	126.72		\$7,060.00		\$895,000	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	IARE FOOT ⁴	SUBTO	TAL
ELEVATED STRUCTURE (TWO-LANE)	4,800.00	43.00	\$175.	.00	\$36,100,000	
SOUTH FORK BRIDGE CONSTRUCTION						
STRUCTURE (TWO-LANE)	655.00	55.00	\$175.	.00	\$6,300,000	
STRUCTURE COST SUBTOTAL					\$42,400,000	
				SUBTOTAL 1	\$44,900	•
	ADDI	TIONAL COSTS		000.02.2	ψ · 1,330	0,000
			LANEOUS @ 20% OI	F SUBTOTAL 1 5	20%	\$9,000,000
			ILIZATION @ 18% OI		18%	\$8,100,000
	CON	NSTRUCTION EN	GINEERING @ 15% (OF SUBTOTAL 1	15%	\$6,700,000
				SUBTOTAL 2	-	\$68,700,000
	INDIRECT COST	(IDC) - CONSTR	UCTION @ 9.64% OI	F SUBTOTAL 2 ⁷	9.64%	\$6,600,000
		CONTINCEN	ICY @ 20% & 50% OI	SUPTOTAL 3 8	20%	\$13,700,000
		CONTINGEN	ICY @ 20% & 50% OI	- SORIOIAL 2	50%	\$34,400,000
	TOTAL IMP	PROVEMENT OP	TION COST @ 20% C	ONTINGENCY 9	\$89,00	0,000
	TOTAL IMF	PROVEMENT OP	TION COST @ 50% C	ONTINGENCY 9	\$109,70	00,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

 $^{^{3}}$ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁵ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

 $^{^{\}rm 6}$ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁷ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁸ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁹ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 THREE LANES RP 140.0 - RP 140.6, TWO LANES RP 140.6 - RP 141.2, THREE LANES RP 141.2 - RP 142.0, FOUR LANES RP 142.0 - 142.4 **Planning Level Estimate of Costs**

			Training Level La		Adjusted Unit Prices		
	Approx. Quantity	l	Average Bi		-		
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³	
			Dollars	Dollars	Dollars	Dollars	
THREE-LANE ROAD (FULL RECONSTRUCT)							
EXCAVATION-UNCLASS BORROW	620.00	CUYD	\$4.67	\$2,895.00		\$2,895.00	
EMBANKMENT IN PLACE	195.00	CUYD	\$6.83	\$1,332.00		\$1,332.00	
CRUSHED AGGREGATE COURSE	425.00	CUYD	\$18.79	\$7,986.00		\$7,986.00	
COVER - TYPE 2	600.00	SQYD	\$0.51	\$306.00		\$306.00	
DUST PALLIATIVE	2.00	TON	625.27	\$0.00	\$120.00	\$240.00	
PLANT MIX BIT SURF GR S-3/4 IN ASPHALT CEMENT PG 64 64-28	165.00 9.00	TON TON	\$25.37 \$674.59	\$4,186.00 \$6,071.00		\$4,186.00 \$6,071.00	
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00	
STRIPING-WHITE EPOXY	1.00	GAL	\$61.96	\$62.00		\$62.00	
STRIPING-YELLOW EPOXY	2.00	GAL	\$62.79	\$126.00		\$126.00	
THREE-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$24,122.00		\$24,362.00	
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00	
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00	
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00	
CATEGORY	LENGTH (STA.)		COST PER STATIO	V	SUBT	OTAL	
THREE-LANE ROAD (FULL RECONSTRUCT)	112.70		\$24,362.00		\$2,700,000		
LANE TRANSITION WEST OF CORRIDOR	20.00		\$20,250.00		\$410,000		
3 TO 4 LANE TRANSITION WEST OF BRIDGE	5.00		\$28,155.00	\$140,000			
ROADWAY COST SUBTOTAL		•			\$3,30	0,000	
CATEGORY	LENGTH (FT.) WIDTH (FT.) COST PER SQUARE FOOT 4				SUBT	OTAL	
CANTILEVER CONSTRUCTION (TWO-LANE)	1,850.00	41.50	41.50 \$125.00		\$9,60	0,000	
,	APPROX. QUANTITY	UNIT				,	
EXCAVATION-UNCLASS BORROW	11,000.00	CUYD	\$4.6		\$51,000.00		
EMBANKMENT IN PLACE	2,665.00	CUYD	\$6.8	3	\$18,200.00		
RETAINING WALL	28,710.00	SQFT	\$50.	00	\$1,400,000.00		
CANTILEVER CONSTRUCTION (TWO-LANE) SUBTOTAL					\$11,100	,000.00	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT 5	SUBT	OTAL	
SOUTH FORK BRIDGE CONSTRUCTION							
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	0,000	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	0,000	
STRUCTURE COST SUBTOTAL					\$20,90	0,000	
				SUBTOTAL 1	\$24,20	00,000	
	ADDI	TIONAL COSTS					
		MISCE	LLANEOUS @ 20% OF	SUBTOTAL 1 6	20%	\$4,800,000	
		MOB	ILIZATION @ 18% OF	SUBTOTAL 1 7	18%	\$4,400,000	
	COI	NSTRUCTION EN	GINEERING @ 15% (OF SUBTOTAL 1	15%	\$3,600,000	
				SUBTOTAL 2		\$37,000,000	
	INDIRECT COS	r (IDC) - CONSTR	RUCTION @ 9.64% OI	SUBTOTAL 2 8	9.64%	\$3,600,000	
		CONTINCES	ICY @ 20% & 50% OI	SUBTOTAL 2 9	20%	\$7,400,000	
		CONTINGEN	1C1 @ 20% & 50% UI	- JUDIUIAL Z	50%	\$18,500,000	
	TOTAL IMP	ROVEMENT OP	TION COST @ 20% CO	ONTINGENCY 10	\$48,00	00,000	
	TOTAL IMP	ROVEMENT OP	TION COST @ 50% CO	ONTINGENCY 10	\$59,10	00,000	

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

⁵ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures. ⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁹ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

level cost estimate.

The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 THREE LANES RP 140.0 - RP 140.6, TWO LANES RP 140.6 - RP 141.2, THREE LANES RP 141.2 - RP 142.0, FOUR LANES RP 142.0 - 142.4 WITH DEDICATED **BICYCLE/PEDESTRIAN FACILITY Planning Level Estimate of Costs**

	Approx. Quantity		Average Bid Prices ²		Adjusted U	Init Prices	
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³	
	(rei Station)		Dollars	Dollars	Dollars	Dollars	
THREE-LANE ROAD (FULL RECONSTRUCT)							
EXCAVATION-UNCLASS BORROW	620.00	CUYD	\$4.67	\$2,895.00		\$2,895.00	
EMBANKMENT IN PLACE	195.00	CUYD	\$6.83	\$1,332.00		\$1,332.00	
CRUSHED AGGREGATE COURSE	425.00	CUYD	\$18.79	\$7,986.00		\$7,986.00	
COVER - TYPE 2	600.00	SQYD	\$0.51	\$306.00		\$306.00	
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00	
PLANT MIX BIT SURF GR S-3/4 IN	165.00	TON	\$25.37	\$4,186.00		\$4,186.00	
ASPHALT CEMENT PG 64 64-28	9.00	TON	\$674.59	\$6,071.00	1	\$6,071.00	
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00	
STRIPING-WHITE EPOXY STRIPING-YELLOW EPOXY	1.00 2.00	GAL GAL	\$61.96 \$62.79	\$62.00 \$126.00		\$62.00 \$126.00	
	2.00	GAL	Ş02.73				
THREE-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$24,122.00	+	\$24,362.00	
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00	
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00	
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00	
CATEGORY	LENGTH (STA.)		COST PER STATION	N	SUBTO	DTAL	
THREE-LANE ROAD (FULL RECONSTRUCT)	111.10		\$24,362.00		\$2,700	0,000	
LANE TRANSITION WEST OF CORRIDOR	20.00		\$20,250.00				
3 TO 4 LANE TRANSITION WEST OF BRIDGE	5.00		\$28,155.00		\$410,000 \$140,000		
DEDICATED BICYCLE/PEDESTRIAN FACILITY	11.20	l	\$2,767.00	\$31,000 \$895,000			
CONCRETE BARRIER RAIL	126.72						
ROADWAY & DEDICATED BICYCLE/PEDESTRIAN FACILITY CO	OST SUBTOTAL					,000	
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT ⁴			SUBTO	OTAL	
CANTILEVER CONSTRUCTION (TWO-LANE)	1,975.00	53.50 \$125.00		\$13,21	0,000		
	APPROX. QUANTITY	UNIT	UNIT P	RICE			
EXCAVATION-UNCLASS BORROW	14,000.00	CUYD	\$4.6	7	\$65,000.00		
EMBANKMENT IN PLACE	7,200.00	CUYD	\$6.8	3	\$49,200.00		
RETAINING WALL	30,200.00	SQFT	\$50.0	00	\$1,500,0	00.00	
CANTILEVER CONSTRUCTION (TWO-LANE) SUBTOTAL					\$14,800,	.000.00	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT 5	SUBTO	OTAL	
SOUTH FORK BRIDGE CONSTRUCTION							
EB STRUCTURE (TWO-LANE) 6	655.00	43.00	\$175.	00	\$4,900	000	
WB STRUCTURE (TWO-LANE)	655.00	55.00	\$175.		\$6,300		
STRUCTURE COST SUBTOTAL	033.00	33.00	ψ173.	00	\$26,00		
STRUCTURE COST SUBTOTAL							
				SUBTOTAL 1	\$30,20	0,000	
	ADDI	TIONAL COSTS			-		
		MISCEL	LANEOUS @ 20% OF	SUBTOTAL 1 7	20%	\$6,000,000	
		МОВ	ILIZATION @ 18% OF	SUBTOTAL 1 8	18%	\$5,400,000	
	CON	ISTRUCTION EN	GINEERING @ 15% O	F SUBTOTAL 1	15%	\$4,500,000	
				SUBTOTAL 2	_	\$46,100,000	
	INDIRECT COST	(IDC) - CONSTR	UCTION @ 9.64% OF	SUBTOTAL 2 9	9.64%	\$4,400,000	
					20%	\$9,200,000	
		CONTINGEN	CY @ 20% & 50% OF S	SUBTOTAL 2 10	50%	\$23,100,000	
	TOTAL IMPE	OVEMENT OPT	ION COST @ 20% CO	NTINGENCY 11	\$59,70		
			ION COST @ 50% CO		\$73,60		
	IOTALIMPE	OVEIVIENT OPT	ION COST @ 50% CO	NTINGENCY	\$73,60	0,000	

¹ One station is equal to 100 feet.

Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

^{**}The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

5 Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

⁷ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁸ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁹ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

10 A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this

planning level cost estimate.

11 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 THREE LANES FROM RP140.0 - 142.0, FOUR LANES RP 142.0 - 142.4 WITH TURN BAY AT BERNE PARK

			Training Ecver Es			
	Approx. Quantity		Average Bi		Adjusted L	
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³
	,		Dollars	Dollars	Dollars	Dollars
THREE-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	620.00	CUYD	\$4.67	\$2,895.00		\$2,895.00
EMBANKMENT IN PLACE	195.00	CUYD	\$6.83	\$1,332.00		\$1,332.00
CRUSHED AGGREGATE COURSE	425.00	CUYD	\$18.79	\$7,986.00		\$7,986.00
COVER - TYPE 2	600.00	SQYD	\$0.51	\$306.00		\$306.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	165.00	TON	\$25.37	\$4,186.00		\$4,186.00
ASPHALT CEMENT PG 64 64-28	9.00	TON	\$674.59	\$6,071.00		\$6,071.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
STRIPING-WHITE EPOXY STRIPING-YELLOW EPOXY	1.00 2.00	GAL GAL	\$61.96 \$62.79	\$62.00 \$126.00		\$62.00 \$126.00
	2.00	GAL	\$62.79			
THREE-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$24,122.00		\$24,362.00
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBTOTAL	
THREE-LANE ROAD (FULL RECONSTRUCT)	111.73		\$24,362.00		\$2,700,000	
LANE TRANSITION WEST OF CORRIDOR	20.00		\$20,250.00		\$410,000	
3 TO 4 LANE TRANSITION WEST OF BRIDGE	5.00		\$28,155.00	\$140,000		
ROADWAY COST SUBTOTAL	,20,2000				\$3,300,000	
CATEGORY	LENGTH (FT.) WIDTH (FT.) COST PER SQUARE FOOT 4				SUBT	
CANTILEVER CONSTRUCTION (THREE-LANE)	1,975.00	55.50	· /		\$13,70	
CANTILLY EN CONSTRUCTION (TIME EARL)	APPROX. QUANTITY	UNIT			Ų13,70	,0,000
EXCAVATION-UNCLASS BORROW	15,000.00	CUYD	\$4.6		\$70,100.00	
EMBANKMENT IN PLACE	7,860.00	CUYD	\$6.8		\$53,700.00	
RETAINING WALL	30,555.00	SQFT	\$50.0		\$1,500,000.00	
CANTILEVER CONSTRUCTION (THREE-LANE) SUBTOTAL	30,333.00	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	ψ30.			
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT 5	\$15,300,000.00 SUBTOTAL	
	LENGTH (F1.)	WIDTH (F1.)	COST PER SQU	ARE FOOT	3081	DIAL
SOUTH FORK BRIDGE CONSTRUCTION	655.00	1 42.00	6475	00	Ć4.00	0.000
EB STRUCTURE (TWO-LANE) WB STRUCTURE (TWO-LANE)	655.00 655.00	43.00 43.00	\$175. \$175.		\$4,90 \$4,90	
· · · · · · · · · · · · · · · · · · ·	055.00	43.00	\$175.	.00		
STRUCTURE COST SUBTOTAL					\$25,10	
				SUBTOTAL 1	\$28,40	0,000
	ADDI	TIONAL COSTS				
		MISCE	LLANEOUS @ 20% OF	SUBTOTAL 1 6	20%	\$5,700,000
		МОВ	ILIZATION @ 18% OF	SUBTOTAL 1 7	18%	\$5,100,000
	COI	NSTRUCTION EN	GINEERING @ 15% (OF SUBTOTAL 1	15%	\$4,300,000
				SUBTOTAL 2		\$43,500,000
	INDIRECT COST	r (IDC) - CONSTR	UCTION @ 9.64% OI	SUBTOTAL 2 8	9.64%	\$4,200,000
			10V C 20V D F5**	SUPTOTAL 3.9	20%	\$8,700,000
		CONTINGEN	ICY @ 20% & 50% OI	SUBTOTAL 2	50%	\$21,800,000
	TOTAL IMP	ROVEMENT OP	TION COST @ 20% CC	ONTINGENCY 10	\$56,40	
	TOTAL IMP	ROVEMENT OP	TION COST @ 50% CO	ONTINGENCY 10	\$69,50	00,000
					1 /	•

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

⁵ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁹ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

level cost estimate.

10 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 THREE LANES FROM RP140.0 - 142.0, FOUR LANES RP 142.0 - 142.4 WITH TURN BAY AT BERNE PARK & WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY

			Average Bio	d Prices ²	Adjusted Unit Prices		
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ³	
, , , , , , , , , , , , , , , , , , ,	(Per Station) 1		Dollars	Dollars	Dollars	Dollars	
THREE-LANE ROAD (FULL RECONSTRUCT)			2011415	2011415	20.10.0	2011010	
EXCAVATION-UNCLASS BORROW	620.00	CUYD	\$4.67	\$2,895.00		\$2,895.00	
EMBANKMENT IN PLACE	195.00	CUYD	\$6.83	\$1,332.00		\$1,332.00	
CRUSHED AGGREGATE COURSE	425.00	CUYD	\$18.79	\$7,986.00		\$7,986.00	
COVER - TYPE 2	600.00	SQYD	\$0.51	\$306.00		\$306.00	
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00	
PLANT MIX BIT SURF GR S-3/4 IN	165.00	TON	\$25.37	\$4,186.00		\$4,186.00	
ASPHALT CEMENT PG 64 64-28	9.00	TON	\$674.59	\$6,071.00		\$6,071.00	
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00	
STRIPING-WHITE EPOXY	1.00	GAL	\$61.96	\$62.00		\$62.00	
STRIPING-YELLOW EPOXY	2.00	GAL	\$62.79	\$126.00		\$126.00	
THREE-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$24,122.00		\$24,362.00	
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00	
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00	
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00	
CATEGORY	LENGTH (STA.)		COST PER STATION	N	SUBTO	TAL	
THREE-LANE ROAD (FULL RECONSTRUCT)	110.13		\$24,362.00		\$2,700,000		
LANE TRANSITION WEST OF CORRIDOR	20.00		\$20,250.00		\$410,000		
3 TO 4 LANE TRANSITION WEST OF BRIDGE	5.00		\$28,155.00		\$140,000		
					\$30,400		
DEDICATED BICYCLE/PEDESTRIAN FACILITY	11.00		\$2,767.00	i '			
CONCRETE BARRIER RAIL	126.72 \$7,060.00				\$895,000		
ROADWAY & DEDICATED BICYCLE/PEDESTRIAN FACILITY CO	ST SUBTOTAL				\$4,200,000		
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT ⁴			SUBTO	TAL	
CANTILEVER CONSTRUCTION (THREE-LANE)	2,180.00	67.50	67.50 \$125.00		\$18,39	0,000	
	APPROX. QUANTITY	UNIT	UNIT P	RICE			
EXCAVATION-UNCLASS BORROW	18,500.00	CUYD	\$4.6	7	\$86,400.00		
EMBANKMENT IN PLACE	14,200.00	CUYD	\$6.8	3	\$97,000.00		
RETAINING WALL	31,900.00	SQFT	\$50.0	00	\$1,600,0	00.00	
CANTILEVER CONSTRUCTION (THREE-LANE) SUBTOTAL					\$20,200,	000.00	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT 5	SUBTO	TAL	
SOUTH FORK BRIDGE CONSTRUCTION							
EB STRUCTURE (TWO-LANE) ⁶	655.00	55.00	\$175.	00	\$6,300	000	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.		\$4,900		
STRUCTURE COST SUBTOTAL					\$31,40		
				SUBTOTAL 1	\$35,60		
	* DD!	TIONAL COSTS		JOBIO IAL I	333,00	0,000	
	ADDI	TIONAL COSTS		7			
			LLANEOUS @ 20% OF		20%	\$7,100,000	
		МОВ	BILIZATION @ 18% OF	SUBTOTAL 1 8	18%	\$6,400,000	
	СО	NSTRUCTION EN	IGINEERING @ 15% C	F SUBTOTAL 1	15%	\$5,300,000	
				SUBTOTAL 2		\$54,400,000	
	INDIRECT COS	T (IDC) - CONSTR	RUCTION @ 9.64% OF	SUBTOTAL 2 9	9.64%	\$5,200,000	
				10	20%	\$10,900,000	
		CONTINGEN	CY @ 20% & 50% OF	SUBTOTAL 2 **	50%	\$27,200,000	
	TOTAL IMID	ROVEMENT OF	TION COST @ 20% CO	NTINGENCY 11	\$70,50		
						-	
	TOTAL IMP	KUVEMENT OP	TION COST @ 50% CC	INTINGENCY	\$86,80	0,000	

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.
⁵ Planning level cost for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

⁷ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

level cost estimate.

11 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES RP 140.0 - RP 140.6, THREE LANES RP 140.6 - RP 141.2, FOUR LANES RP 141.2 - RP 142.4

			Average Bi	d Prices ²	2 Adjusted Unit Prices		
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ³	
·	(Per Station) 1		Dollars	Dollars	Dollars	Dollars	
FOUR-LANE ROAD (FULL RECONSTRUCT)							
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00	
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00	
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00	
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00	
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00	
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00	
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00	
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00	
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00	
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00	
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00	
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00	
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00	
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00	
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBT	OTAL	
FOUR-LANE ROAD (FULL RECONSTRUCT)	110.05		\$28,155.00		\$3,100,000		
LANE TRANSITION WEST OF CORRIDOR	20.00		\$21,600.00		\$430,000		
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00			\$210,000	
ROADWAY COST SUBTOTAL	, ,				\$3,70		
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT 4			SUBTOTAL		
CANTILEVER CONSTRUCTION (THREE-LANE)	1,975.00						
CANTILEVER CONSTRUCTION (THREE-LANE)		55.50 \$125.00 UNIT UNIT PRICE		\$13,700,000			
EXCAVATION-UNCLASS BORROW	APPROX. QUANTITY 15,000.00	CUYD	\$4.6		¢70.1	00.00	
EMBANKMENT IN PLACE	7,860.00	CUYD	\$6.8		\$70,100.00 \$53,700.00		
RETAINING WALL	30,555.00	SQFT	\$50.		\$1,500,000.00		
CANTILEVER CONSTRUCTION (THREE-LANE) SUBTOTAL	30,333.00	30,1	, , , , , , , , , , , , , , , , , , , 	00	\$1,500,000.00		
	LENGTH (FT.)	14/1DTU (ET)	2027 050 201	14D5 5007 5			
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	TARE FOOT	SUBT	UIAL	
SOUTH FORK BRIDGE CONSTRUCTION	655.00	42.00	6475	20	Ć4.00	0.000	
EB STRUCTURE (TWO-LANE) WB STRUCTURE (TWO-LANE)	655.00 655.00	43.00 43.00	\$175 \$175		\$4,90 \$4,90		
·	033.00	43.00	\$173	.00			
STRUCTURE COST SUBTOTAL					\$25,10		
				SUBTOTAL 1	\$28,80	00,000	
	ADDI	TIONAL COSTS					
		MISCEL	LANEOUS @ 20% O	F SUBTOTAL 1 ^b	20%	\$5,800,000	
		МОВ	ILIZATION @ 18% O	F SUBTOTAL 1 ⁷	18%	\$5,200,000	
	COI	NSTRUCTION EN	GINEERING @ 15% (OF SUBTOTAL 1	15%	\$4,300,000	
				SUBTOTAL 2		\$44,100,000	
	INDIRECT COST	r (IDC) - CONSTR	UCTION @ 9.64% O	F SUBTOTAL 2 ⁸	9.64%	\$4,300,000	
				9	20%	\$8,800,000	
		CONTINGEN	ICY @ 20% & 50% O	F SUBTOTAL 2 °	50%	\$22,100,000	
	TOTAL IMP	ROVEMENT OPT	TION COST @ 20% CO	ONTINGENCY 10	\$57,20		
			TION COST @ 50% CO				
	TOTALIMP	KOVEIVIENT OPT	IUN CUSI @ 50% CC	DIVINIGENCY	\$70,50	0,000	

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

⁵ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁹ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

level cost estimate.

The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES RP 140.0 - RP 140.6, THREE LANES RP 140.6 - RP 141.2, FOUR LANES RP 141.2 - RP 142.4 WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY **Planning Level Estimate of Costs**

			Average Bio		Adjusted l	Init Prices
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	
item bescription	(Per Station) 1	J	Dollars	Dollars	Dollars	Amount ³ Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)			Bollars	Donars	Donars	Donais
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
STRIPING-WHITE EPOXY STRIPING-YELLOW EPOXY	2.00 1.00	GAL GAL	\$61.96 \$62.79	\$124.00 \$63.00		\$124.00 \$63.00
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL	1.00	GAL	302.79	\$27,915.00		\$28,155.00
	F00.00	LNET	\$30.20			
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00	¢10,000,00	\$15,100.00
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00
CATEGORY	LENGTH (STA.)		COST PER STATION	N	SUBT	OTAL
FOUR-LANE ROAD (FULL RECONSTRUCT)	110.13		\$28,155.00		\$3,100,000	
LANE TRANSITION WEST OF CORRIDOR	20.00		\$21,600.00		\$430,000	
LANE TRANSITION EAST END OF CORRIDOR	8.00	\$26,250.00			\$210,000	
DEDICATED BICYCLE/PEDESTRIAN FACILITY	11.00	\$2,767.00			\$30,400	
CONCRETE BARRIER RAIL	126.72	126.72 \$7,060.00				,000
ROADWAY & DEDICATED BICYCLE/PEDESTRIAN FACILITY COS	T SUBTOTAL				\$4,70	0,000
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT 4			SUBT	OTAL
CANTILEVER CONSTRUCTION (THREE-LANE)	2,180.00	67.50			\$18,40	0,000
	APPROX. QUANTITY	UNIT	UNIT P	RICE		
EXCAVATION-UNCLASS BORROW	18,500.00	CUYD	\$4.6		\$86,400.00	
EMBANKMENT IN PLACE	14,200.00	CUYD	\$6.8	13	\$97,000.00	
RETAINING WALL	31,900.00	SQFT	\$50.0	00	\$1,600,	000.00
CANTILEVER CONSTRUCTION (THREE-LANE) SUBTOTAL					\$20,200	,000.00
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT 5	SUBT	OTAL
SOUTH FORK BRIDGE CONSTRUCTION						
EB STRUCTURE (TWO-LANE) ⁶	655.00	55.00	\$175.	.00	\$6,30	0,000
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.	.00	\$4,90	0,000
STRUCTURE COST SUBTOTAL					\$31,40	0,000
				SUBTOTAL 1	\$36,10	0,000
	ADDIT	IONAL COSTS				
		MISCE	LLANEOUS @ 20% OF	SUBTOTAL 1 7	20%	\$7,200,000
		МОЕ	BILIZATION @ 18% OF	SUBTOTAL 1 8	18%	\$6,500,000
	COI		IGINEERING @ 15% C		15%	\$5,400,000
				SUBTOTAL 2	-0/1	\$55,200,000
	INDIRECT COST	(IDC) - CONST	RUCTION @ 9.64% OF		9.64%	\$5,300,000
	MDIRECT COS		_		20%	\$11,000,000
		CONTINGEN	CY @ 20% & 50% OF	SUBTOTAL 2 10	50%	\$11,000,000
	TOTAL IMP	ROVEMENT OD	TION COST @ 20% CO	NTINGENCY 11	\$71,50	
					\$88,10	
	IOIALIMP	KOVEWIENI OP	TION COST @ 50% CO	INGENCY	\$88,1U	0,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.
⁵ Planning level cost for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

⁷ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

level cost estimate.

11 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES WITH CENTER MEDIAN RP 140.0 - RP 140.6, THREE LANES RP 140.6 - RP 141.2, FOUR LANES WITH CENTER MEDIAN RP 141.2 - RP 142.4

	Approx. Quantity	-	Average Bi	d Prices ²	Adjusted Unit Prices		
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³	
	(i ei otation)		Dollars	Dollars	Dollars	Dollars	
FOUR-LANE ROAD (FULL RECONSTRUCT)							
EXCAVATION-UNCLASS BORROW	765.00	CUYD	\$4.67	\$3,573.00		\$3,573.00	
EMBANKMENT IN PLACE	240.00	CUYD	\$6.83	\$1,639.00		\$1,639.00	
CRUSHED AGGREGATE COURSE	545.00	CUYD	\$18.79	\$10,241.00		\$10,241.00	
COVER - TYPE 2	825.00	SQYD	\$0.51	\$421.00		\$421.00	
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00	
PLANT MIX BIT SURF GR S-3/4 IN	220.00	TON	\$25.37	\$5,581.00		\$5,581.00	
ASPHALT CEMENT PG 64 64-28	12.00	TON	\$674.59	\$8,095.00		\$8,095.00	
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00	
CONCRETE BARRIER RAIL	10.00	EACH	\$706.02	\$7,060.00		\$7,060.00	
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00	
STRIPING-YELLOW EPOXY	2.00	GAL	\$62.79	\$126.00		\$126.00	
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$38,018.00		\$38,258.00	
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00	
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00	
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00	
CATEGORY	LENGTH (STA.)	LACII	COST DED STATIO	Ť			
FOUR-LANE ROAD (FULL RECONSTRUCT)	109.33		COST PER STATION			\$4,200,000	
LANE TRANSITION WEST OF CORRIDOR	20.00		\$38,258.00				
			\$21,600.00		\$430,000 \$210,000		
LANE TRANSITION EAST END OF CORRIDOR	8.00	.00 \$26,250.00					
ROADWAY COST SUBTOTAL		1			\$4,800	0,000	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT ⁴		SUBTO	OTAL	
CANTILEVER CONSTRUCTION (THREE-LANE)	1,975.00	55.50	\$125	.00	\$13,700,000		
	APPROX. QUANTITY	UNIT	UNIT P	RICE			
EXCAVATION-UNCLASS BORROW	15,000.00	CUYD	\$4.6	57	\$70,100.00		
EMBANKMENT IN PLACE	7,860.00	CUYD	\$6.8	33	\$53,700.00		
RETAINING WALL	30,555.00	SQFT	\$50.	00	\$1,500,000.00		
CANTILEVER CONSTRUCTION (THREE-LANE) SUBTOTAL					\$15,300	,000.00	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT 5	SUBTO	OTAL	
SOUTH FORK BRIDGE CONSTRUCTION	` ,	· · · · ·	<u> </u>				
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	00	\$4,900	0.000	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175		\$4,900		
STRUCTURE COST SUBTOTAL			, -		\$25,10		
				SUBTOTAL 1	\$29,90		
	ADDI	TIONAL COSTS		302.02	Ų 2 3,30	,	
	ADDI		LANEOUS @ 20% OF	SUPTOTAL 1 6	20%	\$6,000,000	
			ILIZATION @ 18% OF		18%	\$5,400,000	
	COI	NSTRUCTION EN	IGINEERING @ 15% C		15%	\$4,500,000	
				SUBTOTAL 2	ī	\$45,800,000	
	INDIRECT COST	(IDC) - CONSTR	UCTION @ 9.64% OF	SUBTOTAL 2 °	9.64%	\$4,400,000	
		CONTINGEN	ICY @ 20% & 50% OF	SUBTOTAL 2 9	20%	\$9,200,000	
			_		50%	\$22,900,000	
	TOTAL IMP	ROVEMENT OPT	TION COST @ 20% CO	ONTINGENCY 10	\$59,40	0,000	
	TOTAL IMP	ROVEMENT OPT	TION COST @ 50% CO	ONTINGENCY 10	\$73,10	0,000	

 $^{^{\}rm 1}$ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

⁵ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations. ⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this

planning level cost estimate.

The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES WITH CENTER MEDIAN RP 140.0 - RP 140.6, THREE LANES RP 140.6 - RP 141.2, FOUR LANES WITH CENTER MEDIAN RP 141.2 - RP 142.4 WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY Planning Level Estimate of Costs

			r lanning Ecver Ec				
	Approx. Quantity		Average Bi	d Prices ²	Adjusted l	Jnit Prices	
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³	
	(Fei Station)		Dollars	Dollars	Dollars	Dollars	
FOUR-LANE ROAD (FULL RECONSTRUCT)							
EXCAVATION-UNCLASS BORROW	765.00	CUYD	\$4.67	\$3,573.00		\$3,573.00	
EMBANKMENT IN PLACE	240.00	CUYD	\$6.83	\$1,639.00		\$1,639.00	
CRUSHED AGGREGATE COURSE	545.00	CUYD	\$18.79	\$10,241.00		\$10,241.00	
COVER - TYPE 2	825.00	SQYD	\$0.51	\$421.00		\$421.00	
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00	
PLANT MIX BIT SURF GR S-3/4 IN	220.00	TON	\$25.37	\$5,581.00		\$5,581.00	
ASPHALT CEMENT PG 64 64-28	12.00	TON	\$674.59	\$8,095.00		\$8,095.00	
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00	
CONCRETE BARRIER RAIL	10.00	EACH	\$706.02	\$7,060.00		\$7,060.00	
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00	
STRIPING-YELLOW EPOXY	2.00	GAL	\$62.79	\$126.00		\$126.00	
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$38,018.00		\$38,258.00	
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00	
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00	
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00	
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBTOTAL		
FOUR-LANE ROAD (FULL RECONSTRUCT)	110.13		\$38,258.00		\$4,200,000		
LANE TRANSITION WEST OF CORRIDOR	20.00		\$21,600.00		\$430,000		
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00		\$210,000		
DEDICATED BICYCLE/PEDESTRIAN FACILITY	11.00	1.00 \$2,767.00			\$30,	400	
CONCRETE BARRIER RAIL	126.72					,000	
ROADWAY & DEDICATED BICYCLE/PEDESTRIAN FACILITY CO	ST SUBTOTAL				\$5,80	0,000	
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT 4			SUBTOTAL		
CANTILEVER CONSTRUCTION (THREE-LANE)	2,180.00	67.50	\$125	.00	\$18,400,000		
	APPROX. QUANTITY	UNIT	UNIT P	PRICE			
EXCAVATION-UNCLASS BORROW	18,500.00	CUYD	\$4.6	57	\$86,400.00		
EMBANKMENT IN PLACE	14,200.00	CUYD	\$6.8	33	\$97,000.00		
RETAINING WALL	31,900.00	SQFT	\$50.	00	\$1,600,	000.00	
CANTILEVER CONSTRUCTION (THREE-LANE) SUBTOTAL					\$20,200	,000.00	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQL	JARE FOOT ⁵	SUBT	OTAL	
SOUTH FORK BRIDGE CONSTRUCTION							
EB STRUCTURE (TWO-LANE) 6	655.00	55.00	\$175	.00	\$6,30	0,000	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	0,000	
STRUCTURE COST SUBTOTAL	•				\$31,40	00.000	
				SUBTOTAL 1	\$37,20		
	ADDIT	TIONAL COSTS		SOBIOTALI	\$37,20	,0,000	
	ADDIT		LANEOUS @ 20% OF	SUBTOTAL 1 7	20%	\$7,400,000	
			ILIZATION @ 18% OF	_	18%	\$6,700,000	
	CON				15%		
	CON	STRUCTION EN	GINEERING @ 15% C		15%	\$5,600,000	
	INDIDECT CO.	(IDC) CO.::=-	HOTION & COST -	SUBTOTAL 2 9	0.5***	\$56,900,000	
	INDIRECT COST	(IDC) - CONSTR	UCTION @ 9.64% OF	- SUBTOTAL 2	9.64%	\$5,500,000	
		CONTINGEN	CY @ 20% & 50% OF	SUBTOTAL 2 10	20%	\$11,400,000	
					50%	\$28,500,000	
			TION COST @ 20% CC		\$73,80	•	
	TOTAL IMPR	OVEMENT OPT	TON COST @ 50% CC	ONTINGENCY 11	\$90,90	00,000	

¹ One station is equal to 100 feet.

Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

⁷The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁸ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁹ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

10 A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

11 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all

scenarios and circumstances



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES THROUGHOUT CORRIDOR Planning Level Estimate of Costs

	A 2		Average Bid Prices ²		Adjusted Unit Prices	
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ³
	(Per Station) 1		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00
CATEGORY	LENGTH (STA.)		COST PER STATION	N	SUBTOTAL	
FOUR-LANE ROAD (FULL RECONSTRUCT)	110.05		\$28,155.00		\$3,100,000	
LANE TRANSITION WEST OF CORRIDOR	20.00	\$21,600.00			\$430,000	
LANE TRANSITION EAST END OF CORRIDOR	8.00	\$26,250.00			\$210,000	
ROADWAY COST SUBTOTAL					\$3,700,000	
CATEGORY	LENGTH (FT.)	H (FT.) WIDTH (FT.) COST PER SQUARE FOOT ⁴				OTAL
CANTILEVER CONSTRUCTION (FOUR-LANE)	2,115.00	65.00 \$125.00		\$17,20	0,000	
	APPROX. QUANTITY	UNIT UNIT PRICE				
EXCAVATION-UNCLASS BORROW	18,000.00	CUYD	\$4.6		\$84,060.00	
EMBANKMENT IN PLACE	13,980.00	CUYD	\$6.8	33	\$95,500.00	
RETAINING WALL	31,590.00	SQFT	\$50.0	00	\$1,600,000.00	
CANTILEVER CONSTRUCTION (FOUR-LANE) SUBTOTAL					\$19,000,000.00	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT 5	SUBTO	OTAL
SOUTH FORK BRIDGE CONSTRUCTION						
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.	.00	\$4,900	0,000
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.	.00	\$4,900	0,000
STRUCTURE COST SUBTOTAL					\$28,80	0,000
				SUBTOTAL 1	\$32,50	0,000
	ADDI"	TIONAL COSTS				
			LLANEOUS @ 20% OF	SUBTOTAL 1 6	20%	\$6,500,000
			ILIZATION @ 18% OF		18%	\$5,900,000
	COL		IGINEERING @ 15% C		15%	\$4,900,000
	COI		E.IIII & 13/0 C	SUBTOTAL 2	13/0	\$49,800,000
	INDIRECT COST	(IDC) - CONSTR	RUCTION @ 9.64% OF		9.64%	\$4,800,000
	INDIRECT COS	(10C) - CONSTR	000110N @ 5.04% OF	JODIOTAL 2	20%	\$10,000,000
		CONTINGEN	ICY @ 20% & 50% OF	SUBTOTAL 2 9		
	TOTAL INAD	DOVEMENT ON	rion cost @ 20% co	ONTINGENCY 10	50% \$64,60	\$24,900,000
						-
	TOTAL IMP	KOVEMENT OPT	TION COST @ 50% CC	ONTINGENCY **	\$79,50	10,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

 $^{^{\}rm 3}$ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

⁵ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

^{*}Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁹ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

level cost estimate.

10 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES THROUGHOUT CORRIDOR WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY Planning Level Estimate of Costs

	Approx. Quantity		Average Bi	d Prices ²	Adjusted I	Jnit Prices
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³
	(rei station)		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBT	OTAL
FOUR-LANE ROAD (FULL RECONSTRUCT)	117.05		\$28,155.00		\$3,300,000	
LANE TRANSITION WEST OF CORRIDOR	20.00		\$21,600.00		\$430,000	
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00	\$210,000		
DEDICATED BICYCLE/PEDESTRIAN FACILITY	11.50		\$2,767.00	\$31,800		
CONCRETE BARRIER RAIL	126.72		\$895			
ROADWAY & DEDICATED BICYCLE/PEDESTRIAN FACILITY COS						0,000
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT ⁴			SUBT	
CANTILEVER CONSTRUCTION (FOUR-LANE)	2,510.00	77.00 \$125.00		\$24,20		
CANTILLVER CONSTRUCTION (1 OUR-LANE)	,	UNIT UNIT PRICE		Ş24,20	50,000	
EXCAVATION-UNCLASS BORROW	APPROX. QUANTITY 22,000.00	CUYD	\$4.		\$102,740.00	
EMBANKMENT IN PLACE	21,500.00	CUYD	\$6.		\$146,800.00	
RETAINING WALL	36,500.00	SQFT	\$50.		\$146,800.00	
CANTILEVER CONSTRUCTION (FOUR-LANE) SUBTOTAL	30,300.00	34	, , , , , , , , , , , , , , , , , , , 		\$26,200	
				5		
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQL	JARE FOOT	SUBT	OTAL
SOUTH FORK BRIDGE CONSTRUCTION						
EB STRUCTURE (TWO-LANE) ⁶	655.00	55.00	\$175		\$6,30	,
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	
STRUCTURE COST SUBTOTAL					\$37,40	00,000
				SUBTOTAL 1	\$42,30	00,000
	ADDIT	IONAL COSTS				
		MISCEI	LLANEOUS @ 20% O	F SUBTOTAL 1 7	20%	\$8,500,000
		МОВ	ILIZATION @ 18% O	F SUBTOTAL 1 8	18%	\$7,600,000
	COI	NSTRUCTION EN	IGINEERING @ 15%	OF SUBTOTAL 1	15%	\$6,300,000
				SUBTOTAL 2		\$64,700,000
	INDIRECT COST	(IDC) - CONSTR	RUCTION @ 9.64% O		9.64%	\$6,200,000
					20%	\$12,900,000
		CONTINGEN	CY @ 20% & 50% OF	SUBTOTAL 2 10	50%	\$32,400,000
	TOTAL INAD	DOVEMENT OF	TION COST @ 20% C	ONTINGENCY 11	\$83,80	
	TOTAL IMP	KUVEMENT OPT	TION COST @ 50% C	UN FINGENCY **	\$103,3	00,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

⁷ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

level cost estimate.

11 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES THROUGHOUT CORRIDOR, ELEVATED FOUR LANE ROADWAY STRUCTURE RP 140.6 - RP 141.2 Planning Level Estimate of Costs

				2	Adjusted Unit Prices	
Itama Description	Approx. Quantity	11	Average B		•	
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³
	, ,		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00
CATEGORY	LENGTH (STA.)		COST PER STATIC	N	SUBT	OTAL
FOUR-LANE ROAD (FULL RECONSTRUCT)	85.11		\$28,155.00		\$2,400,000	
LANE TRANSITION WEST OF CORRIDOR	20.00	\$21,600.00			\$430,000	
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00		\$210,000	
ROADWAY COST SUBTOTAL					\$3,00	0,000
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQ	UARE FOOT ⁴	SUBT	OTAL
ELEVATED STRUCTURE (FOUR-LANE)	4,800.00	67.00	\$175	5.00	\$56,300,000	
SOUTH FORK BRIDGE CONSTRUCTION						
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	5.00	\$4,900,000	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	5.00	\$4,900,000	
STRUCTURE COST SUBTOTAL					\$66,10	00,000
				SUBTOTAL 1	\$69,10	00,000
	ADDI	TIONAL COSTS		-		
		MISCEI	LLANEOUS @ 20% C	F SUBTOTAL 1 5	20%	\$13,800,000
		МОВ	ILIZATION @ 18% C	F SUBTOTAL 1 6	18%	\$12,400,000
	COI	NSTRUCTION EN	IGINEERING @ 15%	OF SUBTOTAL 1	15%	\$10,400,000
				SUBTOTAL 2		\$106,000,000
	INDIRECT COST	(IDC) - CONSTR	RUCTION @ 9.64% C	F SUBTOTAL 2 ⁷	9.64%	\$10,200,000
		CONTINCE	NCY @ 20% & 50% C	S SUBTOTAL 3 8	20%	\$21,200,000
		CONTINGEN	uc r @ 20% & 50% 0	F SUBTUTAL 2	50%	\$53,000,000
	TOTAL IMP	PROVEMENT OP	TION COST @ 20%	CONTINGENCY 9	\$137,0	00,000
	TOTAL IMP	PROVEMENT OP	TION COST @ 50%	CONTINGENCY 9	\$169,0	00,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

 $^{^{\}scriptsize 3}$ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁵ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁶ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁷ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁸ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁹ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES THROUGHOUT CORRIDOR,

ELEVATED FOUR LANE ROADWAY STRUCTURE RP 140.6 - RP 141.2 WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY

			Average Bio		Adjusted Unit Prices	
Item Description	Approx. Quantity	Unit	Unit Price Amount		Unit Price	Amount ³
	(Per Station) 1		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBTO	OTAL
FOUR-LANE ROAD (FULL RECONSTRUCT)	85.11		\$28,155.00		\$2,400,000	
LANE TRANSITION WEST OF CORRIDOR	20.00	\$21,600.00			\$430,000	
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00		\$210,000	
DEDICATED BICYCLE/PEDESTRIAN FACILITY	8.40	3.40 \$2,767.00				200
CONCRETE BARRIER RAIL	126.72	126.72 \$7,060.00				.000
ROADWAY & DEDICATED BICYCLE/PEDESTRIAN FACILITY	COST SUBTOTAL				\$4,000	0,000
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT ⁴	SUBTO	OTAL
ELEVATED STRUCTURE (FOUR-LANE)	4,800.00	67.00	\$175.	00	\$56,300,000	
SOUTH FORK BRIDGE CONSTRUCTION	ĺ		·			•
EB STRUCTURE (TWO-LANE) 5	655.00	55.00	\$175.	00	\$6,300,000	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.		\$4,900	,
STRUCTURE COST SUBTOTAL		1 10100	7-131		\$67,50	,
STREET ORLE COST SOSTOTAL				SUBTOTAL 1	\$71,50	
	ADDIT	TIONAL COSTS		SOBIOTALI	ψ, 1,30·	0,000
	ADDI		LANEOUS @ 20% OF	SUPTOTAL 1 6	20%	\$14,300,000
			ILIZATION @ 18% OF			
					18%	\$12,900,000
	CON	NSTRUCTION EN	GINEERING @ 15% C		15%	\$10,700,000
				SUBTOTAL 2		\$109,000,000
	INDIRECT COST	(IDC) - CONSTR	UCTION @ 9.64% OF	SUBTOTAL 2 °	9.64%	\$10,500,000
		CONTINGEN	ICY @ 20% & 50% OF	SUBTOTAL 2 9	20%	\$21,800,000
			-		50%	\$54,500,000
	TOTAL IMP	ROVEMENT OPT	TION COST @ 20% CC	ONTINGENCY 10	\$141,00	
	TOTAL IMP	ROVEMENT OPT	ION COST @ 50% CO	ONTINGENCY 10	\$174,00	00,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁵ Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁹ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

¹⁰ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES THROUGHOUT CORRIDOR, CANTILIVER AND RAISED ROADWAY STRUCTURE RP 140.0 - RP 141.2 **Planning Level Estimate of Costs**

			Fianning Level Es				
	Approx. Quantity		Average Bid Prices ²		Adjusted Unit Prices		
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³	
	, ,		Dollars	Dollars	Dollars	Dollars	
FOUR-LANE ROAD (FULL RECONSTRUCT)							
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00	
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00	
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00	
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00	
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00	
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00	
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00	
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00	
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00	
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00	
TWO-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00	
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBT	OTAL	
TWO-LANE ROAD (FULL RECONSTRUCT)	104.59		\$28,155.00		\$2,90	0,000	
LANE TRANSITION WEST OF CORRIDOR	20.00		\$21,600.00		\$430	,000	
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00		\$210,000		
ROADWAY COST SUBTOTAL					\$3,500,000		
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT			SUBTOTAL		
ELEVATED STRUCTURE (TWO-LANE) 4	4,800.00	39.00 \$175.00			\$32,800,000		
CANTILEVER CONSTRUCTION (TWO-LANE) 5	1,850.00	37.50 \$125.00		\$8,70	0,000		
	APPROX. QUANTITY	UNIT	UNIT UNIT PRICE				
EXCAVATION-UNCLASS BORROW	11,000.00	CUYD	\$4.67		\$51,400.00		
EMBANKMENT IN PLACE	2,665.00	CUYD	\$6.8	33	\$18,200.00		
RETAINING WALL	28,710.00	SQFT	\$50.	00	\$1,400,000.00		
CANTILEVER CONSTRUCTION (TWO-LANE) SUBTOTAL					\$10,200,000.00		
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQL	JARE FOOT ⁴	SUBTOTAL		
SOUTH FORK BRIDGE CONSTRUCTION							
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	0.000	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175		\$4,90	,	
STRUCTURE COST SUBTOTAL			·		\$52,80	000	
STROCTORE COST SOBTOTAL				SUBTOTAL 1	\$56,30	•	
	ADDII	TIONAL COSTS		SUBIUTALI	\$30,30	10,000	
	ADDII		LLANEOUS @ 20% O	CURTOTAL 1 6	20%	¢11 200 000	
						\$11,300,000	
			BILIZATION @ 18% O		18%	\$10,100,000	
	COI	NOT KUCTION EN	IGINEERING @ 15% (15%	\$8,400,000	
		(15.0)		SUBTOTAL 2	0.549/	\$86,100,000	
	INDIRECT COST	(IDC) - CONSTR	RUCTION @ 9.64% O	F SUBTOTAL 2 °	9.64%	\$8,300,000	
		CONTINGE	NCY @ 20% & 50% O	F SUBTOTAL 2 9	20%	\$17,200,000	
	TOT:	DOL/FRAFAIT CC	TION COST O 25°' S'	DALTINGENGY 10	50%	\$43,100,000	
			TION COST @ 20% CO		\$112,0	•	
	TOTAL IMP	ROVEMENT OP	TION COST @ 50% CO	ONTINGENCY 10	\$138,0	00,000	

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁵ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁹ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

10 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES THROUGHOUT CORRIDOR, CANTILIVER AND RAISED ROADWAY STRUCTURE RP 140.0 - RP 141.2 WITH DEDICATED **BICYCLE/PEDESTRIAN FACILITY**

			g			
	Approx. Quantity		Average Bi	d Prices ²	Adjusted I	Jnit Prices
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount 3
	(Per Station)		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
TWO-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBT	OTAL
TWO-LANE ROAD (FULL RECONSTRUCT)	104.59		\$28,155.00		\$2,90	0,000
LANE TRANSITION WEST OF CORRIDOR	20.00		\$21,600.00		\$430	,000
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00		\$210),000
DEDICATED BICYCLE/PEDESTRIAN FACILITY	8.40		\$2,767.00		\$23,200	
CONCRETE BARRIER RAIL	126.72	\$7,060.00			\$895,000	
ROADWAY & DEDICATED BICYCLE/PEDESTRIAN FACILITY CO	OST SUBTOTAL	AL				0,000
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT			SUBT	OTAL
ELEVATED STRUCTURE (TWO-LANE) 4	4,800.00	39.00 \$175.00			\$32,800,000	
CANTILEVER CONSTRUCTION (TWO-LANE) 5	1,850.00	37.50 \$125.00			\$8,700,000	
	APPROX. QUANTITY	UNIT UNIT PRICE		ψο,,,ο	0,000	
EXCAVATION-UNCLASS BORROW	11,000.00	CUYD	\$4.6		\$51,400.00	
EMBANKMENT IN PLACE	2,665.00	CUYD	\$6.8		\$18,200.00	
RETAINING WALL	28,710.00	SQFT	\$50.		\$1,400,000.00	
CANTILEVER CONSTRUCTION (TWO-LANE) SUBTOTAL	.,		,		\$10,200,000.00	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQL	IARE FOOT 4	\$10,200,000.00 SUBTOTAL	
SOUTH FORK BRIDGE CONSTRUCTION	ELITOTIT (TT.)	WIDIII (I II.)	COSTTENSQU	ARETOOT	3051	OTAL
EB STRUCTURE (TWO-LANE) ⁶	655.00	55.00	\$175	00	\$6,30	0.000
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175			0,000
STRUCTURE COST SUBTOTAL		1 10100	7-17			00,000
STRUCTURE COST SUBTOTAL				SUBTOTAL 1	\$58,70	
	ADDI	TIONAL COSTS		SODIGIALI	, , , , , , , , , , , , , , , , , , , 	50,000
	ADDI		LANEOUS @ 20% OI	CURTOTAL 1 7	20%	\$11,700,000
				_		
			ILIZATION @ 18% OI		18%	\$10,600,000
	CO	NSTRUCTION EN	GINEERING @ 15% (15%	\$8,800,000
				SUBTOTAL 2		\$89,800,000
	INDIRECT COST	r (IDC) - CONSTR	UCTION @ 9.64% OI	SUBTOTAL 2 ⁹	9.64%	\$8,700,000
		CONTINGEN	CY @ 20% & 50% OF	SUBTOTAL 2 10	20%	\$18,000,000
					50%	\$44,900,000
	TOTAL IMP	ROVEMENT OPT	TION COST @ 20% CO	ONTINGENCY 11	\$117,0	00,000
<u> </u>	TOTAL IMP	ROVEMENT OPT	TION COST @ 50% CO	ONTINGENCY 11	\$143,0	00,000
	•	•	•		•	

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁵ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs.

⁶ Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

⁷ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁸ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

¹⁰ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

11 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all

scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES WITH CENTER MEDIAN THROUGHOUT CORRIDOR **Planning Level Estimate of Costs**

	Annual Quantity	Average Bi	d Prices ²	Adjusted Unit Prices		
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ³
	(Per Station) 1		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	765.00	CUYD	\$4.67	\$3,573.00		\$3,573.00
EMBANKMENT IN PLACE	240.00	CUYD	\$6.83	\$1,639.00		\$1,639.00
CRUSHED AGGREGATE COURSE	545.00	CUYD	\$18.79	\$10,241.00		\$10,241.00
COVER - TYPE 2	825.00	SQYD	\$0.51	\$421.00		\$421.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	220.00	TON	\$25.37	\$5,581.00		\$5,581.00
ASPHALT CEMENT PG 64 64-28	12.00	TON	\$674.59	\$8,095.00		\$8,095.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
CONCRETE BARRIER RAIL	10.00	EACH	\$706.02	\$7,060.00		\$7,060.00
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00
STRIPING-YELLOW EPOXY	2.00	GAL	\$62.79	\$126.00		\$126.00
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$38,018.00		\$38,258.00
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBTOTAL	
FOUR-LANE ROAD (FULL RECONSTRUCT)	109.33	\$38,258.00			\$4,200,000	
LANE TRANSITION WEST OF CORRIDOR	20.00	\$21,600.00			\$430,000	
LANE TRANSITION EAST END OF CORRIDOR	8.00	8.00 \$26,250.00				,000
ROADWAY COST SUBTOTAL					\$4,80	0,000
CATEGORY	LENGTH (FT.)	NGTH (FT.) WIDTH (FT.) COST PER SQUARE FOOT 4				OTAL
CANTILEVER CONSTRUCTION (FOUR-LANE)	2,210.00	75.50 \$125.00		\$20,90		
	APPROX. QUANTITY	UNIT UNIT PRICE		·		
EXCAVATION-UNCLASS BORROW	20,000.00	CUYD	\$4.6		\$93,400.00	
EMBANKMENT IN PLACE	18,955.00	CUYD	\$6.8		\$129,000.00	
RETAINING WALL	32,310.00	SQFT	\$50.	00	\$1,600,000.00	
CANTILEVER CONSTRUCTION (FOUR-LANE) SUBTOTAL					\$22,700,000.00	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQL	JARE FOOT ⁵	SUBTO	
SOUTH FORK BRIDGE CONSTRUCTION	` ,	· · · · ·	·			
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	0.000
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175		\$4,90	
STRUCTURE COST SUBTOTAL					\$32,50	
				SUBTOTAL 1	\$37,30	
	ADDI	TIONAL COSTS			401,00	,
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		LANEOUS @ 20% O	E SURTOTAL 1 6	20%	\$7,500,000
			ILIZATION @ 18% O	_	18%	\$6,700,000
	CO1		GINEERING @ 15% (
	COI	NSTRUCTION EN	GINEERING @ 15% (15%	\$5,600,000
	INDIDECT COST	(IDC) CONSTR	UCTION @ 9.64% O	SUBTOTAL 2 8	0.649/	\$57,100,000
	INDIRECT COST	(IDC) - CONSTR	OCTION @ 9.64% O	r SUBTUTAL Z	9.64%	\$5,500,000
		CONTINGEN	ICY @ 20% & 50% O	F SUBTOTAL 2 9	20%	\$11,400,000
	TOTA: :::	DOVERACE CO	TION COST & 2007 OF	ONTINGENCY 10	50%	\$28,600,000
			TION COST @ 20% CO		\$74,00 \$01,30	
	TOTAL IMP	KOVEMENT OPT	TION COST @ 50% CO	JN FINGENCY **	\$91,20	00,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations. ⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this

planning level cost estimate.

The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES WITH CENTER MEDIAN THROUGHOUT CORRIDOR WITH DEDICATED **BICYCLE/PEDESTRIAN FACILITY Planning Level Estimate of Costs**

			Average Bi	d Prices ²	Adjusted Unit Prices	
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ³
·	(Per Station) 1		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	765.00	CUYD	\$4.67	\$3,573.00		\$3,573.00
EMBANKMENT IN PLACE	240.00	CUYD	\$6.83	\$1,639.00		\$1,639.0
CRUSHED AGGREGATE COURSE	545.00	CUYD	\$18.79	\$10,241.00		\$10,241.00
COVER - TYPE 2	825.00	SQYD	\$0.51	\$421.00		\$421.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	220.00	TON	\$25.37	\$5,581.00		\$5,581.00
ASPHALT CEMENT PG 64 64-28	12.00	TON	\$674.59	\$8,095.00		\$8,095.0
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.0
CONCRETE BARRIER RAIL	10.00	EACH	\$706.02	\$7,060.00		\$7,060.0
STRIPING-WHITE EPOXY STRIPING-YELLOW EPOXY	2.00 2.00	GAL GAL	\$61.96 \$62.79	\$124.00 \$126.00		\$124.0 \$126.0
	2.00	GAL	302.73			
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL		l l		\$38,018.00		\$38,258.0
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.0
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.0
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.0
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBTOTAL	
FOUR-LANE ROAD (FULL RECONSTRUCT)	107.58	107.58 \$38,258.00			\$4,100,000	
LANE TRANSITION WEST OF CORRIDOR	20.00 \$21,600.00				\$430,000	
LANE TRANSITION EAST END OF CORRIDOR	8.00 \$26,250.00				\$210,000	
DEDICATED BICYCLE/PEDESTRIAN FACILITY	10.83 \$2,767.00			\$30,0	000	
CONCRETE BARRIER RAIL	126.72 \$7,060.00				\$895,000	
ROADWAY & DEDICATED BICYCLE/PEDESTRIAN FACILITY CO	OST SUBTOTAL	•			\$5,700	0,000
CATEGORY	LENGTH (FT.) WIDTH (FT.) COST PER SQUARE FOOT 4				SUBTO	
CANTILEVER CONSTRUCTION (FOUR-LANE)	2,385.00	87.50	\$125.00		\$26,100,000	
CHITIEVEN CONSTRUCTION (FOOR EARLY		UNIT	UNIT F		\$20,100,000	
EXCAVATION-UNCLASS BORROW	APPROX. QUANTITY 22,000.00	CUYD	\$4.0		\$102,740.00	
EMBANKMENT IN PLACE	23,500.00	CUYD	\$6.8		\$102,740.00 \$161,000.00	
RETAINING WALL	35,000.00	SQFT	\$50.			
CANTILEVER CONSTRUCTION (FOUR-LANE) SUBTOTAL	33,000.00	30,1	730.	00	\$1,800,000.00 \$28,200,000.00	
			****	5		
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQL	JARE FOOT	SUBTO	JIAL
SOUTH FORK BRIDGE CONSTRUCTION		1				
EB STRUCTURE (TWO-LANE) ⁶	655.00	55.00	\$175		\$6,300	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,900	•
STRUCTURE COST SUBTOTAL					\$39,40	
				SUBTOTAL 1	\$45,10	0,000
	ADDI	TIONAL COSTS				
		MISCEL	LANEOUS @ 20% OF	SUBTOTAL 1 7	20%	\$9,000,00
		МОВ	ILIZATION @ 18% OF	SUBTOTAL 1 8	18%	\$8,100,00
	CON	ISTRUCTION EN	GINEERING @ 15% C	OF SUBTOTAL 1	15%	\$6,800,00
				SUBTOTAL 2		\$69,000,00
	INDIRECT COST	(IDC) CONSTR	UCTION @ 9.64% OF		9.64%	\$6,700,00
	INDIRECT COST	(IDC) - CONSTR	OCTION @ 5.04% OF	JOBIOTAL 2		
		CONTINGEN	CY @ 20% & 50% OF	SUBTOTAL 2 10	20%	\$13,800,00
				44	50%	\$34,500,00
			ION COST @ 20% CO		\$89,50	•
	TOTAL IMPR	ROVEMENT OPT	ION COST @ 50% CO	ONTINGENCY 11	\$110,20	00,000

Average MDT bid prices provided for the period January 2011 to December 2011.
 Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

⁷ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

8 The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁹ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

¹⁰ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

11 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all

scenarios and circumstances



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES THROUGHOUT CORRIDOR WITH CENTER MEDIAN, ELEVATED FOUR LANE ROADWAY STRUCTURE WITH NO CENTER MEDIAN RP 140.6 - RP 141.2 Planning Level Estimate of Costs

			Average Bi	d Prices ²	Adjusted Unit Prices	
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ³
	(Per Station) 1	-	Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	765.00	CUYD	\$4.67	\$3,573.00		\$3,573.00
EMBANKMENT IN PLACE	240.00	CUYD	\$6.83	\$1,639.00		\$1,639.00
CRUSHED AGGREGATE COURSE	545.00	CUYD	\$18.79	\$10,241.00		\$10,241.00
COVER - TYPE 2	825.00	SQYD	\$0.51	\$421.00		\$421.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	220.00	TON	\$25.37	\$5,581.00		\$5,581.00
ASPHALT CEMENT PG 64 64-28	12.00	TON	\$674.59	\$8,095.00		\$8,095.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
CONCRETE BARRIER RAIL	10.00	EACH	\$706.02	\$7,060.00		\$7,060.00
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00
STRIPING-YELLOW EPOXY	2.00	GAL	\$62.79	\$126.00		\$126.00
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$38,018.00		\$38,258.00
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBTOTAL	
FOUR-LANE ROAD (FULL RECONSTRUCT)	85.11		\$38,258.00		\$3,300,000	
LANE TRANSITION WEST OF CORRIDOR	20.00		\$21,600.00			,000
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00		\$210,000	
ROADWAY COST SUBTOTAL					\$3,90	0,000
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	IARE FOOT ⁴	SUBT	OTAL
RAISED STRUCTURE (FOUR-LANE)	4,800.00	67.00	\$175	.00	\$56,300,000	
SOUTH FORK BRIDGE CONSTRUCTION						
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	0,000
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	0,000
STRUCTURE COST SUBTOTAL					\$66,10	00,000
				SUBTOTAL 1	\$70,00	00,000
	ADDIT	IONAL COSTS		_		
		MISCEL	LANEOUS @ 20% O	F SUBTOTAL 1 5	20%	\$14,000,000
		МОВ	ILIZATION @ 18% OI	F SUBTOTAL 1 ⁶	18%	\$12,600,000
	CON	ISTRUCTION EN	GINEERING @ 15% (OF SUBTOTAL 1	15%	\$10,500,000
				SUBTOTAL 2		\$107,000,000
	INDIRECT COST	(IDC) - CONSTR	UCTION @ 9.64% OI	F SUBTOTAL 2 ⁷	9.64%	\$10,300,000
					20%	\$21,400,000
		CONTINGEN	ICY @ 20% & 50% OI	- SORIOIAL Z	50%	\$53,500,000
	TOTAL IMP	ROVEMENT OP	TION COST @ 20% C	ONTINGENCY 9	\$139,0	00,000
	TOTAL IMP	ROVEMENT OP	TION COST @ 50% C	ONTINGENCY 9	\$171,0	00,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁵ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁶ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁷ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁸ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁹ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES THROUGHOUT CORRIDOR WITH CENTER MEDIAN, ELEVATED FOUR LANE ROADWAY STRUCTURE WITH NO CENTER MEDIAN RP 140.6 - RP 141.2 WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY

		Approx Quantity Average Bid Prices ²				Adjusted Unit Prices		
Item Description	Approx. Quantity	Unit						
item bescription	(Per Station) 1	0,,,,	Unit Price Dollars	Amount Dollars	Unit Price Dollars	Amount ³ Dollars		
			Dollars	Dollars	Dollars	Dollars		
FOUR-LANE ROAD (FULL RECONSTRUCT)	765.00	CLIVE	64.67	62.572.00		¢2 572 00		
EXCAVATION-UNCLASS BORROW	765.00	CUYD	\$4.67	\$3,573.00		\$3,573.00		
EMBANKMENT IN PLACE	240.00	CUYD	\$6.83	\$1,639.00		\$1,639.00		
CRUSHED AGGREGATE COURSE	545.00	CUYD	\$18.79	\$10,241.00		\$10,241.00		
COVER - TYPE 2	825.00	SQYD	\$0.51	\$421.00	Ć120.00	\$421.00		
DUST PALLIATIVE	2.00	TON	625.27	\$0.00	\$120.00	\$240.00		
PLANT MIX BIT SURF GR S-3/4 IN	220.00	TON	\$25.37	\$5,581.00		\$5,581.00		
ASPHALT CEMENT PG 64 64-28	12.00	TON	\$674.59	\$8,095.00		\$8,095.00		
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00		
CONCRETE BARRIER RAIL	10.00	EACH	\$706.02	\$7,060.00		\$7,060.00		
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00		
STRIPING-YELLOW EPOXY	2.00	GAL	\$62.79	\$126.00		\$126.00		
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$38,018.00		\$38,258.00		
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBTO	OTAL		
FOUR-LANE ROAD (FULL RECONSTRUCT)	85.11		\$38,258.00		\$3,300,000			
LANE TRANSITION WEST OF CORRIDOR	20.00		\$21,600.00		\$430,000			
LANE TRANSITION EAST END OF CORRIDOR	8.00	0 \$26,250.00				,000		
DEDICATED BICYCLE/PEDESTRIAN FACILITY	8.40	8.40 \$2,767.00				200		
CONCRETE BARRIER RAIL	126.72	126.72 \$7,060.00				,000		
ROADWAY & DEDICATED BICYCLE/PEDESTRIAN FACILITY	COST SUBTOTAL	OST SUBTOTAL						
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	IARE FOOT ⁴	SUBTOTAL			
RAISED STRUCTURE (FOUR-LANE)	4,800.00	67.00	\$175	.00	\$56,300,000			
SOUTH FORK BRIDGE CONSTRUCTION								
EB STRUCTURE (TWO-LANE) 5	655.00	55.00	\$175	00	\$6,300	0.000		
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175		\$4,900	•		
•	055.00	43.00	7173	.00				
STRUCTURE COST SUBTOTAL					\$67,50	,		
				SUBTOTAL 1	\$72,40	0,000		
	ADDI	TIONAL COSTS						
		MISCEL	LANEOUS @ 20% O	F SUBTOTAL 1 ⁶	20%	\$14,500,000		
		МОВ	ILIZATION @ 18% O	F SUBTOTAL 1 7	18%	\$13,000,000		
	COP	NSTRUCTION EN	GINEERING @ 15% (OF SUBTOTAL 1	15%	\$10,900,000		
				SUBTOTAL 2		\$111,000,000		
	INDIRECT COST	(IDC) - CONSTR	UCTION @ 9.64% O	F SUBTOTAL 2 ⁸	9.64%	\$10,700,000		
		CONTINCEN	ICY @ 20% & 50% OI	E SUBTOTAL 2 9	20%	\$22,200,000		
		CONTINGEN	20% & 30% UI	- JUDIUIAL Z	50%	\$55,500,000		
	TOTAL IMP	ROVEMENT OPT	TION COST @ 20% CO	ONTINGENCY 10	\$144,0	00,000		
	TOTAL IMP	ROVEMENT OPT	ION COST @ 50% CO	ONTINGENCY 10	\$177,0	00,000		

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁵ Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁹ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

¹⁰ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES THROUGHOUT CORRIDOR WITH TURN BAY AT BERNE PARK **Planning Level Estimate of Costs**

			Average Bi	d Prices ²	Adjusted Unit Prices		
Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ³	
	(Per Station) 1		Dollars	Dollars	Dollars	Dollars	
FOUR-LANE ROAD (FULL RECONSTRUCT)							
EXCAVATION-UNCLASS BORROW	795.00	CUYD	\$4.67	\$3,713.00		\$3,713.00	
EMBANKMENT IN PLACE	250.00	CUYD	\$6.83	\$1,708.00		\$1,708.00	
CRUSHED AGGREGATE COURSE	570.00	CUYD	\$18.79	\$10,710.00		\$10,710.00	
COVER - TYPE 2	870.00	SQYD	\$0.51	\$444.00		\$444.00	
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00	
PLANT MIX BIT SURF GR S-3/4 IN	235.00	TON	\$25.37	\$5,962.00		\$5,962.00	
ASPHALT CEMENT PG 64 64-28	13.00	TON	\$674.59	\$8,770.00		\$8,770.00	
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00	
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00	
STRIPING-YELLOW EPOXY	3.00	GAL	\$62.79	\$188.00		\$188.00	
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$32,777.00		\$33,017.00	
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00	
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00	
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00	
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBTOTAL		
FOUR-LANE ROAD (FULL RECONSTRUCT)	109.33		\$33,017.00		\$3,600,000		
LANE TRANSITION WEST OF CORRIDOR	20.00	\$21,600.00			\$430,000		
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00	\$210	,000		
ROADWAY COST SUBTOTAL					\$4,20	0,000	
CATEGORY	LENGTH (FT.)	(FT.) WIDTH (FT.) COST PER SQUARE FOOT 4			SUBTO	OTAL	
CANTILEVER CONSTRUCTION (FOUR-LANE)	2,210.00	75.50 \$125.00		\$20,90	0,000		
	APPROX. QUANTITY	UNIT UNIT PRICE					
EXCAVATION-UNCLASS BORROW	20,000.00	CUYD	\$4.6		\$93,400.00		
EMBANKMENT IN PLACE	18,955.00	CUYD	\$6.8	33	\$129,000.00		
RETAINING WALL	32,310.00	SQFT	\$50.	00	\$1,600,000.00		
CANTILEVER CONSTRUCTION (FOUR-LANE) SUBTOTAL					\$22,700,000.00		
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT 5	SUBTO	OTAL	
SOUTH FORK BRIDGE CONSTRUCTION							
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	0,000	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,90	0,000	
STRUCTURE COST SUBTOTAL					\$32,50	0,000	
				SUBTOTAL 1	\$36,70	0,000	
	ADDI"	TIONAL COSTS		-			
			LLANEOUS @ 20% OI	SURTOTAL 1 6	20%	\$7,300,000	
			ILIZATION @ 18% OI		18%	\$6,600,000	
	COL		GINEERING @ 15% C	i	15%	\$5,500,000	
	COI	N31KUCTION EN	GINEEKING @ 15% C		1376		
	INDIDECT	r (IDC) CONCE	UCTION @ 9.64% OI	SUBTOTAL 2 8	0.649/	\$56,100,000	
	INDIRECT COST	(IDC) - CONSTR	OCTION @ 9.64% OF	- SUBTUTAL Z	9.64%	\$5,400,000	
		CONTINGEN	ICY @ 20% & 50% OI	SUBTOTAL 2 9	20%	\$11,200,000	
					50%	\$28,100,000	
			TION COST @ 20% CO		\$72,70	•	
1	TOTAL IMP	ROVEMENT OP	TION COST @ 50% CO	ONTINGENCY 10	\$89,60	0,000	

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

⁵ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁹ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

level cost estimate.

10 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 2 FOUR LANES THROUGHOUT CORRIDOR WITH TURN BAY AT BERNE PARK & WITH DEDICATED **BICYCLE/PEDESTRIAN FACILITY Planning Level Estimate of Costs**

			Adjusted Unit Prices			
	Approx. Quantity		Average Bi		•	
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³
	, ,		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	795.00	CUYD	\$4.67	\$3,713.00		\$3,713.00
EMBANKMENT IN PLACE	250.00	CUYD	\$6.83	\$1,708.00		\$1,708.00
CRUSHED AGGREGATE COURSE	570.00	CUYD	\$18.79	\$10,710.00		\$10,710.00
COVER - TYPE 2	870.00	SQYD	\$0.51	\$444.00	4420.00	\$444.00
DUST PALLIATIVE PLANT MIX BIT SURF GR S-3/4 IN	2.00 235.00	TON TON	\$25.37	\$0.00 \$5,962.00	\$120.00	\$240.00 \$5,962.00
ASPHALT CEMENT PG 64 64-28	13.00	TON	\$674.59	\$8,770.00		\$8,770.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00
STRIPING-YELLOW EPOXY	3.00	GAL	\$62.79	\$188.00		\$188.00
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$32,777.00		\$33,017.00
GUARD RAIL-STEEL/7 FOOT POSTS	500.00	LNFT	\$30.20	\$15,100.00		\$15,100.00
REGRADE APPROACH ROAD CONNECTION	1.00	EACH		\$0.00	\$10,000.00	\$10,000.00
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00
CATEGORY	LENGTH (STA.)	E/(G/)	COST PER STATIO		SUBT	
	i i			•		
FOUR-LANE ROAD (FULL RECONSTRUCT)	117.05		\$33,017.00		\$3,900,000	
LANE TRANSITION WEST OF CORRIDOR	20.00	\$21,600.00			\$430,000	
LANE TRANSITION EAST END OF CORRIDOR	8.00	\$26,250.00			\$210,000	
DEDICATED BICYCLE/PEDESTRIAN FACILITY	11.50		\$2,767.00	\$31,	800	
CONCRETE BARRIER RAIL	126.72		\$7,060.00		\$895	,000
ROADWAY & DEDICATED BICYCLE/PEDESTRIAN FACILITY CO	ST SUBTOTAL				\$5,50	0,000
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT ⁴			SUBT	OTAL
CANTILEVER CONSTRUCTION (FOUR-LANE)	2,510.00	77.00	77.00 \$125.00			00,000
	APPROX. QUANTITY	UNIT	UNIT P	RICE		
EXCAVATION-UNCLASS BORROW	22,000.00	CUYD	\$4.6		\$102,700.00	
EMBANKMENT IN PLACE	21,500.00	CUYD	\$6.8		\$147,0	
RETAINING WALL	36,500.00	SQFT	\$50.	00	\$1,800,	000.00
CANTILEVER CONSTRUCTION (FOUR-LANE) SUBTOTAL					\$26,200	,000.00
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT 5	SUBT	OTAL
SOUTH FORK BRIDGE CONSTRUCTION						
EB STRUCTURE (TWO-LANE) ⁶	655.00	55.00	\$175.	.00	\$6,30	0,000
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.	.00	\$4,90	0,000
STRUCTURE COST SUBTOTAL					\$37,40	00,000
				SUBTOTAL 1	\$42,90	00,000
	ADDI	TIONAL COSTS				
		MISCE	LLANEOUS @ 20% OF	SUBTOTAL 1 7	20%	\$8,600,000
		МОЕ	BILIZATION @ 18% OF	SUBTOTAL 1 8	18%	\$7,700,000
	CO	NSTRUCTION EN	IGINEERING @ 15% C	F SUBTOTAL 1	15%	\$6,400,000
				SUBTOTAL 2		\$65,600,000
	INDIRECT COS	T (IDC) - CONSTE	RUCTION @ 9.64% OF	SUBTOTAL 2 9	9.64%	\$6,300,000
		CONTINCT	CY @ 20% & 50% OF	CURTOTAL 3 10	20%	\$13,100,000
		CONTINGEN	LT @ 20% & 50% OF	SUBTUTAL 2	50%	\$32,800,000
	TOTAL IMP	ROVEMENT OP	TION COST @ 20% CC	ONTINGENCY 11	\$85,00	00,000
	TOTAL IMP	ROVEMENT OP	TION COST @ 50% CC	ONTINGENCY 11	\$104,7	00,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.
⁵ Planning level cost for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

⁷ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

level cost estimate.

11 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 3 FOUR LANES THROUGHOUT CORRIDOR, FOUR LANE TUNNEL RP 140.6 - RP 141.1 Planning Level Estimate of Costs

Item Description	Approx. Quantity		Average Bi		Adjusted Unit Prices	
	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³
	(Fel Station)		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00
GUARD RAIL-STEEL/7 FOOT POSTS	850.00	LNFT	\$30.20	\$25,670.00		\$25,670.00
REGRADE APPROACH ROAD CONNECTION	3.00	EACH		\$0.00	\$10,000.00	\$30,000.00
ADDITIONAL EXCAVATION-UNCLASSIFIED	10,500.00	CUYD	\$4.27	\$44,835.00		\$44,835.00
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00
CATEGORY	LENGTH (STA.)		COST PER STATION		SUBTOTAL	
FOUR-LANE ROAD (FULL RECONSTRUCT)	104.59		\$28,155.00		\$2,900,000	
LANE TRANSITION WEST OF CORRIDOR	20.00	\$21,600.00		\$430,000		
LANE TRANSITION EAST END OF CORRIDOR	8.00	\$26,250.00		\$210,000		
TUNNEL CONSTRUCTION (FOUR-LANE) 4	27.47		\$7,300,000.00		\$201,000,000	
ROADWAY COST SUBTOTAL					\$205,000,000	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQL	JARE FOOT ⁵	SUBT	OTAL
SOUTH FORK BRIDGE CONSTRUCTION						
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,900,000	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175	.00	\$4,900,000	
STRUCTURE COST SUBTOTAL					\$9,80	0,000
				SUBTOTAL 1	\$215,0	00,000
	ADDI	TIONAL COSTS			· · · · · ·	•
			LLANEOUS @ 20% O	F SUBTOTAL 1 ⁶	20%	\$43,000,000
			ILIZATION @ 18% O	_	18%	\$38,700,000
	100		IGINEERING @ 15%		15%	\$32,300,000
				SUBTOTAL 2		\$329,000,000
	INDIRECT COST	(IDC) - CONSTR	RUCTION @ 9.64% O		9.64%	\$31,700,000
		•	 		30%	\$98,700,000
		CONTINGEN	ICY @ 30% & 60% O	F SUBTOTAL 2 9	60%	\$197,000,000
	TOTAL IMP	ROVEMENT OPT	TION COST @ 30% CO	ONTINGENCY 10	\$459,0	
	TOTAL IMP	DOVEMENT OR	TION COST @ 60% CO	01-11-05-10V ¹⁰	\$558,0	

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

 $^{^{\}rm 4}$ Unit cost provided by MDT Geotechnical Division.

⁵ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁶ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁷ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁸ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁹ A contingency range of 30 to 60 percent was used due to the high degree of unknown factors involved in rock excavation and uncertainties over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

¹⁰ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 3 FOUR LANES THROUGHOUT CORRIDOR, TWO LANE TUNNEL AND TWO LANE CANTILEVER RP 140.6 - RP 141.1 **Planning Level Estimate of Costs**

			Average Bi		Adjusted Unit Prices		
Item Description	Approx. Quantity (Per Station) 1	Unit	Average Bi	Amount	Unit Price		
		Oilit	Dollars	Dollars	Dollars	Amount ³ Dollars	
FOUR LANE DO AD (FULL DECONCERNICE)			Donars	Donars	Donars	Donars	
FOUR-LANE ROAD (FULL RECONSTRUCT) EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00	
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00	
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00	
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00	
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00	
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00	
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00	
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00	
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00	
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00	
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00	
GUARD RAIL-STEEL/7 FOOT POSTS	850.00	LNFT	\$30.20	\$25,670.00		\$25,670.00	
REGRADE APPROACH ROAD CONNECTION	3.00	EACH		\$0.00	\$10,000.00	\$30,000.00	
ADDITIONAL EXCAVATION-UNCLASSIFIED	7,000.00	CUYD	\$4.27	\$29,890.00		\$29,890.00	
REGRADE APPROACHES	12.00	EACH		\$0.00	\$1,000.00	\$12,000.00	
CATEGORY	LENGTH (STA.)		COST PER STATIO	N	SUBTOTAL		
FOUR-LANE ROAD (FULL RECONSTRUCT)	104.59		\$28,155.00		\$2,900,000		
LANE TRANSITION WEST OF CORRIDOR	20.00		\$21,600.00		\$430,000		
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00		\$210,000		
TUNNEL CONSTRUCTION (TWO-LANE) 4	27.47		\$5,500,000.00		\$151,000,000		
ROADWAY COST SUBTOTAL	•	•			\$155,00		
CATEGORY	LENGTH (FT.)	WIDTH (FT.) COST PER SQUARE FOOT 5		SUBTOTAL			
CANTILEVER CONSTRUCTION (TWO-LANE)	1,850.00	41.50	\$125.	.00	\$9,600,000		
,	APPROX. QUANTITY	UNIT	UNIT P		, , , , , ,		
EXCAVATION-UNCLASS BORROW	11,000.00	CUYD	\$4.6		\$51,400.00		
EMBANKMENT IN PLACE	2,665.00	CUYD	\$6.8		\$18,200.00		
RETAINING WALL	28,710.00	SQFT	\$50.		\$1,400,		
CANTILEVER CONSTRUCTION (TWO-LANE) SUBTOTAL	,		·		\$11,100,000.00		
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	IARE FOOT ⁶	SUBTOTAL		
SOUTH FORK BRIDGE CONSTRUCTION							
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.	00	\$4,900	0.000	
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.		\$4,900,000		
STRUCTURE COST SUBTOTAL			7=:		\$20,900,000		
				SUBTOTAL 1	\$187,00		
	ADDI	TIONAL COSTS		005.0	\$107,00	30,000	
	ADDII		LLANEOUS @ 20% OF	CURTOTAL 1 7	20%	¢37,400,000	
						\$37,400,000	
			SILIZATION @ 18% OF		18%	\$33,700,000	
	COI	NSTRUCTION EN	IGINEERING @ 15% C		15%	\$28,100,000	
				SUBTOTAL 2		\$286,000,000	
	INDIRECT COST	r (IDC) - CONSTI	RUCTION @ 9.64% OF	SUBTOTAL 2	9.64%	\$27,600,000	
		CONTINGEN	CY @ 30% & 60% OF	SUBTOTAL 2 10	30%	\$85,800,000	
					60%	\$172,000,000	
	TOTAL IMP	ROVEMENT OP	TION COST @ 30% CC	ONTINGENCY 11	\$399,00	00,000	
			TION COST @ 60% CC		\$486,00		

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

Unit cost provided by MDT Geotechnical Division.
 The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs.

⁶ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁷ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

^{**}The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

A contingency range of 30 to 60 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substantial amount of items not accounted for in this planning level and the substanti

level cost estimate.

11 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 4 FOUR LANES THROUGHOUT CORRIDOR

Item Description	Approx. Quantity		Average Bid Prices ²		Adjusted Unit Prices	
		Unit	Unit Price	Amount	Unit Price	Amount ³
	(Per Station) 1		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.0
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.0
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.0
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.0
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.0
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.0
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.0
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.0
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.0
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.0
GUARD RAIL-STEEL/7 FOOT POSTS	800.00	LNFT	\$30.20	\$24,160.00		\$24,160.0
REGRADE APPROACH ROAD CONNECTION	3.00	EACH		\$0.00	\$10,000.00	\$30,000.00
PAVEMENT REMOVAL	1,700.00	CUYD		\$0.00	\$3.00	\$5,100.0
ADDITIONAL EXCAVATION-UNCLASSIFIED	8,000.00	CUYD	\$4.27	\$34,160.00		\$34,160.00
REGRADE APPROACHES	6.00	EACH	·	\$0.00	\$1,000.00	\$6,000.0
CATEGORY	LENGTH (STA.)		COST PER STATION		SUBTOTAL	
FOUR-LANE ROAD (FULL RECONSTRUCT)	109.93		\$28,155.00		\$3,100,000	
LANE TRANSITION WEST OF CORRIDOR	20.00	\$21,600.00		\$430,000		
LANE TRANSITION EAST END OF CORRIDOR	8.00	\$26,250.00		\$210,000		
ROADWAY COST SUBTOTAL	3100	ψ=0)250100		\$3,700,000		
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT ⁴	SUBTO	
BRIDGE CONSTRUCTION						
WEST STRUCTURE (FOUR-LANE)	800.00	67.00	\$175.	00	¢0.400	000
MIDDLE STRUCTURE (FOUR-LANE)	1,050.00	67.00	\$175. \$175.		\$9,400,000 \$12,300,000	
SOUTH FORK BRIDGE STRUCTURE EB (TWO-LANE)	655.00	43.00	\$175. \$175.		\$12,300,000	
SOUTH FORK BRIDGE STRUCTURE WB (TWO-LANE)	655.00	43.00	\$175.		\$4,900,000	
STRUCTURE COST SUBTOTAL	033.00	43.00	Ψ173.	00	\$31,500	
				SUBTOTAL 1	\$35,300	
	ADDI	TIONAL COSTS		SOBIOTALI	755,500	,,000
	ADDIT		LANEOUS @ 20% OF	SURTOTAL 1 5	20%	\$7,100,000
			ILIZATION @ 18% OF	_	18%	
			-			\$6,400,00
	COr	NSTRUCTION EN	GINEERING @ 15% C		15%	\$5,300,00
		. ()		SUBTOTAL 2	2 2 2 2 2	\$54,100,00
	INDIRECT COST	(IDC) - CONSTR	UCTION @ 9.64% OF	SUBTOTAL 2	9.64%	\$5,200,00
		CONTINGEN	ICY @ 20% & 50% OF	SUBTOTAL 2 9	20%	\$10,800,00
			_		50%	\$27,100,00
			TION COST @ 20% CO		\$70,100	·
	TOTAL IMP	ROVEMENT OPT	ION COST @ 50% CO	NTINGENCY 10	\$86,400	0,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁵ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.
⁶ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁷ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁸ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors involved in rock excavation and uncertainties over the planning horizon, as well as the substantial

amount of items not accounted for in this planning level cost estimate.

The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 5 FOUR LANES THROUGHOUT CORRIDOR

Item Description	Ammoy Oventity		Average Bid Prices ²		Adjusted Unit Prices	
	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount 3
	(Per Station) 1		Dollars	Dollars	Dollars	Dollars
FOUR-LANE ROAD (FULL RECONSTRUCT)						
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00
EMBANKMENT IN PLACE	220.00	CUYD	\$6.83	\$1,503.00		\$1,503.00
CRUSHED AGGREGATE COURSE	485.00	CUYD	\$18.79	\$9,113.00		\$9,113.00
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00
DUST PALLIATIVE	2.00	TON		\$0.00	\$120.00	\$240.00
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00
EMULS ASPHALT CRS-2P	2.00	TON	\$578.92	\$1,158.00		\$1,158.00
STRIPING-WHITE EPOXY	2.00	GAL	\$61.96	\$124.00		\$124.00
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00
FOUR-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00
GUARD RAIL-STEEL/7 FOOT POSTS	800.00	LNFT	\$30.20	\$24,160.00		\$24,160.00
REGRADE APPROACH ROAD CONNECTION	3.00	EACH		\$0.00	\$10,000.00	\$30,000.00
PAVEMENT REMOVAL	1,700.00	CUYD		\$0.00	\$3.00	\$5,100.00
RELOCATE PRIVATE ROAD	1.00	LS		\$0.00	\$20,000.00	\$20,000.00
ADDITIONAL EXCAVATION-UNCLASSIFIED	8,000.00	CUYD	\$4.27	\$34,160.00		\$34,160.00
REGRADE APPROACHES	6.00	EACH		\$0.00	\$1,000.00	\$6,000.00
CATEGORY	LENGTH (STA.)		COST PER STATION		SUBTOTAL	
FOUR-LANE ROAD (FULL RECONSTRUCT)	99.25	\$28,155.00		\$2,800,000		
LANE TRANSITION WEST OF CORRIDOR	20.00	\$21,600.00		\$430,000		
LANE TRANSITION EAST END OF CORRIDOR	8.00	\$26,250.00		\$210),000	
ROADWAY COST SUBTOTAL					\$3,400,000	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQU	ARE FOOT ⁴	SUBTOTAL	
BRIDGE CONSTRUCTION (FOUR-LANE)						
WEST STRUCTURE	800.00	67.00	\$175.	00	\$9,400,000	
MIDDLE STRUCTURE	1,729.00	67.00	\$175.	00	\$20,300,000	
EAST STRUCTURE	1,012.00	67.00	\$175.	00	\$11,900,000	
STRUCTURE COST SUBTOTAL					\$41,60	00,000
				SUBTOTAL 1	\$45,10	00,000
	ADDI	TIONAL COSTS		'		·
			LANEOUS @ 20% OF	SUBTOTAL 1 5	20%	\$9,000,000
MOBILIZATION @ 18% OF SUBTOTAL 1					18%	\$8,100,000
CONSTRUCTION ENGINEERING @ 15% OF SUBTOTAL 1					15%	\$6,800,000
					13/0	\$69,000,000
	INDIDECT COC	r (IDC) - CONSTR	UCTION @ 9.64% OF	SUBTOTAL 2	9.64%	
	INDIRECT COS	(IDC) - CONSTR	00110N @ 9.04% UF	JUDIUIAL Z		\$6,700,000
CONTINGENCY @ 20% & 50% OF SUBTOTAL 2 9		20%	\$13,800,000			
	TOT:	DOVERNENT COT	HON COST O 2021 CO	ANTINGENGY 10	50%	\$34,500,000
			TION COST @ 20% CO			00,000
	TOTAL IMP	ROVEMENT OPT	TION COST @ 50% CC	INTINGENCY **	\$110,0	00,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

³ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

⁵ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.
⁶ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁷ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁸ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors involved in rock excavation and uncertainties over the planning horizon, as well as the substantial

amount of items not accounted for in this planning level cost estimate.

The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - ALIGNMENT 6 FOUR LANES THROUGHOUT CORRIDOR Planning Level Estimate of Costs

	Approx. Quantity (Per Station) 1		Average B	id Prices ²	Adjusted Unit Prices		
Item Description		Unit	Unit Price	Amount	Unit Price	Amount ³	
			Dollars	Dollars	Dollars	Dollars	
FOUR-LANE ROAD (FULL CONSTRUCT)							
EXCAVATION-UNCLASS BORROW	690.00	CUYD	\$4.67	\$3,222.00		\$3,222.00	
EMBANKMENT IN PLACE CRUSHED AGGREGATE COURSE	220.00 485.00	CUYD	\$6.83 \$18.79	\$1,503.00 \$9,113.00		\$1,503.00 \$9,113.00	
COVER - TYPE 2	715.00	SQYD	\$0.51	\$365.00		\$365.00	
DUST PALLIATIVE	2.00	TON	70.02	\$0.00	\$120.00	\$240.00	
PLANT MIX BIT SURF GR S-3/4 IN	195.00	TON	\$25.37	\$4,947.00		\$4,947.00	
ASPHALT CEMENT PG 64 64-28	11.00	TON	\$674.59	\$7,420.00		\$7,420.00	
EMULS ASPHALT CRS-2P STRIPING-WHITE EPOXY	2.00 2.00	TON GAL	\$578.92 \$61.96	\$1,158.00 \$124.00		\$1,158.00 \$124.00	
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00	
FOUR-LANE ROAD (FULL CONSTRUCT) SUBTOTAL				\$27,915.00		\$28,155.00	
TWO-LANE US 2 REALIGNMENT (FULL RECONSTRUCT)							
EXCAVATION-UNCLASS BORROW	515.00	CUYD	\$4.67	\$2,405.00		\$2,405.00	
EMBANKMENT IN PLACE	160.00	CUYD	\$6.83	\$1,093.00		\$1,093.00	
CRUSHED AGGREGATE COURSE COVER - TYPE 2	345.00 445.00	CUYD SQYD	\$18.79 \$0.51	\$6,483.00 \$227.00		\$6,483.00 \$227.00	
DUST PALLIATIVE	1.00	TON	7	\$0.00	\$120.00	\$120.00	
PLANT MIX BIT SURF GR S-3/4 IN	125.00	TON	\$25.37	\$3,171.00	Ψ120.00	\$3,171.00	
ASPHALT CEMENT PG 64 64-28	7.00	TON	\$674.59	\$4,722.00		\$4,722.00	
EMULS ASPHALT CRS-2P	1.00	TON	\$578.92	\$579.00		\$579.00	
STRIPING-WHITE EPOXY	1.00	GAL	\$61.96	\$62.00		\$62.00	
STRIPING-YELLOW EPOXY	1.00	GAL	\$62.79	\$63.00		\$63.00	
TWO-LANE ROAD (FULL RECONSTRUCT) SUBTOTAL	1.00	GAL	Ç02.73	\$18,805.00		\$18,925	
	349,000,00	CLIVD	\$4.27				
ADDITIONAL EXCAVATION-UNCLASSIFIED EMBANKMENT IN PLACE	348,000.00	CUYD	·	\$1,485,960.00		\$1,485,960.00 \$35,133,520.00	
GUARD RAIL-STEEL/7 FOOT POSTS	5,144,000.00 4,800.00	LNFT	\$6.83 \$30.20	\$35,133,520.00 \$144,960.00		\$35,133,520.00	
REINFORCED CONCRETE RETAINING WALL	9,200.00	SQFT	\$25.00	\$230,000.00	\$50.00	\$460,000.00	
REGRADE APPROACH ROAD CONNECTION	1.00	EACH	\$23.00	\$0.00	\$10,000.00	\$10,000.00	
CATEGORY	LENGTH (STA.)	LACII	COST PER STATIO		\$10,000.00 SUBT		
FOUR-LANE ROAD (FULL CONSTRUCT)	31.54		\$28,155.00			0,000	
LANE TRANSITION WEST OF CORRIDOR	20.00		\$21,600.00			0,000	
LANE TRANSITION EAST END OF CORRIDOR	8.00		\$26,250.00		\$210,000		
TWO-LANE US 2 REALIGNMENT (FULL RECONSTRUCT)	9.00		\$18,925.00		\$170,000		
ROADWAY COST SUBTOTAL	•		•			0,000	
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQ	UARE FOOT 4	SUBT	•	
BRIDGE CONSTRUCTION		,,					
WEST STRUCTURE (FOUR-LANE)	3830.00	67.00	\$175	5.00	\$44,9	00,000	
MIDDLE STRUCTURE (FOUR-LANE)	1,744.00	67.00	\$17!			00,000	
EAST STRUCTURE (FOUR-LANE)	4303.00	67.00	\$17	5.00	\$50,5	00,000	
STRUCTURE COST SUBTOTAL						000,000	
				SUBTOTAL 1	\$155,0	000,000	
	ADDI	TIONAL COSTS		_			
			LANEOUS @ 20% O		20%	\$31,000,000	
	MOBILIZATION @ 18% OF SUBTOTAL 1 7				18%	\$27,900,000	
	CON	NSTRUCTION EN	GINEERING @ 15%		15%	\$23,300,000	
				SUBTOTAL 2		\$237,000,000	
	INDIRECT COST	(IDC) - CONSTR	UCTION @ 9.64% O	F SUBTOTAL 2 ⁷	9.64%	\$22,800,000	
		CONTINGEN	CY @ 20% & 50% O	F SUBTOTAL 2 9	20%	\$47,400,000	
					50%	\$119,000,000	
	TOTAL IMP	ROVEMENT OPT	ION COST @ 20% C	ONTINGENCY 10	\$307,0	00,000	
	TOTAL IMP	ROVEMENT OPT	ION COST @ 50% C	ONTINGENCY 10	\$379,0	00,000	

¹ One station is equal to 100 feet.

¹ One station is equal to 100 feet.
2 Average MDT bid prices provided for the period January 2011 to December 2011.
3 Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.
4 Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.
5 The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.
6 The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.
7 Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.
8 A contingency range of 20 to 50 percent was used due to the high degree of unknown factors involved in rock excavation and uncertainties over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.
9 The Total improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.

scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - CANTILEVER CONSTRUCTION (TWO LANES) RP 140.6 - RP 141.2

Cantilever Construction (Two-Lane)	Length (FT.)	Width (FT.)	Cost Per Square Foot ¹	Subtotal	
CANTILEVER CONSTRUCTION (TWO-LANE)	1,850.00	41.50	\$125.00	\$9,60	00,000
	APPROX. QUANTITY	UNIT	UNIT PRICE		
EXCAVATION-UNCLASS BORROW	11,000.00	CUYD	\$4.67	\$51,4	100.00
EMBANKMENT IN PLACE	2,665.00	CUYD	\$6.83	\$18,2	200.00
RETAINING WALL	28,710.00	SQFT	\$50.00	\$1,400	,000.00
CANTILEVER CONSTRUCTION (TWO-LANE) SUBTOTAL				\$11,100	0,000.00
STRUCTURE COST SUBTOTAL				\$11,1	00,000
SUBTOTAL 1				\$11,100,000	
	ADDIT	TIONAL COSTS			
		MISCE	LLANEOUS @ 20% OF SUBTOTAL 1 2	20%	\$2,200,000
		МОЕ	BILIZATION @ 18% OF SUBTOTAL 1 3	18%	\$2,000,000
	co	NSTRUCTION EN	IGINEERING @ 15% OF SUBTOTAL 1	15%	\$1,700,000
			SUBTOTAL 2		\$17,000,000
INDIRECT COST (IDC) - CONSTRUCTION @ 9.64% OF SUBTOTAL 2 4			9.64%	\$1,600,000	
	CONTINGENCY @ 20% & 50% OF SUBTOTAL 2 ⁵			20%	\$3,400,000
		CONTINGER	CT @ 20% & 30% OF SUBTUTAL 2	50%	\$8,500,000
	TOTAL IM	PROVEMENT OF	TION COST @ 20% CONTINGENCY 6	\$22,0	00,000
	TOTAL IM	PROVEMENT OF	TION COST @ 50% CONTINGENCY 6	\$27,1	00,000

¹ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

² The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁴ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁵ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁶ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - CANTILEVER CONSTRUCTION (TWO LANES) RP 140.6 - RP 141.2 WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY Planning Level Estimate of Costs

Cantilever Construction (Two-Lane)	Length (FT.)	Width (FT.)	/idth (FT.) Cost Per Square Foot ¹		total
CANTILEVER CONSTRUCTION (TWO-LANE)	1,975.00	53.50	\$125.00	\$13,2	00,000
	APPROX. QUANTITY	UNIT	UNIT PRICE		
EXCAVATION-UNCLASS BORROW	14,000.00	CUYD	\$4.67	\$65,4	00.00
EMBANKMENT IN PLACE	7,200.00	CUYD	\$6.83	\$49,2	.00.00
RETAINING WALL	30,200.00	SQFT	\$50.00	\$1,500	,000.00
CANTILEVER CONSTRUCTION (TWO-LANE) SUBTOTAL				\$14,800	0,000.00
STRUCTURE COST SUBTOTAL				\$14,8	00,000
SUBTOTAL 1				\$14,800,000	
	ADDIT	TIONAL COSTS			
		MISCE	LLANEOUS @ 20% OF SUBTOTAL 1 2	20%	\$3,000,000
		МОВ	ILIZATION @ 18% OF SUBTOTAL 1 3	18%	\$2,700,000
	co	NSTRUCTION EN	IGINEERING @ 15% OF SUBTOTAL 1	15%	\$2,200,000
			SUBTOTAL 2		\$22,700,000
INDIRECT COST (IDC) - CONSTRUCTION @ 9.64% OF SUBTOTAL 2 4			9.64%	\$2,200,000	
	5			20%	\$4,500,000
CONTINGENCY @ 20% & 50% OF SUBTOTAL 2 ⁵		50%	\$11,400,000		
	TOTAL IM	PROVEMENT OP	TION COST @ 20% CONTINGENCY 6	\$29,4	00,000
	TOTAL IM	PROVEMENT OP	TION COST @ 50% CONTINGENCY 6	\$36,3	00,000

¹ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

² The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

³ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁴ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁵ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁶ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - CANTILEVER CONSTRUCTION (FOUR LANES WITH MEDIAN) RP 140.6 - RP 141.2

Cantilever Construction (Four-Lane)	Length (FT.)	Width (FT.)	Cost Per Square Foot ¹	Sub	total
CANTILEVER CONSTRUCTION (FOUR-LANE)	2,210.00	75.50	\$125.00	\$20,9	00,000
	APPROX. QUANTITY	UNIT	UNIT PRICE		
EXCAVATION-UNCLASS BORROW	20,000.00	CUYD	\$4.67	\$93,4	100.00
EMBANKMENT IN PLACE	18,955.00	CUYD	\$6.83	\$129,	000.00
RETAINING WALL	32,310.00	SQFT	\$50.00	\$1,600	,000.00
CANTILEVER CONSTRUCTION (FOUR-LANE) SUBTOTAL				\$22,700	0,000.00
STRUCTURE COST SUBTOTAL				\$22,7	00,000
SUBTOTAL 1				\$22,700,000	
	ADDI	TIONAL COSTS			
		MISCEI	LLANEOUS @ 20% OF SUBTOTAL 1 2	20%	\$4,500,000
		МОВ	SILIZATION @ 18% OF SUBTOTAL 1 3	18%	\$4,100,000
	со	NSTRUCTION EN	IGINEERING @ 15% OF SUBTOTAL 1	15%	\$3,400,000
			SUBTOTAL 2		\$34,700,000
INDIRECT COST (IDC) - CONSTRUCTION @ 9.64% OF SUBTOTAL 2 4				9.64%	\$3,300,000
		CONTINCE	10V @ 200/ 8 F00/ OF SURTOTAL 2 5	20%	\$6,900,000
		CONTINGEN	ICY @ 20% & 50% OF SUBTOTAL 2 5	50%	\$17,400,000
	TOTAL IM	PROVEMENT OP	TION COST @ 20% CONTINGENCY 6	\$44,9	00,000
	TOTAL IM	PROVEMENT OP	TION COST @ 50% CONTINGENCY 6	\$55,40	00,000

¹ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

² The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁴ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁵ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁶ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - CANTILEVER CONSTRUCTION (FOUR LANES WITH MEDIAN) RP 140.6 - RP 141.2 WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY Planning Level Estimate of Costs

Cantilever Construction (Four-Lane)	Length (FT.)	Width (FT.)	Cost Per Square Foot ¹	Subtotal	
CANTILEVER CONSTRUCTION (FOUR-LANE)	2,510.00	77.00	\$125.00	\$24,2	00,000
	APPROX. QUANTITY	UNIT	UNIT PRICE		
EXCAVATION-UNCLASS BORROW	22,000.00	CUYD	\$4.67	\$102,	700.00
EMBANKMENT IN PLACE	21,500.00	CUYD	\$6.83	\$147,	000.00
RETAINING WALL	36,500.00	SQFT	\$50.00	\$1,800	,000.00
CANTILEVER CONSTRUCTION (FOUR-LANE) SUBTOTAL				\$26,200	0,000.00
STRUCTURE COST SUBTOTAL				\$26,2	00,000
SUBTOTAL 1				\$26,200,000	
	ADDIT	TIONAL COSTS			
	MISCELLANEOUS @ 20% OF SUBTOTAL 1 ²				\$5,200,000
		МОВ	SILIZATION @ 18% OF SUBTOTAL 1 3	18%	\$4,700,000
	co	NSTRUCTION EN	IGINEERING @ 15% OF SUBTOTAL 1	15%	\$3,900,000
			SUBTOTAL 2		\$40,000,000
INDIRECT COST (IDC) - CONSTRUCTION @ 9.64% OF SUBTOTAL 2 4			9.64%	\$3,900,000	
		CONTINCEN	NCV @ 200/ 8 F09/ OF SURTOTAL 2 5	20%	\$8,000,000
CONTINGENCY @ 20% & 50% OF SUBTOTAL 2 ⁵			50%	\$20,000,000	
	TOTAL IM	PROVEMENT OP	TION COST @ 20% CONTINGENCY 6	\$51,9	00,000
	TOTAL IM	PROVEMENT OP	TION COST @ 50% CONTINGENCY 6	\$63,9	00,000

¹ The planning level cost for a cantilever deck was estimated at \$125 per square foot based on average MDT bridge costs and construction sequencing.

² The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

³ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁴ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁵ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁶ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY -ELEVATED TWO LANE ROADWAY STRUCTURE RP 140.6 - RP 141.2 Planning Level Estimate of Costs

Elevated Structure (Two-Lane)	Length (FT.)	Width (FT.)	Cost Per Square Foot ¹	Sub	ototal
ELEVATED STRUCTURE (TWO-LANE)	4,800.00	43.00	\$175.00	\$36,1	20,000
STRUCTURE COST SUBTOTAL				\$36,1	100,000
			SUBTOTAL 1	\$36,1	100,000
	ADDI	TIONAL COSTS			
MISCELLANEOUS @ 20% OF SUBTOTAL 1 ²				20%	\$7,200,000
		МОЕ	BILIZATION @ 18% OF SUBTOTAL 1 3	18%	\$6,500,000
CONSTRUCTION ENGINEERING @ 15% OF SUBTOTAL 1				15%	\$5,400,000
			SUBTOTAL 2		\$55,200,000
	INDIRECT COS	T (IDC) - CONSTI	RUCTION @ 9.64% OF SUBTOTAL 2 4	9.64%	\$5,300,000
		CONTINGE	NCV @ 20% & E0% OF SUPTOTAL 2 5	20%	\$11,000,000
	CONTINGENCY @ 20% & 50% OF SUBTOTAL 2 ⁵			50%	\$27,600,000
	TOTAL IM	PROVEMENT OF	PTION COST @ 20% CONTINGENCY 6	\$71,5	00,000
TOTAL IMPROVEMENT OPTION COST @ 50% CONTINGENCY ⁶			\$88,1	.00,000	

¹ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

² The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

³ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁴ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁵ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁶ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY -ELEVATED FOUR LANE ROADWAY STRUCTURE RP 140.6 - RP 141.2 Planning Level Estimate of Costs

Elevated Structure (Four-Lane)	Length (FT.)	Width (FT.)	Cost Per Square Foot ¹	Sul	ototal
ELEVATED STRUCTURE (FOUR-LANE)	4,800.00	67.00	\$175.00	\$56,3	300,000
STRUCTURE COST SUBTOTAL				\$56,3	300,000
			SUBTOTAL 1	\$56,3	300,000
	ADDI	TIONAL COSTS			
MISCELLANEOUS @ 20% OF SUBTOTAL 1 ²				20%	\$11,300,000
		МОЕ	BILIZATION @ 18% OF SUBTOTAL 1 3	18%	\$10,100,000
	со	NSTRUCTION EN	IGINEERING @ 15% OF SUBTOTAL 1	15%	\$8,400,000
			SUBTOTAL 2		\$86,100,000
	INDIRECT COS	T (IDC) - CONSTI	RUCTION @ 9.64% OF SUBTOTAL 2 4	9.64%	\$8,300,000
		CONTINCE	NCY @ 20% & 50% OF SUBTOTAL 2 5	20%	\$17,200,000
		CONTINGE	50%	\$43,100,000	
	TOTAL IM	PROVEMENT OF	TION COST @ 20% CONTINGENCY 6	\$112,	000,000
TOTAL IMPROVEMENT OPTION COST @ 50% CONTINGENCY ⁶			\$138,	000,000	

¹ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for these structures.

² The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

³ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁴ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁵ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁶ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - RECONSTRUCTION OF SOUTH FORK BRIDGE (TWO LANE)

Planning Level Estimate of Costs

South Fork Bridge Construction	Length (FT.)	Width (FT.)	Cost Per Square Foot ¹	Sub	ototal
STRUCTURE (TWO-LANE)	655.00	43.00	\$175.00	\$4,9	00,000
STRUCTURE COST SUBTOTAL				\$4,9	00,000
	SUBTOTAL 1				
	ADI	DITIONAL COSTS			
MISCELLANEOUS @ 20% OF SUBTOTAL 1 ²				20%	\$1,000,000
MOBILIZATION @ 18% OF SUBTOTAL 1 ³				18%	\$900,000
	С	ONSTRUCTION EN	GINEERING @ 15% OF SUBTOTAL 1	15%	\$700,000
			SUBTOTAL 2		\$7,500,000
	INDIRECT CO	OST (IDC) - CONSTRI	UCTION @ 9.64% OF SUBTOTAL 2 4	9.64%	\$700,000
		CONTINGEN	CY @ 20% & 50% OF SUBTOTAL 2 5	20%	\$1,500,000
		CONTINGEN	50%	\$3,800,000	
	TOTAL II	MPROVEMENT OPT	TION COST @ 20% CONTINGENCY 6	\$9,70	00,000
	TOTAL IMPROVEMENT OPTION COST @ 50% CONTINGENCY 5 \$12,00			00,000	

¹ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for this structure.

² The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁵ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

⁶ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - RECONSTRUCTION OF SOUTH FORK BRIDGE (TWO LANE) WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY **Planning Level Estimate of Costs**

South Fork Bridge Construction	Length (FT.)	Width (FT.) Cost Per Square Foot ¹		Sub	total
STRUCTURE (TWO-LANE)	655.00	55.00	\$175.00	\$6,30	00,000
STRUCTURE COST SUBTOTAL				\$6,30	00,000
			SUBTOTAL 1	\$6,30	00,000
	ADDI	TIONAL COSTS			
MISCELLANEOUS @ 20% OF SUBTOTAL 1 ²				20%	\$1,300,000
MOBILIZATION @ 18% OF SUBTOTAL 1 ³				18%	\$1,100,000
	со	NSTRUCTION EN	IGINEERING @ 15% OF SUBTOTAL 1	15%	\$900,000
			SUBTOTAL 2		\$9,600,000
	INDIRECT COS	T (IDC) - CONSTI	RUCTION @ 9.64% OF SUBTOTAL 2 4	9.64%	\$900,000
		CONTINCE	ICV @ 200/ 8 FOW OF SURTOTAL 2 5	20%	\$1,900,000
	CONTINGENCY @ 20% & 50% OF SUBTOTAL 2 ⁵			50%	\$4,800,000
	TOTAL IMPROVEMENT OPTION COST @ 20% CONTINGENCY 6			\$12,4	00,000
	TOTAL IM	PROVEMENT OF	TION COST @ 50% CONTINGENCY 6	\$15,3	00,000

¹ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for this structure.

² The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁴ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁵ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning

⁶ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - RECONSTRUCTION OF SOUTH FORK BRIDGE (FOUR LANE)

Planning Level Estimate of Costs

South Fork Bridge Construction	Length (FT.)	Width (FT.)	Cost Per Square Foot ¹	Sub	total
EB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.00	\$4,90	00,000
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.00	\$4,90	00,000
STRUCTURE COST SUBTOTAL				\$9,80	00,000
			SUBTOTAL 1	\$9,80	00,000
ADDITIONAL COSTS					
MISCELLANEOUS @ 20% OF SUBTOTAL 1 ²			20%	\$2,000,000	
		МОВ	BILIZATION @ 18% OF SUBTOTAL 1 3	18%	\$1,800,000
	CON	NSTRUCTION EN	IGINEERING @ 15% OF SUBTOTAL 1	15%	\$1,500,000
			SUBTOTAL 2		\$15,100,000
	INDIRECT COST	r (IDC) - CONSTF	RUCTION @ 9.64% OF SUBTOTAL 2 4	9.64%	\$1,500,000
		CONTINGEN	NCY @ 20% & 50% OF SUBTOTAL 2 5	20%	\$3,000,000
CONTINGENCY @ 20% & 50% OF SUBTOTAL 2				50%	\$7,600,000
	TOTAL IMF	PROVEMENT OP	TION COST @ 20% CONTINGENCY 6	\$19,6	00,000
	TOTAL IMP	PROVEMENT OP	TION COST @ 50% CONTINGENCY 6	\$24,2	00,000

¹ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for this structure.

² The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

³ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁴ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁵ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁶ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - RECONSTRUCTION OF SOUTH FORK BRIDGE (FOUR LANE) WITH DEDICATED BICYCLE/PEDESTRIAN FACILITY Planning Level Estimate of Costs

South Fork Bridge Construction	Length (FT.)	Length (FT.) Width (FT.) Cost Per Square Foot ¹		Sub	total
EB STRUCTURE (TWO-LANE) ²	655.00	55.00	\$175.00	\$6,30	00,000
WB STRUCTURE (TWO-LANE)	655.00	43.00	\$175.00	\$4,90	00,000
STRUCTURE COST SUBTOTAL				\$11,2	00,000
			SUBTOTAL 1	\$11,2	00,000
	ADD	ITIONAL COSTS			
MISCELLANEOUS @ 20% OF SUBTOTAL 1 ³				20%	\$2,200,000
		МОЕ	ILIZATION @ 18% OF SUBTOTAL 1 4	18%	\$2,000,000
CONSTRUCTION ENGINEERING @ 15% OF SUBTOTAL 1					\$1,700,000
			SUBTOTAL 2		\$17,100,000
	INDIRECT COS	ST (IDC) - CONSTE	RUCTION @ 9.64% OF SUBTOTAL 2 5	9.64%	\$1,600,000
		CONTINCE	ICV @ 200/ 8 F09/ OF SURTOTAL 2 6	20%	\$3,400,000
	CONTINGENCY @ 20% & 50% OF SUBTOTAL 2 ⁶				\$8,600,000
	TOTAL IN	IPROVEMENT OF	TION COST @ 20% CONTINGENCY 7	\$22,1	00,000
	TOTAL IM	IPROVEMENT OF	TION COST @ 50% CONTINGENCY 7	\$27,3	00,000

¹ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$175 per square foot was utilized for this structure.

² Dedicated bicycle/pedestrian facility could be incorporated on either eastbound or westbound bridge structure.

³ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁴ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁵ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁶ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁷ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - BICYCLE/PEDESTRIAN OVERCROSSING

Planning Level Estimate of Costs ¹

Item Description	Approx. Quantity	Unit	Unit Price	Amount	Unit Price	Amount ²
			Dollars	Dollars	Dollars	Dollars
ELEVATED CAST IN PLACE CONCRETE RAMP	600.00	LNFT	\$325.00	\$195,000.00		\$195,000.00
PICKETED STEEL HAND RAILS	1,200.00	LNFT	\$184.00	\$220,800.00		\$220,800.00
RAMP PIERS AND FOUNDATION	1.00	LS			\$47,000.00	\$47,000.00
CATEGORY	LENGTH (FT.)	WIDTH (FT.)	COST PER SQ	UARE FOOT ³	SUBT	OTAL
BICYCLE/PEDESTRIAN OVERCROSSING						
STRUCTURE	50.00	12.00	\$15	0.00	\$90	,000
STRUCTURE COST SUBTOTAL					\$90	,000
				SUBTOTAL 1	\$550),000
	ADDI	TIONAL COSTS				
		MISCEI	LLANEOUS @ 20% (OF SUBTOTAL 1 4	20%	\$110,000
		МОВ	SILIZATION @ 10% (OF SUBTOTAL 1 5	10%	\$60,000
	COI	NSTRUCTION EN	IGINEERING @ 15%	OF SUBTOTAL 1	15%	\$80,000
				SUBTOTAL 2		\$800,000
INDIRECT COST (IDC) - CONSTRUCTION @ 9.64% OF SUBTOTAL 2 ⁶					9.64%	\$80,000
CONTINGENCY @ 20% SUBTOTAL 2 7					20%	\$160,000
тотл	AL IMPROVEMENT OPTION COS	T (LOW RANGE	ESTIMATE @ 20% (CONTINGENCY) 8	\$1,00	0,000
	TOTAL IMPROVE	MENT OPTION	COST (UPPER RANG	GE ESTIMATE) ^{8, 9}	\$2,50	0,000

¹ Location of the bicycle/pedestrian overcrossing is assumed at Berne Park with existing two-lane configuration.

² Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

³ Planning level costs for simple bridge structures range on average between \$110 and \$175 per square foot. A conservative estimate of \$150 per square foot was utilized for this structure.

⁴ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁵ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.
⁶ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁷ A contingency of 20 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁸ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.

⁹ Upper range planning level cost estimate attempts to account for miscellaneous aesthetic amenities, other optional features, and potential mitigation elements not included in the low range estimate. For comparison purposes, the Pablo, MT pedestrian overcrossing was constructed to span the multilane US 93 facility at a cost of approximately \$3.0 million for construction engineering and construction. The upper range planning level cost estimate for the US 2 – Badrock Canyon Corridor pedestrian overcrossing is less than \$3.0 million due to the narrower width of US 2 compared to US 93.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - DEDICATED BICYCLE/PEDESTRIAN FACILITY

Planning Level Estimate of Costs

	Anney Quantity	Approx. Quantity	Average Bio	d Prices ²	Adjusted Unit Prices	
Item Description	(Per Station) 1	Unit	Unit Price	Amount	Unit Price	Amount ³
	(Per Station)		Dollars	Dollars	Dollars	Dollars
BICYCLE/PEDESTRIAN FACILITY (FULL CONSTRUCT)						
EXCAVATION-UNCLASS BORROW	150.00	CUYD	\$4.67	\$701.00		\$701.00
EMBANKMENT IN PLACE	50.00	CUYD	\$6.83	\$342.00		\$342.00
CRUSHED AGGREGATE COURSE	31.00	CUYD	\$18.79	\$582.00		\$582.00
DUST PALLIATIVE	0.30	TON		\$0.00	\$120.00	\$36.00
PLANT MIX BIT SURF GR S-3/4 IN	17.00	TON	\$25.37	\$431.00		\$431.00
ASPHALT CEMENT PG 64 64-28	1.00	TON	\$674.59	\$675.00		\$675.00
BICYCLE/PEDESTRIAN FACILITY (FULL CONSTRUCT) SUBTO	OTAL			\$2,731.00		\$2,767.00
EMBANKMENT IN PLACE	3,200.00	CUYD	\$6.83	\$21,856.00		\$21,856.00
BICYCLE RAILING	3,500.00	LNFT	\$60.00	\$210,000.00	\$60.00	\$210,000.00
REINFORCED CONCRETE RETAINING WALL	27,680.00	SQFT	\$25.00	\$692,000.00	\$50.00	\$1,384,000.00
CATEGORY	LENGTH (STA.)		COST PER STATION	N	SUBTOTAL	
CONCRETE BARRIER RAIL	126.72		\$7,060.00		\$895,000	
DEDICATED BICYCLE/PEDESTRIAN FACILITY	116.00		\$2,767.00		\$320,000	
				SUBTOTAL 1	\$2,800),000
	ADDIT	IONAL COSTS		-		
		MISCE	LLANEOUS @ 20% OF	SUBTOTAL 1 4	20%	\$560,000
		МОІ	BILIZATION @ 10% OF	SUBTOTAL 1 7	10%	\$280,000
	CON	STRUCTION E	NGINEERING @ 15% C	F SUBTOTAL 1	15%	\$420,000
				SUBTOTAL 2		\$4,100,000
	INDIRECT COST	(IDC) - CONST	RUCTION @ 9.64% OF	SUBTOTAL 2 6	9.64%	\$400,000
			NOV C 200/ S 500/ C	SUPTOTAL 2.7	20%	\$820,000
	CONTINGENCY @ 20% & 50% OF SUBTOTAL 2 7				50%	\$2,050,000
	TOTAL IMP	ROVEMENT O	PTION COST @ 20% C	ONTINGENCY 8	\$5,300	0,000
	TOTAL IMP	ROVEMENT O	PTION COST @ 50% C	ONTINGENCY 8	\$6,600	0,000

¹ One station is equal to 100 feet.

² Average MDT bid prices provided for the period January 2011 to December 2011.

Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

⁴ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁵ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁶ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁷ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors involved in rock excavation and uncertainties over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

amount of items not accounted for in this planning level cost estimate.

8 The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - PARKING LOT Planning Level Estimate of Costs

Item Description	Approx. Quantity	Approx. Quantity Unit	Unit Price	Amount	Unit Price	Amount ¹
			Dollars	Dollars	Dollars	Dollars
PARKING LOT						
PAVEMENT SURFACE	30,193.00	SQFT	\$2.25	\$67,934.00		\$67,934.00
CURB AND GUTTER	1,015.00	LNFT	\$17.00	\$17,255.00		\$17,255.00
PAVEMENT MARKINGS	40.00	GAL	\$12.00	\$480.00		\$480.00
AMENITIES ²	1.00	LS	\$0.00	\$0.00	\$50,000.00	\$50,000.00
DRAINAGE SYSTEM	1.00	LS	\$0.00	\$0.00	\$60,000.00	\$60,000.00
PARKING LOT SUBTOTAL				\$85,669.00		\$195,669.00
				SUBTOTAL 1	\$200,	000
	ADDIT	IONAL COSTS				
		MISCE	LLANEOUS @ 20% C	F SUBTOTAL 1 3	20%	\$40,000
		MOE	BILIZATION @ 18% C	F SUBTOTAL 1 4	18%	\$36,000
	CON	STRUCTION EN	IGINEERING @ 15%	OF SUBTOTAL 1	15%	\$30,000
				SUBTOTAL 2		\$310,000
	INDIRECT COST	(IDC) - CONSTI	RUCTION @ 9.64% O	F SUBTOTAL 2 5	9.64%	\$29,900
		CONTINGE	NCV @ 20% & E0% C	E SUPTOTAL 2 6	20%	\$62,000
		CONTINGENCY @ 20% & 50% OF SUBTOTAL 2 6				\$155,000
	TOTAL IMPI	ROVEMENT OF	TION COST @ 20%	CONTINGENCY 7	\$400,	,000
	TOTAL IMPI	ROVEMENT OF	TION COST @ 50%	CONTINGENCY 7	\$500,	,000

 $^{^{\}mathrm{1}}$ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

² Amenity features may provide or enhance existing landscaping, fencing, lighting, benches or picnic areas, and bathrooms.

³ The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control, noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

⁴ The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

⁵ Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁶ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁷ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



US 2 - BADROCK CANYON CORRIDOR PLANNING STUDY - WILDLIFE UNDERCROSSING **Planning Level Estimate of Costs**

Item Description	Approx. Quantity	Approx. Quantity Unit	Unit Price	Amount	Unit Price	Amount ¹
			Dollars	Dollars	Dollars	Dollars
RENFORCED CONCRETE BOX (22 FEET BY 12 FEET)	170.00	LNFT	\$2,500.00	\$425,000.00		\$425,000.00
ADDITIONAL EXCAVATION-UNCLASSIFIED	4,700.00	CUYD	\$4.27	\$20,069.00		\$20,069.00
WILDLIFE EXIT RAMPS (JUMP OUTS)	4.00	EACH	\$7,500.00	\$30,000.00		\$30,000.00
WILDLIFE FENCING	6,000.00	SQFT	\$2.50	\$15,000.00		\$15,000.00
				SUBTOTAL 1	\$490	0,000
	ADDIT	IONAL COSTS				
		MISCE	LLANEOUS @ 20% O	F SUBTOTAL 1 ²	20%	\$100,000
		МОЕ	BILIZATION @ 10% O	F SUBTOTAL 1 3	10%	\$49,000
	CON	STRUCTION EN	IGINEERING @ 15%	OF SUBTOTAL 1	15%	\$74,000
				SUBTOTAL 2		\$710,000
	INDIRECT COST	(IDC) - CONSTI	RUCTION @ 9.64% O	F SUBTOTAL 2 ⁴	9.64%	\$68,000
		CONTINCE	NCV @ 200/ 8 F00/ 0	E CURTOTAL 2 5	20%	\$140,000
CONTINGENCY @ 20% & 50% OF SUBTOTAL 2 ⁵					50%	\$360,000
TOTAL IMPROVEMENT OPTION COST @ 20% CONTINGENCY ⁶					\$920),000
	TOTAL IMP	ROVEMENT OF	TION COST @ 50% (CONTINGENCY 6	\$1,10	0,000

 $^{^{1}}$ Cost estimates are provided in 2012 dollars. All dollar amounts are rounded for planning purposes.

² The Miscellaneous category is estimated at 20 percent due to unknown factors including but not limited to excavation, embankment, topsoil, guardrail, BMPs, utilities, traffic control,

noxious weeds, slope treatments, ditch or channel excavation, incidental pavement transitional areas, temporary striping, temporary water pollution/erosion control measures and public relations.

The Mobilization category includes all costs incurred in assembling and transporting materials to the work site.

Indirect costs are costs not directly associated with the construction of a project, but incurred during the construction processes. IDC percentage is subject to change.

⁵ A contingency range of 20 to 50 percent was used due to the high degree of unknown factors involved in rock excavation and uncertainties over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate.

⁶ The Total Improvement Option Cost reflects an estimate of potential construction costs based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances.



Appendix 3

Typical Sections and Spot Improvements

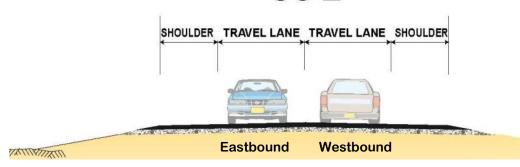


RANGE OF POTENTIAL TYPICAL SECTIONS CONSIDERED

Typical Section 1: Two-Lane

(RP 140.0 to 140.6± and RP 141.2± to RP 142.4)

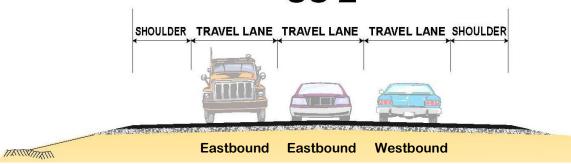
US₂



Typical Section 2: Three-Lane

(3-2-3-4 Configuration from RP 140.0 to 140.6± and Reverse 3-2-3-4 Configuration from RP 141.2± to RP 142.0±)

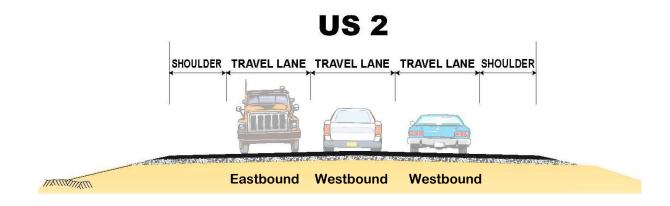
US₂





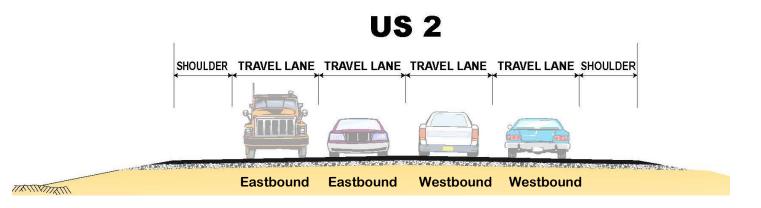
Typical Section 3: Reverse Three-Lane

(Reverse 3-2-3-4 Configuration from RP 140.0 to 140.6± and 3-2-3-4 Configuration from RP 141.2± to RP 142.0±)



Typical Section 4: Four-lane

(RP 140.0 to 140.6± and RP 141.2± to RP 142.4)

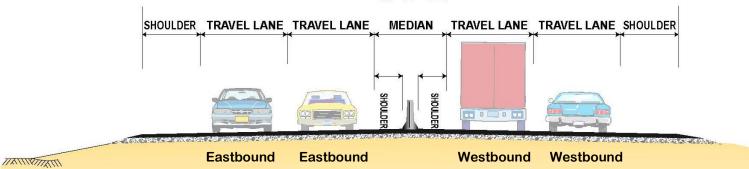




Typical Section 5: Four-lane with Center Median

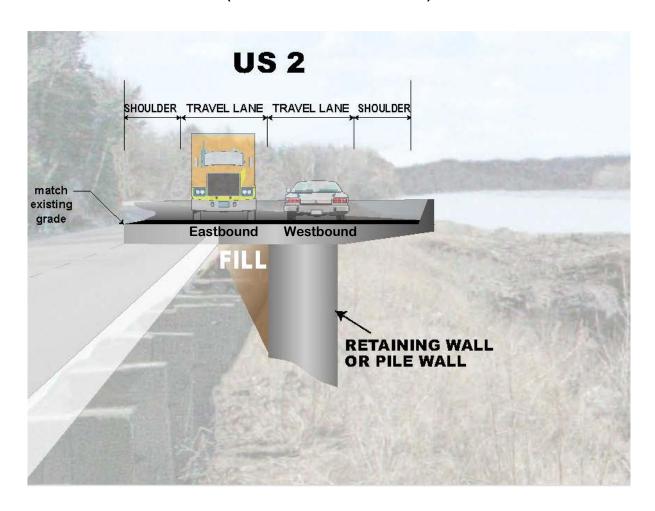
(RP 140.0 to 140.6± and RP 141.2± to RP 142.4)

US 2





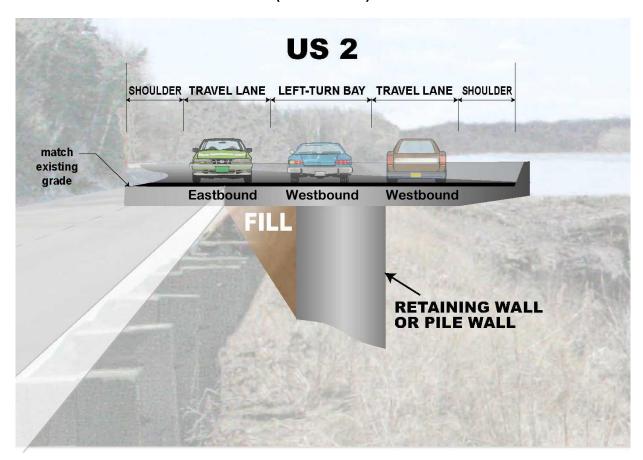
Typical Section 6: Two-Lane Cantilevered Structure





Typical Section 7: Two-Lane Cantilevered Structure with Left-Turn Bay at Berne Park

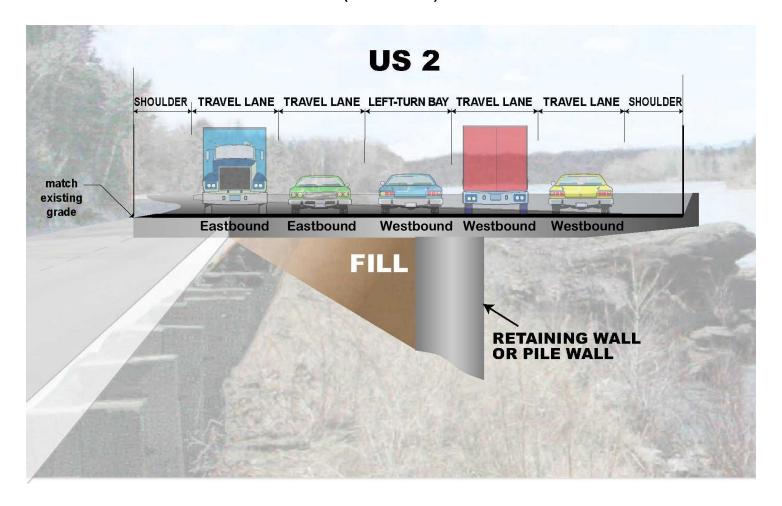
(RP 140.9±)





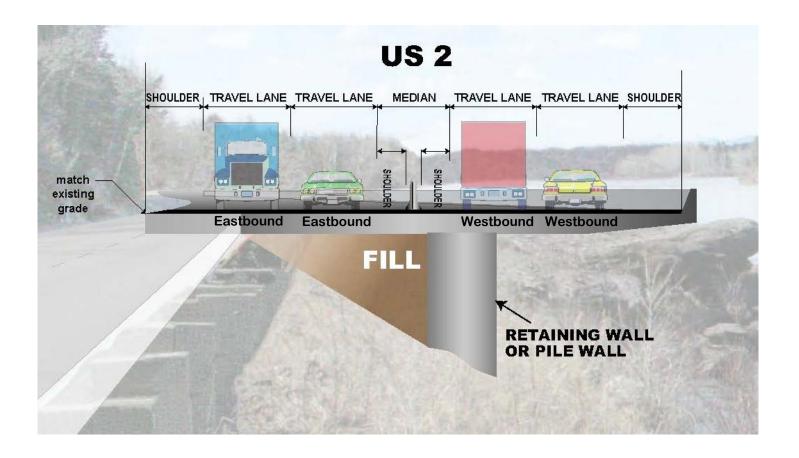
Typical Section 8: Four-Lane Cantilevered Structure with Left-Turn Bay at Berne Park

(RP 140.9±)





<u>Typical Section 9: Four-Lane Cantilevered Structure</u> <u>with Median</u>





Typical Section 10: Two-Lane Elevated Structure



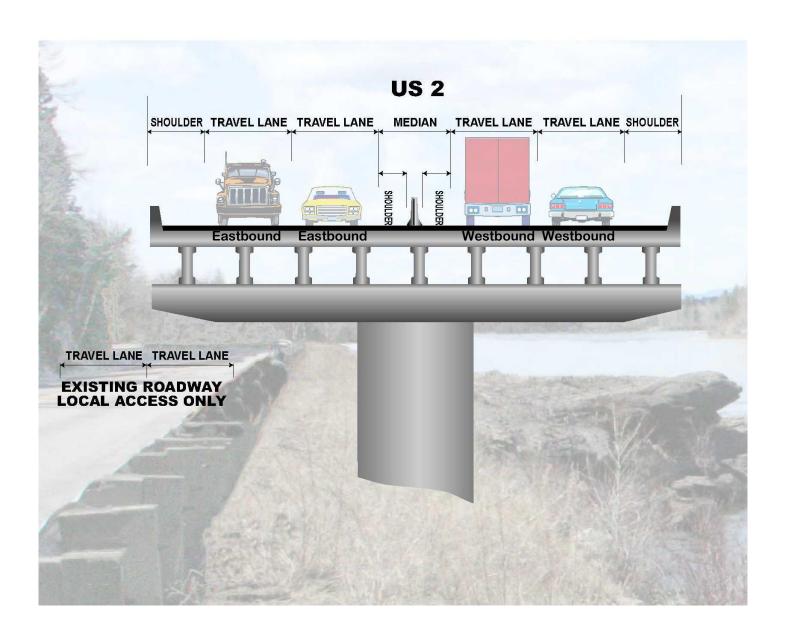


Typical Section 11: Four-Lane Elevated Structure



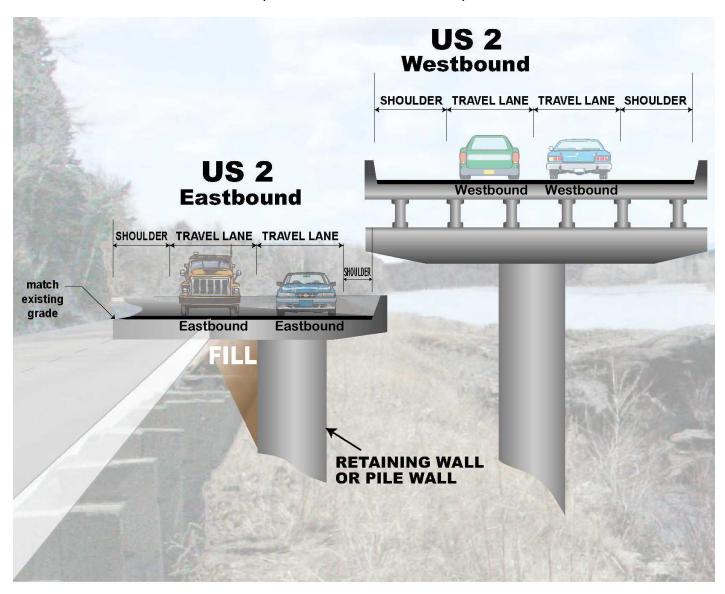


<u>Typical Section 12: Four-Lane Elevated Structure with Median</u>





Typical Section 13: Four-Lane Elevated Structure / Cantilevered Structure Combination

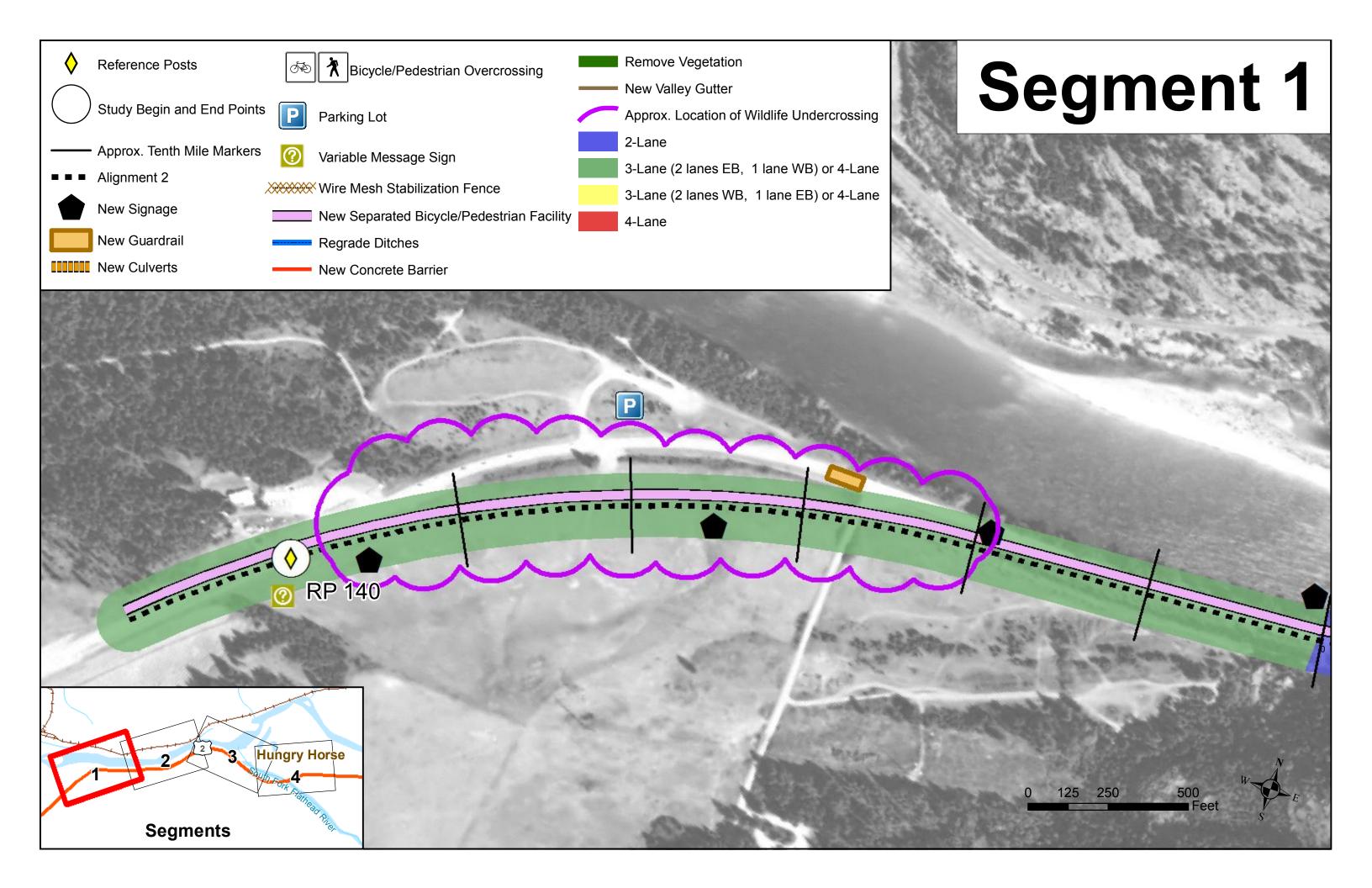


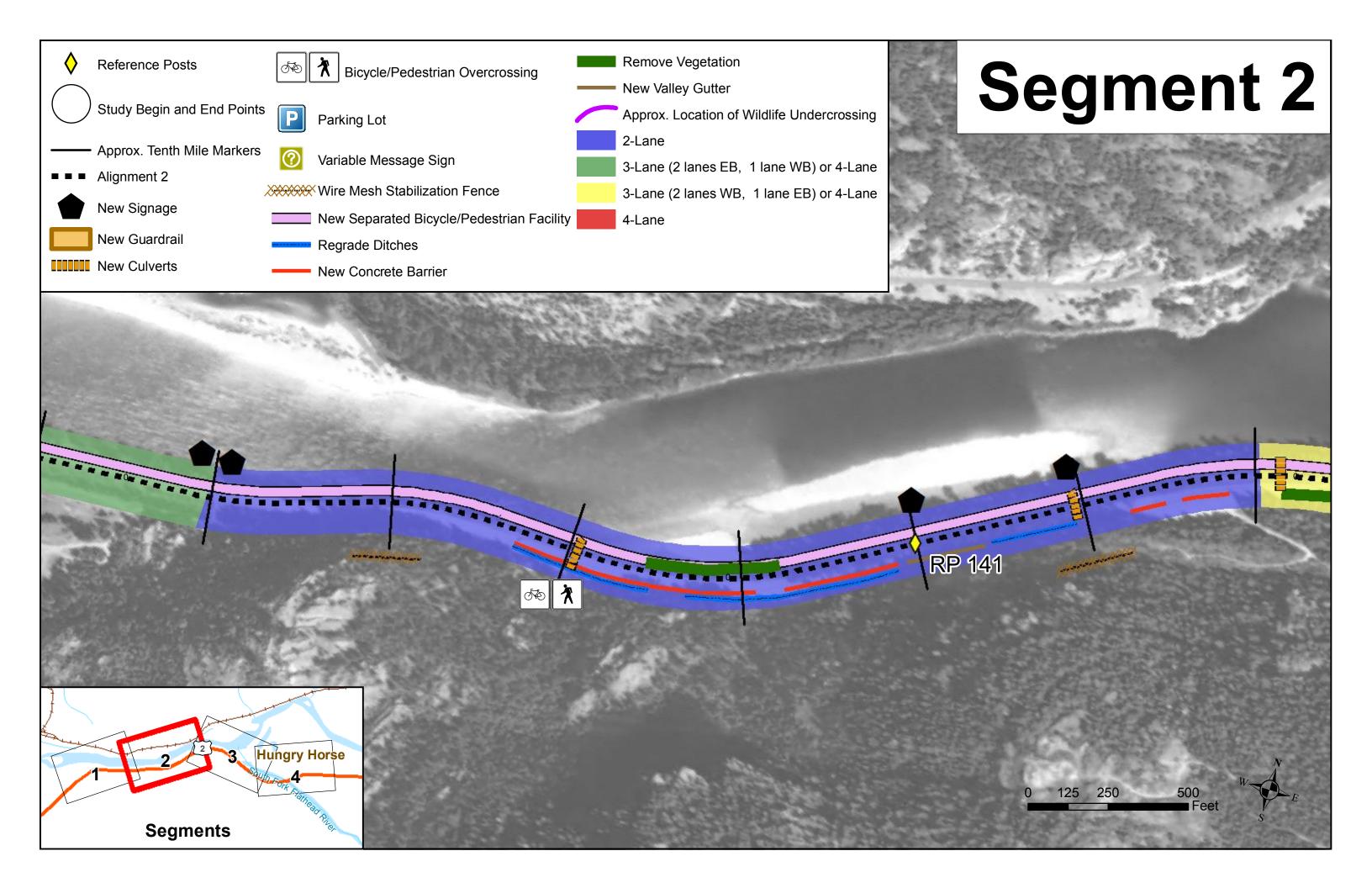


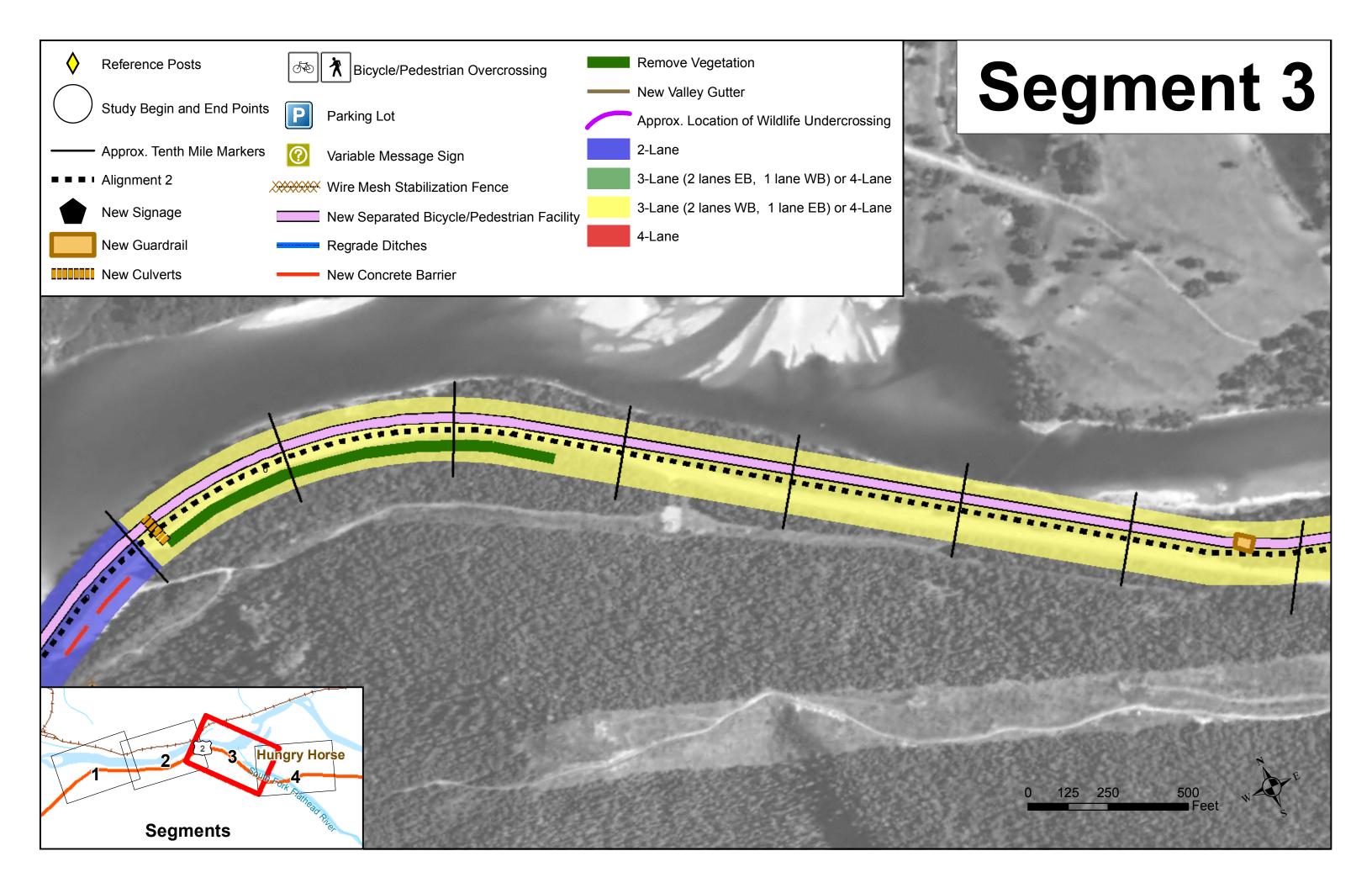
Separated Bicycle / Pedestrian Facility

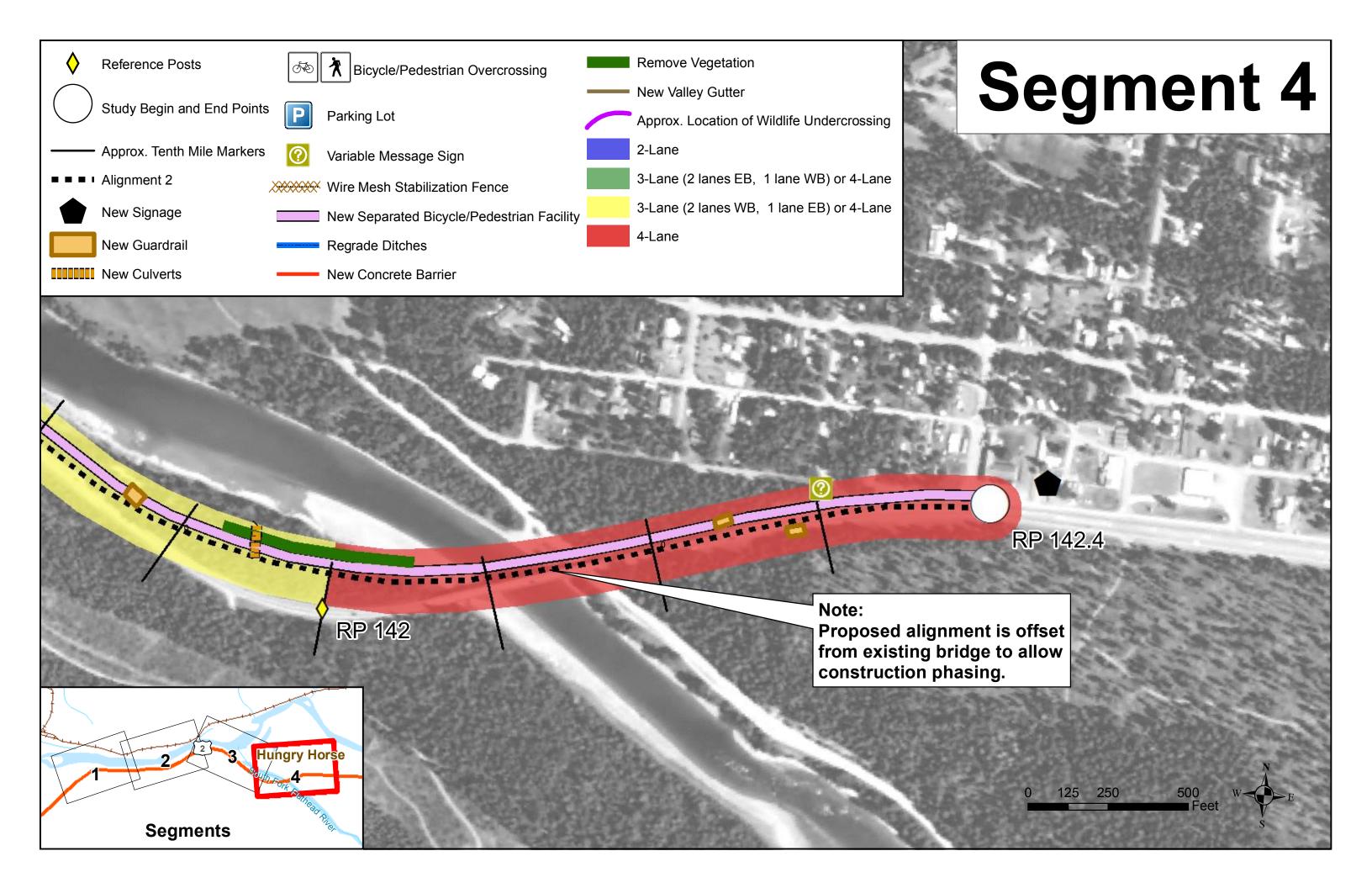
(Throughout Corridor)













Appendix 4

Operational Analysis Worksheets



Appendix 4

Operational Analysis Worksheets

Existing Peak Season

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 10/27/2011	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H EB Flathead County
Analysis Time Period AM Peak	Analysis Year	2011
Project Description: US 2 - Badrock Canyon Corridor P® Input Data	······································	
Shoulder width tt Lane width tt	Close I	highway ☑ Class II
Lane width It Shoulder width It		Class III highway
Segment length, L _t mi	Terrain Grade Length Peak-hour to	ctor, PHF 0.92
Analysis direction vol., V _d 553veh/h	Show North Arrow % Trucks and	
Opposing direction vol., V _o 351veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4	% Recreation Access point	nal vehicles, P _R 4% s <i>mi</i> 3/mi
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.7	2.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ $P_T(E_T$ -1)+ $P_R(E_R$ -1))	0.956	0.940
Grade adjustment factor ¹ ,f _{g,ATS} (Exhibit 15-9)	0.97	0.89
Demand flow rate ² , v _/ (pc/h) v =V / (PHF* f _{g,ATS} * f _{HV,ATS})	648	456
Free-Flow Speed from Fleld Measurement		ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	60.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	⁴ f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, <i>v</i>	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 <i>mi/h</i>
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BFI	FS-f _{LS} -f _A) 55.0 mi/h
·	Average travel speed, ATS _d =FFS	S-0.00776(v _{d,ATS} + 43.9 mi/h
	V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	79.8 %
Percent Time-Spent-Following	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.0	1.6
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	1.000	0.965
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.97	0.89
Directional flow rate ² , v,(pc/h) v _j =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	620	444
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	5	6.8
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	34.5	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	7	76.9
sr . s		
V _{o,PTSF})		Management
Vo.PTSF ⁷ Level of Service and Other Performance Measures Level of service, LOS (Exhibit 15-3)		D

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1544	500 min
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	79.8	
Bicycle Level of Service		av.
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	601.1	14
Effective width, Wv (Eq. 15-29) ft	13.00	-
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.76	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

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^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TW	O-LANE HIGHWA	Y SEGMENT WORK	(SHEET
General Information		Site Information	
Analyst David Ston Agency or Company DOWI. HKI Date Performed 10/27/2011	М	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H WB Flathead County
Analysis Time Period AM Peak		Analysis Year	2011
Project Description: US 2 - Badrock Canyon Corrid Input Data	or Planning Study		
Imput Data			
\$ Shoulder	widthtt		
Lane wid	th t	Class	highway V Class II
——— ‡ Lane wid	thft		
\$\frac{1}{2} \text{ Shoulder width } \text{t1}		highway Class III highway	
Segment length, L _t mi		Terrain Level Rolling Grade Length mi Up/down Peak-hour factor, PHF 0.84 No-passing zone 100%	
Analysis direction vol., V _d 351veh/h		Show North Arrow % Trucks and Buses , P _T 6 %	
Opposing direction vol., V _o 553veh/h		% Recreational vehicles, P _R 4%	
Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4		Access points <i>mi</i> 3/mi	
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-	-11 or 15-12)	2.0	1.6
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)		1.1	1.1
Heavy-vehicle adjustment factor, f _{HV,ATS} =1/ (1+ P _T	E _T -1)+P _R (E _R -1))	0.940	0.962
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)		0.91	0.98
Demand flow rate ² , v_i (pc/h) v_i = V_i / (PHF* $f_{g,ATS}$ * f_{HV}	/,ATS)	488	698
Free-Flow Speed from Field Mea	surement	Estimated Free-Flow Speed	
		Base free-flow speed ⁴ , BFFS	62.0 mi/h
Manage and a Community 3 Co		Adj. for lane and shoulder width,	f _{IS} (Exhibit 15-7) 4.2 mi/h
Mean speed of sample ³ , S _{FM} Total demand flow rate, both directions, <i>v</i>		Adj. for access points ⁴ , f_{Δ} (Exhibit 15-8) 0.8 mi/h	
		1 "	
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})		Free-flow speed, FFS (FSS=BFFS-f _{LS} -f _A) 57.0 mi/h	
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.7 mi/h		Average travel speed, ATS _d =FFS-0.00776($v_{d,ATS}$ + 46.2 mi/h $v_{o,ATS}$) - $f_{np,ATS}$	
		Percent free flow speed, PFFS	80.9 %
Percent Time-Spent-Following		I A	
Pacconger our on only interest for twelve Community	10 45 40'	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-1		1.4	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 15-14 Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)		0.977	1.00
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or E		0.91	0.98
Directional flow rate ² , v_i (pc/h) v_i = V_i /(PHF* $f_{HV,PTSF}$ * $f_{g,PTSF}$)		470	672
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} _d ^b)		51.4	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)		32.7	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +		A. A.	
v _{o,PTSF})		6	4.9
Level of Service and Other Performance Measure	\$		
Level of service, LOS (Exhibit 15-3)		·	C
/olume to capacity ratio, v/c		0	.28

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1603	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1666	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	80.9	
Bicycle Level of Service	A CONTRACTOR OF THE CONTRACTOR	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	417.9	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.58	
Bicycle level of service (Exhibit 15-4)	F	
Nede	The second secon	

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^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTION	NAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET	
General Information		Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 10/27/2011 Median Off-Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H EB Flathead County	
Project Description: US 2 - Badrock Ca		Alidiysis Teal	2011	
Input Data	y control of the state of the s			
 				
	Shoulder width t			
	Lane width tt	Class I	highway 🔽 Class II	
	Lane widthlt Shoulder widthft	highway lim	Class III highway	
Segment length, L ₁ mi		Terrain Level Rolling Grade Length mi Up/down		
Analysis direction vol., V _d 493veh/h		Peak-hour factor, PHF 0.91 No-passing zone 100% % Trucks and Buses , P _T 6 %		
Opposing direction vol., V _o 430v	eh/h	% Recreation	nal vehicles, P _R 4%	
Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4		Access points <i>mi</i> 3/mi		
Average Travel Speed				
		Analysis Direction (d)	Opposing Direction (o)	
Passenger-car equivalents for trucks, E ₁	- (Exhibit 15-11 or 15-12)	1.8	1.9	
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1	
Heavy-vehicle adjustment factor, f _{HV,ATS}		0.951	0.945	
Grade adjustment factor ¹ , f _{g,ATS} (Exhib		0.96	0.94	
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF	* f _{g,ATS} * f _{HV,ATS})	593	532	
Free-Flow Speed fro	m Field Measurement	Estimated Free-Flow Speed		
		Base free-flow speed ⁴ , BFFS	61.0 mi/h	
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder width,	f _{LS} (Exhibit 15-7) 4.2 mi/h	
Total demand flow rate, both directions,	v	Adj. for access points ⁴ , f _A (Exhibit 15-8) 0.8 mi/h		
Free-flow speed, FFS=S _{FM} +0.00776(v/ f		Free-flow speed, FFS (FSS=BF)	=S-f _{1.S} -f _a) 56.0 mi/h	
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 2.3 mi/h		Average travel speed, ATS _d =FFS-0.00776(v _{d,ATS} + 45.0 mi/h		
Percent Time-Spent-Following		V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	80.3 %	
s second time-opend-ronowing	The state of the s	Analysis Direction (d)	Opposing Direction (o)	
Passenger-car equivalents for trucks, E _T	(Exhibit 15-18 or 15-19)	1.2	1.4	
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0	
Heavy-vehicle adjustment factor, f _{HV} =1/	$(1+P_T(E_{T}-1)+P_R(E_{R}-1))$	0.988	0.977	
Grade adjustment factor ¹ , f _{g,PTSF} (Exhib		0.96	0.94	
Directional flow rate ² , v _f (pc/h) v _i =V _f /(PHF*f _{HV,PTSF} * f _{g,PTSF})		571	515	
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)		55.5		
	for no-passing zone, f _{np,PTSF} (Exhibit 15-21)		36.9	
Percent time-spent-following, PTSF _d (%)=	*BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	7	4.9	
O,PTSF)				
Level of Service and Other Performance	ce Measures			
Level of service, LOS (Exhibit 15-3) Volume to capacity ratio, v/c			D	
лоние то сараспутано, ИС		0	.35	

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1613	<u> </u>
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	80.3	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	541.8	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Bicycle level of service score, BLOS (Eq. 15-31)	5.71	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_1(v_d \text{ or } v_o) \ge 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET	
General Information	Site Information		
Analyst David Stoner Agency or Company DOWL HKM Date Performed 10/27/2011	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H WB Flathead County	
Analysis Time Period Median Off-Peak Project Description: US 2 - Badrock Canyon Corridor Planning Study	Analysis Year	2011	
Input Data			
1		personal control of the second	
\$\frac{1}{2} \text{ Shoulder width } \tag{tt}			
Lane width tt	Class I highway Class II highway Class III highway		
Lane width It			
\$\frac{1}{2} \text{ Shoulder width } \frac{1}{2} \text{ It }			
Segment length, L ₁ mi	Terrain Level Rolling Grade Length mi Up/down Peak-hour factor, PHF 0.89 No-passing zone 100%		
Analysis direction vol., V _d 430veh/h	Show North Arrow % Trucks and Buses , P _T 6 %		
Opposing direction vol., V _o 493veh/h	% Recreation	nal vehicles, P _R 4%	
Shoulder width ft 1.0	Access point		
Lane Width ft 12.0 Segment Length mi 2.4			
Average Travel Speed			
	Analysis Direction (d)	Opposing Direction (o)	
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.8	1.7	
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1	
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ $P_T(E_T$ -1)+ $P_R(E_R$ -1))	0.951	0.956	
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.94	0.96	
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g.ATS} * f _{HV.ATS})	540	604	
Free-Flow Speed from Field Measurement	Estimated Fro	ee-Flow Speed	
	Base free-flow speed ⁴ , BFFS	61.0 mi/h	
	Adj. for lane and shoulder width,	f _{I S} (Exhibit 15-7) 4.2 mi/h	
Mean speed of sample ³ , S _{FM}	Adj. for access points ⁴ , f _A (Exhib		
Total demand flow rate, both directions, v	1		
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BFFS-f _{LS} -f _A) 56.0 mi/h		
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.9 mi/h	Average travel speed, ATS _d =FFS-0.00776(v _{d,ATS} + 45.3 mi/h v _{o,ATS}) - f _{np,ATS}		
	Percent free flow speed, PFFS	80.8 %	
Percent Time-Spent-Following	I A. J. D. C. C.		
	Analysis Direction (d)	Opposing Direction (o)	
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.4	1.2	
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0	
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	0.977	0.988	
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.95	0.97	
Directional flow rate ² , v _f (pc/h) v _j =V _f (PHF*f _{HV,PTSF} * f _{g,PTSF})	521	578	
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	53.6		
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	36.5		
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *($v_{d,PTSF} / v_{d,PTSF} + v_{d,PTSF}$	70.9		
V _{o,PTSF})	ALCONOMICS CONTRACTOR OF THE PROPERTY OF THE P		
Level of Service and Other Performance Measures			
Level of service, LOS (Exhibit 15-3)		D	
Volume to capacity ratio, v/c	0	.32	

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1576
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1629
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	80.8
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	483.1
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _{f.} (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.65
Bicycle level of service (Exhibit 15-4)	F
Notes	The state of the s

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTION	NAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET	
General Information		Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 10/27/2011 PM Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H EB Flathead County 2011	
Project Description: US 2 - Badrock Ca		Analysis real	2011	
Input Data				
<u> </u>	.			
	Shoulder widthtt Lane width tt	TOOL IN	beau	
	Lane width tt		highway 🔽 Class II	
	Shoulder width tt	highway	Class III highway	
Segment length	ı, L _t mi	Terrain Grade Lengti Peak-hour fa	ctor, PHF 0.88	
Analysis direction vol., V _d 410v	eh/h	Show Herith Arrow % Trucks and		
Opposing direction vol., V _o 687v	eh/h		nal vehicles, P _R 4%	
Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4		Access point	s <i>mi 3</i> /mi	
Average Travel Speed				
		Analysis Direction (d)	Opposing Direction (o)	
Passenger-car equivalents for trucks, E ₁	(Exhibit 15-11 or 15-12)	1.9	1.4	
Passenger-car equivalents for RVs, E_R ((Exhibit 15-11 or 15-13)	1.1	1.1	
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$		0.945	0.973	
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)		0.93	0.99	
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})		530	810	
Free-Flow Speed fro	m Field Measurement	Estimated Free-Flow Speed		
		Base free-flow speed ⁴ , BFFS	61.0 mi/h	
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder width,	f _{LS} (Exhibit 15-7) 4.2 mi/h	
Total demand flow rate, both directions,	v	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h	
Free-flow speed, FFS=S _{FM} +0.00776(v/ f	hvats)	Free-flow speed, FFS (FSS=BFI	S-f _{LS} -f _A) 56.0 mi/h	
Adj. for no-passing zones, f _{np,ATS} (Exhib		Average travel speed, ATS _d =FFS	FFS-0.00776(v _{d,ATS} + 44.3 mi/l	
Percent Time-Spent-Following		v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	79.0 %	
rercent time-spent-ronowing		Analysis Direction (d)	Opposing Direction (o)	
Passenger-car equivalents for trucks, E _T	(Exhibit 15-18 or 15-19)	1.4	1.0	
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0	
Heavy-vehicle adjustment factor, f _{HV} =1/	(1+ P _T (E _T -1)+P _R (E _R -1))	0.977	1.000	
Grade adjustment factor ¹ , f _{g,PTSF} (Exhib		0.94	1.00	
Directional flow rate ² , v _/ (pc/h) v _i =V _i /(PHF	*f _{HV,PTSF} * f _{g,PTSF})	508	781	
Base percent time-spent-following ⁴ , BPT	SF _d (%)=100(1-e ^{av} d ^b)	55.5		
Adj. for no-passing zone, $f_{n\rho,PTSF}$ (Exhib	A CONTRACTOR OF THE PROPERTY O	2	8.5	
Percent time-spent-following, PTSF _d (%)=	=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	TSF [†] 66.7		
v _{o,PTSF})				
Level of Service and Other Performant Level of service, LOS (Exhibit 15-3)	ce measures		^	
LUTUI OI OUI VIOU, LOU (LAHIDIL 10-0)		i .	С	

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1638
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1700
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	79.0
Bicycle Level of Service	A CONTRACTOR OF THE CONTRACTOR
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	465.9
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.63
Bicycle level of service (Exhibit 15-4)	F
Notes	The state of the s

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) \ge 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Analyst David Stoner Agency or Company DOWL HKM Fro Date Performed 10/27/2011 Analysis Time Period PM Peak An Project Description: US 2 - Badrock Canyon Corridor Planning Study Input Data Shoulder width tt Lane width tt Shoulder width tt	Class I h highway / Class I h highway / C Show Horth Arrow Strong Horth Arrow Wild the first of the control o	US 2 Columbia F to Hungry H WB Flathead County 2011 ighway Class II Class III highway Level Rolling mi Up/down itor, PHF 0.91 one 100% Buses , P _T 6 % al vehicles, P _R 4%
Agency or Company Date Performed 10/27/2011 Analysis Time Period Project Description: US 2 - Badrock Canyon Corridor Planning Study Input Data Shoulder width tt Lane width It Shoulder width It Segment length, Lt Ind Segment length Shoulder width It Segment length Shoulder width Shoulder width Shoulder width Shoulder width ft Ind Segment Length Segment le	Class I h highway Terrain Grade Length Peak-hour fac No-passing zo % Trucks and % Recreations Access points Analysis Direction (d) 1.5 1.1	Columbia F to Hungry H WB Flathead County 2011 ighway Class II Class III highway Level Rolling mi Up/down otor, PHF 0.91 one 100% Buses , P _T 6 % al vehicles, P _R 4% mi 3/mi Opposing Direction (o) 1.9 1.1
Project Description: US 2 - Badrock Canyon Corridor Planning Study Input Data Shoulder width tt Lane width It Shoulder width It Shoulder width It Shoulder width It Segment length, Lt mi Analysis direction vol., Vd 687veh/h Opposing direction vol., Vo 410veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, ET (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, ER (Exhibit 15-11 or 15-13)	Class I h highway C Terrain Grade Length Peak-hour fac No-passing zo % Trucks and % Recreations Access points Analysis Direction (d) 1.5 1.1	ighway Class II Class III highway Level PRolling mi Up/down one 100% Buses , PT 6 % al vehicles, PR 4% mi 3/mi Opposing Direction (o) 1.9
Input Data Shoulder width It	highway Terrain Grade Length Peak-hour fac No-passing zo % Trucks and % Recreations Access points Analysis Direction (d) 1.5 1.1	Class III highway Level V Rolling mi Up/down clor, PHF 0.91 one 100% Buses , P _T 6 % al vehicles, P _R 4% mi 3/mi Opposing Direction (o) 1.9 1.1
Lane width tt Lane width tt Shoulder width tt Segment length, Lt mi Analysis direction vol., Vd 687veh/h Opposing direction vol., Vo 410veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, ET (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, ER (Exhibit 15-11 or 15-13)	highway Terrain Grade Length Peak-hour fac No-passing zo % Trucks and % Recreations Access points Analysis Direction (d) 1.5 1.1	Class III highway Level V Rolling mi Up/down clor, PHF 0.91 one 100% Buses , P _T 6 % al vehicles, P _R 4% mi 3/mi Opposing Direction (o) 1.9 1.1
Lane width tt Lane width tt Shoulder width tt Segment length, Lt mi Analysis direction vol., Vd 687veh/h Opposing direction vol., Vo 410veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, ET (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, ER (Exhibit 15-11 or 15-13)	highway Terrain Grade Length Peak-hour fac No-passing zo % Trucks and % Recreations Access points Analysis Direction (d) 1.5 1.1	Class III highway Level V Rolling mi Up/down clor, PHF 0.91 one 100% Buses , P _T 6 % al vehicles, P _R 4% mi 3/mi Opposing Direction (o) 1.9 1.1
Analysis direction vol., V _d 687veh/h Opposing direction vol., V _o 410veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	highway Terrain Grade Length Peak-hour fac No-passing zo % Trucks and % Recreations Access points Analysis Direction (d) 1.5 1.1	Class III highway Level V Rolling mi Up/down clor, PHF 0.91 one 100% Buses , P _T 6 % al vehicles, P _R 4% mi 3/mi Opposing Direction (o) 1.9 1.1
Shoulder width tt Segment length, Lt mi Analysis direction vol., Vd 687veh/h Opposing direction vol., Vo 410veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, ET (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, ER (Exhibit 15-11 or 15-13)	Terrain Grade Length Peak-hour fac No-passing zo % Trucks and % Recreations Access points Analysis Direction (d) 1.5 1.1	Level PRolling mi Up/down tor, PHF 0.91 nne 100% Buses , PT 6 % al vehicles, PR 4% mi 3/mi Opposing Direction (o) 1.9 1.1
Segment length, L _t mi Analysis direction vol., V _d 687veh/h Opposing direction vol., V _o 410veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	Grade Length Peak-hour fac No-passing zo % Trucks and % Recreations Access points Analysis Direction (d) 1.5 1.1	mi Up/down flor, PHF 0.91 one 100% Buses , P _T 6 % al vehicles, P _R 4% mi 3/mi Opposing Direction (o) 1.9 1.1
Analysis direction vol., V _d 687veh/h Opposing direction vol., V _o 410veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	Peak-hour factor No-passing zo % Trucks and % Recreations Access points Analysis Direction (d) 1.5 1.1	mi Up/down flor, PHF 0.91 one 100% Buses , P _T 6 % al vehicles, P _R 4% mi 3/mi Opposing Direction (o) 1.9 1.1
Opposing direction vol., V _o 410veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	Show Horth Arrow % Trucks and % Recreations Access points Analysis Direction (d) 1.5 1.1	Buses , P _T 6 % al vehicles, P _R 4% mi 3/mi Opposing Direction (o) 1.9 1.1
Shoulder width ft Lane Width ft 1.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	% Recreations Access points Analysis Direction (d) 1.5 1.1	Opposing Direction (o) 1.9 1.1
Shoulder width ft Lane Width ft 1.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	Analysis Direction (d) 1.5 1.1	Opposing Direction (o) 1.9 1.1
Average Travel Speed Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.5 1.1	1.9 1.1
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.5 1.1	1.9 1.1
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.5 1.1	1.9 1.1
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.967	0.945
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	0.99	0.93
Demand flow rate ² , v_i (pc/h) v_i = V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	789	513
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Ba	ase free-flow speed ⁴ , BFFS	63.0 mi/h
Mean speed of sample ³ , S _{FM}	dj. for lane and shoulder width,4	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, <i>v</i>	dj. for access points ⁴ , f _A (Exhibit	15-8) 0.8 mi/h
	ree-flow speed, FFS (FSS=BFF)	S-f _{LS} -f _A) 58.0 ml/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 2.6 mi/h Ave	verage travel speed, ATS _d =FFS	-0.00776(v _{d,ATS} + 45.3 mi/h
Per Per	o,ATS ^{) - f} np,ATS ercent free flow speed, PFFS	78.1 %
Percent Time-Spent-Following	Analysis Direction (d)	Onnering Direction (a)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for RVs, E _T (Exhibit 15-18 or 15-19)	1.0	1.4
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.977
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	1.00	0.93
Directional flow rate ² , v _i (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	755	496
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av_db})	64.5	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	29).4
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	82.2	
v _{o,PTSF})	UZ	
Level of Service and Other Performance Measures	2000	
Level of service, LOS (Exhibit 15-3) Volume to capacity ratio, v/c		

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1594	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	78.1	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	754.9	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.88	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.



Appendix 4

Operational Analysis Worksheets

Existing Adjusted Annual Average

DIRECTION	NAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information		Site Information	
Analyst Agency or Company Date Performed	David Stoner DOWL HKM 10/27/2011	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H EB Flathead County
Analysis Time Period	AM Peak	Analysis Year	2011
Project Description: US 2 - Badrock Ca Input Data	anyon Comaor Planning Study		
L	*		
	Shoulder widthft		
	Lane width tt	Class I	highway 🔽 Class II
	Lane widthtt Shoulder width tt	hiohway	Class III highway
	Shoulder widthtt _	Terrain	Level V Rolling
Segment length	ı, L ₁ mi	Grade Lengtl Peak-hour fa No-passing z	h mi Up/down ctor, PHF 0.92
Analysis direction vol., V _d 279v	eh/h	Show North Arrow % Trucks and	d Buses , P _T 6 %
Opposing direction vol., V _o 175v	eh/h	% Recreation	nal vehicles, P _R 4%
Shoulder width ft 1.0		Access point	
Lane Width ft 12.0 Segment Length mi 2.4			
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E	(Exhibit 15-11 or 15-12)	2.1	2.3
Passenger-car equivalents for RVs, E _R ((Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$		0.935	0.924
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)		0.83	0.74
Demand flow rate ² , v _/ (pc/h) v _i =V _i / (PHF	* f _{g,ATS} * f _{HV,ATS})	* f _{HV,ATS})	
Free-Flow Speed fro	m Fleid Measurement	Estimated Free-Flow Speed	
		Base free-flow speed ⁴ , BFFS	60.0 mi/h
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder width,4	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions,	v	Adj. for access points ⁴ , f _A (Exhibi	it 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f		Free-flow speed, FFS (FSS=BFF	FS-f _{1.0} -f _A) 55.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhib	,	Average travel speed, ATS _d =FFS	
		V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	84.0 %
Percent Time-Spent-Following		Apolysis Discotion (4)	I o a b
Passenger-car equivalents for trucks, E _T	/Eyhihit 15 19 0- 45 40\	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for RVs, E _R (_	1.6	1.8
Heavy-vehicle adjustment factor, f _{HV} =1/		0.965	0.954
Grade adjustment factor ¹ , f _{g,PTSF} (Exhib		0.85	0.79
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF		370	252
Base percent time-spent-following ⁴ , BPT		37.3	
Adj. for no-passing zone, f _{np,PTSF} (Exhib	it 15-21)	52.1	
Percent time-spent-following, PTSF _d (%)=	*BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	1SF ⁺ 68.3	
o,PTSF)		0	O.J
evel of Service and Other Performant	ce Measures		
evel of service, LOS (Exhibit 15-3)			С
/olume to capacity ratio, v/c		<u> </u>	.27

Capacity, C _{d,ATS} (Equation 15-12) pc/h	0
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1354
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	84.0
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	303.3
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.42
Bicycle level of service (Exhibit 15-4)	E
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information	Site Information	-
Analyst David Stoner Agency or Company DOWL HKM Date Performed 10/27/2011 Analysis Time Period AM Peak	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H WB Flathead County
Project Description: US 2 - Badrock Canyon Corridor Planning Study	Analysis Year	2011
Input Data		
\$\frac{1}{2} \text{Shoutder width} \tag{1}		
Lane width		17
Lane width		highway
\$\ \$\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	highway I	Class III highway
Segment length, L _t mi	Terrain Grade Lengti Peak-hour fa No-passing z	ctor, PHF 0.84
Analysis direction vol., V _d 175veh/h	Show North Arrow % Trucks and	d Buses , P _T 6 %
Opposing direction vol., V _o 279veh/h	% Recreation	nal vehicles, P _R 4%
Shoulder width ft 1.0	Access point	**
Lane Width ft 12.0 Segment Length mi 2.4		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	2.3	2.1
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ $P_T(E_T$ -1)+ $P_R(E_R$ -1))	0.924	0.935
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	nent factor ¹ , f _{g,ATS} (Exhibit 15-9) 0.76	
Demand flow rate ² , v _f (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	297	418
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
	Base free-flow speed ⁴ , BFFS	62.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, <i>v</i>	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})	Free-flow speed, FFS (FSS=BFI	-S-f _{1.S} -f _A) 57.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 3.1 mi/h	Average travel speed, ATS _d =FFS	20 //
Percent Time-Spent-Following	V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	84.8 %
r droom rane-openier onowing	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.7	1.6
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	0.960	0.965
Grade adjustment factor ¹ , f _{g.PTSF} (Exhibit 15-16 or Ex 15-17)	0.80	0.87
Directional flow rate ² , v _/ (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	271	396
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	32.3	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	49.1	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *($v_{d,PTSF}/v_{d,PTSF}$ +	SF [†]	
v _{o,PTSF})	5	2.2
Level of Service and Other Performance Measures		
Level of service, LOS (Exhibit 15-3)		В
Volume to capacity ratio, v∕c	0	.18

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1438	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1477	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	84.8	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	208.3	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.23	
Bicycle level of service (Exhibit 15-4)	E	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIO	NAL TWO-LANE HIGHWA	Y SEGMENT WORK	SHEET
General Information		Site Information	
Analyst Agency or Company Date Performed	David Stoner DOWL HKM 10/27/2011	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H EB Flathead County
Analysis Time Period	Median Off-Peak	Analysis Year	2011
Project Description: US 2 - Badrock Ca Input Data	anyon Corridor Planning Study		
III Data			
	\$\frac{1}{2} \text{Shoulder widthft}		
	Lane width tt	Class I	highway 🔽 Class II
	Lane width It	highway [Class III highway
	Shoulder width tt	Terrain	Level Rolling
Segment lengtl	n, L ₁ mi	Grade Lengtl Peak-hour fa	n mi Up/down ctor, PHF 0.91
Analysis direction vol., V _d 246v	eh/h	Show North Arrow % Trucks and	
Opposing direction vol., V _a 214v	eh/h		nal vehicles, P _R 4%
Shoulder width ft 1.0		Access point	
Lane Width ft 12.0 Segment Length mi 2.4		1	
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E ₁	(Exhibit 15-11 or 15-12)	2.2	2.2
Passenger-car equivalents for RVs, E _R	(Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$		0.929	0.929
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)		0.81	0.78
Demand flow rate ² , v_i (pc/h) v_i = V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)		359	325
Free-Flow Speed fro	m Field Measurement	Estimated Free-Flow Speed	
		Base free-flow speed ⁴ , BFFS	61.0 mi/h
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder width,	f _{LS} (Exhibit 15-7) 4.2 mi/h
Fotal demand flow rate, both directions,	v	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/		Free-flow speed, FFS (FSS=BFf	
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 3.4 mi/h		Average travel speed, ATS _d =FFS-0.00776(v _{d,ATS} + 47.3 mi	
		v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	84.4 %
Percent Time-Spent-Following		I A literature	
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T		1.7	1.7
Passenger-car equivalents for RVs, E_R (Heavy-vehicle adjustment factor, f_{HV} =1/		1.0 0.960	0.960
Grade adjustment factor ¹ , f _{q.PTSF} (Exhib		0.84	0.82
Directional flow rate ² , v _/ (pc/h) v _i =V _/ /(PHF		335	299
Base percent time-spent-following ⁴ , BPT		36.0	
dj. for no-passing zone, f _{np,PTSF} (Exhib		54.1	
	=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} /v _{d,PTSF} +	TSF [†]	
o,PTSF)		5	4.6
evel of Service and Other Performan	ce Measures		
evel of service, LOS (Exhibit 15-3)			C
olume to capacity ratio, v/c		0	24

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1387	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	84.4	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	270.3	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	nu.
Bicycle level of service score, BLOS (Eq. 15-31)	5.36	• • •
Bicycle level of service (Exhibit 15-4)	E	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

	⊑ ⊓IG⊓VV <i>F</i>	AY SEGMENT WORK	(SHEET
General Information		Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 10/27/2011 Analysis Time Period Median Off-Peak	·	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H WB Flathead County 2011
Project Description: US 2 - Badrock Canyon Corridor Planning S	Study	a maryon a car	2011
Input Data			
1 Shoulder width			
Lane width		pan-e	printe
Lane width	11		highway 🔽 Class II
\$\frac{1}{2} Shoulder width	tt	highway [Class III highway
Segment length, L _t mi	3	Terrain Grade Lengtl Peak-hour fa No-passing z Show North Arrow Of Trucks and	ctor, PHF 0.89 cone 100%
Analysis direction vol., V _d 214veh/h		Show north Priest % Trucks and	d Buses , P _T 6 %
Opposing direction vol., V _o 246veh/h			nal vehicles, P _R 4%
Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4		Access point	s <i>mi 3/</i> mi
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)		2.2	2.1
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)		1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$		0.929	0.935
Grade adjustment factor ¹ , f _{9,ATS} (Exhibit 15-9)		0.78	0.81
Demand flow rate ² , $v_i(pc/h)$ $v_i = V_i/(PHF^* f_{g,ATS}^* f_{HV,ATS})$		332 365	
Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
		Base free-flow speed ⁴ , BFFS	61.0 mi/h
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder width,4	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, v		Adj. for access points ⁴ , f _A (Exhibi	it 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})		Free-flow speed, FFS (FSS=BFF	S-f _{LS} -f _A) 56.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15)	3.2 mi/h	Average travel speed, ATS _d =FFS	S-0.00776(v _{d,ATS} + 47.4 mi/h
		v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	84.6 %
Percent Time-Spent-Following		Analysis Direction (d)	Opposing Disastian (s)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)		Analysis Direction (d)	Opposing Direction (o) 1.7
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)		1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))		0.960	0.960
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)		0.82	0.84
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	W.	306	343
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)		34.7	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)		5	3.3
Percent time-spent-following, PTSF $_{ m d}$ (%)=BPTSF $_{ m d}$ +f $_{ m np,PTSF}$ *(V $_{ m d,F}$	PTSF / V _{d,PTSF} +	5	9.8
		I	
(o,PTSF)	Jan Maria		
(o,PTSF) Level of Service and Other Performance Measures Level of service, LOS (Exhibit 15-3)			C

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1367
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1428
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	84.6
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	240.4
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S ₁ (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.30
Bicycle level of service (Exhibit 15-4)	E
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information	Site Information	
Analyst David Stoner	Highway / Direction of Travel	US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H EB
Date Performed 10/27/2011 Analysis Time Period PM Peak	Jurisdiction Analysis Year	Flathead County 2011
Project Description: US 2 - Badrock Canyon Corridor Planning Study	p manyoro roar	2011
Input Data		
\$\frac{1}{2} \text{ Shoulder width } \tag{tt}		
Lane widtht	Class I	highway 🔽 Class II
Lane width		
\$\frac{1}{2} \text{ Shoulder width } tt	highway I	Class III highway
	Terrain	Level Rolling
Segment length, L ₁ mi	Grade Lengt	
' '	No-passing a	
Analysis direction vol., V _d 207veh/h	Show North Arrow % Trucks an	
"		•
Opposing direction vol., V _o 343veh/h	4	nal vehicles, P _R 4%
Shoulder width ft 1.0 Lane Width ft 12.0	Access point	s <i>mi 3/</i> mi
Segment Length mi 2.4		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	2.2	2.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.929	0.940
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.78	0.89
Demand flow rate ² , v _f (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	325	466
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
	Base free-flow speed ⁴ , BFFS 61.0	
	Adj. for lane and shoulder width,	
Mean speed of sample ³ , S _{FM}		
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BF	FS-f _{tS} -f _A) 56.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 2.7 mi/h	Average travel speed, ATS _d =FF	S-0.00776/v. +
ray, for no possing conest, inp,ATS (Exhibit 10-10)	į.	47.2 mi/h
	Vo,ATS) - fnp,ATS	242.44
Percent Time-Spent-Following	Percent free flow speed, PFFS	84.3 %
- control open control	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.7	1.6
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	0.960	0.965
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.82	0.89
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	299	454
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	35.9	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	43.0	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	+ 53.0	
v _{o,PTSF})		
Level of Service and Other Performance Measures		
Level of service, LOS (Exhibit 15-3)	400	В
Volume to capacity ratio, v/c	[1.19

Directional Page 2 of 2

1494	
1544	CONTRACTOR OF THE PARTY OF THE
84.3	macro-ji
235.2	
13.00	· · · · · · · · · · · · · · · · · · ·
4.79	
5.29	
E	
	1544 84.3 235.2 13.00 4.79

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only

^{5.} Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Analyst Agency or Company DOWL HKM From/1 Date Performed 10/2/72011 Jurisdin Analysis Time Period PM Peak Analysis Project Description: US 2 - Badrock Canyon Corridor Planning Study Input Data Shoulder width It	formation ay / Direction of Travel U To C ction F, is Year 2 Class I hig	class III highway Level Rolling mi Up/down pr, PHF 0.91 e 100% Buses , P _T 6 % vehicles, P _R 4%
Agency or Company Date Performed 10/27/2011 Analysis Time Period Poposing direction vol., V _d Segment Length ft Lane Width 12.0 Segment Length ft Lane Width 12.0 Segment Length ft Lane Width 15.0 Lane Width 12.0 Segment Length in 13.0 Segment Length in 14.0 Shoulder width i	Clion Frisis Year 2 Class I highway Class For the Arrow Willorth Arrow William Willia	columbia F to Hungry H WB lathead County 011 chway Class II lass III highway Level Rolling mi Up/down or, PHF 0.91 lee 100% Buses , P _T 6% vehicles, P _R 4% mi 3/mi Opposing Direction (o) 2.2 1.1 0.929
Project Description: US 2 - Badrock Canyon Comidor Planning Study Input Data Shoulder width It Lane width It Shoulder	highway Cl Terrain Grade Length Peak-hour facto No-passing zon % Trucks and E % Recreational Access points n Analysis Direction (d) 2.0 1.1 0.940	hway Class II lass III highway Level Rolling mi Up/down or, PHF 0.91 le 100% Buses , P _T 6 % vehicles, P _R 4% mi 3/mi Opposing Direction (o) 2.2 1.1 0.929
Input Data Shoulder width	highway Cl Terrain Grade Length Peak-hour facto No-passing zon % Trucks and E % Recreational Access points n Analysis Direction (d) 2.0 1.1 0.940	Level P Rolling mi Up/down or, PHF 0.91 le 100% Buses , P _T 6 % vehicles, P _R 4% mi 3/mi Opposing Direction (o) 2.2 1.1 0.929
Lane width Lane width Shoulder width Shoulder width It Should	highway Cl Terrain Grade Length Peak-hour facto No-passing zon % Trucks and E % Recreational Access points n Analysis Direction (d) 2.0 1.1 0.940	Level Rolling mi Up/down or, PHF 0.91 lee 100% Buses , P _T 6 % vehicles, P _R 4% ni 3/mi Opposing Direction (o) 2.2 1.1 0.929
Lane width Lane width Shoulder width Shoulder width It Should	highway Cl Terrain Grade Length Peak-hour facto No-passing zon % Trucks and E % Recreational Access points n Analysis Direction (d) 2.0 1.1 0.940	Level P Rolling mi Up/down or, PHF 0.91 le 100% Buses , P _T 6 % vehicles, P _R 4% mi 3/mi Opposing Direction (o) 2.2 1.1 0.929
Lane width Shoulder width It It It Shoulder width It It It It It It It It It	highway Cl Terrain Grade Length Peak-hour facto No-passing zon % Trucks and E % Recreational Access points n Analysis Direction (d) 2.0 1.1 0.940	Level P Rolling mi Up/down or, PHF 0.91 le 100% Buses , P _T 6 % vehicles, P _R 4% mi 3/mi Opposing Direction (o) 2.2 1.1 0.929
Shoulder width the state of the	Terrain Grade Length Peak-hour facto No-passing zon % Trucks and E % Recreational Access points n Analysis Direction (d) 2.0 1.1 0.940	Level Rolling mi Up/down or, PHF 0.91 lee 100% Buses , P _T 6 % vehicles, P _R 4% ni 3/mi Opposing Direction (o) 2.2 1.1 0.929
Analysis direction vol., V_d 343veh/h Opposing direction vol., V_o 207veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ Grade adjustment factor $f_{g,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ Demand flow rate $f_{g,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ Free-Flow Speed from Field Measurement Base from Mean speed of sample $f_{g,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ Total demand flow rate, both directions, $f_{g,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ Free-flow speed, FFS= $f_{g,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	Grade Length Peak-hour facto No-passing zon % Trucks and E % Recreational Access points n Analysis Direction (d) 2.0 1.1 0.940	mi Up/down or, PHF 0.91 ie 100% Buses , P _T 6 % vehicles, P _R 4% ii 3/mi Opposing Direction (o) 2.2 1.1 0.929
Opposing direction vol., V_0 207veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ P_T (E_T -1)+ P_R (E_R -1)) Grade adjustment factor ¹ , $f_{g,ATS}$ (Exhibit 15-9) Demand flow rate ² , v_i (pc/h) v_i = V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$) Free-Flow Speed from Field Measurement Base fr Mean speed of sample ³ , S_{FM} Total demand flow rate, both directions, v Free-flow speed, FFS= S_{FM} +0.00776(v / $f_{HV,ATS}$)	% Recreational Access points in Analysis Direction (d) 2.0 1.1 0.940	Opposing Direction (o) 2.2 1.1 0.929
Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ Grade adjustment factor ¹ , $f_{g,ATS}$ (Exhibit 15-9) Demand flow rate ² , v_i (pc/h) v_i = V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$) Free-Flow Speed from Field Measurement Base from Mean speed of sample ³ , S_{FM} Total demand flow rate, both directions, v Free-flow speed, FFS= S_{FM} +0.00776(v / $f_{HV,ATS}$)	Access points not analysis Direction (d) 2.0 1.1 0.940	Opposing Direction (o) 2.2 1.1 0.929
Lane Width ft Segment Length mi 2.4 Average Travel Speed Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ Grade adjustment factor ¹ , $f_{g,ATS}$ (Exhibit 15-9) Demand flow rate ² , v_I (pc/h) $v_I=V_I$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$) Free-Flow Speed from Field Measurement Base from Mean speed of sample ³ , S_{FM} Total demand flow rate, both directions, v Free-flow speed, FFS= S_{FM} +0.00776(v / $f_{HV,ATS}$)	2.0 1.1 0.940	Opposing Direction (o) 2.2 1.1 0.929
Average Travel Speed Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ P_T (E_T -1)+ P_R (E_R -1)) Grade adjustment factor ¹ , $f_{g,ATS}$ (Exhibit 15-9) Demand flow rate ² , v_j (pc/h) v_i = v_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$) Free-Flow Speed from Field Measurement Base fr Adj. for Total demand flow rate, both directions, v Free-flow speed, FFS= S_{FM} +0.00776(v / $f_{HV,ATS}$)	2.0 1.1 0.940	2.2 1.1 0.929
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ Grade adjustment factor ¹ , $f_{g,ATS}$ (Exhibit 15-9) Demand flow rate ² , v_i (pc/h) $v_i=v_i/(PHF^*f_{g,ATS}^*f_{HV,ATS})$ Free-Flow Speed from Field Measurement Base from the properties of Sample 10	2.0 1.1 0.940	2.2 1.1 0.929
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ Grade adjustment factor ¹ , $f_{g,ATS}$ (Exhibit 15-9) Demand flow rate ² , v_i (pc/h) v_i = V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$) Free-Flow Speed from Field Measurement Base from the speed of sample $f_{g,ATS}$ (Exhibit 15-9) Total demand flow rate, both directions, $f_{g,ATS}$ (Exhibit 15-9) Free-flow speed, FFS= $f_{g,ATS}$ (Free-flow speed, FFS= $f_{g,ATS}$ (Exhibit 15-11 or 15-13)	2.0 1.1 0.940	2.2 1.1 0.929
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ Grade adjustment factor ¹ , $f_{g,ATS}$ (Exhibit 15-9) Demand flow rate ² , v_f (pc/h) $v_i=v_f/(PHF^*f_{g,ATS}^*f_{HV,ATS})$ Free-Flow Speed from Field Measurement Base fr Adj. for Total demand flow rate, both directions, v Free-flow speed, FFS= S_{FM} +0.00776($v/f_{HV,ATS}$)	0.940	0.929
Grade adjustment factor 1 , $f_{g,ATS}$ (Exhibit 15-9) Demand flow rate 2 , v_i (pc/h) v_i = V_i / (PHF* 4 4 4 4 4 4 f _{HV,ATS}) Free-Flow Speed from Field Measurement Base from Speed of sample 3 , S_{FM} Total demand flow rate, both directions, v Free-flow speed, FFS= S_{FM} +0.00776(v / $f_{HV,ATS}$)		
Demand flow rate ² , v_I (pc/h) v_i = V_I / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$) Free-Flow Speed from Field Measurement Base fr Mean speed of sample ³ , S_{FM} Total demand flow rate, both directions, v Free-flow speed, FFS= S_{FM} +0.00776(v / $f_{HV,ATS}$)	0.88	0.77
Free-Flow Speed from Field Measurement Base fr Adj. for Mean speed of sample 3 , S_{FM} Total demand flow rate, both directions, v Free-flow speed, FFS= S_{FM} +0.00776(v / $f_{HV,ATS}$)		0.77
Mean speed of sample 3 , S_{FM} Total demand flow rate, both directions, v Free-flow speed, FFS= S_{FM} +0.00776(v / $f_{HV,ATS}$)	456	318
Mean speed of sample 3 , S_{FM} Total demand flow rate, both directions, v Adj. for Free-flow speed, FFS= S_{FM} +0.00776(v / $f_{HV,ATS}$) Free-flow	Estimated Free-Flow Speed	
Total demand flow rate, both directions, v Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS}) Adj. for	Base free-flow speed ⁴ , BFFS 63.0	
Total demand flow rate, both directions, v Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS}) Free-flow	r lane and shoulder width, 4 f _t	S(Exhibit 15-7) 4.2 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	access points ⁴ , f _A (Exhibit 1	5-8) 0.8 mi/h
	ow speed, FFS (FSS=BFFS	-f _{LS} -f _A) 58.0 mi/h
WELL III =	e travel speed, ATS _d =FFS-0	0.00776(v _{d,ATS} + 48.3 mi/h
Percen	^{- f} np,ATS It free flow speed, PFFS	83.2 %
Percent Time-Spent-Following	nalysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.6	1.7
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	0.965	0.960
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.89	0.81
Directional flow rate ² , v _/ (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	439	293
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	44.2	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	44.3	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +		3
V _{o,PTSF})	70.8	
Level of Service and Other Performance Measures	70.8	
Level of service, LOS (Exhibit 15-3) Volume to capacity ratio, v/c	70.8 D	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1387	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	83.2	
Bicycle Level of Service		***************************************
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	376.9	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.53	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.



Appendix 4

Operational Analysis Worksheets

2035 Two-Lane Peak Season

DIRECTIONAL TWO-LANE HIGHW	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner	Highway / Direction of Travel	US 2
Agency or Company DOWL HKM Date Performed 11/15/2011	From/To	Columbia F to Hungry H EB
Date Performed 11/15/2011 Analysis Time Period AM Peak	Jurisdiction Analysis Year	Flathead County 2035
Project Description: US 2 - Badrock Canyon Corridor Planning Study	7 maryora Toda	2000
Input Data		
\$\frac{1}{2} Shoulder width \frac{1}{2} \tag{1}		
Lane widthit	Class I	highway 🔽 Class II
Lane width tt	highway	Class III highway
\$\frac{1}{2} \text{Shoulder width} \frac{1}{2} \text{ft}		- ·
Segment length, L _t mi	Terrain Grade Lengt	Level F Rolling h ml Up/down
Jeginera tengur, ti	Peak-hour fa	
	Show North Arrow % Trucks on	
Analysis direction vol., V _d 791veh/h	% Trucks an	d Buses , P _T 6 %
Opposing direction vol., V _o 502veh/h	% Recreation	nal vehicles, P _R 4%
Shoulder width ft 1.0	Access point	is <i>mi</i> 3/mi
Lane Width ft 12.0 Segment Length mi 2.4		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.3	1.8
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.978	0.951
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	1.00	0.96
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	870 591	
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
	Base free-flow speed ⁴ , BFFS 60.0	
_	Adj. for lane and shoulder width,	⁴ f _{ce} (Exhibit 15-7) 4.2 mi/h
Mean speed of sample ³ , S _{FM}		
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BF)	$FS-f_{LS}-f_A$) 55.0 mi/h
Adj. for no-passing zones, f _{np.ATS} (Exhibit 15-15) 1.9 mi/h	Average travel speed, ATS _d =FFS	S-0.00776(v _{d ATS} +
	V _{o,ATS}) - f _{np,ATS}	¹ 41.8 mi/h
	Percent free flow speed, PFFS	75.9 %
Percent Time-Spent-Following		
Passangar our aquityalanta far tayaka E (Eykihit 45 49 ay 45 40)	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.0	1.2
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	1.000	0.988
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	1.00	0.96
Directional flow rate ² , v _i (pc/h) v _i =V _i (PHF*f _{HV,PTSF} * f _{g,PTSF})	851	569
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} _d ^b)	68.6	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)		26.4
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} /v _{d,PTSF}	+ 84.4	
v _{o,PTSF})		
Level of Service and Other Performance Measures		
Level of service, LOS (Exhibit 15-3)		D
Volume to capacity ratio, v/c		2.52

0	
1629	10.182
75.9	
850.5	
13.00	
4.79	
5.94	
F	
	75.9 850.5 13.00 4.79

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner	Highway / Direction of Travel	US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H WB
Date Performed 11/15/2011 Analysis Time Period AM Peak	Jurisdiction Analysis Year	Flathead County 2035
Project Description: US 2 - Badrock Canyon Corridor Planning Study	Alfalysis Teal	2033
Input Data		
<u> </u>		
\$ Shoulder widthft		
	Class I	highway 🔽 Class II
Lane widthtt		- ,
Shoulder widtht	highway I	Class III highway
	Terrain	Level V Rolling
Segment length, L _l mi	Grade Lengt	
'	Peak-hour fa No-passing 2	
Analysis direction vol., V _d 502veh/h	21	
	% Hucks an	d Buses , P _T 6 %
Opposing direction vol., V _o 791veh/h		nal vehicles, P _R 4%
Shoulder width ft 1.0	Access point	s <i>mi</i> 3/mi
Lane Width ft 12.0 Segment Length mi 2.4		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.7	1.3
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.956	0.978
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	0.97	1.00
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	622 930	
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
	Base free-flow speed ⁴ , BFFS 60.0	
	Adj. for lane and shoulder width,	⁴ f _{ce} (Exhibit 15-7) 4.2 mi/h
Mean speed of sample ³ , S _{FM}		-
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 <i>mi∕h</i>
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})	Free-flow speed, FFS (FSS=BF	$FS-f_{1S}-f_{\Delta}$) 55.0 mi/h
,	Average travel speed, ATS _d =FFS	/-
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.2 mi/h	l .	3-0.00770(v _{d,ATS} + 41.8 mi/h
	V _{o,ATS}) - f _{np,ATS}	
Percent Time-Spent-Following	Percent free flow speed, PFFS	75.9 %
retent time-spent-ronowing	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.2	1.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	0.988	1.000
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.97	1.00
Directional flow rate ² , v _/ (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	602	909
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	61.7	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	24.9	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +		
v _{o,PTSF})	7	71.6
Level of Service and Other Performance Measures		
Level of Service and Other Performance Measures Level of service, LOS (Exhibit 15-3)		D

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1663
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1700
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	75.9
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	577.0
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.74
Bicycle level of service (Exhibit 15-4)	F
Notes	the state of the s

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) \ge 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL T	WO-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information		Site Information	
Analyst David St	oner	Highway / Direction of Travel	US 2
Agency or Company DOWL H		From/To	Columbia F to Hungry H EB
Date Performed 11/15/20	• •	Jurisdiction	Flathead County
Analysis Time Period Median C Project Description: US 2 - Badrock Canyon Con		Analysis Year	2035
Input Data	noor Planning Study		
L			and the second s
3 Should	ler widthtt		
── 1 Lane w	idthtt	Close I	highway 🔽 Class II
Lane w	idth It		- ,
	ler widthft	highway [Class III highway
		Terrain	Level F Rolling
Segment length, L _t	mi	Grade Lengt	
	***	Peak-hour fa	ctor, PHF 0.91
		No-passing z	
Analysis direction vol., V _d 704veh/h		Show Horth Arrow % Trucks and	d Buses , P _T 6 %
Opposing direction vol., V _o 614veh/h		i i	nal vehicles, P _R 4%
Shoulder width ft 1.0		Access point	
Lane Width ft 12.0		7,00035 point	o an only
Segment Length mi 2.4			
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit	15-11 or 15-12)	1.5	1.6
Passenger-car equivalents for RVs, E_R (Exhibit 15	-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, f _{HV,ATS} =1/ (1+ P	$_{T}(E_{T}^{-1}) + P_{R}(E_{R}^{-1}))$	0.967	0.962
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)		0.99	0.98
Demand flow rate ² , v_i (pc/h) $v_i = V_i I$ (PHF* $f_{g,ATS}$ *	HV,ATS)	808 716	
Free-Flow Speed from Field N	easurement	Estimated Free-Flow Speed	
		Base free-flow speed ⁴ , BFFS 61.0	
		Adj. for lane and shoulder width,	f _{1.0} (Exhibit 15-7) 4.2 mi/h
Mean speed of sample ³ , S _{FM}			20
Total demand flow rate, both directions, v		Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})		Free-flow speed, FFS (FSS=BF)	S-f _{LS} -f _A) 56.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15)	1.6 mi/h	Average travel speed, ATS _d =FF8	6-0.00776(v +
np,Ais (***************************************		42.6 mi/h
		V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	70.0.0/
Percent Time-Spent-Following		reicent nee now speed, rrrs	76.0 %
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, $E_{T}(Exhibit\ 1)$	5-18 or 15-19)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 15	-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ $P_{T}(E_{T}$	-1)+P _R (E _R -1))	1.000	1.000
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or		1.00	0.99
Directional flow rate ² , v _/ (pc/h) v _i =V _/ /(PHF*f _{HV,PTSF}		774	682
Base percent time-spent-following ⁴ , BPTSF _d (%)=1	00(1-e ^{av} d ^b)	67.4	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)		27.2	
Percent time-spent-following, PTSF _d (%)=BPTSF _d	f np,PTSF *(V _{d,PTSF} / V _{d,PTSF} +	+ 81.9	
v _{o,PTSF})			
Level of Service and Other Performance Measu	res		
Level of service, LOS (Exhibit 15-3)			D
Volume to capacity ratio, v/c		0	.46

Capacity, C _{d,ATS} (Equation 15-12) pc/h	0	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1683	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	76.0	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	773.6	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	·
Bicycle level of service score, BLOS (Eq. 15-31)	5.89	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	The state of the s
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H WB Flathead County 2035
Project Description: US 2 - Badrock Canyon Corridor Planning Study		
Input Data		
Shoulder width tt Lane width It Lane width It		highway
Segment length, L _t mi	Terrain Grade Lengt Peak-hour fa	Level Rolling h mi Up/down ctor, PHF 0.89
Analysis direction vol., V _d 614veh/h	Show Horth Arrow % Trucks an	d Buses , P _T 6 %
Opposing direction vol., V _o 704veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4	% Recreation Access point	nal vehicles, P _R 4% s <i>mi</i> 3/mi
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.6	1.4
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.962	0.973
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.98	0.99
Demand flow rate ² , v _f (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	732 821	
Free-Flow Speed from Fleid Measurement	Estimated Free-Flow Speed	
	Base free-flow speed ⁴ , BFFS	61.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	⁴ f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BF	FS-f _{LS} -f _A) 56.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.4 mi/h	Average travel speed, ATS _d =FF	S-0.00776(V _{d,ATS} + 42.6 mi/h
Percent Time-Spent-Following	V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	76.1 %
rercent Time-Spent-rollowing	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.0	1.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	1.000	1.000
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.99	1.00
Directional flow rate ² , v,(pc/h) v _i =V,/(PHF*f _{HV,PTSF} * f _{g,PTSF})	697	791
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	64.7	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	26.7	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	+ 77.2	
v _{o,PTSF})		
Level of Service and Other Performance Measures		7/35
Level of service, LOS (Exhibit 15-3)		D
Volume to capacity ratio, v/c	C	0.41

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1638	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1700	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	76.1	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	689.9	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.83	
Bicycle level of service (Exhibit 15-4)	F	
Notes	· · · · · · · · · · · · · · · · · · ·	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H EB Flathead County
Analysis Time Period PM Peak	Analysis Year	2035
Project Description: US 2 - Badrock Canyon Corridor Planning Study		
Input Data	1	
1 Shoulder widthtt		
Lane width	Class I	highway Class II
Lane width tt		
\$\frac{1}{2} \text{Shoulder width} \tag{tt}	1 / 1 \	Class III highway
Segment length, L _t mi	Terrain Grade Lengt Peak-hour fa No-passing z	ctor, PHF 0.89
Analysis direction vol., V _d 586veh/h		d Buses , P _T 6 %
Opposing direction vol., V _o 981veh/h		nal vehicles, P _R 4%
Shoulder width ft 1.0	Access point	• • • • • • • • • • • • • • • • • • • •
Lane Width ft 12.0 Segment Length mi 2.4		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.6	1.3
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ $P_T(E_T$ -1)+ $P_R(E_R$ -1))	0.962	0.978
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.98	1.00
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	698	1127
Free-Flow Speed from Field Measurement	Estimated Fr	ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	62.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	⁴ f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, <i>v</i>	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 <i>mi/h</i>
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})	Free-flow speed, FFS (FSS=BF	FS-f _{1.8} -f _A) 57.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.1 mi/h	Average travel speed, ATS _d =FFS	
	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	73.3 %
Percent Time-Spent-Following	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.0	1.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	1.000	1.000
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.98	1.00
Directional flow rate ² , v/,pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	672	1102
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	67.8	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	2	20.1
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *($v_{d,PTSF}$ / $v_{d,PTSF}$ +		5.4
v _{o,PTSF})		
Level of Service and Other Performance Measures	and the second s	
Level of service, LOS (Exhibit 15-3)		D
Volume to capacity ratio, v/c	0	.40

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1663	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1700	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	73.3	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	658.4	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.81	
Bicycle level of service (Exhibit 15-4)	F	· · · · · · · · · · · · · · · · · · ·
Notes	The state of the s	

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^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

	DIRECTION	NAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
Genera	al Information		Site Information	
Date Pe	or Company erformed s Time Period	David Stoner DOWL HKM 11/15/2011 PM Peak	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H WB Flathead County
		Canyon Corridor Planning Study	Analysis Year	2035
Input D		caryon comacn ranning citaly		
		7-5-5-5-5-5-5-5-5-5-5-5-5-5-5-5-5-5-5-5		
▎├		3 Shoulder width tt	puncer	ستم
	<u>i-</u>	Lane width It		highway 🔽 Class II
		\$ Shoulder width tt	highway [Class III highway
-		յչի, Lլ mi	Terrain Grade Lengtl Peak-hour fa No-passing z	ctor, PHF 0.91 cone 100%
Analysis	s direction vol., V _d 98	1veh/h	Show North Arrow % Trucks and	d Buses , P _T 6 %
Shoulde	er width ft 1.0		% Recreation Access point	nal vehicles, P _R 4% s <i>mi</i> 3/mi
Lane Wi Segmen	fidth ft 12.0 nt Length mi 2.4			
	e Travel Speed			
			Analysis Direction (d)	Opposing Direction (o)
Passenç	ger-car equivalents for trucks,	E _T (Exhibit 15-11 or 15-12)	1.3	1.7
Passenç	ger-car equivalents for RVs, E	R (Exhibit 15-11 or 15-13)	1.1	1.1
	The state of the s	ATS =1/(1+ $P_T(E_T-1)+P_R(E_R-1)$)	0.978	0.956
	ndjustment factor ¹ , f _{g,ATS} (Ext		1.00	0.97
Demand	d flow rate ² , v _i (pc/h) v _i =V _i / (Pl	HF* f _{g,ATS} * f _{HV,ATS})	1102	694
	Free-Flow Speed f	rom Field Measurement	Estimated Fro	ee-Flow Speed
			Base free-flow speed ⁴ , BFFS	60.0 mi/h
Mean sr	peed of sample ³ , S _{FM}		Adj. for lane and shoulder width,	f _{LS} (Exhibit 15-7) 4.2 mi/h
	mand flow rate, both direction	s, <i>v</i>	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h
	w speed, FFS=S _{FM} +0.00776(Free-flow speed, FFS (FSS=BFI	FS-f _{LS} -f _A) 55.0 mi/h
	no-passing zones, f _{np,ATS} (Ex	·	Average travel speed, ATS _d =FF5	39.4 mi/h
Percent	t Time-Spent-Following		v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	71.7 %
. orogint	open onowing		Analysis Direction (d)	Opposing Direction (o)
Passeng	ger-car equivalents for trucks,	E _T (Exhibit 15-18 or 15-19)	1.0	1.0
Passeng	ger-car equivalents for RVs, E _l	R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))		1.000	1.000	
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)		1.00	0.98	
Directional flow rate ² , v _s (pc/h) v _j =V _s ((PHF*f _{HV,PTSF} * f _{g,PTSF})		1078	657	
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)		76.5		
	no-passing zone, f _{np,PTSF} (Exl		2	0.7
Percent f		6)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} /v _{d,PTSF} +	8	9.4
			I	
v _{o,PTSF})				The second secon
v _{o,PTSF}) Level of	Service and Other Performs service, LOS (Exhibit 15-3)	ance Measures		E

Directional Page 2 of 2

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1666	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	71.7	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	1078.0	
Effective widlh, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	6.06	
Bicycle level of service (Exhibit 15-4)	F	
Notes	······································	

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.



Appendix 4

Operational Analysis Worksheets

2035 Two-Lane Adjusted Annual Average

DIRECTION	IAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information		Site Information	
	David Stoner	Highway / Direction of Travel	US 2
	DOWL HKM	From/To	Columbia F to Hungry H EB
.	11/15/2011 AM Peak	Jurisdiction Analysis Year	Flathead County 2035
Project Description: US 2 - Badrock Car		Palarysis Tear	2039
Input Data	, and the second		
L			
	Shoulder widthtt		
	Lane widthtt	Class I I	nighway 🔽 Class II
	Lane widthtt	highway [Class III highway
	Shoulder widthtt		Level V Rolling
Sagment length	. L _t mi	Terrain Grade Lengti	
Jegmerk rengul,	·	Peak-hour fa	ctor, PHF 0.93
		Show Horth Arrow % Trucks and	
Analysis direction vol., V _d 398ve	h/h	Show Horin Arrow % Trucks and	d Buses , P _T 6 %
Opposing direction vol., V _o 250ve	h/h	% Recreation	ial vehicles, P _R 4%
Shoulder width ft 1.0		Access points	s <i>mi 3/</i> mi
Lane Width ft 12.0 Segment Length mi 2.4			
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T	(Exhibit 15-11 or 15-12)	1.9	2.2
Passenger-car equivalents for RVs, E _R (I	Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, f _{HV,ATS}	=1/ (1+ P _T (E _T -1)+P _R (E _R -1))	0.945	0.929
Grade adjuslment factor ¹ , f _{g,ATS} (Exhibit	15-9)	0.91	0.81
Demand flow rate ² , v_j (pc/h) $v_i = V_i$ / (PHF*	fg,ATS * fHV,ATS)	498	357
Free-Flow Speed from	n Fleid Measurement	Estimated Fre	ee-Flow Speed
		Base free-flow speed ⁴ , BFFS	60.0 mi/h
		Adj. for lane and shoulder width,4	f _{LS} (Exhibit 15-7) 4.2 mi/h
Mean speed of sample ³ , S _{FM}		Adj. for access points ⁴ , f _A (Exhibi	
Total demand flow rate, both directions, v		,,	
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _l		Free-flow speed, FFS (FSS=BFF	20 ,.
Adj. for no-passing zones, f _{np,ATS} (Exhibi	t 15-15) 3.1 mi/h	Average travel speed, ATS _d =FFS	3-0.00776(v _{d,ATS} + 45.3 mi/h
		v _{o,ATS}) - f _{np,ATS}	40.0 mm
		Percent free flow speed, PFFS	82.3 %
Percent Time-Spent-Following		Analysis Direction (d)	Opposing Dispetion (a)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.4	Opposing Direction (o) 1.7
		1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))		0.977	0.960
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)		0.92	0.83
Directional flow rate ² , v _i (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})		476	337
Base percent time-spent-following ⁴ , BPTS			6.3
Adj. for no-passing zone, f _{np,PTSF} (Exhibi			0.2
Percent time-spent-following, PTSF _d (%)=			-
v _{o,PTSF})	ם אליי ופו , מיג ופו. מ'ג נפן.	6	9.8
Level of Service and Other Performanc	e Measures		
Level of service, LOS (Exhibit 15-3)			C
Volume to capacity ratio, v/c	The state of the s		33

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1428
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.3
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	428.0
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.59
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

	IAL TWO-LANE HIGHWA		SHEET
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 11/15/2011 AM Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H WB Flathead County 2035
Project Description: US 2 - Badrock Ca		Tatayolo Tour	2000
Input Data			
L			
	Shoulder widthft		
	Lane width tt	Class I i	nighway 🔽 Class II
<u></u> >	Lane width It		Class III highway
	Shoulder widthtt	1 / 1 \	
Segment length	, L _t mi	Terrain Grade Length Peak-hour fa No-passing z	ctor, PHF 0.87
Analysis direction vol., V _d 250vo	eh/h	Show North Arrow % Trucks and	Buses , P _T 6 %
Opposing direction vol., V _o 398ve	eh/h	% Recreation	al vehicles, P _R 4%
Shoulder width ft 1.0		Access points	
Lane Width ft 12.0 Segment Length mi 2.4			
Average Travel Speed	, , , , , , , , , , , , , , , , , , , ,		
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T	(Exhibit 15-11 or 15-12)	2.1	1.9
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, f _{HV,ATS}	=1/(1+P _T (E _T -1)+P _R (E _R -1))	0.935	0.945
Grade adjustment factor ¹ , f _{g,ATS} (Exhibi	t 15-9)	0.82	0.93
Demand flow rate ² , v _j (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})		375	521
Free-Flow Speed from	m Field Measurement	Estimated Fre	e-Flow Speed
		Base free-flow speed4, BFFS	60.0 mi/h
		Adj. for lane and shoulder width, ⁴	f _{co} (Exhibit 15-7) 4.2 mi/h
Mean speed of sample ³ , S _{FM}		Adj. for access points ⁴ , f _A (Exhibi	
Total demand flow rate, both directions,		1	
Free-flow speed, FFS=S _{FM} +0.00776(v/ f	hv,ats)	Free-flow speed, FFS (FSS=BFF	
Adj. for no-passing zones, f _{np,ATS} (Exhib	it 15-15) 2.3 <i>mi/h</i>	Average travel speed, ATS _d =FFS	3-0.00776(v _{d,ATS} + 45.8 <i>mi/</i> h
Parcent Time Sport Following		V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	83.3 %
Percent Time-Spent-Following		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T	(Exhibit 15-18 or 15-19)	1.7	1.4
Passenger-car equivalents for RVs, E _R (I	Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_{R}-1))$		0.960	0.977
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)		0.84	0.93
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})		356	504
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)		41.6	
Adj. for no-passing zone, f _{np,PTSF} (Exhib	it 15-21)	3.	9.1
Percent time-spent-following, PTSF _d (%)=	:BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	5	7.8
V _{o,PTSF})			
Level of Service and Other Performance	ce Measures		
Level of service, LOS (Exhibit 15-3)			С
Volume to capacity ratio, v/c		0.	22

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1536
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1613
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	83.3
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	287.4
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.39
Bicycle level of service (Exhibit 15-4)	E
Atata	

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^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information	Site Information	
Analyst David Stoner		US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H EB
Date Performed 11/15/2011 Analysis Time Period Median Off-Peak		Flathead County
Project Description: US 2 - Badrock Canyon Corridor Planning Study	Analysis real	2035
Input Data		,
<u> </u>		
\$\ \$\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		
Lane width tt	Class I h	ighway 🔽 Class II
Lane width		
Shoulder widthtt	1 / 1 🕆	Class III highway
	Terrain	Level V Rolling
Segment length, L _t mi	Grade Length	mi Up/down
1	Peak-hour fac	
Analysis disastian val. V. 254L.C.	Show North Arrow O/ Toucke and	
Analysis direction vol., V _d 351veh/h	Show North Priow % Trucks and	Buses , P _T 6 %
Opposing direction vol., V _o 306veh/h	% Recreation	al vehicles, P _R 4%
Shoulder width ft 1.0	Access points	<i>mi 3</i> /mi
Lane Width ft 12.0 Segment Length mi 2.4		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	2.0	2.1
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.940	0.935
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.89	0.86
Demand flow rate ² , v _f (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	461	418
Free-Flow Speed from Field Measurement	Estimated Fre	e-Flow Speed
· · · · · · · · · · · · · · · · · · ·	Base free-flow speed ⁴ , BFFS	61.0 mi/h
	Adj. for lane and shoulder width,4	f _{Le} (Exhibit 15-7) 4.2 mi/h
Mean speed of sample ³ , S _{FM}	1	-
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhibit	15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BFF	S-f _{LS} -f _A) 56.0 mi/h
·	Average travel speed, ATS _d =FFS	20 //
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 2.9 mi/h		46.3 mi/h
	V _{o,ATS}) - f _{np,ATS}	
Percent Time-Spent-Following	Percent free flow speed, PFFS	82.6 %
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.6	1.6
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	0.965	0.965
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.89	0.87
Directional flow rate ² , v _i (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	449	400
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	46	5.1
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	43.4	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	69	11
v _{o,PTSF})		·· •
Level of Service and Other Performance Measures	<u> </u>	
Level of service, LOS (Exhibit 15-3)		>
Volume to capacity ratio, v/c	0.	30

Capacity, C _{d.ATS} (Equation 15-12) pc/h	0
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1477
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.6
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	385.7
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S ₁ (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.54
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL	TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information		Site Information	
	Stoner	Highway / Direction of Travel	US 2
	L HKM	From/To	Columbia F to Hungry H WB
Date Performed 11/15 Analysis Time Period Media	/2011 an Off-Peak	Jurisdiction Analysis Year	Flathead County
Project Description: US 2 - Badrock Canyon	The second secon	Allalysis Teal	2035
Input Data	Johnson Friedming Globy		
L			
	oulder widthtt		
<u> </u>	e widthtt	Class I	highway 🔽 Class II
Lan	e widthft		- ·
	oulder widthft	nignway	Class III highway
		Terrain	Level Rolling
Segment length, L _t _	mi	Grade Lengt Peak-hour fa No-passing z	ictor, PHF 0.89
Analysis direction vol., V _d 306veh/h		1 4 1 1	d Buses , P _T 6 %
		l .	•
Opposing direction vol., V _o 351veh/h Shoulder width ft 1.0		Access point	nal vehicles, P _R 4% is <i>mi 3/</i> mi
Lane Width ft 12.0		Access point	S HII
Segment Length mi 2.4			
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhi	bit 15-11 or 15-12)	2.1	2.0
Passenger-car equivalents for RVs, E _R (Exhibi	l 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, f _{HV,ATS} =1/ (1	$+ P_T(E_T-1)+P_R(E_R-1)$	0.935	0.940
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)		0.86	0.90
Demand flow rate ² , v_i (pc/h) $v_i = V_i$ / (PHF* $f_{g,AT}$)		428	466
Free-Flow Speed from Fiel	d Measurement	Estimated Fr	ee-Flow Speed
•		Base free-flow speed ⁴ , BFFS	61.0 mi/h
		Adj. for lane and shoulder width,	⁴ f _{i.e} (Exhibit 15-7) 4.2 mi/h
Mean speed of sample ³ , S _{FM}		Adj. for access points ⁴ , f _A (Exhib	
Total demand flow rate, both directions, v		1	
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS}	;)	Free-flow speed, FFS (FSS=BF	
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-1	5) 2.7 <i>mi∕h</i>	Average travel speed, ATS _d =FFS	S-0.00776(v _{d,ATS} + 46.4 mi/h
•		Vo ATS) - fon ATS	40.4 MVII
		v _{o.ATS}) - f _{np.ATS} Percent free flow speed, PFFS	82.9 %
Percent Time-Spent-Following			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhib		1.6	1.6
Passenger-car equivalents for RVs, E _R (Exhibit		1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T		0.965	0.965
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-1) Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f _{HV,P}		0.87 409	0.90
Base percent time-spent-following ⁴ , BPTSF _d (%			454
		44.7	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-2		4	13.0
Percent time-spent-following, PTSF _d (%)=BPTS	t _d +1 _{np,PTSF} *(V _{d,PTSF} / V _{d,PTSF} +	6	85.1
v _{o,PTSF})			
Level of Service and Other Performance Med	asures	Market Ma	
Level of service, LOS (Exhibit 15-3)			С
Volume to capacity ratio, v∕c	40.	0	2.26

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1494
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1544
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.9
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	343.8
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.48
Bicycle level of service (Exhibit 15-4)	E
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information	Site Information	ACCOUNTS
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H EB Flathead County 2035
Project Description: US 2 - Badrock Canyon Corridor Planning Study		
Input Data		
Shoulder width tt Lane width tt Lane width tt Shoulder width tt		nighway
Segment length, L ₁ mi Analysis direction vol., V _d 296veh/h	Grade Length Peak-hour fa No-passing z Show Horth Arrow **Trucks and	n mi Up/down ctor, PHF 0.89 one 100%
Opposing direction vol., V _o 491veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 2.4 Average Travel Speed		nal vehicles, P _R 4%
Average Travel Speed	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	2.1	1.7
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.935	0.956
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	0.85	0.96
Demand flow rate ² , v _f (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	418	601
Free-Flow Speed from Field Measurement	Estimated Fre	e-Flow Speed
Mean speed of sample ³ , S _{FM}	Base free-flow speed ⁴ , BFFS Adj. for lane and shoulder width, ⁴ Adj. for access points ⁴ , f _A (Exhibi	
Total demand flow rate, both directions, <i>v</i> Free-flow speed, FFS=S _{FM} +0.00776(<i>v</i> / f _{HV,ATS}) Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.9 mi/h	Free-flow speed, FFS (FSS=BFI Average travel speed, ATS _d =FFS	-S-f _{LS} -f _A) 57.0 ml/n
	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	82.7 %
Percent Time-Spent-Following	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.6	1.2
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ $P_T(E_T$ -1)+ $P_R(E_R$ -1))	0.965	0.988
Grade adjustment factor ¹ , f _{g.PTSF} (Exhibit 15-16 or Ex 15-17)	0.87	0.97
Directional flow rate ² , v _/ (pc/h) v =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	396	576
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	4	5.3
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	3	6.0
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *($v_{d,PTSF} / v_{d,PTSF} + v_{d,PTSF}$	6	0.0
V _{o,PTSF})		
Level of Service and Other Performance Measures Level of service, LOS (Exhibit 15-3)		С
Volume to capacity ratio, v/c		.24

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1576
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1629
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.7
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	332.6
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S ₁ (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.46
Bicycle level of service (Exhibit 15-4)	Ε
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d^{\dagger} \text{ or } v_o^{\dagger}) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM	Highway / Direction of Travel From/To	US 2 Columbia F to Hungry H WB
Date Performed 11/15/2011 Analysis Time Period PM Peak	Jurisdiction Analysis Year	Flathead County 2035
Project Description: US 2 - Badrock Canyon Corridor Planning Study	ratoryoto 1 car	2000
Input Data		
\$\frac{1}{2} \text{ Shoulder width } \text{ It } \text{ Lane width } \text{ It }	humi	primar
Lane width	i	highway 🔽 Class II
Shoulder width 11	highway I	Class III highway
Segment length, L ₁ mi	Terrain Grade Length Peak-hour fa No-passing z	ctor, PHF 0.91 cone 100%
Analysis direction vol., V _d 491veh/h	Show North Arrow % Trucks and	d Buses , P _T 6 %
Opposing direction vol., V _o 296veh/h		nal vehicles, P _R 4%
Shoulder width ft 1.0 Lane Width ft 12.0	Access point	s <i>mi 3/</i> mi
Segment Length mi 2.4		
Average Travel Speed		
December our equivalents for truster 5 (5) tiltitis 45 44 - 47 40)	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.8	2.1
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.951	0.935
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	0.96	0.85
Demand flow rate ² , v _j (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	591	409
Free-Flow Speed from Field Measurement	Estimated Fro	ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	60.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	⁴ f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h
	Free-flow speed, FFS (FSS=BF)	FS-f _{LS} -f _A) 55.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 2.8 <i>mi/h</i>	Average travel speed, ATS _d =FFS	S-0.00776(v _{d,ATS} + 44.5 mi/h
Percent Time-Spent-Following	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	80.9 %
, vivori inno-oponici onomity	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1,2	1.6
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.988	0.965
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.96	0.86
Directional flow rate ² , v _i (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	569	392
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	5	4.1
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	36.2	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	7	5.5
v _{o,PTSF})		
		D

Directional Page 2 of 2

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1477	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	80.9	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.6	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.71	
Bicycle level of service (Exhibit 15-4)	F	
Notes	to the second	

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^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.



Appendix 4

Operational Analysis Worksheets

2035 3-2-3-4 Peak Season
Three-Lane RP 140.0 – RP 140.6
Two-Lane RP 140.6 – RP 141.2
Three-Lane RP 141.2 – 142.0

	MENT WORKSHEET WITH PASSING LANE SHEET
General Information	Site Information
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035
Project Description: US 2 Badrock Canyon Corridor PlafA	
Input Data	
Class I highway 「Class II highway 「Class III	highway
Opposing direction	
Analysis direction ->	
L _{II} L _{de} L _d	
J	Strow Heath Augur
Shoulder width (ft)	1.0
Lane Width (ft)	12.0
Segment Length (mi)	2.4
Total length of analysis segment, L _t	2.4
Length of two-lane highway upstream of the passing lane, L _u	0.0
Length of passing lane including tapers , \boldsymbol{L}_{pl}	0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	41.8
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	84.4
Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment	D
Worksheet) Average Travel Speed	
Length of the downstream highway segment within the effective length of	
passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	0.10
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t)$ /	44.5
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	77.0
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	80.9
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of	4.64
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	7,07
Length of two-lane highway downstream of effective length of the passing	
lane for percent-time-following,	-2.84
$L_{d} = L_{t} - (L_{u} + L_{pl} + L_{de})$	
Adj. factor for the effect of passing lane on percent time-spent-following,	

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	WWW.	
PTSF _{pl} = PTSF _d l L _u +L _d +f _{pl,PTSF} L _{pl} +((1+f _{pl,PTSF})/2)L _{de} J/L _l	57.0	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	C	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	11.5	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	850,5	
Effective width, W _v (Eq. 15-29) ft	13.00	, , and in the
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.94	
Bicycle level of service (Exhibit 15-4)	F	
Notes		·
1. If LOS _d =F, passing lane analysis cannot be performed.		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

	MENT WORKSHEET WITH PASSING LANE SHEET
General Information	Site information
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak Project Description: US 2 Badrock Canyon Corridor PlanÝ	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035
Input Data	
Class I highway Class II highway Class III	hìghway
Analysis direction Lu L ₁₁ L _{de} L _d	
L,	Snow Heath Into u
Shoulder width (ft)	1.0
Lane Width (ft)	12.0
Segment Length (mi)	2.4
Total length of analysis segment, L _t	2.4
Length of two-lane highway upstream of the passing lane, $\mathbf{L}_{\mathbf{u}}$	0.0
Length of passing lane including tapers , L _{p!}	1.1
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	41.8
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	71.6
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d = L_f - (L_u + L_{pl} + L_{de})$	-0.40
Adj. factor for the effect of passing lane on average speed, f _{pt} (Exhibit 15-28)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$	45.4
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$ Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	82.5
Percent Time-Spent-Following	02.3
Length of the downstream highway segment within the effective length of	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	6.48
Length of two-lane highway downstream of effective length of the passing	
lane for percent-time-following,	
$L_{d} = L_{t} - (L_{u} + L_{pl} + L_{de})$	-5.18
Adj. factor for the effect of passing lane on percent time-spent-following,	

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following Including passing lane ³ , PTSF _{p1} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	45.2	
Level of Service and Other Performance Measures ⁴		A
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	7.6	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	577.0	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.74	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

General Information	Site Information
Analyst David Stoner Agency or Company DOWL HKM	Highway of Travel US 2 From/To Columbia F to Hungry H EB
Date Performed 11/15/2011	Jurisdiction Flathead County
nalysis Time Period Median Off-Peak Project Description: US 2 Badrock Canyon Corridor PlaW	Analysis Year 2035
nput Data	
Class I highway Class II highway Class III	highway
	1
Opposing direction	-
Analysis direction>	
Lu T L _{pi} T L _{de} T L _d	
<u>,</u>	Stow Heath Augus
Shoulder width (ft)	
ane Width (ft)	1.0
egment Length (mi)	2.4
otal length of analysis segment, L,	2.4
	2,4
ength of two-lane highway upstream of the passing lane, L _u	0.0
ength of passing lane including tapers, L _{p1}	0.6
verage travel speed, ATS _d (from Directional Two-Lane Highway Segment	
Vorksheet)	42.6
ercent time-spent-following, PTSF _d (from Directional Two-Lane Highway	
egment Worksheet)	81.9
evel of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Vorksheet)	D
verage Travel Speed	
ength of the downstream highway segment within the effective length of	
assing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70
ength of two-lane highway downstream of effective length of the passing	
ane for avg travel speed, L_d $L_d = L_{t-1}(L_u + L_{pl} + L_{de})$	0.10
•	
dj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 8)	1.11
	3,000
verage travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) /	45,4
$-u^{+}L_{d}^{+}(L_{\rho l}f_{\rho l})^{+}(2L_{de}f(1+f_{\rho l,ATS})))$	
ercent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	81.0
ercent Time-Spent-Following	
ength of the downstream highway segment wilhin the effective length of	
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	5.18
ength of two-lane highway downstream of effective length of the passing	
ne for percent-time-following,	-3.38

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%) $PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	54.8	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	10.2	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	773.6	,
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	,
Bicycle level of service score, BLOS (Eq. 15-31)	5.89	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If $L_{ m d}$ <0, use alternative Equation 15-18.		
3. If L _d <0, use alternative Equation 15-16.		

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet. Copyright © 2012 University of Florida, All Rights Reserved

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	SHEET	
General Information Analyst David Stoner	Site Information Highway of Travel	US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H WB
Date Performed 11/15/2011	Jurisdiction	Flathead County
Analysis Time Period Median Off-Peak Project Description: US 2 Badrock Canyon Corridor Plat	Analysis Year	2035
Input Data		
Class I highway Class II highway Class II	l highway	
← Opposing direction ←		
→ Analysis direction →		
L _u L _{pl} L _{de} L _d		
Γ <u>,</u>	Show Harth	Anon
Shoulder width (ft)		1.0
Lane Width (ft)		12.0
Segment Length (mi)		2.4
Fotal length of analysis segment, $\mathbf{L_{t}}$		2.4
Length of two-lane highway upstream of the passing lane, $\boldsymbol{L}_{\boldsymbol{u}}$		0.0
Length of passing lane including tapers , L _{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		42.7
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		77.2
Segment Worksheet)		
.evel of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		D
Average Travel Speed		
ength of the downstream highway segment within the effective length of bassing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing ane for avg travel speed, $L_d L_d = L_t - (L_u + L_{\rho l} + L_{de})$		-0.40
ddj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 88)		1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t)$		16.5
$L_{u}^{+}L_{d}^{+}(L_{pl}/f_{pl})^{+}$ (2 L_{de}^{\prime} (1+ $f_{pl,ATS}$)))		46.5
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)		82.9
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of		5.70
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		5.79
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,		-4.49
$_{d} = L_{t} - (L_{u} + L_{p} + L_{de})$		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	48.9	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	8.8	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	682.2	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.83	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEG WORK	MENT WORKSHEET WITH PASSING LANE SHEET
General Information	Site Information
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035
Project Description: US 2 Badrock Canyon Corridor Pla/	
Input Data	
Class I highway Class II highway Class III Opposing direction	highway
→ Analysis direction →	
L ₁₁ L _{do} L _d	Show Heath Aurow
Shoulder width (ft)	1.0
Lane Width (ft)	12.0
Segment Length (mi)	2.4
Total length of analysis segment, $\mathbf{L}_{\mathbf{t}}$	2.4
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0
Length of passing lane including tapers , L _{pl}	0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	41.8
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	75.4
Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_l - (L_u + L_{pl} + L_{de})$	0.10
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t) /$	44.6
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	44.0
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	78.1
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of	5.03
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	5.92
Length of two-lane highway downstream of effective length of the passing	
lane for percent-time-following,	-4.12
urivu pi qe/	

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF}L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	49.3	
Level of Service and Other Performance Measures ⁴		D.33004073
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pi}	8.9	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	658.4	
Effeclive width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.81	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla±PB		
Input Data		
Class I highway Class II highway Class II Opposing direction Analysis direction	l highway	
L _u L _{pl} L _{do} L _d		
ļ.	Show Rath Anow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0	
Length of passing lane including tapers , $L_{\rm pl}$	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	39.4	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	89.4	
Segment Worksheet)	07,7	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	Е	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d = L_t \cdot (L_u + L_{pl} + L_{de})$	-0.40	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.11	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_l) /$		
$(L_u + L_d + (L_{\rho l}/f_{\rho l}) + (2L_{d\theta}/(1 + f_{\rho l,ATS})))$	42.9	
Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/FFS)$	77.9	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of	3.60	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	3,00	
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following,	-2.30	
$L_{d} = L_{t} - (L_{u} + L_{p1} + L_{de})$		
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	58.8	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + f_{pl} + ((1 + f_{pl,PTSF})/2) + f_{de} + f_{pl} $		
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	C	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	15.1	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	1078.0	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	6.06	· · · · · · · · · · · · · · · · · · ·
Bicycle level of service (Exhibit 15-4)	F	
Notes		

If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.



Appendix 4

Operational Analysis Worksheets

2035 3-2-3-4 Four-Lane Peak Season RP 142.0 – RP 142.4

Direction 1 = Eastbound

Direction 2 = Westbound

MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stu		P== D(/)
Flow Inputs		Des. (N)	☐ Plan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d) Peak-Hour Direction Prop, D	791	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain:	0.93 6 4 Rolling
DDHV (veh/h) Driver Type Adjustment	1.00	Grade Length (mi) Up/Down % Number of Lanes	0.00 0.00 2
Calculate Flow Adjus	tments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	
<u>Operational (LOS)</u> Flow Rate, v _p (pc/h/in) Speed, S (mi/h) D (pc/mi/in) LOS	480 60.0 8.0 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	425.3	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.55	
Bicycle level of service (Exhibit 15-4)	D	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stud		page
Coper.(LOS)		Des. (N)	Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	502) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (ml) Up/Down % Number of Lanes	0.87 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _p E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	326 60.0 5.4 A	<u>Design (N)</u> Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	288.5	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.36	
Bicycle level of service (Exhibit 15-4)	\boldsymbol{c}	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
Ĭ <u>×</u>			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off Peak Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description US 2 Badr			
Flow Inputs		Des. (N)	Γ Plan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	704) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.91 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _ρ E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
<u>Operational (LOS)</u> Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	437 60.0 7.3 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	386.8	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.51	
Bicycle level of service (Exhibit 15-4)	D	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
Consul Information			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off Peak Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description US 2 Badr	rock Canyon Corridor Planning	g Study	
П Oper.(LOS)		Des. (N)	☐ Plan. (vp)
Flow Inputs			
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D	614	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain;	0.89 6 4
DDHV (veh/h) Driver Type Adjustment	1.00	Gride Terrain. Grade Length (mi) Up/Down % Number of Lanes	Rolling 0.00 0.00 2
Calculate Flow Adjus	tments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	389 60.0 6.5 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln Design LOS)
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	344.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.45	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stud		
Oper.(LOS)		Des. (N)	☐ Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	586) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _p E _T	1.00 2.5	E _R	2.0 0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 62.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	62.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	372 60.0 6.2 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	329.2	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.42	
Bicycle level of service (Exhibit 15-4)	C	WL.

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst	David Stoner		110.0
Agency or Company	DOWL HKM	Highway/Direction to Travel From/To	US 2 Columbia Falls to Hungry Horse
Date Performed	4/30/2012	Jurisdiction	Flathead County
Analysis Time Period	PM Peak	Analysis Year	2035
Project Description US 2 Badi	ock Canyon Corridor Plann	ing Study	
☐ Oper.(LOS)		Des. (N)	☐ Plan. (vp)
Flow Inputs			
Volume, V (veh/h)	981	Peak-Hour Factor, PHF	0.91
AADT(veh/h)		%Trucks and Buses, P _T	6
Peak-Hour Prop of AADT (veh/c)	%RVs, P _R	4
Peak-Hour Direction Prop, D DDHV (veh/h)		General Terrain:	Rolling
Driver Type Adjustment	1.00	Grade Length (mi) Up/Down %	0.00 0.00
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		Number of Lanes	2
Calculate Flow Adjus	tments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and	IFFS
Lane Width, LW (ft)	12.0		
Total Lateral Clearance, LC (ft)	12.0	f _{LW} (mi/h)	
Access Points, A (A/mi)	0	f _{LC} (mi/h)	
Median Type, M	v	f _A (mi/h)	
FFS (measured)	60.0	f _M (mi/h)	
Base Free-Flow Speed, BFFS	00.0	FFS (mi/h)	60.0
Operations		Design	
Орстанона		Design	
		Dogian (AI)	
Operational (LOS)		Design (N) Required Number of Lence, N	
Flow Rate, v _p (pc/h/ln)	609	Required Number of Lanes, N	
Speed, S (mi/h)	60.0	Flow Rate, v _p (pc/h)	-1
D (pc/mi/ln)	10.1	Max Service Flow Rate (pc/h/li	1)
LOS	A	Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.0	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.67	
Bicycle level of service (Exhibit 15-4)	D	

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Appendix 4

Operational Analysis Worksheets

2035 3-2-3-4 Adjusted Annual Average Three-Lane RP 140.0 – RP 140.6 Two-Lane RP 140.6 – RP 141.2 Three-Lane RP 141.2 – 142.0

DIRECTIONAL TWO-LANE HIGHWAY SEG WORK	MENT WORKSHEET WITH PASSING LANE SHEET
General Information	Site Information
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035
Project Description: US 2 Badrock Canyon Corridor PlaÛ¬¤B	
Input Data	
Class I highway Class II highway Class III Opposing direction	highway
→ Analysis direction →	
L ₁₁ L _{de} L _d	Stron Heath From
Shoulder width (ft)	1.0
Lane Width (ft)	12.0
Segment Length (mi)	2.4
Total length of analysis segment, L _t	2.4
Length of two-lane highway upstream of the passing lane, $\boldsymbol{L}_{\boldsymbol{u}}$	0.0
Length of passing lane including tapers , $\mathbf{L}_{ extsf{pl}}$	0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	45.3
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	69.8
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	С
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_l - (L_u + L_{pl} + L_{de})$	0.10
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.10
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _l) / $(L_u+L_d+(L_p)/f_p)+(2L_{de}/(1+f_{pl,ATS}))$)	48.0
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	87.3
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of	7.49
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	
Length of two-lane highway downstream of effective length of the passing	
lane for percent-time-following, $L_{\mathbf{d}} = L_{\mathbf{i}}^{-}(L_{\mathbf{u}}^{+} + L_{\mathbf{pl}}^{+} + L_{\mathbf{de}}^{-})$	-5.69
P, VV	

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%) PTSF _{pl} = PTSF _d [L_u + L_d + $f_{pl,PTSF}$ L_{pl} +((1+ $f_{pl,PTSF}$)/2) L_{de} J / L_t	45.0	**************************************
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS ₀₁ 5.3		
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	428.0	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.59	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Plañ		
Input Data		
Class I highway	highway	
Opposing direction		
→ Analysis direction →		
L ₁₁ L _{de} L _d		
<u>,</u>	Stron Heeth Arron	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0	
Length of passing lane including tapers , \mathbf{L}_{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	45.8	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	57.8	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	C	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-0.40	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$	49.5	
(L _u +L _d +(L _p)f _{pl})+ (2L _{de} /(1+f _{pl,ATS}))) Percent free flow speed including passing lane PEES = (ATS / EES)	89.8	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	ОУ.Š	
Percent Time-Spent-Following Length of the downstream highway segment within the effective length of		
· · · · · · · · · · · · · · · · · · ·	9.64	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, $L_{d} = L_{t} - (L_{u} + L_{p_{1}} + L_{de})$	-8.34	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.60	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	, , , , , , , , , , , , , , , , , , , ,	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + f_{pl,PTSF} + ((1 + f_{pl,PTSF})/2) + f_{de}]/L_{t}$	35.5	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{p1} (Exhibit 15-3)	A	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{p1}	3.5	
Bicycle Level of Service		7000 OH 111
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	287.4	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _{f.} (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.39	
Bicycle level of service (Exhibit 15-4)	E	
Notes		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla¶3¥B		
Input Data		
Class I highway Class II highway Class III Opposing direction Analysis direction	highway	
Lu ' L _{pl} ' L _{de} ' L _d		
ļ,	Stron Hath Anon	
Shoulder width (ft)		
Lane Width (ft)	1.0	
Segment Length (mi)	12.0	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, $\mathbf{L}_{\mathbf{u}}$	0.0	
Length of passing lane including tapers , L _{pl}	0.6	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	46.3	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	69.1	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	· C	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d = L_l - (L_u + L_{pl} + L_{de})$	0.10	
Adj. factor for the effect of passing lane on average speed, \mathbf{f}_{pl} (Exhibit 15-28)	1.10	
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) / $(L_u + L_d + (L_p)^t f_{pl}) + (2L_{de}^t / (1 + f_{pl,ATS}))$)	49.1	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	87.5	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	7.71	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following,	C 0.1	
$L_{d} = L_{l} - (L_{u} + L_{pl} + L_{de})$	-5.91	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{nl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + f_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	44.5	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₆ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{p1}	ne, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{p1} 4.7	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	385.7	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.54	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel From/To Columbia F to Hungry H WB Jurisdiction Analysis Year US 2 Columbia F to Hungry H WB Flathead County 2035	
Project Description: US 2 Badrock Canyon Corridor Pla¼¼¥B	Allalysis Teal 2000	
Input Data		
Class I highway Class II highway Class II	highway	
Analysis direction	1	
L ₁₁ L _{de} L _d	Show Heath Puro u	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, $\mathbf{L_{t}}$	2.4	
Length of two-lane highway upstream of the passing lane, L _u	0.0	
Length of passing lane including tapers, Lpl	I.I	
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	46.4	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	65.1	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	С	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t \cdot (L_u + L_{pt} + L_{de})$	-0.40	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{d}^* L_{l}) /$	50.1	
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$		
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	89.4	
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of	8.03	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	0.03	
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following, L _d =L _t -(L _u + L _{pf} + L _{de})	-6.73	
u ivu pi de/		

f _{pl,PTSF} (Exhibit 15-26)	0.61		
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%) PTSF _{pl} = PTSF _d [L _u +L _d +f _{pl,PTSF} L _{pl} +((1+f _{pl,PTSF})/2)L _{de}]/L _t	40.8		
Level of Service and Other Performance Measures ⁴			
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В		
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}			
Bicycle Level of Service			
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	343.8		
Effective width, W _v (Eq. 15-29) ft	13.00		
Effective speed factor, S ₁ (Eq. 15-30)	4.79		
Bicycle level of service score, BLOS (Eq. 15-31)	5.48		
Sicycle level of service (Exhibit 15-4)			
Notes			
1. If LOS _d =F, passing lane analysis cannot be performed.			
2. If L _d <0, use alternative Equation 15-18.			
3. If L _d <0, use alternative Equation 15-16.			

4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LAN WORKSHEET			
General Information	Site Information		
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035		
Project Description: US 2 Badrock Canyon Corridor PlaÝ{¥B			
Input Dala			
Class I highway Class II highway Class III	highway		
Analysis direction $L_{ii} \qquad L_{pl} \qquad L_{de} \qquad L_{d}$	Show Herith Fuow		
Shoulder width (ft)	1.0		
Lane Width (ft)	12.0		
Segment Length (mi)	2.4		
Total length of analysis segment, L _t	2.4		
Length of two-lane highway upstream of the passing lane, L _u	0.0		
Length of passing lane including tapers, Lp!	0.6		
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	47.2		
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	60.0		
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	C		
Average Travel Speed			
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70		
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t \cdot (L_u + L_{pt} + L_{de})$	0.10		
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.10		
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t) /$	50.0		
$(L_{u}^{+}L_{d}^{+}(L_{p!}f_{p!})^{+} (2L_{de}f(1+f_{\rho l,ATS})))$			
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	87.7		
Percent Time-Spent-Following			
Length of the downstream highway segment within the effective length of	8.24		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	0.27		
Length of two-lane highway downstream of effective length of the passing			
lane for percent-time-following, $L_d = L_t - (L_u + L_{pl} + L_{de})$	-6.44		
Adj. factor for the effect of passing lane on percent time-spent-following,			

f _{pl,PTSF} (Exhibit 15-26)	0.60	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	38.0	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2) L_{de}]/L_{t}$	30.0	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{p1} (Exhibit 15-3)	A	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	4.0	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	332.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.46	
Bicycle level of service (Exhibit 15-4)	E	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

General Information Analyst David Stoner Highway of Travel Agency or Company DOWL HKM From/To Date Performed 11/15/2011 Jurisdiction Analysis Time Period PM Peak Analysis Year Project Description: US 2 Badrock Canyon Corridor Plac¾B Input Data Class I highway Class III highway Class III highway → Analysis direction → Analysis direction	US 2 Columbia F to Hungry H WB Flathead County 2035	
Analyst David Stoner Agency or Company DOWL HKM From/To Date Performed 11/15/2011 Jurisdiction Analysis Time Period PM Peak Analysis Year Project Description: US 2 Badrock Canyon Corridor Plac¾B Input Data Class I highway Class II highway Class III highway Opposing direction	Columbia F to Hungry H WB Flathead County	
Input Data Class I highway Class II highway Class III highway Opposing direction		
Class I highway Class II highway Class III highway Opposing direction		
✓ Opposing direction		
Analysis direction —>		
L _{II} L _{de} L _d Show No	Th Arrow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, L _u	0.0	
Length of passing lane including tapers , L _{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	44.5	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	75.5	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t \cdot (L_u + L_{pl} + L_{de})$	-0.40	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{d}^* L_{t}) /$	19.0	
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	48.0	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	87.3	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of	6.75	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	0.77	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, $ L_d = L_{l'} (L_u + L_{pl} + L_{de}) $	-5.45	
v (u pi ve		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	, , , , , , , , , , , , , , , , , , ,	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	47.6	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	6.7	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.71	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.



Appendix 4

Operational Analysis Worksheets

2035 3-2-3-4 Four-Lane Adjusted Annual Average

RP 142.0 - RP 142.4

Direction 1 = Eastbound

Direction 2 = Westbound

MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst	David Stoner	Highway/Direction to Travel	US 2
Agency or Company	DOWL HKM	From/To	Columbia Falls to Hungry Horse
Date Performed	4/30/2012	Jurisdiction	Flathead County 2035
Analysis Time Period	AM Peak	Analysis Year	2030
Project Description US 2 Badr	ock Canyon Corridor Planning Stu	ıdy	
☐ Oper.(LOS))	Des. (N)	Γ Plan. (vp)
Flow Inputs			
Volume, V (veh/h)	398	Peak-Hour Factor, PHF	0.93
AADT(veh/h)		%Trucks and Buses, P _T	6
Peak-Hour Prop of AADT (veh/d)	%RVs, P _R	4
Peak-Hour Direction Prop, D		General Terrain:	Rolling
DDHV (veh/h) Driver Type Adjustment	1.00	Grade Length (mi) Up/Down %	0.00 0.00
Britor Typo Adjudancin	1.00	Number of Lanes	2
Calculate Flow Adjus	stments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs			
	10.0	Calc Speed Adj and	rra
Lane Width, LW (ft)	12.0	f _{LW} (mi/h)	
Total Lateral Clearance, LC (ft)	12.0	f _{LC} (mi/h)	
Access Points, A (A/mi)	0	f _A (mi/h)	
Median Type, M		f _M (mi/h)	
FFS (measured)	60.0		00.0
Base Free-Flow Speed, BFFS		FFS (mi/h)	60.0
Operations		Design	
	· ····		
O		Design (N)	
Operational (LOS)		Required Number of Lanes, N	
Flow Rate, v _p (pc/h/ln)	241	Flow Rate, v _p (pc/h)	
Speed, S (mi/h)	60.0	Max Service Flow Rate (pc/h/ln)	
D (pc/mi/ln)	4.0	Design LOS	
LOS	Α	500igi, 100	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	214.0	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.21	
Bicycle level of service (Exhibit 15-4)	C	

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MU	MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×				
General Information		Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035	
	ock Canyon Corridor Planning Stu			
Oper.(LOS)		Des. (N)	Plan. (νρ)	
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	250) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.87 6 4 Rolling 0.00 0.00	
Calculate Flow Adjus	tments			
f _P E _T	1.00 2.5	E _R	2.0 0.885	
Speed Inputs		Calc Speed Adj and	FFS	
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0	
Operations		Design		
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	162 60.0 2.7 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS		
Bicycle Level of Service				
		1		

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	143.7	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.00	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)					
×					
General Information	General Information Site Information				
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off-Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035		
Project Description 05 2 Baur	ock Canyon Corridor Planning Stud	es. (N)			
Flow Inputs	Į U	es. (N)	Plan. (vp)		
Volume, V (veh/h) AADT(veh/h)	351	Peak-Hour Factor, PHF %Trucks and Buses, P _T	0.91		
Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	1.00	%RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	4 Rolling 0.00 0.00 2		
Calculate Flow Adjus	tments	Trained of Earloo			
f _p	1.00	E _R	2.0		
E _T	2.5	f _{HV}	0.885		
Speed Inputs		Calc Speed Adj and I	FFS		
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0		
Operations		Design			
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	217 60.0 3.6 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS			
Bicycle Level of Service	· · · · · · · · · · · · · · · · · · ·				

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	192.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.15	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period Project Description US 2 Badr	David Stoner DOWL HKM 4/30/2012 Median Off-Peak ock Canyon Corridor Planning Stu	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Secondaria Go 2 Bath		Des. (N)	Diam (m)
Flow Inputs	J	DG3. (IV)	☐ Plan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	306) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _p E _T	1.00	E _R	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	194 60.0 3.2 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, $v_{ m OL}$ (Eq. 15-24) veh/h	171.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.09	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			•
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
<u> </u>	ock Canyon Corridor Planning Stud		
Coper.(LOS)	J . C	Des. (N)	Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	296) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _p E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 62.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	62.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	187 60.0 3.1 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			
		1	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	166.3	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	***************************************
Bicycle level of service score, BLOS (Eq. 15-31)	3.08	*
Bicycle level of service (Exhibit 15-4)	c	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
X			
General Information		Site Information	
	D11 Ol	Site information	
Analyst Agency or Company	David Stoner DOWL HKM	Highway/Direction to Travel	US 2
Date Performed	4/30/2012	From/To Jurisdiction	Columbia Falls to Hungry Horse Flathead County
Analysis Time Period	PM Peak	Analysis Year	2035
	ock Canyon Corridor Planning Stu	ıdv	
C Oper.(LOS)		Des. (N)	Plan. (vp)
Flow Inputs			
Volume, V (veh/h)	491	Peak-Hour Factor, PHF	0.91
AADT(veh/h)		%Trucks and Buses, P _T	6
Peak-Hour Prop of AADT (veh/d)	%RVs, P _R	4
Peak-Hour Direction Prop, D		General Terrain:	Rolling
DDHV (veh/h)	4.00	Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down % Number of Lanes	0.00 2
Calculate Flow Adjus	tments	Number of Lanes	
f _p	1.00	E _R	2.0
E _T	2.5		0.885
	2.0	f _{HV}	
Speed Inputs		Calc Speed Adj and	rrs
Lane Width, LW (ft)	12.0	f _{LW} (mi/h)	
Total Lateral Clearance, LC (ft)	12.0	f _{LC} (mi/h)	
Access Points, A (A/mi)	0	f _A (mi/h)	
Median Type, M		f _M (mi/h)	
FFS (measured)	60.0		
Base Free-Flow Speed, BFFS		FFS (mi/h)	60.0
Operations		Design	
Operational (LOS)		Design (N)	
Operational (LOS)	004	Required Number of Lanes, N	
Flow Rate, v _p (pc/h/ln)	304	Flow Rate, v _p (pc/h)	
Speed, S (mi/h)	60.0	Max Service Flow Rate (pc/h/ln)	
D (pc/mi/ln)	5.1	Design LOS	
LOS	A	Ĭ	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	269.8	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	Market -
Bicycle level of service score, BLOS (Eq. 15-31)	3,32	
Bicycle level of service (Exhibit 15-4)	C	

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Appendix 4

Operational Analysis Worksheets

2035 Reverse 3-2-3-4 Peak Season
Three-Lane RP 140.0 – RP 140.6
One-Lane Eastbound
Two-Lane Westbound

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H EB Flathead County
Project Description: US 2 Badrock Canyon Corridor PlafÁ	Analysis Year	2035
Input Data		
\$\frac{1}{2} \text{ Shoulder width } ft		
Lone width tt	Class I	highway 🔽 Class II
Lane width tt	highway T	Class III highway
	Terrain	「Level ▼ Rolling
Segment length, L _t mi	Grade Lengt Peak-hour fa No-passing z	h mi Up/down actor, PHF 0.93
Analysis direction vol., V _d 791veh/h	Show North Arrow % Trucks an	d Buses , P _T 6 %
Opposing direction vol., V _o 502veh/h	% Recreation	nal vehicles, P _R 4%
Shoulder width ft 1.0	Access point	
Lane Width ft 12.0 Segment Length mi 0.6		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.3	1.8
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.978	0.951
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	1.00	0.96
Demand flow rate ² , v _j (pc/h) v _i ≂V _i / (PHF* f _{g.ATS} * f _{HV.ATS})	870	591
Free-Flow Speed from Field Measurement	Estimated Fr	ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	60.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	⁴ f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, <i>v</i>	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi∕h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})	Free-flow speed, FFS (FSS=BF	
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.9 mi/h	Average travel speed, ATS _d =FFS-0.00776(v _{d,ATS} +	
	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	75.9 %
Percent Time-Spent-Following		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.0	1.2
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	1.000	0.988
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	1.00	0.96
Directional flow rate ² , v _/ (pc/h) v _I =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	851	569
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b) 68.6		88.6
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)		26.4
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	<u>ε</u>	34.4
v _{o,PTSF})		
Level of Service and Other Performance Measures		
Level of service, LOS (Exhibit 15-3)		D
Volume to capacity ratio, v/c	<u>C</u>	0.52

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1629
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	75.9
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	850.5
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _f (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.94
Bicycle level of service (Exhibit 15-4)	F
Notes	The state of the s

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) \ge 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

VVORK	SHEET	
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM	Highway of Travel	US 2
Date Performed 11/15/2011	From/To Jurisdiction	Columbia F to Hungry H WB Flathead County
Analysis Time Period AM Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor PlanÝ		
Input Data		
Class I highway Class II highway Class II	l highway	
← Opposing direction ←		
Analysis direction		
		_
L _{II} L _{pi} » L _{de} L _d	1 -	
	ļ <u>\</u> _	/
Ļ,	Show flath.	Anow
Shoulder width (ft)		1.0
ane Width (ft)		12.0
Segment Length (mi)		0.6
Fotal length of analysis segment, L _t		0.6
ength of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}		0.0
ength of passing lane including tapers, Lpl		0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		41.8
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		
Segment Worksheet)		71.6
evel of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Vorksheet)		D
Average Travel Speed		
ength of the downstream highway segment within the effective length of assing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing		
ane for avg travel speed, $L_d L_d = L_l - (L_u + L_{pl} + L_{de})$		-1.70
dj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-8)		1.11
verage travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) /		
$-u^{+}L_{d}^{+}(L_{p} f_{p})^{+}$ (2 $L_{de}/(1+f_{p,A,TS})$))		46.4
ercent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)		84.3
ercent Time-Spent-Following		
ength of the downstream highway segment within the effective length of	And the second s	
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		6.48
ength of two-lane highway downstream of effective length of the passing	, 46-h	
ne for percent-time-following,		
		-6.48
$_{d} = L_{f}(L_{u} + L_{pl} + L_{de})$		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pt} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + f_{pl} + ((1 + f_{pl,PTSF})/2) + f_{de}]/L_{t}$	43.7	
Level of Service and Other Performance Measures ⁴		· · · · · · · · · · · · · · · · · · ·
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	M
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	1.9	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	577.0	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S, (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5,74	
Bicycle level of service (Exhibit 15-4)	F	
Notes	And the second s	Description of the second
If LOS _d =F, passing lane analysis cannot be performed.		* • • • • • • • • • • • • • • • • • • •
2. If L _d <0, use alternative Equation 15-18.		
3. If L _d <0, use alternative Equation 15-16.		
4. v/c, VMT ₁₅ and VMT ₆₀ are calculated on Directional Two-Lane Highway Segment Wo	uksheet	

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DIRECTIONAL TWO-LANE HIGHW	YAY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H EB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor PlaW		
Input Data		
Shoulder width ft Lane width ft Lane width ft Shoulder width ft Shoulder width ft Shoulder width ft	į.	ctor, PHF 0.91
Analysis direction vol., V _d 704veh/h	Show Horth Arrow % Trucks and	
Opposing direction vol., V _o 614veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 0.6		nal vehicles, P _R 4%
Average Travel Speed	Applicate Discotion (II)	
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.5	1.6
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.967	0.962
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.99 0.98	
Demand flow rate ² , v_j (pc/h) $v_i = V_j$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	808	716
Free-Flow Speed from Field Measurement	Estimated Fre	e-Flow Speed
	Base free-flow speed ⁴ , BFFS	61.0 mi∕h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,4	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhibi	t 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BFF	S-f _{LS} -f _A) 56.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.6 mi/h		
	Percent free flow speed, PFFS	76.0 %
Percent Time-Spent-Following		
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	Analysis Direction (d) 1.0	Opposing Direction (o) 1.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	1.000	1.000
Grade adjustment factor ¹ , f _{g.PTSF} (Exhibit 15-16 or Ex 15-17)	1.00	0.99
Directional flow rate ² , v _/ (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	774	682
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	67.4	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	27.2	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	+ 81.9	
o _{PTSF}) Level of Service and Other Performance Measures	0	••
.crc, or our rice and Onter Performance Measures		
evel of service, LOS (Exhibit 15-3))

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1683
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	76.0
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	773.6
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _{f.} (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.89
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) \ge 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

For the analysis direction only and for v>200 veh/h.
 For the analysis direction only
 Exhibit 15-20 provides coefficients a and b for Equation 15-10.
 Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEG WORK	MENT WORKSHEET SHEET	WITH PASSING LANE
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H WB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Plat	Arraiysis Teal	2033
Input Data		
Class I highway	highway	
← Opposing direction ←		
Analysis direction —>		
L _{II} L _{de} L _d		
J	Show Health Priory	
Shoulder width (ft)	(Give nom 2100	1.0
Lane Width (ft)		1.0
Segment Length (mi)		0.6
Total length of analysis segment, L _t		0.6
Length of two-lane highway upstream of the passing lane, L,		0.0
Length of passing lane including tapers , L _{pf}		0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		42.7
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		
Segment Worksheet)		77.2
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		D
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d L_d = L_t - $(L_u$ + L_{pl} + L_{de})		-1.70
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)		1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t)$		17.1
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	200	47.4
Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/FFS)$		84.7
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of		5.79
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		J.17
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following, L _d =L _t -(L _u + L _{pl} + L _{de})		-5.79
Adj. factor for the effect of passing lane on percent time-spent-following,		

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f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		100006-10-1
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2) L_{de}] / L_{t}$	47.1	
Level of Service and Other Performance Measures ⁴	, mil C 632	
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	2.1	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	682.2	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.83	
Bicycle level of service (Exhibit 15-4)	F	
Notes	1000000 1000000 1000000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 1000000	
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If L _d <0, use alternative Equation 15-18.		
3. If L_d <0, use alternative Equation 15-16.		
4. v/c, VMT ₁₅ and VMT ₆₀ are calculated on Directional Two-Lane Highway Segment W	orksheet.	

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DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H EB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Pla/		
Input Data		
t Shoulder widthtt		
Lane width tt	Class I I	highway 🔽 Class II
Lane width It		Class III highway
II Shoulder width		- ·
Segment length, L _t mi	Terrain Grade Lengtl Peak-hour fa No-passing z Show North Arrow	ctor, PHF 0.89 one 100%
Analysis direction vol., V _d 586veh/h	% Trucks and	Buses,P _T 6%
Opposing direction vol., V _o 981veh/h		nal vehicles, P _R 4%
Shoulder width ft 1.0	Access points	
Lane Width ft 12.0 Segment Length mi 0.6		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.6	1.3
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ $P_T(E_T$ -1)+ $P_R(E_R$ -1))	0.962	0.978
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.98	1.00
Demand flow rate ² , v_j (pc/h) v_i = V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	698	1127
Free-Flow Speed from Field Measurement	Estimated Fre	e-Flow Speed
	Base free-flow speed ⁴ , BFFS	62.0 mi/h
	Adj. for lane and shoulder width, 4	f _{1.c} (Exhibit 15-7) 4.2 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for access points ⁴ , f _A (Exhibi	
Total demand flow rate, both directions, v	1	
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BFF	-0 /,
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.1 mi/h	Average travel speed, ATS _d =FFS	6-0.00776(v _{d,ATS} + 41.8 mi/h
	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	73.3 %
Percent Time-Spent-Following	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.0	1.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	1.000	1.000
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.98	1.00
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	672	1102
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	67.8	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	20	0.1
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} * (v _{d,PTSF} / v _{d,PTSF} +	75	5.4
v _{o,PTSF})		
		D

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1663
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1700
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	73.3
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	658.4
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S_t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.81
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d$ or $v_o) >=1,700$ pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel From/To Jurisdiction	JS 2 Columbia F to Hungry H WB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Pla±PB		
Input Data		· · · · · · · · · · · · · · · · · · ·
Class I highway	highway	
✓ Opposing direction		
→ Analysis direction →		
L _{II} L _{de} L _d		
J	Stron fleith Prion	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	0.6	
Total length of analysis segment, L _t	0.6	
Length of two-lane highway upstream of the passing lane, L _u	0.0	
Length of passing lane including tapers , \mathbf{L}_{pl}	0.6	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	39,4	THE PARTY OF THE P
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	89.4	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	E	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing ane for avg travel speed, $L_d L_d = L_t (L_u + L_{pl} + L_{de})$	-1.70	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-	1.11	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l) /$	The state of the s	
$L_{u}^{+}L_{d}^{+}(L_{\rho l}/f_{\rho l})^{+}$ (2 $L_{d\theta}^{-}$ /(1+ $f_{\rho l,ATS}^{-}$)))	43.8	
Percent free flow speed including passing lane, PFFS _{p1} = (ATS _{p1} / FFS)	79.5	
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of		and the second s
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	3.60	
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,	-3.60	
$_{d} = L_{t} - (L_{u} + L_{pl} + L_{de})$		

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pf} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + p_{l} + ((1 + f_{pl,PTSF})/2) L_{de}]/L_{t}$	55.4	
Level of Service and Other Performance Measures ⁴		
Level of service Including passing lane LOS _{pl} (Exhibit 15-3)	С	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS ₀	3.7	· · · · · · · · · · · · · · · · · · ·
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	1078.0	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	6.06	
Bicycle level of service (Exhibit 15-4)	F	
Notes	and the second s	
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If L _d <0, use alternative Equation 15-18.		
3. If L _d <0, use alternative Equation 15-16.		
4. v/c, VMT $_{15}$ and VMT $_{60}$ are calculated on Directional Two-Lane Highway Segment Wo	orksheet.	
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Appendix 4

Operational Analysis Worksheets

2035 Reverse 3-2-3-4 Peak Season
Two-Lane RP 140.6 – RP 141.2
One-Lane Eastbound
One-Lane Westbound

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	KSHEET
General Information	Site Information	
Analyst David Stoner	Highway / Direction of Travel	US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H EB
Date Performed 11/15/2011 Analysis Time Period AM Peak	Jurisdiction	Flathead County
Analysis Time Period AM Peak Project Description: US 2 Badrock Canyon Corridor PlafÁ	Analysis Year	2035
Input Data		
	MANAGEM AND	
🕽 Shoulder widthtt		
± ‡ Lane width 1t		highway V Class II
Lane width		= · ·
Shoulder width ft	highway	Class III highway
	Terrain	Level Rolling
Sognant longth 1	Grade Lengt	th mi Up/down
Segment length, L ₁ mi	Peak-hour fa	actor, PHF 0.93
	Show North Arrow of Trucks on	
Analysis direction vol., V _d 791veh/h	% Trucks an	nd Buses , P _T 6 %
Opposing direction vol., V _o 502veh/h	% Recreatio	nal vehicles, P _R 4%
Shoulder width ft 1.0	Access poin	
Lane Width ft 12.0	·	
Segment Length mi 0.6 Average Travel Speed		
Average Travel Opecu	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.3	1.8
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.978 0.951	
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	1.00	0.96
Demand flow rate ² , v_i (pc/h) v_i = V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	870 591	
Free-Flow Speed from Field Measurement	Estimated Fr	ree-Flow Speed
	Base free-flow speed ⁴ , BFFS	60.0 mi/h
	Adj. for lane and shoulder width,	⁴ f _{i.e} (Exhibit 15-7) 4.2 mi/h
Mean speed of sample ³ , S _{FM}		
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	oit 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})	Free-flow speed, FFS (FSS=BF	$FS-f_{LS}-f_{A}$) 55.0 mi/h
,	Average travel speed, ATS _d =FF	
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.9 mi/h		3-0.00776(V _{d,ATS} + 41.8 mi/h
	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	
Paysant Time Spant Sallauting	Percent free flow speed, PFFS	75.9 %
Percent Time-Spent-Following	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.0	1.2
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	1.000	0.988
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	1.00	0.96
Directional flow rate ² , v _f (pc/h) v _i =V _f (PHF*f _{HV,PTSF} * f _{g,PTSF})	851	569
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	68.6	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	26.4	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	+	
v _{o,PTSF})	[B 4.4
Level of Service and Other Performance Measures		<u></u>
Level of service, LOS (Exhibit 15-3)		D

Capacity, C _{d,ATS} (Equation 15-12) pc/h	0
Capacily, C _{d,PTSF} (Equation 15-13) pc/h	1629
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	75.9
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	850.5
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.94
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHW	AY SEGMENT WORK	KSHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H WB Flathead County
Analysis Time Period AM Peak Project Description: US 2 Badrock Canyon Corridor PlanÝ	Analysis Year	2035
Input Data		
\$\frac{1}{2} \text{ Shoulder width } \tag{tt}		
Lane width tt	Class I	highway 「 Class II
Lane width tt		Class III highway
\$\frac{1}{2} \text{Shoulder width } \frac{1}{2} \text{It}	Terrain	Level F Rolling
Segment length, L _t mi	Grade Lengt Peak-hour fa No-passing	h mi Up/down actor, PHF 0.87
Analysis direction vol., V _d 502veh/h	Show Horth Arrow % Trucks an	d Buses , P _T 6 %
Opposing direction vol., Vo 791veh/h		nal vehicles, P _R 4%
Shoulder width ft 1.0	Access point	
Lane Width ft 12.0 Segment Length mi 0.6		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.7	1.3
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.956	0.978
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.97	1.00
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	622	930
Free-Flow Speed from Field Measurement	Estimated Fr	ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	60.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	⁴ f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, <i>v</i>	Adj. for access points ⁴ , f _A (Exhib	20
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BF	
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.2 mi/n	Average travel speed, ATS _d =FFS	LO A
	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	75.9 %
Percent Time-Spent-Following		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.2	1.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	0.988	1.000
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.97	1.00
Directional flow rate ² , v _i (pc/h) v _i =V _i (PHF*f _{HV,PTSF} * f _{g,PTSF})	602 909	
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av_db})	61.7	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	24.9	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	7	1.6
t _{o,PTSF}) Level of Service and Other Performance Measures		
evel of service, LOS (Exhibit 15-3)		D

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1663
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1700
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	75.9
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	577.0
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.74
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIO	NAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information		Site Information	
Analyst	David Stoner	Highway / Direction of Travel	US 2
Agency or Company	DOWL HKM	From/To	Columbia F to Hungry H EB
Date Performed	11/15/2011	Jurisdiction	Flathead County
Analysis Time Period	Median Off-Peak	Analysis Year	2035
Project Description: US 2 Badrock Ca	nyon Corridor PlaW		
Input Data			7.7.10
 			
	\$\frac{1}{2} Shoulder widthIt		
*****	T Lane widthtt	Class	highway 🔽 Class II
	1 Lane width It		- ·
	1 Shoulder width tt	highway I	Class III highway
	··	Terrain	☐ Level ☑ Rolling
Segment Lengt	h, L ₁ mi	Grade Lengt	_
oogcrk renge	··· 4 ····	Peak-hour fa	
		No-passing z	one 100%
Analysis direction vol., V _d 7049	veh/h	Show North Arrow % Trucks and	d Buses , P _T 6 %
		i i	•
	veh/h	 	nal vehicles, P _R 4%
Shoulder width ft 1.0 Lane Width ft 12.0		Access point	s <i>mi 3</i> /mi
Lane Width ft 12.0 Segment Length mi 0.6			
Average Travel Speed			
Average Traver opeeu			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E	T (Exhibit 15-11 or 15-12)	1.5	1.6
Passenger-car equivalents for RVs, E _R	(Eyhibit 15-11 or 15-13)	1.1	4.4
			1.1
Heavy-vehicle adjustment factor, f _{HV,AT}		0.967	0.962
	ade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)		0.98
Demand flow rate ² , v _/ (pc/h) v _i =V _i / (PHI		808 716	
Free-Flow Speed fro	om Field Measurement	Estimated Fro	ee-Flow Speed
		Base free-flow speed ⁴ , BFFS	61.0 mi/h
		1	
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder width,	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions,	V	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h
		Free-flow speed, FFS (FSS=BFI	
Free-flow speed, FFS=S _{FM} +0.00776(v/	THV,ATS)		
Adj. for no-passing zones, f _{np.ATS} (Exhi	bit 15-15) 1.6 mi/h	Average travel speed, ATS _d =FFS	S-0.00776(v _{d ATS} +
		1	42.6 mi/h
		v _{o,ATS}) * f _{np,ATS} Percent free flow speed, PFFS	76.0.0/
Percent Time-Spent-Following		reicent nee now speed, FFF3	76.0 %
- stantino aponti onormig		Anglusia Disastina (4)	Opposite Die de de
D		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E		1.0	1.0
Passenger-car equivalents for RVs, E _R		1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/	(1+ P _T (E _T -1)+P _R (E _R -1))	1.000	1.000
Grade adjustment factor ¹ , f _{g,PTSF} (Exhit		1.00	0.99
Directional flow rate ² , v _/ (pc/h) v _i =V _i /(PHI	F*f _{HV,PTSF} * f _{g,PTSF})	774	682
Base percent time-spent-following ⁴ , BP		67.4	
Adj. for no-passing zone, f _{np,PTSF} (Exhi	pit 15-21)	27.2	
	=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	-	
v _{o,PTSF})	2	8	1.9
Level of Service and Other Performan	ice Measures		
evel of service, LOS (Exhibit 15-3)			0
		D	
/olume to capacity ratio, v/c	×0.00	0	.46

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1683	***************************************
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	76.0	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	773.6	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _{f.} (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.89	
Bicycle level of service (Exhibit 15-4)	F	
Notes	and the same of	

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.

^{4.} For the analysis direction only
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner	Highway / Direction of Travel	US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H WB
Date Performed 11/15/2011	Jurisdiction	Flathead County
Analysis Time Period Median Off-Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor Plat Input Data		
Impat Data		
1. Shoulder width		
Lane width It	Class I	highway 🔽 Class II
Lane widthtt	highway	Class III highway
I Shoulder width It	Ingriway I	
	Terrain	☐ Level ☐ Rolling
Segment length, L _t mi	Grade Lengt	ctor, PHF 0.90
Analysis direction vol., V _d 614veh/h	Show North Arrow % Trucks an	
Opposing direction vol., V 704veh/h	% Recreation	nal vehicles, P _R 4%
Shoulder width ft 1.0	Access point	
Lane Width ft 12.0	1 .55555 pont	57M
Segment Length mi 0.6		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.6	1.4
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.962	0.973
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	0.98	0.99
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})		
Free-Flow Speed from Field Measurement	Estimated Fr	ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	61.0 mi/n
	· · · · · · · · · · · · · · · · · · ·	
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	-
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi∕h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})	Free-flow speed, FFS (FSS=BF)	
		20 11
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.4 mi/h	Average travel speed, ATS _d =FFS	5-0.00776(v _{d,ATS} + 42.7 <i>mi/</i> h
	V _{o,ATS}) - f _{np,ATS}	72.7 110/11
	Percent free flow speed, PFFS	76.3 %
Percent Time-Spent-Following		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.0	1.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.99	1.00
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	689	782
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	64.6	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	27.0	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	77.2	
v _{o,PTSF})	I	
Level of Service and Other Performance Measures		
		D

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1638	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1700	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	76.3	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	682.2	
Effective width, Wv (Eq. 15-29) ft	13.00	** <u> </u>
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.83	***********
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.

^{4.} For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TW	O-LANE HIGHWA	AY SEGMENT WOR	RKSHEET
General Information		Site Information	
Analyst David Ston Agency or Company DOWL HKI Date Performed 11/15/2011 Analysis Time Period PM Peak	М	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H EB Flathead County 2035
Project Description: US 2 Badrock Canyon Corrido	r Pla/		2000
Input Data			
Shoulder Lane wid	th It		I highway
Segment length, L ₁	widthtt _	Terrain Grade Len	factor, PHF 0.89
Analysis direction vol., V _d 586veh/h		61 11 1	and Buses , P _T 6%
Opposing direction vol., V _o 981veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 0.6	мр	i .	ional vehicles, P _R 4%
Average Travel Speed			
Personner out on the last to t		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-		1.6	1.3
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)		1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ P_T (E _T -1)+P _R (E _R -1))	0.962	0.978
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)		0.98	1.00
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})		698	1127
Free-Flow Speed from Field Mea	surement	Estimated l	Free-Flow Speed
		Base free-flow speed ⁴ , BFFS	62.0 mi/h
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder widtl	
Total demand flow rate, both directions, v		Adj. for access points ⁴ , f _A (Exh	ibit 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})		Free-flow speed, FFS (FSS=BFFS-f _{LS} -f _A) 57.0 mi/	
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15)		Average travel speed, ATS _d =F	FS-0.00776(v _{d,ATS} + 41.8 mi/h
Percent Time-Spent-Following		v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	73.3 %
rano-openti unormy		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-1	8 or 15-19)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 15-18	3 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)	+P _R (E _R -1))	1.000	1.000
Grade adjustment factor ¹ , f _{g.PTSF} (Exhibit 15-16 or E		0.98	1.00
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f _{HV,PTSF} * f _g	. _{PTSF})	672	1102
Base percent time-spent-following ⁴ , BPTSF _d (%)=100	(1-e ^{av} d)	67.8	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)		20.1	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _n	p,PTSF *(V _{d,PTSF} / V _{d,PTSF} +	- + 75.4	
o,PTSF)			
Level of Service and Other Performance Measures			
evel of service, LOS (Exhibit 15-3) /olume to capacity ratio, v/c		D	
Source to supporty ratio, Wo	water the state of	0.40	

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1663	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1700	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	73.3	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	658.4	
Effective width, Wv (Eq. 15-29) ft	13.00	-
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.81	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	(0.00)
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H WB Flathead County
Analysis Time Period PM Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor Pla±PB Input Data		
input Sata		
Shoulder width tt	Circo I	highway
Lane width		- ·
Shoulder width t	highway I	Class III highway
Segment longth, L _t mi	Terrain Grade Lengtl Peak-hour fa No-passing z	ctor, PHF 0.91
Analysis direction vol., V _d 981veh/h	Show North Arrow % Trucks and	d Buses , P _T 6 %
Opposing direction vol., V _o 586veh/h Shoulder width ft 1.0	İ	nal vehicles, P _R 4%
Lane Width ft 12.0 Segment Length mi 0.6		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.3	1.7
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ $P_T(E_T$ -1)+ $P_R(E_R$ -1))	0.978	0.956
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	1.00	0.97
Demand flow rate ² , v_i (pc/h) v_i = V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	1102 694	
Free-Flow Speed from Fleld Measurement	Estimated Fro	ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	60.0 mi/h
Mean speed of sample 3 , S $_{FM}$	Adj. for lane and shoulder width,	⁴ f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, <i>v</i>	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BFI	FS-f _{1.S} -f _A) 55.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.7 mi/h	Average travel speed, ATS _d =FFS	20 71
	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	71.7 %
Percent Time-Spent-Following		1
Passanger car equivalente for trucke E // whithis 45 49 a- 45 40	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor ¹ , f _{a.PTSF} (Exhibit 15-16 or Ex 15-17)	1.00	0.98
Directional flow rate ² , v _i (pc/h) v _i =V _i (PHF*f _{HV,PTSF} * f _{g,PTSF})	1078	657
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	76.5	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	20.7	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(V _{d,PTSF} /V _{d,PTSF} +	+ 89.4	
v _{o,PTSF})	Į	J. 4
Level of Service and Other Performance Measures	I .	
Level of service, LOS (Exhibit 15-3)	E	
Volume to capacity ratio, <i>v/c</i>	<u> </u>	.65

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1666	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	71.7	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	1078.0	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	6.06	
Bicycle level of service (Exhibit 15-4)	F	
Notes	and the second s	

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.



Appendix 4

Operational Analysis Worksheets

2035 Reverse 3-2-3-4 Peak Season
Three-Lane RP 141.2 – RP 142.0
Two-Lane Eastbound
One-Lane Westbound

Analysis David Stoner Highway of Travel From ITO Columbia F to Hungry H Jurisdiction Analysis Time Period AM Peak Jurisdiction Analysis Vear Class II highway Following F to Hungry H From ITO Columbia F to Hungry H From ITO Columbia F to Hungry H From ITO Columbia F to Hungry H From ITO Class III highway Following From ITO Class III highway Following From ITO Finishead County Following From ITO Finishead County Finishe	General Information	Site Information	
Analysis Time Period Project Description: US 2 Badrock Canyon Corridor PlatA Input Data Class I highway Class II highway Lut Undown II highway Class II highway Lut Undown II highway Class II highway Class II highway Lut Lut Undown II highway Class II highway Class II highway Lut Undown II highway Class II highway Class II highway Class III highway Class I	Agency or Company DOWL HKM	Highway of Travel From/To	Columbia F to Hungry H EB
Class II highway Class II highway Class III highw	Analysis Time Period AM Peak		
Class I highway Class II highway Class III highwa			
Opposing direction Analysis direction Analysis direction Analysis direction Lu Lpl Lde Ld Ly Shoutder width (ft) Loane Width (ft) 1.0 Lane Width (ft) 1.1 Total length of analysis segment, Lt 1.1 Length of two-lane highway upstream of the passing lane, Lu 0.0 Length of passing lane including tapers, Lpl 1.1 Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service from Directional Two-Lane Highway Segment Worksheet) Level of service from Directional Two-Lane Highway Segment Worksheet) Le		· · · · · · · · · · · · · · · · · · ·	
Analysis direction Lil Lpl Lde Ld Shoulder width (ft) Lane Width (ft) Lane Width (ft) Segment Length (mi) Total length of analysis segment, Lt Length of two-lane highway upstream of the passing lane, La Length of passing lane including tapers , Lpl Length of passing lane including tapers , Lpl Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet) Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Average Travel Speed Length of the downstream highway segment within the effective length of the downstream or effective length of the downstream or effective length of the passing ane for average travel speed, L _d (Exhibit 15-23) Add, factor for the effect of passing lane on average speed, f _p (Exhibit 15-28) Average travel speed including passing lane ² , ATS _{pl} = (ATS _{pl} + L _{pl}) / Lu+L _{pl} + (L _{pl} + L _{pl} + L _{pl} + L _{pl}) Lu+L _{pl} + (L _{pl} + L _{pl} + L _{pl} + L _{pl} + L _{pl}) Percent Time-Spent-Following Length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the passing lane for average lane for lockeding passing lane PFFS _{pl} = (ATS _{pl} + FFS) Percent Time-Spent-Following Length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of the downstream	Class I highway IV: Class II highway I Class III	l highway	
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Shoulder width (ft) Lane Width (ft) 1.0 Segment Length (mi) Total length of analysis segment, L_1 Length of two-lane highway upstream of the passing lane, L_n Length of passing lane including tapers , L_p Length of passing lane including tapers , L_p Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet) Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing lane for average travel speed, L_{de} (Exhibit 15-23) Ald, factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28) Average travel speed including passing lane ² , ATS _{pl} = (ATS _{pl} * L_{t}) / (L_{u} + L_{d} + L_{pl}			
Shoulder width (ft) 1.0 Lane Width (ft) 12.0 Segment Length (mi) 1.1 Total length of analysis segment, L_t 1.1 Length of two-lane highway upstream of the passing lane, L_u 0.0 Length of passing lane including tapers , $L_{\rm pl}$ 1.1 Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet) Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Length of the downstream highway segment within the effective length of passing lane for average travel speed, $L_{\rm d}$ (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing lane for average lane for average speed, $L_{\rm d}$ (Exhibit 15-23) Ald, factor for the effect of passing lane on average speed, $I_{\rm pl}$ (Exhibit 15-23) Average travel speed including passing lane ² , ATS _{p1} = (ATS _p ' $I_{\rm pl}$) Average travel speed including passing lane, PFFS _{p1} = (ATS _{p1} / FFS) Percent Time-Spent-Following Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, $I_{\rm cl}$ (Exhibit 15-23) Average travel speed including passing lane, PFFS _{p1} = (ATS _{p1} / FFS)			/
Lane Width (ft) 12.0 Segment Length (mi) 1.1 Total length of analysis segment, L_1 1.1 Length of two-lane highway upstream of the passing lane, L_0 0.0 Length of passing lane including tapers , $L_{\rm pl}$ 1.1 Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet) 1.8 Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet) 2.1 Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) 3.1 Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) 4.1 Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) 4.1 Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) 4.1 Average Travel Speed Length of the downstream highway segment within the effective length of passing lane for average travel speed, $L_{\rm de}$ (Exhibit 15-23) 1.70 Length of two-lane highway downstream of effective length of the passing ane for average travel speed, $L_{\rm de}$ $L_{$! Snow flath	Anon
Segment Length (mi) 1.1 Total length of analysis segment, L_1 1.1 Length of two-lane highway upstream of the passing lane, L_0 Length of passing lane including tapers , L_p 1.1 Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet) Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet) Average Travel Speed Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{da} (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing ane for avg travel speed, L_d L_d L_t L_d L_t L_d L_t L_d L_t			1.0
Total length of analysis segment, L_1 Length of two-lane highway upstream of the passing lane, L_0 Length of passing lane including tapers , $L_{\rm pl}$ Average travel speed, ${\rm ATS_d}$ (from Directional Two-Lane Highway Segment Worksheet) Percent time-spent-following, ${\rm PTSF_d}$ (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , ${\rm LOS_d}$ (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , ${\rm LOS_d}$ (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , ${\rm LOS_d}$ (from Directional Two-Lane Highway Segment Worksheet) Length of the downstream highway segment within the effective length of passing lane for average travel speed, ${\rm L_{do}}$ (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing lane for avgravel speed, ${\rm L_d}$ ${\rm L_d}$ ${\rm L_C}$ ${\rm L_C}$ ${\rm L_D}$ ${\rm L_C}$ ${\rm L_$			
Length of two-lane highway upstream of the passing lane, L_0 Length of passing lane including tapers, $L_{\rm pl}$ Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet) Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Average Travel Speed Length of the downstream highway segment within the effective length of passing lane for average travel speed, $L_{\rm de}$ (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing lane for average travel speed, $L_{\rm de}$ L ₀ -L ₁ -(L ₁ +L _p +L _{de}) AdJ. factor for the effect of passing lane on average speed, $f_{\rm pl}$ (Exhibit 15-28) Average travel speed including passing lane ² , ATS _{pl} = (ATS _{pl} +E _{Ll}) / (L ₁ +L _d +(L _{pl} /f _{pl})+ (2L _d -d/(1+f _{pl} ATS))) Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS) 8-1.2 Percent Time-Spent-Following Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, $L_{\rm de}$ (Exhibit 15-23)			
Length of passing lane including tapers , L_{pl}			
Average travel speed, ATS $_d$ (from Directional Two-Lane Highway Segment Worksheet) Percent time-spent-following, PTSF $_d$ (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS $_d$ (from Directional Two-Lane Highway Segment Worksheet) D Average Travel Speed Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_d (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing lane for average travel speed, $L_d = L_t - (L_u + L_p) + L_{de}$) And factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28) Average travel speed including passing lane ² , ATS $_{pl} = (ATS_d + L_t) / (L_u + L_d + (L_p)f_p) + (2L_de)(1+f_{pl,ATS}))$ Percent free flow speed including passing lane, PFFS $_{pl} = (ATS_p / FFS)$ 24.2 Percent Time-Spent-Following Length of the downstream highway segment within the effective length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)			0.0
Worksheet) Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Length of service Speed Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing lane for ave travel speed, L_{de} (Exhibit 15-23) Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28) Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{pl}' FFS)$ Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}' FFS)$ 84.2 Percent Time-Spent-Following Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)	Length of passing lane including tapers, Lpl		1.1
Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Average Travel Speed Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_{d} = L_{t} \cdot (L_{u} + L_{p} + L_{de})$ Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28) Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{d} \cdot L_{t}) I$ $L_{t} \cdot L_{d} \cdot L_{p} \cdot L_{d}			41.8
Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet) Average Travel Speed Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_{de} L_{de} L_$	Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	,	011
Worksheet) Average Travel Speed Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing ane for avg travel speed, $L_{d} = L_{t} - (L_{u} + L_{pl} + L_{de})$ Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28) Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{d} + L_{t})$ $(L_{u} + L_{d} + (L_{p}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$ Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/FFS)$ 84.2 Percent Time-Spent-Following Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)	Segment Worksheet)		04.4
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_{d} = L_{t} \cdot (L_{u} + L_{pl} + L_{de})$ Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28) Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{d} \cdot L_{t}) / (L_{u} + L_{d} + (L_{p})/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS}))$ Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/FFS)$ 84.2 Percent Time-Spent-Following Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)	Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		D
passing lane for average travel speed, L_{de} (Exhibit 15-23) Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_{d} L_{d} = L_{t} (L_{u} + L_{pl} + L_{de})$ Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28) Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{d} * L_{t}) / (L_{u} + L_{d} + (L_{pl}/f_{pl}) + (2L_{dd}/(1 + f_{pl,ATS})))$ Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/FFS)$ 84.2 Percent Time-Spent-Following Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)			
lane for avg travel speed, $L_d L_d = L_f - (L_u + L_{pl} + L_{de})$ Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28) Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_f) / (L_u + L_d + (L_p / f_{pl}) + (2L_{de} / (1 + f_{pl,ATS})))$ Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS) 84.2 Percent Time-Spent-Following Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)	passing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t) /$ $(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$ Percent free flow speed including passing lane, PFFS _{pl} = (ATS_{pl}/FFS) 84.2 Percent Time-Spent-Following Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)			-1.70
$ (L_{u} + L_{d} + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS}))) $ Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS) **Percent Time-Spent-Following** Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23) 4.64			1.11
$ (L_{u} + L_{d} + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS}))) $ Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS) **Percent Time-Spent-Following** Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23) 4.64	Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t)$		16.1
Percent Time-Spent-Following Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L _{de} (Exhibit 15-23) 4.64	i i i i i i i i i i i i i i i i i i i		40.4
Percent Time-Spent-Following Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L _{de} (Exhibit 15-23) 4.64	Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)		84.2
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	Percent Time∙Spent-Following		
Assaug tare for percent unie-spert-following, L _{de} (Exhibit 15-23)	- I		161
			4.04
Length of two-lane highway downstream of effective length of the passing	· -		
ane for percent-time-following, $ -4.64 $ $ L_{d} = L_{t} - (L_{u} + L_{pl} + L_{de}) $			-4.64

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%) PTSF _{pl} = PTSF _d [L_u + L_d + $f_{pl,PTSF}$ L_{pl} +((1+ $f_{pl,PTSF}$)/2) L_{de} J/ L_l	52.3	;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
Level of Service and Other Performance Measures ⁴	4355444	
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	5.0	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	850.5	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.94	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
If LOS _d =F, passing lane analysis cannot be performed.		
2. If L _d <0, use alternative Equation 15-18.		
3. If L _d <0, use alternative Equation 15-16.		

^{4.} v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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DIRECTIONAL TWO-LANE HIGHW		SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H WB Flathead County
Analysis Time Period AM Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor PlanÝ Input Data		
input butu		
\$\ \frac{1}{2} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		
Lane width tt	Class II	nighway 🔽 Class II
— ➤ Lane width tt		
t Shoulder widthtt	highway I	Class III highway
Community of 1	Terrain	Level F Rolling
Segment length, L _l mi	Grade Length Peak-hour fa No-passing z	ctor, PHF 0.87
Analysis direction vol., V _d 502veh/h	Show North Arrow % Trucks and	
Opposing direction vol., V _o 791veh/h		al vehicles, P _R 4%
Shoulder width ft 1.0 Lane Width ft 12.0	Access points	s <i>mi</i> 3/mi
Segment Length ml 1.1		
Average Travel Speed		and the second of the second o
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.7	1.3
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ $P_T(E_T$ -1)+ $P_R(E_R$ -1))	0.956	0.978
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	0.97	1.00
Demand flow rate ² , v _f (pc/h) v _i =V ₁ / (PHF* f _{g,ATS} * f _{HV,ATS})	622 930	
Free-Flow Speed from Field Measurement	Estimated Fre	e-Flow Speed
	Base free-flow speed ⁴ , BFFS	60.0 mi/h
Mean speed of sample ³ , S_{FM}	Adj. for lane and shoulder width,4	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhibi	i 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})	Free-flow speed, FFS (FSS=BFF	
Adj. for no-passing zones, f _{np.ATS} (Exhibit 15-15) 1.2 mi/h		**
7 No. 10 The passing 2016s, Inp,ATS (Exhibit 15-18)	Average travel speed, ATS _d ≃FFS V _{o,ATS}) - f _{пp,ATS}	-0.00776(V _{d,ATS} + 41.8 mi/h
Percent Time-Spent-Following	Percent free flow speed, PFFS	75.9 %
research one wing	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.2	1.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.988	1.000
Grade adjustment factor ¹ , f _{g.PTSF} (Exhibit 15-16 or Ex 15-17)	0.97	1.00
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	602	909
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	61.7	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	24.9	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} $^*(v_{d,PTSF} / v_{d,PTSF} + v_{d,PTSF})$	71.6	
evel of Service and Other Performance Measures		
evel of service, LOS (Exhibit 15-3))
· · · · · · · · · · · · · · · · · · ·	D 0.35	

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1663
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1700
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	75.9
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	577.0
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.74
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011	Highway of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H EB Flathead County
Analysis Time Period Median Off-Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor PlaW Input Data		
Class I highway Class II highway Class II	l highway	
Opposing direction		
→ Analysis direction →	1	
L _{II} L _{de} L _d		
L,	Show Haith A	
Shoulder width (ft) Lane Width (ft)		1.0
Segment Length (mi)		1.1
Total length of analysis segment, L _t		1.1
Length of two-lane highway upstream of the passing lane, L _u		0.0
Length of passing lane including tapers , L _{pl}		1.1
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		42.6
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		81.9
Segment Worksheet)		~***
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		D
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing ane for avg travel speed, L_d L_d = L_t - $(L_u$ + $L_{\rho l}$ + L_{de})		-1.70
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)		1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l) /$		42.3
$L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS}))$)		47.3
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)		84.4
Percent Time-Spent-Following	, 110-contractive de la contractive de	
ength of the downstream highway segment within the effective length of		5.18
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		
ength of two-lane highway downstream of effective length of the passing ane for percent-time-following,		-5.18
$L_{d} = L_{t} - (L_{u} + L_{pl} + L_{de})$		

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f _{pl,PTSF} (Exhibit 15-26)	0.62		
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%) PTSF _{pl} = PTSF _d [L _u +L _d +f _{pl,PTSF} L _{pl} +((1+f _{pl,PTSF})/2)L _{de}]/L _t	50.8	- Control of the Cont	
Level of Service and Other Performance Measures ⁴			
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В		
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	4.5		
Bicycle Level of Service			
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	773.6		
Effective width, W _v (Eq. 15-29) ft	13.00		
Effective speed factor, S _t (Eq. 15-30)	4.79		
Bicycle level of service score, BLOS (Eq. 15-31)	5.89		
Bicycle level of service (Exhibit 15-4)	F		
Notes			
1. If LOS _d =F, passing lane analysis cannot be performed.			
2. If L _d <0, use alternative Equation 15-18.			
3. If L _d <0, use alternative Equation 15-16.			
4. v/c, VMT ₁₅ and VMT ₆₀ are calculated on Directional Two-Lane Highway Segment W	orksheet.		

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DIRECTIONAL TW	O-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information		Site Information	
Analyst David Stone Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-	1	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H WB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor		/ maryoto real	2000
Input Data			
Shoulder Lane widt Lane widt Shoulder Shoulder	h lt		highway 🔽 Class II Class III highway
Segment length, L _t	mi	Terrain Grade Length Peak-hour fa No-passing z Show North Arrow V. Tayaka an	ctor, PHF 0.90 cone 100%
Analysis direction vol., V _d 614veh/h		Show North Arrow % Trucks and	d Buses , P _T 6 %
Opposing direction vol., V _o 704veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 1.1		% Recreation Access point	nal vehicles, P _R 4% s <i>mi</i> 3/mi
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-	11 or 15-12)	1.6	1.4
Passenger-car equivalents for RVs, E _R (Exhibit 15-11	or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ P_T (1	E_T -1)+ P_R (E_R -1))	0.962	0.973
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)		0.98	0.99
Demand flow rate ² , v_i (pc/h) $v_i = V_i$ / (PHF* $f_{g,ATS}$ * f_{HV}	, _{ATS})	724	812
Free-Flow Speed from Field Mea	surement	Estimated Fr	ee-Flow Speed
		Base free-flow speed ⁴ , BFFS	61.0 mi/h
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder width,	⁴ f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, <i>v</i>		Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 <i>mi∕h</i>
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})		Free-flow speed, FFS (FSS=BF	$FS-f_{LS}-f_{\Delta}$) 56.0 mi/h
Adj. for no-passing zones, f _{np.ATS} (Exhibit 15-15)	1.4 mi/h	Average travel speed, ATS _d =FFS	20 /1
		V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	76.3 %
Percent Time-Spent-Following		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-1	8 or 15-19)	1.0	1.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-18		1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)		1.000	1.000
Grade adjustment factor ¹ , f _{g.PTSF} (Exhibit 15-16 or E		0.99	1.00
Directional flow rate ² , v _i (pc/h) v _i =V _i (PHF*f _{HV,PTSF} * f ₉	_{.PTSF})	689	782
Base percent time-spent-following ⁴ , BPTSF _d (%)=100		64.6	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)		27.0	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _n	p,PTSF *(V _{d,PTSF} / V _{d,PTSF} +	+ 77.2	
v _{o,PTSF})	-yn Allionde Village habe -	,	* * * * * * * * * * * * * * * * * * *
Level of Service and Other Performance Measures	5		
Level of service, LOS (Exhibit 15-3)			D

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1638
Capacily, C _{d,PTSF} (Equalion 15-13) pc/h	1700
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	76.3
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	682.2
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.83
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

For the analysis direction only and for v>200 veh/h.

^{5.} For the analysis direction only
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla/		
Input Data		
Class I highway Class II highway Class III	l highway	
✓ Opposing direction		
→ Analysis direction →		
L ₁₁ L _{d0} L _d	Show Heith Arrow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	1.1	
Total length of analysis segment, L _t	1.1	
Length of two-lane highway upstream of the passing lane, $\boldsymbol{L}_{\!\!\boldsymbol{u}}$	0.0	
Length of passing lane including tapers , \boldsymbol{L}_{pl}	I.I	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	41.8	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	75.4	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.70	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.11	
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) / $(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	46.4	
Percent free flow speed including passing lane, PFFS _{p1} = (ATS _{p1} /FFS)	81.3	
Percent Time-Spent-Following	VIII	
Length of the downstream highway segment within the effective length of		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	5.92	
Length of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,	• • •	
$L_{d} = L_{l} - (L_{u} + L_{pl} + L_{de})$	-5.92	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pj} (%)	46.0	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$		
Level of Service and Other Performance Measures ⁴	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	3.9	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	658.4	
Effeclive width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.81	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If L _d <0, use alternative Equation 15-18.		
3. If L _d <0, use alternative Equation 15-16.		
4. v/c, VMT ₁₅ and VMT ₆₀ are calculated on Directional Two-Lane Highway Segment Wo	orksheet.	

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DIRECTIONAL TWO-LANE HIGHWA	Y SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner	Highway / Direction of Travel	US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H WB
Date Performed 11/15/2011	Jurisdiction	Flathead County
Analysis Time Period PM Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor Pla±PB		
Input Data		2
Shoulder width ft		
Lane width tt	Class I	highway 🔽 Class II
Lane width It		= •
🕽 Shoulder width tt	highway I	Class III highway
	Terrain	☐ Level ☐ Rolling
Segment length, L ₁ mi	Grade Lengt	
ocginera renga, ci	Peak-hour fa	
	No-passing z	
Analysis direction vol., V _d 981veh/h	Show North Arrow % Trucks and	d Buses , P _⊤ 6 %
-		·
Opposing direction vol., V _o 586veh/h		nal vehicles, P _R 4%
Shoulder width ft 1.0	Access point	s <i>mi 3</i> /mi
Lane Width ft 12.0	Ì	
Segment Length mi 1.1		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.3	1.7
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.978	0.956
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	1.00	0.97
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g.ATS} * f _{HV.ATS})	1102	694
Free-Flow Speed from Fleid Measurement	Estimated Fr	ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	60.0 mi/h
	•	
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi/h
	1	
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BFI	
Adj. for no-passing zones, f _{no.ATS} (Exhibit 15-15) 1.7 mi/h	Average travel speed, ATS _d =FFS	S-0.00776(v _{d.ATS} +
		39.4 mi/h
	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	747 0/
Percent Time-Spent-Following	reicent liee llow speed, FFFS	71.7 %
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.0	1.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_{T}-1)+P_R(E_{R}-1))$	1.000	1.000
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	1.00	0.98
Directional flow rate ² , v _i (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	1078	657
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} _d ^b)	76.5	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	20.7	
	2	V. I
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	89. <i>4</i>	
V _{o,PTSF})	,	
Level of Service and Other Performance Measures		
Level of service, LOS (Exhibit 15-3)		E
Volume to capacity ratio, v/c	0	.65

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1666	(1.5.)
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	71.7	With the second
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	1078.0	h
Effective width, Ww (Eq. 15-29) ft	13.00	
Effective speed factor, S _{t.} (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	6.06	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.



Appendix 4

Operational Analysis Worksheets

2035 Reverse 3-2-3-4 Four-Lane Peak Season RP 142.0 – RP 142.4

Direction 1 = Eastbound

Direction 2 = Westbound

MULTILANE HIGHWAYS WORKSHEET(Direction 1)				
×				
General Information Site Information				
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035	
	ock Canyon Corridor Planning Stu		P	
Flow Inputs		Des. (N)	☐ Plan. (vp)	
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D	791	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain:	0.93 6 4 Rolling	
DDHV (veh/h) Driver Type Adjustment	1.00	Grade Length (mi) Up/Down % Number of Lanes	0.00 0.00 2	
Calculate Flow Adjus	Transition of the state of the			
f _p	1.00	E _R	2.0	
E _T	2.5	f _{HV}	0.885	
Speed Inputs		Calc Speed Adj and	FFS	
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0	
Operations		Design		
<u>Operational (LOS)</u> Flow Rate, v _p (pc/h/in) Speed, S (mi/h) D (pc/mi/in) LOS	480 60.0 8.0 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS		
Bicycle Level of Service				

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	425.3	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.55	
Bicycle level of service (Exhibit 15-4)	D	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stud		page
Coper.(LOS)		Des. (N)	Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	502) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (ml) Up/Down % Number of Lanes	0.87 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _p E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	326 60.0 5.4 A	<u>Design (N)</u> Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	288.5	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.36	
Bicycle level of service (Exhibit 15-4)	c	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
Ĭ <u>X</u>			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off Peak Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description US 2 Badr			
Flow Inputs		Des. (N)	Γ Plan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	704) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.91 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _ρ E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
<u>Operational (LOS)</u> Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	437 60.0 7.3 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	386.8	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.51	
Bicycle level of service (Exhibit 15-4)	D	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
Consul Information			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off Peak Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description US 2 Badr	rock Canyon Corridor Planning	g Study	
П Oper.(LOS)		Des. (N)	☐ Plan. (vp)
Flow Inputs			
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D	614	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain;	0.89 6 4
DDHV (veh/h) Driver Type Adjustment	1.00	Gride Terrain. Grade Length (mi) Up/Down % Number of Lanes	Rolling 0.00 0.00 2
Calculate Flow Adjus	tments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	389 60.0 6.5 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln Design LOS)
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	344.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.45	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stud		
Oper.(LOS)		Pes. (N)	Г⊓ Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	586) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _p E _T	1.00 2.5	E _R	2.0 0.885
Speed Inputs		Calc Speed Adj and I	rF5
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 62.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	62.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	372 60.0 6.2 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	329.2	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.42	
Bicycle level of service (Exhibit 15-4)	c	WL

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst	David Stoner		110.0
Agency or Company	DOWL HKM	Highway/Direction to Travel From/To	US 2 Columbia Falls to Hungry Horse
Date Performed	4/30/2012	Jurisdiction	Flathead County
Analysis Time Period	PM Peak	Analysis Year	2035
Project Description US 2 Badi	ock Canyon Corridor Plann	ing Study	
Coper.(LOS)		C Des. (N)	Plan. (vp)
Flow Inputs			
Volume, V (veh/h)	981	Peak-Hour Factor, PHF	0.91
AADT(veh/h)		%Trucks and Buses, P _T	6
Peak-Hour Prop of AADT (veh/c)	%RVs, P _R	4
Peak-Hour Direction Prop, D DDHV (veh/h)		General Terrain:	Rolling
Driver Type Adjustment	1.00	Grade Length (mi) Up/Down %	0.00 0.00
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		Number of Lanes	2
Calculate Flow Adjus	tments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and	IFFS
Lane Width, LW (ft)	12.0		
Total Lateral Clearance, LC (ft)	12.0	f _{LW} (mi/h)	
Access Points, A (A/mi)	0	f _{LC} (mi/h)	
Median Type, M	v	f _A (mi/h)	
FFS (measured)	60.0	f _M (mi/h)	
Base Free-Flow Speed, BFFS	00.0	FFS (mi/h)	60.0
Operations		Design	
Орстанона		Design	
		Dogian (AI)	
Operational (LOS)		Design (N) Required Number of Lence, N	
Flow Rate, v _p (pc/h/ln)	609	Required Number of Lanes, N	
Speed, S (mi/h)	60.0	Flow Rate, v _p (pc/h)	_1
D (pc/mi/ln)	10.1	Max Service Flow Rate (pc/h/li	n)
LOS	A	Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.0	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.67	
Bicycle level of service (Exhibit 15-4)	D	

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Appendix 4

Operational Analysis Worksheets

2035 Reverse 3-2-3-4 Adjusted Annual Average
Three-Lane RP 140.0 – RP 140.6
One-Lane Eastbound
Two-Lane Westbound

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel From/To Columbia F to Hungry H EB Jurisdiction Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor PlaŪ¬¤B		
Input Data		
Class I highway F Class II highway F Class III	highway	
← Opposing direction ←		
Analysis direction		
L _{II} L _{de} L _d		
ļ,	Show Heath Anow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	1.1	
Total length of analysis segment, L _t	1.1	
Length of two-lane highway upstream of the passing lane, $\boldsymbol{L}_{\boldsymbol{u}}$	0.0	
Length of passing lane including tapers , $\mathbf{L}_{\mathbf{p}\mathbf{l}}$	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	45.3	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	69.8	
Segment Worksheet)		
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	C	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_l - (L_u + L_{\rho l} + L_{de})$	-1.70	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$	49.9	
$(L_u + L_d + (L_p)/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$		
Percent free flow speed including passing lane, PFFS _{pt} = (ATS _{pt} /FFS)	90.6	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of	7.40	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	7.49	
Length of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,	-7,49	
$L_d = L_t - (L_u + L_{pl} + L_{de})$		
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2) L_{de}]/L_{t}$	42.6	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	2.4	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	428.0	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.59	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTION	AL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information		Site Information	
Agency or Company Date Performed	David Stoner DOWL HKM 1/15/2011 NM Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H WB Flathead County 2035
Project Description: US 2 Badrock Canyo	on Corridor Plañ		
Input Data			
	Shoulder width tt		
-	Lane width tt	Class II	
	Lane width It		nighway Class II
	Shoulder widthtt	highway I	Class III highway
I	L ₁ mi	Terrain Grade Length Peak-hour fa No-passing z	ctor, PHF 0.87 one 100%
Analysis direction vol., V _d 250vet	n/h	Show Horth Arrow % Trucks and	Buses , P _T 6 %
Opposing direction vol., V _o 398vet	n/h		al vehicles, P _R 4%
Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 1.1		Access points	s <i>mi 3/</i> mi
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	2.1	1.9
Passenger-car equivalents for RVs, E _R (E	xhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, f _{HV,ATS} =		0.935	0.945
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit		0.82	0.93
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})		375	521
Free-Flow Speed from Field Measurement		1	e-Flow Speed
		Base free-flow speed ⁴ , BFFS	60.0 mi/h
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder width,4	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, v		Adj. for access points ⁴ , f _A (Exhibi	t 15-8) 0.8 mi∕h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _H	v.ats)	Free-flow speed, FFS (FSS=BFF	-S-f _{LS} -f _A) 55.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 2.3 mi/h		Average travel speed, ATS _d =FFS-0.00776(V _{d,ATS} + 45.8 mi/h	
0		V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	83.3 %
Percent Time-Spent-Following		Analysis Direction (d)	Onnosina Direction (a)
Passenger-car equivalents for trucks, E _T (E	Exhibit 15-18 or 15-19)	1.7	Opposing Direction (o) 1.4
Passenger-car equivalents for RVs, E _R (Ex		1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1		0.960	0.977
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit		0.84	0.93
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f		356	504
Base percent time-spent-following ⁴ , BPTS		41.6	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit	15-21)	39.1	
ercent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +		5	7.8
V _{o,PTSF})			
Level of Service and Other Performance Level of service, LOS (Exhibit 15-3)	Measures		^
Volume to capacity ratio, v/c			С

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1536
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1613
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	83.3
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	287.4
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.39
Bicycle level of service (Exhibit 15-4)	E
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

For the analysis direction only and for v>200 veh/h.

^{4.} For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla¶3¥B		
Input Data		
Class I highway Class II highway Class III Opposing direction	highway	
→ Analysis direction →		
L _u L _{pl} L _{de} L _d	Strow Heath Arrow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	1.1	
Fotal length of analysis segment, L _t	1.1	
length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0	
ength of passing lane including tapers , \boldsymbol{L}_{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	46.3	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	69.1	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	C	
Average Travel Speed		
ength of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
ength of two-lane highway downstream of effective length of the passing ane for avg travel speed, L_d L_d = L_t - $(L_u$ + L_{pl} + L_{de})	-1.70	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{d} L_{t})$	60.0	
$L_{u}^{+}L_{d}^{+}(L_{pl}^{\prime}/f_{pl})^{+}$ (2 $L_{de}^{\prime}(1+f_{pl,ATS})$))	50.9	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	90.9	
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of	7.71	
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	7.11	
ength of two-lane highway downstream of effective length of the passing		
a sa an s	-7.71	
ane for percent-time-following,	-7.71	

42.2
В
2.1
385.7
13.00
4.79
5.54
F

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^{3.} If L_d <0, use alternative Equation 15-16. 4. v/c, VMT $_{15}$ and VMT $_{60}$ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H WB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Pla¼¼¥B		
Input Data		
Shoulder width tt Lane width tt Lane width tt Shoulder width tt Shoulder width tt Shoulder width tt Segment length, L _t mi Analysis direction vol., V _d 306veh/h Opposing direction vol., V _o 351veh/h	Highway Terrain Grade Lengt Peak-hour fa No-passing z % Trucks and	ctor, PHF 0.89 cone 100%
Shoulder width ft 1.0 Lane Width ft 12.0	Access point	s <i>mi 3/</i> mi
Segment Length mi 1.1		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	2.1	2.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.935	0.940
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	0.86	0.90
Demand flow rate ² , v _f (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	428	466
Free-Flow Speed from Field Measurement	Estimated Fr	ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	61.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	EQ.
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 <i>mi/h</i>
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BF	FS-f _{LS} -f _A) 56.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 2.7 <i>mi/</i> h	Average travel speed, ATS _d =FFS V _{o.ATS}) - f _{np.ATS}	46.4 MVn
Percent Time-Spent-Following	Percent free flow speed, PFFS	82.9 %
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.6	1.6
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.965	0.965
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.87	0.90
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	409	454
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	44.7	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	43.0	
Percent time-spent-following, PTSF _d (%)=8PTSF _d +f _{np,PTSF} $^{(v_{d,PTSF}/v_{d,PTSF}+}$	6	95.1
v _{o,PTSF})		
Level of Service and Other Performance Measures		
Level of service, LOS (Exhibit 15-3)		C
Volume to capacity ratio, v/c		.26

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1494	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1544	***************************************
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.9	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{Ot.} (Eq. 15-24) veh/h	343.8	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.48	
Bicycle level of service (Exhibit 15-4)	E	
Notes	····	

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^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only

^{5.} Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEG WORK	MENT WORKSHEE SHEET	T WITH PASSING LANE
General Information	Site Information	, , , , , , , , , , , , , , , , , , , ,
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H EB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor PlaÝ{¥B		2000
Input Data		WAR CONTRACTOR OF THE CONTRACT
Class I highway Class II highway Class III	highway	MINISTRAL MARKET
✓ Opposing direction ✓		
Analysis direction ->		
L _{ii} L _{de} L _d)
Ji ji	Show Heath Aug	rii e
Shoulder width (ft)		1.0
Lane Width (ft)		12.0
Segment Length (mi)		1.1
Total length of analysis segment, L _t		1.1
Length of two-lane highway upstream of the passing lane, L _u		0.0
Length of passing lane including tapers , $\mathbf{L}_{ extstyle{pl}}$		1.1
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		47.2
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		60.0
Segment Worksheet)		00.0
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		С
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	· · · · · · · · · · · · · · · · · · ·	-1.70
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)		1.10
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{d}^* L_t)$		
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$		51.9
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)		91.0
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of		9.7.5
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		8.24
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following, $L_d = L_t - (L_u + L_{pl} + L_{de})$		-8.24
4 , 4 pi 00		

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f _{pl,PTSF} (Exhibit 15-26)	0.60	
Percent time-spent-following including passing lane ³ , PTSF _{p1} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	36.0	
Level of Service and Other Performance Measures ⁴	, , , , , , , , , , , , , , , , , , , ,	
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	Å	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	1.8	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	332.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.46	
Bicycle level of service (Exhibit 15-4)	E	
Notes		

If LOS_d=F, passing lane analysis cannot be performed.
 If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner	Highway / Direction of Travel	US 2
Agency or Company DOWL HKM Date Performed 11/15/2011	From/To	Columbia F to Hungry H WB
Date Performed 11/15/2011 Analysis Time Period PM Peak	Jurisdiction Analysis Year	Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Plac¾¡B	paration real	2000
Input Data		
\$\frac{1}{x} \text{Shoulder width } \text{tt}		
<u> </u>	Class I	highway
Lane width tt		- ·
\$\frac{1}{2} \text{ Shoulder width } \text{ tt}	highway J	Class III highway
	Terrain	Level Rolling
Segment length, L _t mi	Grade Lengt	h mi Up/down
1	Peak-hour fa No-passing 2	
Analysis disasting of M. (Od.) [7]	44 N A	
Analysis direction vol., V _d 491veh/h	% Hucks an	d Buses , P _T 6 %
Opposing direction vol., V _o 296veh/h		nal vehicles, P _R 4%
Shoulder width ft 1.0	Access point	is <i>mi 3/</i> mi
Lane Width ft 12.0 Segment Length mi 1.1		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.8	2.1
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.951	0.935
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	0.96	0.85
Demand flow rate ² , v _j (pc/h) v _j =V _j / (PHF* f _{g,ATS} * f _{HV,ATS})	591	409
Free-Flow Speed from Field Measurement	Estimated Fr	ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	60.0 mi∕h
	•	
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 <i>mi/h</i>
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BF	$FS-f_{1S}-f_{A}$) 55.0 mi/h
Adj. for no-passing zones, f _{np.ATS} (Exhibit 15-15) 2.8 mi/h	Average travel speed, ATS _d =FF5	20 71
ray, for no passing 201000, inp,ATS (Exhibit 10 10)		44.5 mi/h
	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	80.9 %
Percent Time-Spent-Following	r oreers meet non speed, 1110	00.9 76
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.2	1.6
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_{T} (E_{T} -1)+ P_{R} (E_{R} -1))	0.988	0.965
Grade adjustment factor ¹ , f _{g.PTSF} (Exhibit 15-16 or Ex 15-17)	0.96	0.86
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	569	392
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av_d b})	54.1	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	3	36.2
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *($v_{d,PTSF}/v_{d,PTSF}$ +		75.5
v _{o,PTSF})	/	
Level of Service and Other Performance Measures	, , , , , , , , , , , , , , , , , , , ,	
Level of service, LOS (Exhibit 15-3)		D
Volume to capacity ratio, v/c		

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1477	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	80.9	
Bicycle Level of Service	3000	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.6	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.71	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_l(v_d \text{ or } v_o) \ge 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.



Appendix 4

Operational Analysis Worksheets

2035 Reverse 3-2-3-4 Adjusted Annual Average Two-Lane RP 140.6 – RP 141.2 One-Lane Eastbound One-Lane Westbound

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	0-1
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H EB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor PlaŪ¬¤B		
Input Data		
Shoulder width tt	gamant	pirmor
Lane width	j	highway 🔽 Class II Class III highway
Segment length, L ₁ mi	Terrain Grade Lengt Peak-hour fa No-passing z	Level Rolling h mi Up/down actor, PHF 0.93
Analysis direction vol., V _d 398veh/h	et. Att Tat 4	d Buses , P _T 6 %
Opposing direction vol., V _o 250veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 0.6	% Recreation Access point	nal vehicles, P _R 4% is <i>mi 3I</i> mi
Average Travel Speed		
V	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.9	2.2
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.945	0.929
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	0.91	0.81
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	498	357
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
	Base free-flow speed ⁴ , BFFS	60.0 mi∕h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	oit 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BF	FS-f _{LS} -f _A) 55.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 3.1 mi/h	Average travel speed, ATS _d =FFS	S-0.00776(v _{d,ATS} + 45.3 mi/h
	V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	82.3 %
Percent Time-Spent-Following	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.4	1.7
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.977	0.960
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.92	0.83
Directional flow rate ² , v _f (pc/h) v _i =V _f (PHF*f _{HV,PTSF} * f _{g,PTSF})	476	337
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	46.3	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	40.2	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	69.8	
v _{o,PTSF})		·
Level of Service and Other Performance Measures Level of service, LOS (Exhibit 15-3)		^
COVOLOGIVIOG, COO (EXHIBIT 10-0)	j	C

Capacity, C _{d,ATS} (Equation 15-12) pc/h	0	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1428	<u> </u>
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.3	artes and the contract of the
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	428.0	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.59	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

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^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H WB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Plañ	Titlanyolo Toul	2000
Input Data		
Shoulder width tt Lane width tt Lane width tt		highway 🔽 Class II
Segment length, L ₁ mi	Terrain Grade Lengt Peak-hour fa No-passing a	ctor, PHF 0.87 cone 100%
Analysis direction vol., V _d 250veh/h	% Trucks an	d Buses , P _T 6 %
Opposing direction vol., V _o 398veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 0.6	% Recreation Access point	nal vehicles, P _R 4% s <i>mi</i> 3/mi
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	2.1	1.9
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}$ =1/ (1+ $P_T(E_T$ -1)+ $P_R(E_R$ -1))	0.935	0.945
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.82	0.93
Demand flow rate ² , $v_f(pc/h) v_i = V_i / (PHF^* f_{g,ATS}^* f_{HV,ATS})$	375 521	
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
	Base free-flow speed ⁴ , BFFS	60.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	⁴ f _{LS} (Exhibit 15-7) 4.2 <i>mi/h</i>
Total demand flow rate, both directions, <i>v</i>	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 <i>mi/h</i>
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})	Free-flow speed, FFS (FSS=BF	FS-f _{LS} -f _A) 55.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 2.3 mi/h	Average travel speed, ATS _d =FFS	S-0.00776(v _{d,ATS} + 45.8 mi/h
Power Time On and Fall and an	V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	83.3 %
Percent Time-Spent-Following	Analysis Direction (d)	Opposing Direction (a)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.7	Opposing Direction (o) 1.4
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	0.960	0.977
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.84	0.93
Directional flow rate ² , v,(pc/h) v _j =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	356	504
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d b)	4	1.6
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	3	9.1
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} $^*(v_{d,PTSF}/v_{d,PTSF}+$	57.8	
v _{o,PTSF})		448
Level of Service and Other Performance Measures		
Level of service, LOS (Exhibit 15-3)		С

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1536
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1613
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	83.3
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	287.4
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.39
Bicycle level of service (Exhibit 15-4)	E
Notes	

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^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	Y SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner	Highway / Direction of Travel	US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H EB
Dale Performed 11/15/2011	Jurisdiction	Flathead County
Analysis Time Period Median Off-Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor Pla¶3¥B		
Input Data		, and contribution of the
1 Shoulder widthtt		
T Lane width	Class I	highway V Class II
t Lane widtht	1	=
🕽 Shoulder widthtt	nignway i	Class III highway
	Terrain	Level Rolling
Segment length, L, mi	Grade Lengt	h mi Up/down
	Peak-hour fa	
	No-passing a	zone 100%
Analysis direction vol., V _d 351veh/h	Show North Arrow % Trucks an	d Buses , P _T 6 %
•		·
Opposing direction vol., V _o 306veh/h		nal vehicles, P _R 4%
Shoulder width ft 1.0	Access point	ts <i>mi</i> 3/mi
Lane Width ft 12.0		
Segment Length mi 0.6		
Average Travel Speed	Analysis Direction (d)	Opposites Discotice (c)
December our equivalents for tassis E (Exhibit 45.44 or 45.42)		Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	2.0	2.1
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.940	0.935
Grade adjustment factor ¹ , f _{g,ATS} (Exhibit 15-9)	0.89	0.86
Demand flow rate ² , v_i (pc/h) v_i = V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	461 418	
Free-Flow Speed from Field Measurement	Estimated Fr	ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	61.0 mi/h
	I	
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhib	oit 15-8) 0.8 mi/h
	Free-flow speed, FFS (FSS=BF	
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})		20 //
Adj. for no-passing zones, f _{ng.ATS} (Exhibit 15-15) 2.9 <i>mi/h</i>	Average travel speed, ATS _d =FF3	S-0.00776(v _{d.ATS} +
1,000	V .==) - f .==	` a,A15 46.3 mi/h
	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	97 6 9/
Percent Time-Spent-Following	refeelt free now speed, 1140	82.6 %
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.6	1.6
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/ (1+ P _T (E _T -1)+P _R (E _R -1))	0.965	0.965
Grade adjustment factor ¹ , f _{a.PTSF} (Exhibit 15-16 or Ex 15-17)	0.89	0.87
	449	
Directional flow rate ² , v _i (pc/h) v _i =V _i (PHF*f _{HV,PTSF} * f _{g,PTSF})		400
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	46.1	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	4	13.4
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	69.1	
v _{o,PTSF})		
Level of Service and Other Performance Measures		
Level of service, LOS (Exhibit 15-3)		С
Volume to capacity ratio, v/c	I /	0.30

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1477
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.6
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	385.7
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.54
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H WB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Pla¼¼¥B		
Input Data		
\$\frac{1}{2} Shoulder width ft		
Lane width tt	Class I I	highway 🔽 Class II
Lane width tt		Class III highway
Segment length, L	Terrain Grade Length	Level V Rolling
į į	Peak-hour far No-passing z	ctor, PHF 0.89 one 100%
Analysis direction vol., V _d 306veh/h	% Hucks and	•
Opposing direction vol., V _o 351veh/h Shoulder width ft 1.0 Lane Width ft 12.0	% Recreation Access points	nal vehicles, P _R 4% s <i>mi 3/</i> mi
Segment Length mi 0.6		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	2.1	2.0
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.935	0.940
Grade adjustment factor ¹ , f _{9,ATS} (Exhibit 15-9)	0.86	0.90
Demand flow rate ² , v _f (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	428	466
Free-Flow Speed from Field Measurement		ee-Flow Speed
	Base free-flow speed ⁴ , BFFS	61.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,4	
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhibi	it 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV,ATS})	Free-flow speed, FFS (FSS=BFF	S-f _{LS} -f _A) 56.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 2.7 mi/h	Average travel speed, ATS _d =FFS	S-0.00776(v _{d,ATS} + 46.4 mi/h
O	V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	82.9 %
Percent Time-Spent-Following	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.6	1.6
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.965	0.965
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.87	0.90
Directional flow rate ² , v _/ (pc/h) v =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	409	454
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	4	4.7
Adj. for no-passing zone, f _{np.PTSF} (Exhibit 15-21)	4	3.0
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} $^*(v_{d,PTSF} / v_{d,PTSF} + v_{d,PTSF})$	6	5.1
V _{o,PTSF})		response to the second
Level of Service and Other Performance Measures Level of service, LOS (Exhibit 15-3)		^
Volume to capacity ratio, v/c		C 26
A Alonio 10 cabanità tano, Mo	V.	.26

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1494	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1544	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.9	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	343.8	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.48	
Bicycle level of service (Exhibit 15-4)	E	
Notes		

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

For the analysis direction only and for v>200 veh/h.

^{4.} For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWA	Y SEGMENT WORK	SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011	Highway / Direction of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H EB Flathead County
Analysis Time Period PM Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor PlaÝ(¥B		
Input Data		
Shoulder width	Class 1	highway 🔽 Class II
Lane width tt Shoulder width tt	highway Class III highway Terrain Level Rolling	
Segment length, L ₁ mi	Grade Lengtl Peak-hour fa No-passing z	n mi Up/down ctor, PHF <i>0.</i> 89
Analysis direction vol., V _d 296veh/h	Show North Arrow % Trucks and	d Buses , P _T 6 %
Opposing direction vol., V _o 491veh/h Shoulder width ft 1.0 Lane Width ft 12.0	% Recreational vehicles, P _R 4% Access points <i>mi</i> 3/mi	
Segment Length mi 0.6		
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	2.1	1.7
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.935	0.956
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.85 0.96	
Demand flow rate ² , $v_i(pc/h)$ $v_i=V_i/(PHF^* f_{g,ATS}^* f_{HV,ATS})$	418 601	
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
	Base free-flow speed ⁴ , BFFS	62.0 mi/h
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, <i>v</i>	Adj. for access points ⁴ , f _A (Exhib	it 15-8) 0.8 mi∕h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HVATS})	Free-flow speed, FFS (FSS=BFI	S-f _{LS} -f _A) 57.0 mi/h
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 1.9 mi/h	Average travel speed, ATS _d =FFS-0.00776(v _{d,ATS} +	
Percent Time-Spent-Following	v _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS	82.7 %
reicent inne-spent-ronowing	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	1.6	1.2
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1))	0.965	0.988
Grade adjustment factor ¹ , f _{g.PTSF} (Exhibit 15-16 or Ex 15-17)	0.87	0.97
Directional flow rate ² , v _/ (pc/h) v _/ =V _/ (PHF*f _{HV,PTSF} * f _{g,PTSF})	396	576
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	45.3	
Adj. for no-passing zone, f _{np.PTSF} (Exhibit 15-21)	36.0	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	60.0	
v _{o,PTSF})	, and the second	
Level of Service and Other Performance Measures		
Level of service, LOS (Exhibit 15-3)	C	
Volume to capacity ratio, v/c	<u> </u>	,24

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1576
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1629
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.7
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	332.6
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.46
Bicycle level of service (Exhibit 15-4)	E
Notes	SSA

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIO	NAL TWO-LANE HIGHWA	AY SEGMENT WORK	KSHEET
General Information		Site Information	
Analyst	David Stoner	Highway / Direction of Travel	US 2
Agency or Company Date Performed	DOWL HKM	From/To	Columbia F to Hungry H WB
Analysis Time Period	11/15/2011 PM Peak	Jurisdiction Analysis Year	Flathead County 2035
Project Description: US 2 Badrock Car	11000	Tractyolo 1 Qui	2000
Input Data			
	.		
	\$\frac{1}{2} Shoulder widthtttt		
*	Lane width tt	Class I	highway V Class II
	Lane widthtt	highway	Class III highway
	I Shoulder width tt	1 / 1 \	
Sogmont longil), L ₁ mi	Terrain Grade Lengt	-
Jegineri rengu	', El IIII	Peak-hour fa	actor, PHF 0.91
		Show North Arrow of Trusto on	
Analysis direction vol., V _d 491v	eh/h	% Trucks an	d Buses , P _T 6 %
Opposing direction vol., V _o 296v	eh/h	% Recreation	nal vehicles, P _R 4%
Shoulder width ft 1.0		Access point	.,
Lane Width ft 12.0 Segment Length mi 0.6			
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (c)
Passenger-car equivalents for trucks, E-	(Eyhibit 15-11 or 15-12)		Opposing Direction (o)
Passenger-car equivalents for RVs, E _R		1.8	2.1
Heavy-vehicle adjustment factor, f _{HV,AT}			1.1
Grade adjustment factor ¹ , f _{g,ATS} (Exhib		0.951 0.935	
Demand flow rate ² , v_j (pc/h) $v_i = V_i$ / (PHF		0.96 0.85	
	'g,ATS 'HV,ATS' m Fleid Measurement	591 409	
Tiee-Flow Speed Ho	m rieta measarement	Estimated Free-Flow Speed	
		Base free-flow speed ⁴ , BFFS 60.0	
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder width,	⁴ f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions,	v	Adj. for access points ⁴ , f _A (Exhib	oit 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/	, , , , , , , , , , , , , , , , , , , ,		
Adj. for no-passing zones, f _{np,ATS} (Exhib	it 15-15) 2.8 mi/h	Average travel speed, ATS _d =FF3	S-0.00776(V _{d,ATS} + 44.5 mi/h
		V _{o,ATS}) - f _{np,ATS}	
Percent Time-Spent-Following		Percent free flow speed, PFFS	80.9 %
rercent rime-Spent-ronowing		Analysis Direction (d)	Opposing Direction (c)
Passenger-car equivalents for trucks, E ₇	(Exhibit 15-18 or 15-19)	1.2	Opposing Direction (o) 1.6
Passenger-car equivalents for RVs, E _R (1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/		0.988	0.965
Grade adjustment factor ¹ , f _{g,PTSF} (Exhib		0.96	0.86
Directional flow rate ² , v _/ (pc/h) v _i ≃V/(PHF		569	392
Base percent time-spent-following ⁴ , BPT		54.1	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)		36.2	
Percent time-spent-following, PTSF _d (%):	=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	+ 75.5	
v _{o,PTSF})			9.9
Level of Service and Other Performan	ce Measures	3000	
Level of service, LOS (Exhibit 15-3)			D
Volume to capacity ratio, v/c			0.39

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1477
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	80.9
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.6
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.71
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.



Appendix 4

Operational Analysis Worksheets

2035 Reverse 3-2-3-4 Adjusted Annual Average

Three-Lane RP 141.2 – RP 142.0

Two-Lane Eastbound

One-Lane Westbound

DIRECTIONAL TWO-LANE HIGHW	AY SEGMENT WORK	(SHEET
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H EB Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor PlaÛ¬¤B	r manyolo real	2000
Input Data		
Shoulder width It		
Lane width tt	Class II	highway 「V Class II
Shoulder width tt	highway T	Class III highway
Segment length, L ₁ mi	Terrain Grade Length Peak-hour fa No-passing z	ctor, PHF 0.93
Analysis direction vol., V _d 398veh/h	Show North Arrow % Trucks and	
Opposing direction vol., V _o 250veh/h Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 0.6	% Recreational vehicles, P _R 4% Access points <i>mi</i> 3/mi	
Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 15-11 or 15-12)	1.9	2,2
Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.945 0.929	
Grade adjustment factor ¹ , f _{g.ATS} (Exhibit 15-9)	0.91	0.81
Demand flow rate ² , v _i (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})	498	357
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
	Base free-flow speed ⁴ , BFFS 6	
Mean speed of sample ³ , S _{FM}	Adj. for lane and shoulder width,4	f _{LS} (Exhibit 15-7) 4.2 mi/h
Total demand flow rate, both directions, v	Adj. for access points ⁴ , f _A (Exhibi	t 15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/ f _{HV.ATS})	Free-flow speed, FFS (FSS=BFFS-f _{IS} -f _A)	
Adj. for no-passing zones, f _{np,ATS} (Exhibit 15-15) 3.1 mi/h		
Percent Time-Spent-Following	Anglusia Discattere (4)	
Passenger-car equivalents for trucks, E _T (Exhibit 15-18 or 15-19)	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for RVs, E _R (Exhibit 15-18 or 15-19)	1.0	1.7
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.977	0.960
Grade adjustment factor ¹ , f _{g,PTSF} (Exhibit 15-16 or Ex 15-17)	0.92	0.83
Directional flow rate ² , v _/ (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})	476	337
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)	46.3	
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)	40.2	
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} /v _{d,PTSF} +	69.8	
o,PTSF) .evel of Service and Other Performance Measures		
evel of Service, LOS (Exhibit 15-3)		2
	0.33	

Capacity, C _{d,ATS} (Equation 15-12) pc/h	o
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1428
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.3
Bicycle Level of Service	No. of the second secon
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	428.0
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S, (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.59
Bicycle level of service (Exhibit 15-4)	F
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

General Information	(SHEET	
Analyst David Stoner	Site Information Highway of Travel	US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H WB
Date Performed 11/15/2011 Analysis Time Period AM Peak	Jurisdiction Analysis Year	Flathead County
Project Description: US 2 Badrock Canyon Corridor Plañ	Trittarysis real	2035
nput Data		
Class I highway Class II highway Class II	l highway	N Constant of the Constant of
← Opposing direction ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ←		
Analysis direction>		
L _u L _{pl} L _{de} L _d		
ļ Ļ,	Stow Hath.	Anon
Shoulder width (ft)		1.0
ane Width (ft)		12.0
Segment Length (mi)		0.6
Total length of analysis segment, L		0.6
ength of two-lane highway upstream of the passing lane, $\mathbf{L}_{\mathbf{u}}$		0.0
ength of passing lane including tapers, Lpl		0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Vorksheet)		45.8
ercent time-spent-following, PTSF _d (from Directional Two-Lane Highway		
egment Worksheet)		57.8
evel of service 1, LOS _d (from Directional Two-Lane Highway Segment Worksheet)		
lverage Travel Speed		
ength of the downstream highway segment within the effective length of assing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing one for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$		-1.70
dj. factor for the effect of passing lane on average speed, \mathbf{f}_{pl} (Exhibit 15-8)		1.10
verage travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t)$		
$-u^{+}L_{d}^{+}(L_{\rho l}/f_{\rho l})^{+}(2L_{d\theta}/(1+f_{\rho l,ATS})))$		50.4
ercent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)		91.6
ercent Time-Spent-Following		
ength of the downstream highway segment within the effective length of	and the second s	And the second s
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		9.64
ength of two-lane highway downstream of effective length of the passing		
ne for percent-time-following,		-9.64
$_{d}$ =L $_{t}$ -(L $_{u}$ + L $_{pl}$ + L $_{de}$)		

f _{pl,PTSF} (Exhibit 15-26)	0.60	
Percent time-spent-following including passing lane ³ , PTSF _{p1} (%)	1/7	****
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	34.7	
Level of Service and Other Performance Measures ⁴	40000	
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	A	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	0.9	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	287.4	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.39	
Bicycle level of service (Exhibit 15-4)	E	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If L_d <0, use alternative Equation 15-18.		
3. If L _d <0, use alternative Equation 15-16.		
4. v/c, VMT ₁₅ and VMT ₆₀ are calculated on Directional Two-Lane Highway Segment Wo	orksheet.	

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DIRECTIO	NAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET
General Information		Site Information	·
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 11/15/2011 Median Off-Peak	Highway / Direction of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H EB Flathead County 2035
Project Description: US 2 Badrock Ca	nyon Corridor Pla¶3¥8	- maryoto roun	2000
Input Data			
	\$\frac{1}{3} \text{ Shoulder width } tt		
4	Lane width tt	F mine	MALACON .
	Lane width	· E	ighway 🔽 Class II
	\$ Shoulder width tt	hlghway	Class III highway
1	ո, Lլ mi	Terrain Level Rollin Grade Length mi Up/down Peak-hour factor, PHF 0.91 No-passing zone 100% Show North Arrow 7 Toucks and Pugas P	
	/eh/h	% Trucks and	•
Opposing direction vol., V _o 306, Shoulder width ft 1.0 Lane Width ft 12.0 Segment Length mi 0.6	reh/h	% Recreational vehicles, P _R 4% Access points <i>mi 3/</i> mi	
Average Travel Speed	Company of the second of the s		
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E	(Exhibit 15-11 or 15-12)	2.0	2.1
Passenger-car equivalents for RVs, E _R	(Exhibit 15-11 or 15-13)	1.1	1.1
Heavy-vehicle adjustment factor, f _{HV,AT}		0.940 0.935	
Grade adjustment factor ¹ , f _{g,ATS} (Exhib	1000	0.89 0.86	
Demand flow rate ² , v_i (pc/h) $v_i = V_i$ / (PHF		461 418	
Free-Flow Speed fro	m Field Measurement	Estimated Free-Flow Speed	
		Base free-flow speed ⁴ , BFFS 61.0	
Mean speed of sample ³ , S _{FM}		Adj. for lane and shoulder width, 4 f _{LS} (Exhibit 15-7) 4.2	
Total demand flow rate, both directions,	v	Adj. for access points ⁴ , f _A (Exhibit	15-8) 0.8 mi/h
Free-flow speed, FFS=S _{FM} +0.00776(v/		Free-flow speed, FFS (FSS=BFFS-f _{IS} -f _A) 56.0	
Adj. for no-passing zones, f _{np,ATS} (Exhib			
		V _{o,ATS}) - f _{np,ATS} Percent free flow speed, PFFS 82.6	
Percent Time-Spent-Following		Analysis Direction (d)	Opposite Disasting (1)
Passenger-car equivalents for trucks, E _T	(Exhibit 15-18 or 15-19)	Analysis Direction (d) 1.6	Opposing Direction (o) 1.6
Passenger-car equivalents for RVs, E _R (1.0	1.0
-feavy-vehicle adjustment factor, f _{HV} =1/	(1+ P _T (E _T -1)+P _R (E _R -1))	0.965	0.965
Grade adjustment factor ¹ , f _{g,PTSF} (Exhib		0.89	0.87
Directional flow rate ² , v _/ (pc/h) v _i =V _/ (PHF	*f _{HV,PTSF} * f _{g,PTSF})	449	400
Base percent time-spent-following ⁴ , BPT		46.1	
dj. for no-passing zone, f _{np,PTSF} (Exhib		43.4	
	:BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	69.1	
o,PTSF)		OS	
evel of Service and Other Performant evel of service, LOS (Exhibit 15-3)	ce measures		
olume to capacity ratio, v/c		C	
The representative of the second		0.30	

Capacity, C _{d,ATS} (Equation 15-12) pc/h	0	
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1477	
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.6	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	385.7	
Effective width, Wv (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.54	
Bicycle level of service (Exhibit 15-4)	F	
Notes	the state of the s	

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) \ge 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011	Highway of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H WB Flathead County
Analysis Time Period Median Off-Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor Pla¼¼¥B Input Data		
Class I highway Class II highway Class III	highway	
◆ Opposing direction ◆		
Analysis direction ->		
L _{II} L _{de} L _d	Show that the August	
Shoulder width (ft)		1.0
Lane Width (ft)		12.0
Segment Length (mi)		0.6
Total length of analysis segment, L _t		0.6
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}		0.0
Length of passing lane including tapers , \mathbf{L}_{pl}		0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		46.4
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		65.1
Segment Worksheet)		05.1
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		С
Average Travel Speed		
Length of the downstream highway segment within the effective length of cassing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
Length of two-lane highway downstream of effective length of the passing ane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$		-1.70
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)		1.10
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$		
$L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl,ATS}))$)		51.1
Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/FFS)$		91.2
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of		8.03
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following, L _d =L _t -(L _u + L _{pt} + L _{de})	-8.03	

f _{pl,P7SF} (Exhibit 15-26)	0.61			
Percent time-spent-following including passing lane ³ , PTSF _{pt} (%)				
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + L_{pl} + ((1 + f_{pl,PTSF})/2) + L_{de}] + ((1 + f_{pl,PTSF})/2) + ((1 + $	39,7			
Level of Service and Other Performance Measures ⁴				
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	A			
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{p1} 1.0				
Bicycle Level of Service				
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h				
Effective width, W _v (Eq. 15-29) ft				
Effective speed factor, S _t (Eq. 15-30)	4.79			
Bicycle level of service score, BLOS (Eq. 15-31)	5.48			
Bicycle level of service (Exhibit 15-4)	E			
Notes				
1. If LOS _d =F, passing lane analysis cannot be performed.				
2. If L _d <0, use alternative Equation 15-18.				
3. If L _d <0, use alternative Equation 15-16.				
4. v/c, VMT ₁₅ and VMT ₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.				

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Date Performed 1773-2011 Park Park Park Park Park Park Park Park Park Park Park Park Park	DIRECTION	NAL TWO-LANE HIGHWA	AY SEGMENT WORK	SHEET
Agening of Company DOVAL HKM Find Float Data Performed PRI Plant Print Pla	General Information		Site Information	
Perject Description: U.S. 2 Backrock Canyon Corridor Pla'YPB Input Data Shoulder width It Lane width It Lane width It Shoulder width It It Shoulder width It It Shoulder width It It Shoulder width It It It It It It It	Agency or Company Date Performed	DOWL HKM 11/15/2011	From/To Jurisdiction	Columbia F to Hungry H EB
Stoulder width It Lano w			Analysis Year	2035
Shoulder width in the Lane wid		yon Comaor PlaY{#B		
Class I highway Class II highway Class II highway Class II highway Class II highway Class III highway Lass	}			
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Segment length, L_	<u> </u>	Shoulder width tt		
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Lane Width ft 22.0 Segment Length mi 2.6 Average Travel Speed Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) 2.7 1.7 Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) 1.1 1.1 Heavy-vehicle adjustment factor, $f_{1N/ATS}^{-1}$ 1/1 + $P_T(E_T^{-1})$ Presenger-car equivalents for RVs, E_R (Exhibit 15-9) 0.935 0.956 Domand flow rate ² , V_t (pcth) V_t^{-1} (PthF f_0 ATS $f_{1N/ATS}^{-1}$ 1/1 Present or RVs, E_R (Exhibit 15-9) 0.85 0.96 Domand flow rate ² , V_t (pcth) V_t^{-1} (PthF f_0 ATS $f_{1N/ATS}^{-1}$ 1/1 Atl 8 601 Free-Flow Speed from Field Measurement Base free-flow speed f_t^{-1} Bress free-flow Speed Base free-flow speed f_t^{-1} Bress free-flow speed Adj. for lane and shoulder width, $f_{1,S}^{-1}$ (Exhibit 15-15) 0.8 Adj. for access points f_t^{-1} (Exhibit 15-8) 0.8 Adj. for non-passing zones, f_{10} ATS (Exhibit 15-15) 1.9 ml/h Average travel speed, ATS f_t^{-1} ATS (Exhibit 15-15) 1.9 ml/h Average travel speed, ATS f_t^{-1} ATS (Exhibit 15-16) 1.9 ml/h Passenger-car equivalents for trucks, f_t^{-1} (Exhibit 15-18 or 15-19) 1.6 1.2 Passenger-car equivalents for RVs, f_t^{-1} (PthF f_t^{-1} Preserved free flow speed, PFFS 0.00778(f_t^{-1} Analysis Direction (d) 0.10 Passenger-car equivalents for RVs, f_t^{-1} (PthF f_t^{-1} Preserved free flow speed, PFFS 0.00778(f_t^{-1} Analysis Direction (d) 0.10 Heavy-vehicle adjustment factor, f_{10} Preserved free flow speed, PFFS 0.00 Base percent time-spent-following f_t^{-1} (Exhibit 15-16 or Ex 15-17) 0.87 0.97 Directional flow rate ² , f_t^{-1} (PthF f_t^{-1} (PthF f_t^{-1} Preserved free flow speed, PFFS 0.00 Base percent time-spent-following f_t^{-1} PREserved f_t^{-1} Preserved free flow speed, PFFS 0.00 Base percent time-spent-following f_t^{-1} Preserved free flow speed free flow speed free flow flow free flow flow free flow flow free flow flow flow flow flow flow flow flow	Opposing direction vol., V _o 491v	eh/h	% Recreation	al vehicles, P _R 4%
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Average Travel Speed Analysis Direction (d) Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) 2.1 1.7 Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) 1.1 Heavy-vehicle adjustment factor, $f_{1NATS}=1/(1+P_T(E_T^-1)+P_R(E_R^{-1}))$ 0.995 0.956 Grade adjustment factor, $f_{1NATS}=1/(1+P_T(E_T^-1)+P_R(E_R^{-1}))$ 0.995 Demand flow rate ² , v_T (pCh) $v_T = v_T$ (PHF* f_{1NATS} f_{1NATS}) 1418 601 Free-Flow Speed from Field Measurement Estimated Free-Flow Speed Base free-flow speed, BFFS Adj. for lane and should wridin, f_{1S} (Exhibit 15-9) Adj. for lane and should wridin, f_{1S} (Exhibit 15-9) Adj. for access points f_T (Exhibit 15-9) Adj. for no-passing zones, f_{1PATS} (Exhibit 15-15) 1.9 min Average travel speed, ATS_FFS-0.00776(v_T ATS f_T ATS Percent Time-Spent-Following Analysis Direction (d) Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19) 1.6 1.2 Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) 1.0 1.0 1.0 Heavy-vehicle adjustment factor, f_{1NTS} (Exhibit 15-16 or Ex 15-17) 0.87 Operation of the RVs, E_R (Exhibit 15-16 or Ex 15-17) 0.87 Operation of the RVs, E_R (Exhibit 15-16 or Ex 15-17) 0.87 Operation of the RVs, E_R (Exhibit 15-16) Percent time-spent-following, PTSF f_T (S)=BPTSF f_T (S)=BPTSF f_T (V), PTSF f_T				
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) 2.1 1.7 Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) 1.1 Heavy-vehicle adjustment factor, $f_{INATS}=II/(1+P_T(E_T-1)+P_R(E_R-1))$ 0.935 0.956 Grade adjustment factor, $f_{INATS}=II/(1+P_T(E_T-1)+P_R(E_R-1))$ 1.9 Mean speed of sample $f_{INATS}=II/(1+P_T(E_T-1)+P_R(E_R-1))$ 1.0 1.0 1.0 Meany speed, FFS = $f_{INATS}=II/(1+P_T(E_T-1)+P_R(E_R-1))$ 1.0 1.0 1.0 1.0 Meany speed, FFS = $f_{INATS}=II/(1+P_T(E_T-1)+P_R(E_R-1))$ 1.0 1.0 1.0 1.0 Meany speed, FFS = $f_{INATS}=II/(1+P_T(E_T-1)+P_R(E_R-1))$ 1.0 1.0 Meany speed, FFS = $f_{INATS}=II/(1+P_T(E_T-1)+P_R(E_R-1))$ 1.0 1.0 Meany speed, FFS = $f_{INATS}=II/(1+P_T(E_T-1)+P_R(E_R-1))$ 1.0 Meany speed, FFS = $f_{INATS}=II/(1+P_T(E_T-1)+P_R(E_R-1))$ 1.0 Meany speed, FFS = $f_{INATS}=II/(1+P_T(E_T-1)+P_R(E_R-1))$ 1.0 Meany speed, FFS = $f_{INATS}=II/(1+P$		A STATE OF THE STA		
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12) 2.1 1.7 Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13) 1.1 Heavy-vehicle adjustment factor, $f_{1NATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ 0.935 0.956 Grade adjustment factor, $f_{0,ATS}$ (Exhibit 15-9) Demand flow rate ² , $v_1(pch)$, $v_1=V_1/(PHF^+f_{0,ATS}^+f_{1N,ATS}^-)$ Tree-Flow Speed from Field Measurement Free-Flow Speed from Field Measurement Base free-flow speed, BFFS Adj. for Iane and shoulder width, f_{1S} (Exhibit 15-7) 4.2 Adj. for access points f_{1S} (Exhibit 15-8) Adj. for access points f_{1S} (Exhibit 15-10) Analysis Direction f_{1S} (Opposing Direction f_{1S} (Apposite 15-10) Analysis Direction f_{1S} (Opposing Direction f_{1S} (Apposite 15-10) Adj. for access points f_{1S} (Apposite 15-10) Adj. for access points f_{1S} (Apposite 15-10) Analysis Direction f_{1S} (Opposing Direction f_{1S			Analysis Direction (d)	Opposing Direction (o)
Heavy-vehicle adjustment factor, $f_{i,N,ATS}$ =1/ (1+ P _T (E _T -1)+P _R (E _R -1)) 0.935 0.956 0.96 Grade adjustment factor, $f_{i,0,ATS}$ (Exhibit 15-9) 0.85 0.96 Demand flow rate ² , $V_{i,0}$ (pc/h) V_{i} V_{i} / (PHF* $f_{i,0,ATS}$ * $f_{i,N,ATS}$) 418 601 Free-Flow Speed from Field Measurement Estimated Free-Flow Speed Measurement Estimated Free-Flow Speed from Field Measurement Base free-flow speed*, BFFS 62.0 Adj. for lane and shoulder width, $f_{i,0}$ (Exhibit 15-7) 4.2 Adj. for access points $f_{i,1}$ (Exhibit 15-8) 0.8 Adj. for access points $f_{i,1}$ (Exhibit 15-8) 0.8 Adj. for no-passing zones, $f_{i,0,ATS}$ (Exhibit 15-15) 1.9 mith Average travel speed, AFS _e =FFS-0.00776($V_{i,0,ATS}$) 47.2 $V_{i,0,ATS}$	Passenger-car equivalents for trucks, E ₇	(Exhibit 15-11 or 15-12)	2.1	
Grade adjustment factor 1 , $f_{Q,ATS}$ (Exhibit 15-9) Demand flow rate 2 , V_{1} (pc/h) V_{1} = V_{1} (PHF 4 4 4 4 frv, ATS) Free-Flow Speed from Field Measurement Free-Flow Speed from Field Measurement Base free-flow speed 4 , BFFS 62.0 Mean speed of sample 3 , S_{FM} Total demand flow rate, both directions, V Free-flow speed, FFS= S_{FM}^+ 0.00776(V_{1}^+ f _{HV,ATS}) Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-16) 1.9 mi/h Average travel speed, ATS_g=FFS=0.00776($V_{d,ATS}^+$) Average travel speed, ATS_g=FFS=0.00776($V_{d,ATS}^+$) Percent Time-Spent-Following Analysis Direction (d) Opposing Direction (e.g., $V_{Q,ATS}^+$) Passenger-car equivalents for trucks, $V_{Q,ATS}^+$ (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, $V_{Q,ATS}^+$ (Exhibit 15-16 or Ex 15-17) Directional flow rate $V_{Q,ATS}^+$ (Schibit 15-16) Base percent time-spent-following $V_{Q,ATS}^+$ (Schibit 15-16) Base percent time-spent-following $V_{Q,ATS}^+$ (Schibit 15-16) Percent time-spent-following $V_{Q,ATS}^+$ ($V_{Q,ATS}^+$ ($V_{Q,ATS}^+$) Percent time-spent-following $V_{Q,ATS}^+$ ($V_{Q,ATS}^+$ ($V_{Q,ATS}^+$) Adj. for no-passing zone, $V_{Q,ATS}^+$ ($V_{Q,ATS}^+$) Percent time-spent-following, PTSF ($V_{Q,ATS}^+$ ($V_{Q,ATS}^+$) Level of Service and Other Performance Measures	Passenger-car equivalents for RVs, E _R (Exhibit 15-11 or 15-13)	1.1	1.1
Demand flow rate², v _j (pc/h) v _i =V _i / (PHF* f _{g,ATS} * f _{HV,ATS})			0.935	0.956
Free-Flow Speed from Field Measurement Base free-flow speed 4 , BFFS 62.0 Mean speed of sample 3 , S _{FM} Total demand flow rate, both directions, v Free-flow speed, FFS=S _{FM} +0.00776(w f _{HV,ATS}) Adj. for no-passing zones, 1 , 1 , (Exhibit 15-15) Adj. for no-passing zones, 1 , 1 , (Exhibit 15-15) Average travel speed, ATS $_a$ =FFS-0.00776(w dATS 2 77.0 Average travel speed, ATS $_a$ =FFS-0.00776(w dATS 3 77.0 Average travel speed, ATS $_a$ =FFS-0.00776(w dATS 3 77.0 Average travel speed, ATS $_a$ =FFS-0.00776(w dATS 3 77.0 Average travel speed, ATS $_a$ =FFS-0.00776(w dATS 4 77.0 Average travel speed, A	Grade adjustment factor ¹ , f _{g,ATS} (Exhib	it 15-9)	0.85	0.96
Base free-flow speed, BFFS 62.0 Mean speed of sample 3, S_{FM} Total demand flow rate, both directions, V Free-flow speed, FFS= S_{FM} +0.00776(V $f_{HV,ATS}$) Adj. for lane and shoulder width, f_{LS} (Exhibit 15-8) Adj. for access points f_{LS} , f_{LS}			418	601
Mean speed of sample 3 , S_{FM} Total demand flow rate, both directions, v Free-flow speed, FFS= S_{FM}^+ 0.00776(v $f_{HV,ATS}$) Adj. for access points 4 , f_A (Exhibit 15-8) Adj. for access points 4 , f_A (Exhibit 15-8) Adj. for access points 4 , f_A (Exhibit 15-8) Adj. for access points 4 , f_A (Exhibit 15-8) Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-16) 1.9 mi/h Free-flow speed, FFS (FSS=BFFS- f_{LS}^- f_A) Average travel speed, ATS $_d$ =FFS-0.00776($v_{d,ATS}^+$ + $V_{0,ATS}^-$) $^ f_{np,ATS}^-$ Percent Time-Spent-Following Analysis Direction (d) Opposing Direction (e) Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19) 1.6 1.2 Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) 1.0 1.0 Heavy-vehicle adjustment factor, f_{HV} =1/(1+ P_T (E_T -1)+ P_R (E_R -1)) Operational flow rate 2 , v_F (pc/h) v_F = 2 (Exhibit 15-16 or Ex 15-17) Directional flow rate 2 , v_F (pc/h) v_F = 2 (v_F)=100(1- $e^{av_D}^h$) Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21) Percent time-spent-following, PTSF $_d$ (%)=BPTSF $_d$ +f $_{np,PTSF}$ + $_d$ (v_G)=TSF $_d$ -	Free-Flow Speed fro	m Field Measurement	Estimated Fre	ee-Flow Speed
Adj. for access points 4 , 4 , (Exhibit 15-8) 0.8 rece-flow speed, FFS=S _{FM} +0.00776(4 f _{HV,ATS}) Free-flow speed, FFS (FSS=BFFS-f _{LS} -f _A) 57.0 Adj. for no-passing zones, 4 f _{np,ATS} (Exhibit 15-15) 1.9 mi/h Average travel speed, ATS _d =FFS-0.00776(4 ATS + 47.2 Percent Time-Spent-Following Analysis Direction (d) Opposing Direction (e.g., Percent free flow speed, PFS (E.S.) 1.0 Heavy-vehicle adjustment factor, 4 f _{np,ATS} (Exhibit 15-16 or Ex 15-17) 0.965 0.988 Grade adjustment factor 4 f _{np,ATS} (Exhibit 15-16 or Ex 15-17) 396 576 Base percent time-spent-following 4 , BPTSF 4 (%)=BPTSF 4 f _{np,PTSF} (4 or no-passing zone, 4 np,PTSF (4 or np			Base free-flow speed ⁴ , BFFS	62.0 mi/h
Adj. for access points 4 , 4 , (Exhibit 15-8) 0.8 rece-flow speed, FFS=S _{FM} +0.00776(4 f _{HV,ATS}) Free-flow speed, FFS (FSS=BFFS-f _{LS} -f _A) 57.0 Adj. for no-passing zones, 4 f _{np,ATS} (Exhibit 15-15) 1.9 mi/h Average travel speed, ATS _d =FFS-0.00776(4 ATS + 47.2 Percent Time-Spent-Following Analysis Direction (d) Opposing Direction (e.g., Percent free flow speed, PFS (E.S.) 1.0 Heavy-vehicle adjustment factor, 4 f _{np,ATS} (Exhibit 15-16 or Ex 15-17) 0.965 0.988 Grade adjustment factor 4 f _{np,ATS} (Exhibit 15-16 or Ex 15-17) 396 576 Base percent time-spent-following 4 , BPTSF 4 (%)=BPTSF 4 f _{np,PTSF} (4 or no-passing zone, 4 np,PTSF (4 or np	Manager and of any self-3		Adj. for lane and shoulder width,4	f _{r.s} (Exhibit 15-7) 4.2 mi/h
Free-flow speed, FFS= S_{FM} +0.00776($V_{fHV,ATS}$) Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15) 1.9 mi/h Percent Time-Spent-Following Analysis Direction (d) Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) 1.0 Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1)) Operational flow rate ² , V_T (pc/h) V_T = V_T (PHF* $f_{HV,PTSF}$ * $f_{g,PTSF}$) Base percent time-spent-following, PTSF f_T (%)=BPTSF f_T 4 f f_T 1, f_T 2, f_T 4, f_T 5 f f_T 5. Percent Time-Spent-following, PTSF f_T 6, f_T 5 f f_T 7, f_T				- -
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15) 1.9 mi/h Average travel speed, ATS_d =FFS-0.00776($v_{d,ATS}$) + $v_{o,ATS}$) - $f_{np,ATS}$ Percent free flow speed, PFFS 82.7 Percent Time-Spent-Following Analysis Direction (d) Opposing Direction (d) Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19) 1.6 1.2 Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) 1.0 1.0 Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1)) One of the expression of the			1	
Percent Time-Spent-Following Analysis Direction (d) Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-16 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18			··	
Percent Time-Spent-Following Analysis Direction (d) Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) 1.0 Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1)) One of the expression of the	Adj. for no-passing zones, f _{np,ATS} (Exhib	it 15-15) 1.9 <i>mi∕h</i>	47.2 m/n	
Analysis Direction (d) Opposing Direction (d) Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19) 1.6 1.2 Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19) 1.0 1.0 1.0 1.0 Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ O.965 O.988 Grade adjustment factor ¹ , $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17) O.87 O.97 Directional flow rate ² , v_t (pc/h) v_t = v_t /(PHF* $f_{HV,PTSF}$ * $f_{g,PTSF}$) Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av_d}) Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21) Percent time-spent-following, PTSF _d (%)=BPTSF _d + $f_{np,PTSF}$ * $(v_{d,PTSF}/v_{d,PTSF})$ 60.0 Level of Service and Other Performance Measures	Payant Time Spant Fallanian		Percent free flow speed, PFFS	82.7 %
Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19) 1.0 1.0 1.0 Heavy-vehicle adjustment factor, f_{HV} =1/ (1+ P_T (E_T -1)+ P_R (E_R -1)) 0.965 0.988 Grade adjustment factor ¹ , $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17) 0.87 0.97 Directional flow rate ² , v_i (pc/h) v_i = v_i /(PHF* $f_{HV,PTSF}$ * $f_{g,PTSF}$) 396 576 Base percent time-spent-following ⁴ , BPTSF $_d$ (%)=100(1- $e^{av}d^b$) 45.3 Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21) 26.0 Percent time-spent-following, PTSF $_d$ (%)=BPTSF $_d$ + $f_{np,PTSF}$ *($v_{d,PTSF}$ / $v_{d,PTSF}$) 60.0 Level of Service and Other Performance Measures	revent rune-spent-ronowing		Analysis Direction (d)	Opposing Direction (c)
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$ 0.965 0.988 Grade adjustment factor 1, $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17) 0.87 0.97 Directional flow rate 2, $v_i(pc/h)$ $v_i=v_i/(PHF^*f_{HV,PTSF}^*f_{g,PTSF})$ 396 576 Base percent time-spent-following 4, BPTSF _d (%)=100(1-e ^{av_d}) 45.3 Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21) 36.0 Percent time-spent-following, PTSF _d (%)=BPTSF _d + $f_{np,PTSF}^*(v_{d,PTSF}/v_{d,PTSF})$ Level of Service and Other Performance Measures	Passenger-car equivalents for trucks, E _T	(Exhibit 15-18 or 15-19)		
Grade adjustment factor 1 , $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17) Directional flow rate 2 , $v_f(pc/h)$ $v_i = V_f/(PHF^*f_{HV,PTSF}^*f_{g,PTSF})$ Base percent time-spent-following 4 , BPTSF $_d$ (%)=100(1-eav $_d$) Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21) Percent time-spent-following, PTSF $_d$ (%)=BPTSF $_d$ + $f_{np,PTSF}^*(v_{d,PTSF}/v_{d,PTSF})$ Level of Service and Other Performance Measures	Passenger-car equivalents for RVs, E _R (l	Exhibit 15-18 or 15-19)	1.0	1.0
Directional flow rate ² , v _i (pc/h) v _i =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF}) Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av_db}) Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21) Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} /v _{d,PTSF} + V _{0,PTSF}) Level of Service and Other Performance Measures	Heavy-vehicle adjustment factor, f _{HV} =1/	(1+ P _T (E _T -1)+P _R (E _R -1))	0.965	0.988
Base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av_db}) Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21) Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} + 60.0 Level of Service and Other Performance Measures			0.87	0.97
Adj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21) Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} + 60.0 Level of Service and Other Performance Measures	Directional flow rate ² , <i>v_i</i> (pc/h) <i>v_i</i> =V _i /(PHF*f _{HV,PTSF} * f _{g,PTSF})		396	576
Percent time-spent-following, PTSF _d (%)=BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} + 60.0 co.o.evel of Service and Other Performance Measures	base percent time-spent-following ⁴ , BPTSF _d (%)=100(1-e ^{av} d ^b)		45.3	
Level of Service and Other Performance Measures	dj. for no-passing zone, f _{np,PTSF} (Exhibit 15-21)		36.0	
V _{o,PTSF}) Level of Service and Other Performance Measures	Percent time-spent-following, PTSF _d (%)=	:BPTSF _d +f _{np,PTSF} *(v _{d,PTSF} / v _{d,PTSF} +	TSF ⁺ 60.0	
			O.	
		ce Measures		
evel of service, LOS (Exhibit 15-3) C /olume to capacity ratio, v/c 0.24				

Capacity, C _{d,ATS} (Equation 15-12) pc/h	1576
Capacity, C _{d,PTSF} (Equation 15-13) pc/h	1629
Percent Free-Flow Speed PFFS _d (Equation 15-11 - Class III only)	82.7
Bicycle Level of Service	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	332.6
Effective width, Wv (Eq. 15-29) ft	13.00
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	5.46
Bicycle level of service (Exhibit 15-4)	E
Notes	

^{1.} Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.

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^{2.} If $v_i(v_d \text{ or } v_o) >= 1,700 \text{ pc/h}$, terminate analysis--the LOS is F.

^{3.} For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET			
General Information	Site Information		
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel From/To Columbia F to Hungry H WB Jurisdiction Analysis Year US 2 Columbia F to Hungry H WB Flathead County 2035		
Project Description: US 2 Badrock Canyon Corridor Plac¾jB			
input Data			
Class I highway Class II highway Class III Opposing direction Analysis direction	highway		
L _u L _{pl} L _{de} L _d	Show Heelin From		
Shoulder width (ft)	1.0		
Lane Width (ft)	12.0		
Segment Length (mi)	0.6		
Total length of analysis segment, L _t	0.6		
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0		
Length of passing lane including tapers , $\mathrm{L_{pl}}$	0.6		
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	44.5		
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	75.5		
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D		
Average Travel Speed			
ength of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70		
ength of two-lane highway downstream of effective length of the passing ane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.70		
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.10		
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t) /$	49.0		
$L_{u}+L_{d}+(L_{p}/f_{p})+(2L_{de}/(1+f_{pl,ATS})))$			
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	89.0		
Percent Time-Spent-Following			
ength of the downstream highway segment within the effective length of	6.75		
easing lane for percent time-spent-following, L _{de} (Exhibit 15-23)			
ength of two-lane highway downstream of effective length of the passing			
ane for percent-time-following, L _d =L _t -(L _u + L _{pt} + L _{de})	-6.75		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
PTSF _{pl} = PTSF _d (L _u +L _d +f _{pl,PTSF} L _{pl} +((1+f _{pl,PTSF})/2)L _{de} l/L _t	46.1	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	<u> </u>
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pt}	1.7	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.71	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If L _d <0, use alternative Equation 15-18.		
• • •		

^{3.} If L_d<0, use alternative Equation 15-16.

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^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.



Appendix 4

Operational Analysis Worksheets

2035 Reverse 3-2-3-4 Four-Lane Adjusted Annual Average

RP 142.0 – RP 142.4

Direction 1 = Eastbound

Direction 2 = Westbound

MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst	David Stoner	Highway/Direction to Travel	US 2
Agency or Company	DOWL HKM	From/To	Columbia Falls to Hungry Horse
Date Performed	4/30/2012	Jurisdiction	Flathead County 2035
Analysis Time Period	AM Peak	Analysis Year	2030
Project Description US 2 Badr	ock Canyon Corridor Planning Stu	ıdy	
☐ Oper.(LOS))	Des. (N)	Γ Plan. (vp)
Flow Inputs			
Volume, V (veh/h)	398	Peak-Hour Factor, PHF	0.93
AADT(veh/h)		%Trucks and Buses, P _T	6
Peak-Hour Prop of AADT (veh/d)	%RVs, P _R	4
Peak-Hour Direction Prop, D		General Terrain:	Rolling
DDHV (veh/h) Driver Type Adjustment	1.00	Grade Length (mi) Up/Down %	0.00 0.00
Britor Typo Adjudancin	1.00	Number of Lanes	2
Calculate Flow Adjus	stments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs			
	10.0	Calc Speed Adj and	rra
Lane Width, LW (ft)	12.0	f _{LW} (mi/h)	
Total Lateral Clearance, LC (ft)	12.0	f _{LC} (mi/h)	
Access Points, A (A/mi)	0	f _A (mi/h)	
Median Type, M		f _M (mi/h)	
FFS (measured)	60.0		00.0
Base Free-Flow Speed, BFFS		FFS (mi/h)	60.0
Operations		Design	
	· ····		
O		Design (N)	
Operational (LOS)		Required Number of Lanes, N	
Flow Rate, v _p (pc/h/ln)	241	Flow Rate, v _p (pc/h)	
Speed, S (mi/h)	60.0	Max Service Flow Rate (pc/h/ln)	
D (pc/mi/ln)	4.0	Design LOS	
LOS	Α	500igi, 100	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	214.0	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.21	
Bicycle level of service (Exhibit 15-4)	C	

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MU	MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×				
General Information		Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035	
	ock Canyon Corridor Planning Stu			
Oper.(LOS)		Des. (N)	Plan. (νρ)	
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	250) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.87 6 4 Rolling 0.00 0.00	
Calculate Flow Adjus	tments			
f _P E _T	1.00 2.5	E _R	2.0 0.885	
Speed Inputs		Calc Speed Adj and	FFS	
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0	
Operations		Design		
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	162 60.0 2.7 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS		
Bicycle Level of Service				
		1		

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	143.7	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.00	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off-Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description 05 2 Baur	ock Canyon Corridor Planning Stud	es. (N)	
Flow Inputs	Į U	es. (N)	Plan. (vp)
Volume, V (veh/h) AADT(veh/h)	351	Peak-Hour Factor, PHF %Trucks and Buses, P _T	0.91
Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	1.00	%RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	4 Rolling 0.00 0.00 2
Calculate Flow Adjus	tments	Trained of Earloo	
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	217 60.0 3.6 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service	· · · · · · · · · · · · · · · · · · ·		

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	192.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.15	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period Project Description US 2 Badr	David Stoner DOWL HKM 4/30/2012 Median Off-Peak ock Canyon Corridor Planning Stu	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Secondaria Go 2 Bath		Des. (N)	Diam (m)
Flow Inputs	J	DG3. (IV)	☐ Plan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	306) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _p E _T	1.00	E _R	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	194 60.0 3.2 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, $v_{ m OL}$ (Eq. 15-24) veh/h	171.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.09	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			•
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
<u> </u>	ock Canyon Corridor Planning Stud		
Coper.(LOS)	J . C	Des. (N)	Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	296) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _p E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 62.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	62.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	187 60.0 3.1 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			
		1	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	166.3	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	***************************************
Bicycle level of service score, BLOS (Eq. 15-31)	3.08	*
Bicycle level of service (Exhibit 15-4)	c	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
X			
General Information		Site Information	
	D11 Ol	Site information	
Analyst Agency or Company	David Stoner DOWL HKM	Highway/Direction to Travel	US 2
Date Performed	4/30/2012	From/To Jurisdiction	Columbia Falls to Hungry Horse Flathead County
Analysis Time Period	PM Peak	Analysis Year	2035
	ock Canyon Corridor Planning Stu	ıdv	
C Oper.(LOS)		Des. (N)	Plan. (vp)
Flow Inputs			
Volume, V (veh/h)	491	Peak-Hour Factor, PHF	0.91
AADT(veh/h)		%Trucks and Buses, P _T	6
Peak-Hour Prop of AADT (veh/d)	%RVs, P _R	4
Peak-Hour Direction Prop, D		General Terrain:	Rolling
DDHV (veh/h)	4.00	Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down % Number of Lanes	0.00 2
Calculate Flow Adjus	tments	Number of Lanes	
f _p	1.00	E _R	2.0
E _T	2.5		0.885
	2.0	f _{HV}	
Speed Inputs		Calc Speed Adj and	rrs
Lane Width, LW (ft)	12.0	f _{LW} (mi/h)	
Total Lateral Clearance, LC (ft)	12.0	f _{LC} (mi/h)	
Access Points, A (A/mi)	0	f _A (mi/h)	
Median Type, M		f _M (mi/h)	
FFS (measured)	60.0		
Base Free-Flow Speed, BFFS		FFS (mi/h)	60.0
Operations		Design	
Operational (LOS)		Design (N)	
Operational (LOS)	004	Required Number of Lanes, N	
Flow Rate, v _p (pc/h/ln)	304	Flow Rate, v _p (pc/h)	
Speed, S (mi/h)	60.0	Max Service Flow Rate (pc/h/ln)	
D (pc/mi/ln)	5.1	Design LOS	
LOS	A	Ĭ	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	269.8	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	Market -
Bicycle level of service score, BLOS (Eq. 15-31)	3,32	
Bicycle level of service (Exhibit 15-4)	C	

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Appendix 4

Operational Analysis Worksheets

2035 Three-Lane Peak Season

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla=â		
Input Data Class highway Class highway Class Class Opposing direction Analysis direction	highway	
L _u L _{de} L _d	Show Reath Auron	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, $\mathbf{L}_{\mathbf{u}}$	0.0	
Length of passing lane including tapers , $L_{\rm pl}$	0.6	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	41.8	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	84.6	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d = L_t \cdot (L_u + L_{pl} + L_{de})$	0.10	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.11	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t) / (L_u + L_d + (L_p) f_{pl}) + (2L_{de} f(1 + f_{pl,ATS}))$)	44.6	
Percent free flow speed including passing lane, PFFS _{p1} = (ATS _{p1} /FFS)	80.9	
Percent Time-Spent-Following	VV.7	
Length of the downstream highway segment within the effective length of		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	4.64	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, $L_d = L_t - (L_u + L_{pl} + L_{de})$	-2.84	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	C7 7	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + f_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	57.1	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	C	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	11.4	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	850.5	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.94	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla 4	- Company - Comp	
Input Data		
Class I highway Class II highway Class III	highway	
← Opposing direction		
Analysis direction		
L _{ti} L _{pl} L _{de} L _{ti}		
ļ,	Ston Hath Fron	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, $\mathbf{L}_{\mathbf{u}}$	0.0	
Length of passing lane including tapers , L _{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	41.9	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	70.5	
Segment Worksheet)		
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-0.40	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.11	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$	15.6	
$(L_u + L_d + (L_{p)}/f_{pl}) + (2L_{de}/(1+f_{pl,ATS})))$	45.5	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	82.7	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of	6.63	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	0.03	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, L _d =L _t -(L _u + L _{pl} + L _{de})	-5.33	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	, 400	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	44.5	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	7.4	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	559.8	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.73	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla:i		
Input Data		
Class I highway Class II highway Class III Opposing direction	highway	
→ Analysis direction →		
L _u L _{pl} L _{de} L _d	Stow Hath Arrow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0	
Length of passing lane including tapers , Lpl	0.6	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	42.7	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	81.6	
Level of service ^I , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L _d L _d =L _t -(L _u +L _{pl} + L _{de})	0.10	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.11	
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) / $(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	45.5	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	81.2	
Percent Time-Spent-Following	V116	
Length of the downstream highway segment within the effective length of	5.18	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	V.10	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, $L_d = L_t - (L_u + L_{pl} + L_{de})$	-3.38	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	54.6	
PTSF _{pl} = PTSF _d [L _u +L _d +f _{pl,PTSF} L _{pl} +((1+f _{pl,PTSF})/2)L _{de} J/L _t		
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pt}	10.2	
Bicycle Level of Service		-
Directional demand flow rate in outside fane, v _{OL} (Eq. 15-24) veh/h	773.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.89	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Plag\$		
Input Data		
Class I hìghway	nighway	
← Opposing direction ←		
→ Analysis direction →		
<u>r</u> ,	Show Harth Auon	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, L _u	0.0	
Length of passing lane including tapers, L _{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	42,9	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	76.6	
Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment	D	
Worksheet)	<i>D</i>	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L _d L _d =L _t -(L _u +L _{pl} + L _{de})	-0.40	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.11	
Average travel speed including passing lane ² , ATS _{p1} = $(ATS_d^* L_t)$ /	14.7	
$(L_{u}+L_{d}+(L_{pl}/ff_{pl})+(2L_{de}/(1+f_{pl,ATS})))$	46.6	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	83.2	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of	5,89	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	J.07	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, $L_{d} = L_{t} \cdot (L_{u} + L_{p} + L_{de})$	-4.59	
a tan hi as.		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%) $PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	48.5	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	8.5	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	662.2	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.81	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.		····
2. If ${ m L_d}$ <0, use alternative Equation 15-18.		
3. If L _d <0, use alternative Equation 15-16.		

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet. Copyright © 2012 University of Florida, All Rights Reserved

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DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla2j		
Input Data		
Class I highway	highway	
← Opposing direction ←		
Analysis direction>		
L ₁₁ L _{de} L _d		
ļ,	Show Hoth Anon	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, $\mathbf{L}_{\mathbf{u}}$	0.0	
Length of passing lane including tapers, L _{pl}	0.6	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	42.1	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	75.4	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d L_d = L_t - $(L_u$ + L_{pl} + L_{de})	0.10	
Adj. factor for the effect of passing lane on average speed, f _{pt} (Exhibit 15- 28)	1.11	
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _l) / $(L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl,ATS})))$	44.8	
Percent free flow speed including passing lane, PFFS _{ol} = (ATS _{ol} /FFS)	78.6	
Percent Time-Spent-Following	/ U.V	
Length of the downstream highway segment within the effective length of		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	5.92	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following,	471	
$L_d = L_{t} \cdot (L_u + L_{pl} + L_{de})$	-4.12	
Adj. factor for the effect of passing lane on percent time-spent-following,		

49.3 B 8.8	
В	
8.8	
658.4	
13.00	
4.79	
5.81	
F	
	13.00 4.79 5.81

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
Site Information		
Highway of Travel From/To Jurisdiction	US 2 Columbia F to Hungry H WB Flathead County 2035	
Acidiyala Ledi	2035	
highway		
Show Heath A	HOW	
	1.0	
	12.0	
	2.4	
	2.4	
	0.0	
	1.1	
	39.7	
	99.0	
	88.9	
	E	
	1.70	
	-0.40	
	1.11	
	43.1	
	78.4	
	3.60	
	-2.30	
	SHEET Site Information Highway of Travel From/To Jurisdiction Analysis Year highway	

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pt} (%)	58.4	***************************************
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2) L_{de}]/L_{t}$	J0.4	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	C	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	14.6	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	1046.2	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	6.04	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.



Appendix 4

Operational Analysis Worksheets

2035 Three-Lane Adjusted Annual Average

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Plaò²aB	Alialysis (Cal	
Input Data		
Class I highway Class II highway Class III	highway	
← Opposing direction ←		
— → Analysis direction →		
L _u L _{pl} L _{de} L _d	Stroy Heeth Purow	
Shoulder width (ft)		
Lane Width (ft)	1.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0	
Length of passing lane including tapers , \mathbf{L}_{pl}	0.6	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	45.3	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	70.4	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t \cdot (L_u + L_{pl} + L_{de})$	0.10	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t) / ($	48.0	
$(L_u + L_d + (L_{pl} f_{pl}) + (2L_{de} / (1 + f_{pl,ATS})))$ Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	87.3	
Percent Time-Spent-Following	07.5	
Length of the downstream highway segment within the effective length of	7.00	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	7.49	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, L _d =L _t -(L _u + L _{pl} + L _{de})	-5.69	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%) $PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + L_{pl} + ((1 + f_{pl,PTSF})/2) + L_{de} / L_{t}$	45.4	
Level of Service and Other Performance Measures ⁴		20/00/00/00/00
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	5.3	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	428.0	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S, (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.59	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If L _d <0, use alternative Equation 15-18.		
3. If L _d <0, use alternative Equation 15-16.	_	

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet. Copyright © 2012 University of Florida, All Rights Reserved

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DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla? B		
Input Data		
Class I highway Class II highway Class II	highway	
← Opposing direction ←		
Analysis direction		
L ₁₁ L _{de} L _{de}		
[· [-]	Show Heath Anow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, \mathbf{L}_{u}	0.0	
Length of passing lane including tapers , L _{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	45.9	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	56.6	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	C	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-0.40	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-	1.10	
28) Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) /		
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	49.5	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	89.9	
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	9.99	
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,	0.40	
$L_d = L_{f}(L_u + L_{pl} + L_{de})$	-8.69	
Adj. factor for the effect of passing lane on percent time-spent-following,		

ol, PTSF (Exhibit 15-26)	0.60	
ercent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + f_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	34.8	
evel of Service and Other Performance Measures ⁴		
evel of service including passing lane LOS _{pl} (Exhibit 15-3)	A	
eak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	3.4	
icycle Level of Service		
irectional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	279.3	
ffective width, W _v (Eq. 15-29) ft	13.00	
ffective speed factor, S, (Eq. 15-30)	4.79	
icycle level of service score, BLOS (Eq. 15-31)	5.37	
icycle level of service (Exhibit 15-4)	E	
oles		

^{3.} If L_d<0, use alternative Equation 15-16.

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^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEG WORK	MENT WORKSHEET WITH PASSING LANE
General Information	Site Information
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035
Project Description: US 2 Badrock Canyon Corridor Pla×A¥B	
Input Data	
Class I highway Class II highway Class III	highway
← Opposing direction ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ←	
Analysis direction ->	
ļ,	Strow Reath Peron
Shoulder width (ft)	1.0
Lane Width (ft)	12.0
Segment Length (mi)	2.4
Total length of analysis segment, L _t	2.4
Length of two-lane highway upstream of the passing lane, L _u	0.0
Length of passing lane including tapers , \mathbf{L}_{pl}	0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	46.3
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	69.5
Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	С
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_1 - (L_u + L_{ol} + L_{de})$	0.10
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-	1.10
28) Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$	
$(L_u + L_d + (L_{\rho)}/f_{\rho}) + (2L_{de}/(1 + f_{\rho!,ATS})))$	49.1
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	87.6
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of	7.71
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	7.71
Length of two-lane highway downstream of effective length of the passing	
lane for percent-time-following,	-5,91
$L_{d} = L_{t} - (L_{u} + L_{p}) + L_{de})$	
Adj. factor for the effect of passing lane on percent time-spent-following,	

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	44.8	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	4.7	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	385.7	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S_t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.54	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEG WORK	IMENT WORKSHEET WITH PASSING L SHEET	ANE
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel From/To Columbia F to Hungry H W. Jurisdiction Analysis Year US 2 Columbia F to Hungry H W. Flathead County 2035	В
Project Description: US 2 Bedrock Canyon Corridor Plaqõ¥B	Alialysis real 2000	
Input Data		
Class I highway Class II highway Class III Opposing direction	l highway	
Analysis direction L _{II} L _{pl} L _{de} L _d	Strow Heath Purow	
Shoulder width (ft)		
Lane Width (ft)	1.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L,	2.4	
Length of two-lane highway upstream of the passing lane, L _u	0.0	
Length of passing lane including tapers, Lpl	I.I	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	46.5	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	63.9	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	C	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_l \cdot (L_u + L_{pl} + L_{de})$	-0.40	
Adj. factor for the effect of passing lane on average speed, f _{pt} (Exhibit 15- 28)	1.10	
Average travel speed including passing lane ² , ATS _{p1} = (ATS _d * L _t) / $(L_u+L_d+(L_p)/f_p)+(2L_{de}/(1+f_{pl,ATS}))$)	50.2	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	89.5	×*
Percent Time-Spent-Following		24 .
Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	8.20	•
ength of two-fane highway downstream of effective length of the passing		
ane for percent-time-following,	-6.90	
$L_{d} = L_{t} - (L_{u} + L_{pi} + L_{de})$	-0,90	
Adj. factor for the effect of passing lane on percent time-spent-following,	<u> </u>	

f _{pl,PTSF} (Exhibit 15-26)	0.60	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de})/L_{t}$	39.4	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	A	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	4.0	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	333.7	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.47	
Bicycle level of service (Exhibit 15-4)	E	
Notes		
	E	

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla		
Input Data		
Class I highway Class II highway Class III	highway	
← Opposing direction ←		
→ Analysis direction →		
L _u L _{de} L _d		
Į,	Snow Hath Anow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, L _t	2.4	
Length of two-lane highway upstream of the passing lane, L _u	0.0	
Length of passing lane including tapers , \boldsymbol{L}_{pl}	0.6	
Average travel speed, ${ m ATS}_{ m d}$ (from Directional Two-Lane Highway Segment Worksheet)	47.2	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	60.2	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	c	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d = L_{t^-}(L_u + L_{pl} + L_{de})$	0.10	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	50.1	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	87.7	
Percent Time-Spent-Following	V///	
Length of the downstream highway segment within the effective length of		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	8.24	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following,	-6.44	
$L_{d} = L_{t} - (L_{u} + L_{pl} + L_{de})$		
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.60	
Percent time-spent-following including passing lane ³ , PTSF _{pt} (%)		And the Second of the Second
PTSF _{pl} = PTSF _d { L _u +L _d +f _{pl,PTSF} L _{pl} +((1+f _{pl,PTSF})/2)L _{de} }/L _l	38.1	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	A	-
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	4.0	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	332.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S, (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.46	
Bicycle level of service (Exhibit 15-4)	E	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.	•	
2. If L _d <0, use alternative Equation 15-18.		
3. If L _d <0, use alternative Equation 15-16.		
4. v/c, VMT ₁₅ and VMT ₆₀ are calculated on Directional Two-Lane Highway Segment Wo	rksheet.	

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DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor PlayeB	Quality (Control of the Control of t	
Input Data		
Class I highway Class II highway Class II	l highway	
✓ Opposing direction		
→ Analysis direction →		
L _{tt} L _{de} L _d		
[] h	Strow Heeth Augu	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	2.4	
Total length of analysis segment, $\mathbf{L}_{\mathbf{t}}$	2.4	
Length of two-lane highway upstream of the passing lane, L _u	0.0	
Length of passing lane including tapers , L _{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	44.6	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	74.6	
Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing	-0.40	
lane for avg travel speed, $L_d L_d = L_{\Gamma}(L_u + L_{pl} + L_{de})$ Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-		
28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l) / L_{pl}$	48.1	
$(L_u + L_d + (L_{\rho l}/f_{\rho l}) + (2L_{d\rho}/(1+f_{\rho l,ATS})))$	300	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	87.4	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of	6.89	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	V.U/	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, $L_d = L_t - (L_u + L_{pl} + L_{de})$	-5.59	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl.PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following Including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	47.0	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	6.5	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	523.1	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.69	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.



Appendix 4

Operational Analysis Worksheets

2035 4-2-4 Peak Season
Four-Lane RP 140.0 – RP 140.6
Two-Lane RP 140.6 – RP 141.2
Four-Lane RP 141.2 – 142.4

Direction 1 = Eastbound

Direction 2 = Westbound

MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stud		
Coper.(LOS)	J D	Pes. (N)	Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	791) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.93 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments	Trained of Editor	
f _ρ E _T Speed Inputs	1.00 2.5	E _R	2.0 0.885
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	Calc Speed Adj and I f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	
<u>Operational (LOS)</u> Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	480 60.0 8.0 A	<u>Design (N)</u> Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	425.3	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.55	
Bicycle level of service (Exhibit 15-4)	D	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
X			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	rock Canyon Corridor Planning Stud	os. (N)	Dian (va)
Flow Inputs	J · L	pes. (N)	□ Plan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	502 I) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.87 6 4 Rolling 0.00 0.00 2
Calculate Flow Adjus	stments		per .
f _p E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	***************************************
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	326 60.0 5.4 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			
		I	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	288.5	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.36	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst	David Stoner	Highway/Direction to Travel	US 2
Agency or Company	DOWL HKM	From/To	Columbia Falls to Hungry Horse
Date Performed	4/30/2012	Jurisdiction Analysis Year	Flathead County
Analysis Time Period	Median Off Peak Peak		2035
l'	rock Canyon Corridor Planning Stu	ıdy	
Oper.(LOS)		Des. (N)	Plan. (vp)
Flow Inputs			
Volume, V (veh/h)	704	Peak-Hour Factor, PHF	0.91
AADT(veh/h)		%Trucks and Buses, P_{T}	6
Peak-Hour Prop of AADT (veh/d	1)	%RVs, P _R	4
Peak-Hour Direction Prop, D DDHV (veh/h)		General Terrain: Grade Length (mi)	Rolling 0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
,		Number of Lanes	2
Calculate Flow Adjus	tments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft)	12.0		
Total Lateral Clearance, LC (ft)	12.0	f _{LW} (mi/h)	
Access Points, A (A/mi)	0	f _{LC} (mi/h)	
Median Type, M		f _A (mi/h)	
FFS (measured)	61.0	f _M (mi/h)	
Base Free-Flow Speed, BFFS		FFS (mi/h)	61.0
Operations	37002-	Design	
0-0-1/		Design (N)	
Operational (LOS)	(am	Required Number of Lanes, N	
Flow Rate, v _p (pc/h/ln)	437	Flow Rate, v _p (pc/h)	
Speed, S (mi/h)	60.0	Max Service Flow Rate (pc/h/ln)	
D (pc/mi/ln)	7.3	Design LOS	
LOS	Α	1-1311 = 1-3	
•			
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	386.8	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.51	
Bicycle level of service (Exhibit 15-4)	D	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off Peak Peak rock Canyon Corridor Planning Stur	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description 03 2 Bad		Des. (N)	Plan. (vp)
Flow Inputs		JCG. (11)	3 · Γιαιι. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	614 1) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down %	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	stments	Number of Lanes	2
f _p E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	389 60.0 6.5 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			
		1	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	344.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	1 100000
Bicycle level of service score, BLOS (Eq. 15-31)	3.45	
Bicycle level of service (Exhibit 15-4)	c	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
X			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description US 2 Badr Oper.(LOS)	ock Canyon Corridor Planning Stud		[Tiple= /w/)
Flow Inputs	J L	Des. (N)	☐ Plan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	586) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down %	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments	Number of Lanes	2
ſ _p	1.00	E _R	2.0
É _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 62.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	62.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	372 60.0 6.2 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	329.2	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.42	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stu		
Oper.(LOS)	[. [Des. (N)	Plan. (vp)
Flow Inputs			Allowed a second
Volume, V (veh/h) AADT(veh/h)	981	Peak-Hour Factor, PHF %Trucks and Buses, P _T	0.91 6
Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	1.00	%RVs, P _R General Terrain: Grade Length (mi) Up/Down %	4 Rolling 0.00 0.00
		Number of Lanes	2
Calculate Flow Adjus	tments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs	4	Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M	12.0 12.0 0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h)	
FFS (measured)	60.0	f _M (mi/h)	00.0
Base Free-Flow Speed, BFFS		FFS (mi/h)	60.0
Operations		Design	
<u>Operational (LOS)</u> Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	609 60.0 10.1 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			
I		1	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.0	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.67	
Bicycle level of service (Exhibit 15-4)	D	

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	MENT WORKSHEET WITH PASSING LANE SHEET
General Information	Site Information
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035
Project Description: US 2 Badrock Canyon Corridor PlafA	
Input Data	
Class I highway Class II highway Class III	highway
← Opposing direction ←	
Analysis direction ——>	
Ļ	Show Heath Anow
Shoulder width (ft)	1.0
Lane Width (ft)	12.0
Segment Length (mi)	1.2
Total length of analysis segment, L _t	1.2
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0
Length of passing lane including tapers , \mathbf{L}_{pl}	0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	41.8
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	84.4
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.10
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.11
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) /	46.0
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl,ATS})))$	4.000
Percent free flow speed including passing lane, PFFS _{p!} = (ATS _{p!} / FFS)	83.5
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of	4.64
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	· · · · · · · · · · · · · · · · · · ·
Length of two-lane highway downstream of effective length of the passing	
lane for percent-time-following,	-4.04
$L_{d} = L_{i} - (L_{u} + L_{pi} + L_{de})$	
Adj. factor for the effect of passing lane on percent time-spent-following,	

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + f_{pl} + ((1 + f_{pl,PTSF})/2) + f_{de}]/L_{t}$	53.4	
Level of Service and Other Performance Measures ⁴	, Heaterstand and I	
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-mln total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	5.5	
Bicycle Level of Service		·
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	850.5	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.94	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

General Information	Site Information	TO THE PARTY OF TH
Analyst David Stoner Agency or Company DOWL HKM	Highway of Travel From/To	US 2
Date Performed 11/15/2011	Jurisdiction	Columbia F to Hungry H WB Flathead County
Analysis Time Period AM Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor PlanÝ	· · · · · · · · · · · · · · · · · · ·	
Input Data		
Class I highway Class II highway Class II	l highway	
Opposing direction	_	
→ Analysis direction →		
L _u L _{pl} L _{do} L _d	\Box	
·		/
] L _j	Stow flath	
Shoulder width (ft) Lane Width (ft)		1.0
Segment Length (mi)		12.0
Total length of analysis segment, L,		1.8
Length of two-lane highway upstream of the passing lane, L _u		0.0
Length of passing lane including tapers , L _{pl}		1.1
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		41.8
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		71.6
Segment Worksheet)		71.0
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		D
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
Length of two-lane highway downstream of effective length of the passing ane for avg travel speed, L_d L_d = L_t - $(L_u$ + L_{pl} + L_{de})		-1.00
Adj. factor for the effect of passing lane on average speed, $f_{ m pl}$ (Exhibit 15-28)		1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t) /$		46.0
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$		46.0
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)		83.6
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of		6.48
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	***************************************	6.48
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,		-5.78
$L_d = L_l - (L_u + L_{pl} + L_{de})$	1	

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	44.3	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + f_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$		
Level of Service and Other Performance Measures ⁴		· · · · · · · · · · · · · · · · · · ·
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	5.6	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	577.0	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.74	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

	MENT WORKSHEET WITH PASSING LANE SHEET
General Information	Site Information
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035
Project Description: US 2 Badrock Canyon Corridor PlaW	
Input Data	
Class I highway Class II highway Class III	highway
Opposing direction	
—→ Analysis direction →	
Lu ' Lpi " Ldo " Ld	
<u>,</u>	Show Health Peron
Shoulder width (ft)	1.0
Lane Width (ft)	12.0
Segment Length (mi)	1.2
Total length of analysis segment, $L_{\rm t}$	1.2
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0
Length of passing lane including tapers , L _{pl}	0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	42.6
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	81.9
Segment Worksheet)	V.17
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.10
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.11
Average travel speed including passing lane ² , $ATS_{p1} = (ATS_d^* L_t)$	
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl,ATS})))$	46.9
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	83.6
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	5.18
Length of two-lane highway downstream of effective length of the passing	
lane for percent-time-following,	100
$L_d = L_t - (L_u + L_{pl} + L_{de})$	-4.58
Adj. factor for the effect of passing lane on percent time-spent-following,	

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pt} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	51.7	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	4.9	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	773.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5,89	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

	MENT WORKSHEET WITH PASSING LANE SHEET
General Information	Site Information
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035
Project Description: US 2 Badrock Canyon Corridor Plat	
Input Data	
Class I highway Class II highway Class III	highway
◆ Opposing direction ◆	
Analysis direction —>	
L _{ti} L _{de} L _d	
Į.	Ston Haith Anon
Shoulder width (ft)	1.0
Lane Width (ft)	12.0
Segment Length (mi)	1.8
Total length of analysis segment, L _t	1.8
Length of two-lane highway upstream of the passing lane, $\boldsymbol{L}_{\!\!\! u}$	0.0
Length of passing lane including tapers , $L_{ m pl}$	1,1
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	42.7
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	77.2
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.00
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-	1.11
28) Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t)$	12.1
$(L_u + L_d + (L_p)/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	47.1
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	84.0
Percent Time-Spent-Following Length of the downstream highway segment within the effective length of	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	5.79
Length of two-lane highway downstream of effective length of the passing	
lane for percent-time-following,	-5,09
$L_d = L_i^-(L_u^+ L_pi^+ L_de^-)$	
Adj. factor for the effect of passing lane on percent time-spent-following,	

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
PTSF _{pl} = PTSF _d [L _u +L _d +f _{pl,PTSF} L _{pl} +((1+f _{pl,PTSF})/2)L _{de} }/L _l	47.8	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	B	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	6.5	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	682.2	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.83	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.		

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

General Information	Site Information	
Analyst David Stoner	Highway of Travel	US 2
Agency or Company DOWL HKM Date Performed 11/15/2011	From/To Jurisdiction	Columbia F to Hungry H EB Flathead County
Analysis Time Period PM Peak	Analysis Year	2035
Project Description: US 2 Badrock Canyon Corridor Pla/		
nput Data		
Class I highway Class II highway Class III	highway	
← Opposing direction ←		
Analysis direction		
L _u L _{pl} L _{de} L _d		
<u></u>		/
ļ',	Show fleith I	hon
Shoulder width (ft)		1.0
Lane Width (ft)		12.0
Segment Length (mi)		1.2
Total length of analysis segment, L		1.2
Length of two-lane highway upstream of the passing lane, $\boldsymbol{L}_{\boldsymbol{u}}$		0.0
Length of passing lane including tapers , L _{pl}		0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		41.8
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		
Segment Worksheet)		75.4
Level of service ^I , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		D
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing		-1.10
ane for avg travel speed, $\mathbf{L_d} \mathbf{L_d}$ = $\mathbf{L_t}$ - $(\mathbf{L_u}$ + $\mathbf{L_{pl}}$ + $\mathbf{L_{de}})$		
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)		1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{d}^* L_{l})$ /		
$ L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})) $		46.0
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)		80.6
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		5.92
ength of two-lane highway downstream of effective length of the passing	3,3444	
ane for percent-time-following,		-5.32
$L_{d} = L_{t}(L_{u} + L_{pl} + L_{de})$		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%) $PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + f_{pl,PTSF})/2)L_{de} VL_{t}$	46.7	
Level of Service and Other Performance Measures ⁴		Commence of the Commence of th
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	4.3	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	658.4	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.81	
Bicycle level of service (Exhibit 15-4)	F	***************************************
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If L _d <0, use alternative Equation 15-18.		

 $^{^{\}prime}$. If $^{\prime}$ L $_{d}$ <0, use alternative Equation 15-18. 3. If $^{\prime}$ L $_{d}$ <0, use alternative Equation 15-16.

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^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

	EET WITH PASSING LANE
Site Information	
Highway of Travel From/To	US 2 Columbia F to Hungry H WB
	Flathead County 2035
highway	
\Box	\supset
	/
Show Harl	1 Arrow
	1.0
	12.0
	1.8
	1.8
	0.0
	1.1
	39.4
	89.4
	09.4
	Е
	1.70
	-1.00
	1.11
	43.4
	78.9
	MADOUR AND
	2.60
2000	3.60
	, , , , , , , , , , , , , , , , , , ,
	-2.90
	SHEET Site Information Highway of Travel From/To Jurisdiction Analysis Year highway

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		Maria de la composición dela composición de la composición dela composición de la composición de la composición de la composición de la composición dela composición de la com
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + f_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	56.7	
Level of Service and Other Performance Measures ⁴	- Aller Annual Control of the Contro	
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	C	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pt}	11.2	
Bicycle Level of Service	, Add	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	1078.0	COLUMN TO SERVICE SERV
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	6.06	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.



Appendix 4

Operational Analysis Worksheets

2035 4-2-4 Adjusted Annual Average Four-Lane RP 140.0 – RP 140.6 Two-Lane RP 140.6 – RP 141.2 Four-Lane RP 141.2 – 142.4

Direction 1 = Eastbound

Direction 2 = Westbound

MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
[<u>₹</u>]			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period Project Description US 2 Badr	David Stoner DOWL HKM 4/30/2012 AM Peak ock Canyon Corridor Planning Stud	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
☐ Oper.(LOS)		es. (N)	Flan. (vp)
Flow Inputs			, , , , , , , , , , , , , , , , , , , ,
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	398) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down %	0.93 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments 1.00	Number of Lanes E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	241 60.0 4.0 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	214.0	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.21	
Bicycle level of service (Exhibit 15-4)	c	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak ock Canyon Corridor Planning Stud	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description Go 2 Back		Pes. (N)	Plan. (vp)
Flow Inputs			r Han (1p)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	250) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.87 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	stments	Number of Lanes	2
f _p E _T	1.00	E _R	2.0 0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	162 60.0 2.7 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			
		i	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	143.7	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.00	
Bicycle level of service (Exhibit 15-4)	С	

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General Information Site Inform	ation
Analyst David Stoner Highway/Direction Agency or Company DOWL HKM From/To Date Performed 4/30/2012 Jurisdiction Analysis Time Period Median Off-Peak Project Description US 2 Badrock Canyon Corridor Planning Study	n to Travel US 2 Columbia Falls to Hungry Horse Flathead County 2035
Coper.(LOS) Des. (N)	☐ Plan. (vp)
Flow Inputs	137
Volume, V (veh/h) AADT(veh/h) Peak-Hour Factor **Trucks and Busin Peak-Hour Prop of AADT (veh/d) Peak-Hour Direction Prop, D General Terrain:	es, P _T 6 4
DDHV (veh/h) Grade Length (Driver Type Adjustment 1.00 Up/Dow Number of Lanes	
Calculate Flow Adjustments	
$egin{array}{lll} f_p & & 1.00 & & E_R \ & E_T & & 2.5 & & f_{HV} \end{array}$	2.0 0.885
	Adj and FFS
Lane Width, LW (ft) 12.0 $f_{LW} \text{ (mi/h)}$ Total Lateral Clearance, LC (ft) 12.0 $f_{LC} \text{ (mi/h)}$ Access Points, A (A/mi) 0 $f_{A} \text{ (mi/h)}$ Median Type, M $FFS \text{ (measured)} \qquad 61.0$ $f_{M} \text{ (mi/h)}$ FFS (mi/h) $FFS \text{ (mi/h)}$	61.0
Operations Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) 3.6 LOS D esign (N) Required Number Flow Rate, v _p (pc/h Max Service Flow Design LOS	h)
Bicycle Level of Service	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	192.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.15	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)					
[X]					
General Information Site Information					
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off-Peak ock Canyon Corridor Planning Stud	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035		
Project Description CS 2 Badi		Pes. (N)	☐ Plan. (vp)		
Flow Inputs	J L	700. (14)	J. Fran. (vp)		
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	306) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.89 6 4 Rolling 0.00 0.00		
Calculate Flow Adjus	tments	Transport of Latios			
f _p E _T	1.00 2.5	E _R f _{HV}	2.0 0.885		
Speed Inputs		Calc Speed Adj and I	FFS		
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0		
Operations		Design	A CONTRACTOR OF THE PROPERTY O		
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	194 60.0 3.2 A	<u>Design (N)</u> Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS			
Bicycle Level of Service					
		I .			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	171.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	-
Bicycle level of service score, BLOS (Eq. 15-31)	3.09	
Bicycle level of service (Exhibit 15-4)	c	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period Project Description US 2 Badr	David Stoner DOWL HKM 4/30/2012 PM Peak ock Canyon Corridor Planning Stud	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
C Oper.(LOS)		es. (N)	Plan. (vp)
Flow Inputs			
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h)	296	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi)	0.89 6 4 Rolling 0.00
Driver Type Adjustment Calculate Flow Adjus	1.00	Up/Down % Number of Lanes	0.00
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and F	
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 62.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	62.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	187 60.0 3.1 A	<u>Design (N)</u> Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	166.3	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.08	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)						
×						
General Information	General Information Site Information					
Analyst	David Stoner	Highway/Direction to Travel	US 2			
Agency or Company	DOWL HKM	From/To	Columbia Falls to Hungry Horse			
Date Performed	4/30/2012	Jurisdiction	Flathead County			
Analysis Time Period	PM Peak	Analysis Year	2035			
ľ	rock Canyon Corridor Planning Stud					
Oper.(LOS)		es. (N)	Plan. (vp)			
Flow Inputs						
Volume, V (veh/h)	491	Peak-Hour Factor, PHF	0.91			
AADT(veh/h)	и	%Trucks and Buses, P _T	6			
Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D	9	%RVs, P _R General Terrain;	4 Polling			
DDHV (veh/h)		Grade Length (mi)	Rolling 0.00			
Driver Type Adjustment	1.00	Up/Down %	0.00			
		Number of Lanes	2			
Calculate Flow Adjus	tments					
f _p	1.00	E _R	2.0			
E _T	2.5	f_{HV}	0.885			
Speed Inputs		Calc Speed Adj and I	FFS			
Lane Width, LW (ft)	12.0	f _{LW} (mi/h)				
Total Lateral Clearance, LC (ft)	12.0	f _{LC} (mi/h)				
Access Points, A (A/mi)	0	f _A (mi/h)				
Median Type, M		1 ***				
FFS (measured)	60.0	f _M (mi/h)				
Base Free-Flow Speed, BFFS		FFS (mi/h)	60.0			
Operations		Design				
Operational (LOS)		Design (N)				
Flow Rate, v _p (pc/h/ln)	304	Required Number of Lanes, N				
Speed, S (mi/h)	60.0	Flow Rate, v _p (pc/h)				
D (pc/mi/ln)	5.1	Max Service Flow Rate (pc/h/ln)				
LOS	A	Design LOS				
Bicycle Level of Service						

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	269.8	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.32	
Bicycle level of service (Exhibit 15-4)	С	

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DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor PlaÛ¬¤B Input Data		
Class I highway Class II highway Class III	highway	
Opposing direction		
→ Analysis direction →		
L ₁₁ L _{de} L _d	Show Heeth Arrow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	1.2	
Total length of analysis segment, L _t	1.2	
Length of two-lane highway upstream of the passing lane, $\boldsymbol{L}_{\!\!\boldsymbol{u}}$	0.0	
Length of passing lane including tapers , L _{pl}	0.6	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	45.3	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	69.8	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	C	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.10	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.10	
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) / $(L_d + L_d + (L_p)^l f_{pl}) + (2L_{de}^l (1 + f_{pl,ATS}))$)	49.5	
Percent free flow speed including passing lane, PFFS _{p1} = (ATS _p / FFS)	89.8	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	7.49	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following,	4.00	
$L_d = L_t - (L_u + L_{pl} + L_{de})$	-6.89	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{dl} L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2) L_{de} V L_{t}$	43.1	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	2.6	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	428.0	
Effective width, W _v (Eq. 15-29) ft	13,00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.59	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If L _d <0, use alternative Equation 15-18.		
3 If L. c0 use alternative Equation 15 16		

^{3.} If L_d<0, use alternative Equation 15-16.

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^{4.} v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Plañ		
Input Data	2000	
Class I highway	highway	
← Opposing direction ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ←		
Analysis direction ——		
L _u L _{pi} L _{de} L _d		
[] [*]	Ston Hath Anon	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	1.8	
Total length of analysis segment, L _t	1.8	
Length of two-lane highway upstream of the passing lane, L _u	0.0	
Length of passing lane including tapers , L _{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	45.8	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	57.8	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	C	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.00	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$	50.0	
$(L_u + L_d + (L_{p!}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$ Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	90.9	
The second secon	70.7	
Percent Time-Spent-Following Length of the downstream highway segment within the effective length of	9.64	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	- 1 ~ /	
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, $L_d = L_{t} - (L_u + L_{pl} + L_{de})$	-8.94	
Adj. factor for the effect of passing lane on percent time-spent-following,		

0.60	
35.0	
A	
2.6	
287.4	
13.00	
4.79	
5.39	
E	
	35.0 A 2.6 287.4 13.00 4.79 5.39

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

General Information	SHEET Site Information	
Analyst David Stoner	Highway of Travel	US 2
Agency or Company <i>DOWL HKM</i> Date Performed <i>11/15/2011</i>	From/To	Columbia F to Hungry H EB
Dale Performed 11/15/2011 Analysis Time Period Median Off-Peak	Jurisdiction Analysis Year	Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Pla¶3¥B		
Input Dala		
Class I highway Class II highway Class III	l highway	
✓ Opposing direction		
Analysis direction		
L ₁₁ L _{de} L _d		
 	Show Haili	(teras)
	\$ SHOW HOURT	
Shoulder width (ft) Lane Width (ft)		1.0
Segment Length (mi)		12.0
Fotal length of analysis segment, \mathbf{L}_{t}		1.2
Length of two-lane highway upstream of the passing lane, L		0.0
Length of passing lane including tapers, L _{pl}		0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		46.3
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		
Segment Worksheet)		69.1
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		C
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing ane for avg travel speed, $L_d L_d = L_t - (L_u + L_{ot} + L_{de})$		-1.10
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-		1.10
28)		1.1V
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) /		50.5
$L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS}))$)		
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)		90.1
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of		7.71
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		7.74
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,		-7.11
$L_{d} = L_{t} - (L_{u} + L_{pl} + L_{de})$		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{p1} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + L_{pl} + ((1 + f_{pl,PTSF})/2) + L_{de}]/L_{t}$	42.7	
Level of Service and Other Performance Measures ⁴	- AMECANA - AMACANA	
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	TANA PARA PARA PARA PARA PARA PARA PARA P
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	2.3	
Bicycle Level of Service	and the second s	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	385.7	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.54	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

General Information	Site Information	
Analyst David Stoner	Highway of Travel	US 2
Agency or Company DOWL HKM Date Performed 11/15/2011	From/To Jurisdiction	Columbia F to Hungry H WB
Analysis Time Period Median Off-Peak	Analysis Year	Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Pla¼¼¥B		
nput Data		
Class I highway Class II highway Class III	l highway	
← Opposing direction ←		
Analysis direction		
L _{II} L _{pl} L _{de} L _d		
ļ.,	Show Hai	lh Anon
Shoulder width (ft)		1.0
Lane Width (ft)		12.0
Segment Length (mi)		1.8
Fotal length of analysis segment, $\mathbf{L_t}$		1.8
ength of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}		0.0
ength of passing lane including tapers , L _{p!}		1.1
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		46.4
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		
Segment Worksheet)		65.1
evel of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Vorksheet)		С
Average Travel Speed		
ength of the downstream highway segment within the effective length of bassing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing ane for avg travel speed, $L_d L_d = L_f - (L_u + L_{gl} + L_{de})$		-1.00
adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-18)		1.10
average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L_l) /		
$L_{u}^{+}L_{d}^{+}(L_{pl}/f_{pl})^{+}$ (2L _{de} /(1+f _{pl,ATS})))	100	50.7
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)		90.5
Percent Time-Spent-Following	100/000-	
ength of the downstream highway segment within the effective length of		
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		8.03
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,		7.22
$_{\rm d}$ =L _i -(L _u + L _{pi} + L _{de})		-7.33

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%) $PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	40.1	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	3.1	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	343.8	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.48	
Bicycle level of service (Exhibit 15-4)	E	
Notes		

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^{3.} If L_d <0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak Project Description: US 2 Pedroit Convent Consider PloY/VR	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor PlaÝ(¥B Input Data		
Class I highway Class II highway Class III	highway	
← Opposing direction		
→ Analysis direction →		
L _{i1} L _{de} L _d		
ļ.,	Show Hath Arrow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	1.2	
Total length of analysis segment, L	1.2	
Length of two-lane highway upstream of the passing lane, $\mathbf{L}_{\mathbf{u}}$	0.0	
Length of passing lane including tapers , \boldsymbol{L}_{pl}	0.6	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	47.2	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	60.0	
Segment Worksheet)		
Level of service [†] , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	C	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.10	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.10	
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) /	<1 c	
$(L_{u}+L_{d}+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl,ATS})))$	51.5	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	90.3	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of	8.24	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, $ L_d = L_t - (L_u + L_{pl} + L_{de}) $	-7.64	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.60	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	36.4	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2) L_{de}]/L_{t}$		
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	Á	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{p1}	1.9	
Bicycle Level of Service	A CONTRACTOR OF THE CONTRACTOR	
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	332.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.46	
Bicycle level of service (Exhibit 15-4)	E	**************************************
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Plac¾iB		
Input Data		
Class I highway Class II highway Class III	highway	
← Opposing direction ←		
Analysis direction		
L _{ti} L _{de} L _{de}		
] *	Show Health Peron	
Shoulder width (ft)		
Lane Width (ft)	1.0	
Segment Length (mi)	1.8	
Total length of analysis segment, L _t	1.8	
Length of two-lane highway upstream of the passing lane, $\mathbf{L_u}$	0.0	
Length of passing lane including tapers , \mathbf{L}_{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	44.5	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	75.5	
Segment Worksheet) Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of		
passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.00	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$	48.6	
$(L_u + L_d + (L_{pl} / f_{pl}) + (2L_{de} / (1 + f_{pl,ATS})))$	10.0	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	88.3	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of	6.75	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following,	, <u>^</u>	
$L_d = L_f - (L_u + L_{pl} + L_{de})$	-6.05	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		·····
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	46.6	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	5.0	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.71	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.	A A A A A A A A A A A A A A A A A A A	
2. If L _d <0, use alternative Equation 15-18.		
2 If L <0 year oldernative Favration 45 40		

^{3.} If L_d<0, use alternative Equation 15-16.

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^{4.} v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.



Appendix 4

Operational Analysis Worksheets

2035 4-3-4 Peak Season
Four-Lane RP 140.0 – RP 140.6
Three-Lane RP 140.6 – RP 141.2
Four-Lane RP 141.2 – 142.4

Direction 1 = Eastbound

Direction 2 = Westbound

MULTILANE HIGHWAYS WORKSHEET(Direction 1)				
×				
General Information		Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035	
	ock Canyon Corridor Planning Stud			
Oper.(LOS)	<u> </u>	Des. (N)	Plan. (vp)	
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	791	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down %	0.93 6 4 Rolling 0.00 0.00	
Calculate Flow Adjus	tments	Number of Lanes	2	
f _p E _T	1.00 2.5	F _R	2.0 0.885	
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	Calc Speed Adj and I f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0	
Operations		Design		
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	480 60.0 8.0 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS		
Bicycle Level of Service				
		I		

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	425,3	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.55	
Bicycle level of service (Exhibit 15-4)	D	

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General Information Site Inform	mation
Analyst David Stoner Highway/Direct Agency or Company DOWL HKM From/To Date Performed 4/30/2012 Jurisdiction Analysis Time Period AM Peak	tion to Travel US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description US 2 Badrock Canyon Corridor Planning Study	
Flow Inputs	Plan. (vp)
Volume, V (veh/h) 502 Peak-Hour Fact AADT(veh/h) %Trucks and Bound Peak-Hour Prop of AADT (veh/d) %RVs, P _R Peak-Hour Direction Prop, D General Terrain DDHV (veh/h) Grade Lengt	uses, P _T 6 4 1: Rolling 1h (mi) 0.00 10 0.00
Calculate Flow Adjustments	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2.0 0.885 ed Adj and FFS
Lane Width, LW (ft) 12.0 f _{LW} (mi/h) Total Lateral Clearance, LC (ft) 12.0 f _{LC} (mi/h) Access Points, A (A/mi) 0 f _A (mi/h) Median Type, M f _A (mi/h) f _A (mi/h) FFS (measured) 60.0 f _M (mi/h) Base Free-Flow Speed, BFFS FFS (mi/h)	60.0
Operations Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) 5.4 LOS D esign (N) Required Numb Flow Rate, v _p (p Max Service Flo Design LOS	·
Bicycle Level of Service	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	288.5	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.36	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)				
×				
General Information		Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off Peak Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035	
Project Description US 2 Badr				
Oper.(LOS)	ľ	Des. (N)	Plan. (vp)	
Flow Inputs				
Volume, V (veh/h) AADT(veh/h)	704	Peak-Hour Factor, PHF %Trucks and Buses, P _T	0.91 6	
Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	1.00	%RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	4 Rolling 0.00 0.00 2	
Calculate Flow Adjus	stments	Hamber of Editos		
f _p	1.00	E _R	2.0	
E _T	2.5	f _{HV}	0.885	
Speed Inputs		Calc Speed Adj and	FFS	
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0	
Operations		Design		
	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Design (N)		
<u>Operational (LOS)</u> Flow Rate, v _p (pc/h/ln)	437	Required Number of Lanes, N		
Speed, S (mi/h)	60.0	Flow Rate, v _p (pc/h)		
D (pc/mi/ln)	7.3	Max Service Flow Rate (pc/h/ln)		
LOS	A	Design LOS		
Bicycle Level of Service				
			- 1133	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	386.8	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.51	
Bicycle level of service (Exhibit 15-4)	D	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)				
×				
General Information		Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off Peak Peak ock Canyon Corridor Planning St	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035	
Coper.(LOS)		Des. (N)	Plan. (vp)	
Flow Inputs				
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h)	,	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi)	0.89 6 4 Rolling 0.00	
Driver Type Adjustment Calculate Flow Adjus	1.00	Up/Down % Number of Lanes	0.00	
f _p	1.00	E _R	2.0	
E _T	2.5	f _{HV}	0.885	
Speed Inputs		Calc Speed Adj and	FFS	
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0	
Operations		Design		
<u>Operational (LOS)</u> Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	389 60.0 6.5 A	<u>Design (N)</u> Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS		
Bicycle Level of Service				
		1	ļ	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	344,9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.45	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)				
×				
General Information		Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035	
·	rock Canyon Corridor Planning St			
Oper.(LOS)		Des. (N)	Plan. (vp)	
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/o Peak-Hour Direction Prop, D DDHV (veh/h)	586 i)	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain:	0.89 6 4 Rolling	
Driver Type Adjustment	1.00	Grade Length (mi) Up/Down % Number of Lanes	0.00 0.00 2	
Calculate Flow Adjus				
f _p E _T	1.00 2.5	E _R	2.0 0.885	
	2.0	f _{HV}		
Speed Inputs	40.0	Calc Speed Adj and	FF3	
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 62.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	62.0	
Operations		Design		
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	372 60.0 6.2 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS		
Bicycle Level of Service				

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	329.2	
Effective width, W _v (Eq. 15-29) ft	24,00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.42	
Bicycle level of service (Exhibit 15-4)	c	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)				
×				
General Information		Site Information		
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035	
	ock Canyon Corridor Planning Stu			
Oper.(LOS)		Des. (N)	Plan. (vp)	
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	981	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down %	0.91 6 4 Rolling 0.00 0.00	
Calculate Flow Adjus	stments	Number of Lanes	2	
f _p Ε _τ	1.00 2.5	E _R	2.0 0.885	
Speed Inputs		Calc Speed Adj and I	FFS	
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0	
Operations		Design		
<u>Operational (LOS)</u> Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	609 60.0 10.1 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS		
Bicycle Level of Service	10.000			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.0	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.67	
Bicycle level of service (Exhibit 15-4)	D	

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WORKSHEET General Information Site Information		
Analyst David Stoner	Highway of Travel	US 2
Agency or Company DOWL HKM Date Performed 11/15/2011	From/To	Columbia F to Hungry H EB
Date Performed 11/15/2011 Analysis Time Period AM Peak	Jurisdiction Analysis Year	Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Pla=â		2000
Input Data		
Class I highway Class II highway Class II	l highway	
✓ Opposing direction ✓	- 	
—→ Analysis direction —→		
L _{II} L _{pl} L _{de} L _d		
ļ,	Show Hardi	Anon
Shoulder width (ft)		1.0
Lane Width (ft)		12.0
Segment Length (mi)		1.2
Fotal length of analysis segment, $\boldsymbol{\mathrm{L}}_{\mathrm{t}}$		1.2
Length of two-lane highway upstream of the passing lane, $\boldsymbol{L}_{\boldsymbol{u}}$		0.0
Length of passing lane including tapers , \boldsymbol{L}_{pl}		0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		41.8
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		04.6
Segment Worksheet)		84.6
evel of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		D
Average Travel Speed		
ength of the downstream highway segment within the effective length of bassing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing ane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$		-1.10
Adj. factor for the effect of passing lane on average speed, $f_{ m pl}$ (Exhibit 15-8)		1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$		
$L_{u}^{+}L_{d}^{+}(L_{pl}^{-}/f_{pl}^{-})^{+}(2L_{de}^{-}/(1+f_{pl,ATS})))$		46.0
Percent free flow speed including passing lane, $PFFS_{p!} = (ATS_{p!} / FFS)$		83.6
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of		
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		4.64
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,		-4.04
$d = L_t - (L_u + L_{pl} + L_{de})$:	

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	53.5	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + L_{pl} + ((1 + f_{pl,PTSF})/2) L_{de}]/L_{t}$		
Level of Service and Other Performance Measures ⁴		
Level of service Including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	5.5	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	850.5	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S ₁ (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.94	
Bicycle level of service (Exhibit 15-4)	F	
Notes		, , , , , , , , , , , , , , , , , , , ,
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If L _d <0, use alternative Equation 15-18.	•	
3. If L _d <0, use alternative Equation 15-16.		
4. v/c, VMT ₁₅ and VMT ₆₀ are calculated on Directional Two-Lane Highway Segment W	orksheet.	

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DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak Project Description: US 2 Badrock Canyon Corridor Pla 4	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Input Data		
Class I highway Class II highway Class III	highway	
← Opposing direction		
Analysis direction		
L _{II} L _{pl} L _{de} L _d	Strow Heath Fuow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	1.8	
Total length of analysis segment, $\mathbf{L_t}$	1.8	
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0	
Length of passing lane including tapers , L _{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	41.9	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	70.5	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{\rho l} + L_{de})$	-1.00	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.11	
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _t) / $(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	46.1	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	83.8	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	6.63	
Length of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,	-5.93	
$L_{d} = L_{l} \cdot (L_{u} + L_{pl} + L_{de})$		
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	43.6	
$PTSF_{pl} = PTSF_{d} \{ L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2) L_{de} \} / L_{l}$ Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	5.5	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	559.8	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.73	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla:i		
Input Data		
Class I highway 🧖 Class II highway 🗖 Class III	l highway	
← Opposing direction ←		
→ Analysis direction →		
L _{ii} L _{de} L _d	Show Heath Arrow	
Shoulder width (ft)		
Lane Width (ft)	1.0	
Segment Length (mi)	12.0	
Total length of analysis segment, L _t	1.2	
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0	
Length of passing lane including tapers , L _{pl}	0.6	
Average travel speed, ${ m ATS}_{ m d}$ (from Directional Two-Lane Highway Segment Worksheet)	42.7	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	81.6	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.10	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.11	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_{d}^{+}L_{t})$ /	47.0	
(L _u +L _d +(L _p /f _{pl})+ (2L _{de} /(1+f _{pl,ATS})))	02.0	
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	83.8	
Percent Time-Spent-Following Length of the downstream highway segment within the effective length of		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	5.18	
Length of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,	-4.58	
$L_{d} = L_{t} \cdot (L_{u} + L_{pl} + L_{de})$		
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	51.5	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	4.9	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	773.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _{f.} (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.89	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{2.} If L_d <0, use alternative Equation 15-18.

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Plag\$ Input Data		
Class I highway Class II highway Class III	highway	
← Opposing direction ←		
Analysis direction L _{II} L _{pl} L _{de} L _d		
ļ,	Snow Reath Anon	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	1.8	
Total length of analysis segment, L _t	1.8	
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0	
Length of passing lane including tapers , \boldsymbol{L}_{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	42.9	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	76.6	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.00	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.11	
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d ⁴ L _l) / $(L_u + L_d + (L_p / f_{pl}) + (2L_{de} / (1 + f_{pl,ATS})))$	47.3	
Percent free flow speed including passing lane, PFFS _{ol} = (ATS _{ol} /FFS)	84.3	
Percent Time-Spent-Following	91.7	
Length of the downstream highway segment within the effective length of		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	5.89	
Length of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,	-5.19	
$L_{d} = L_{1} - (L_{u} + L_{p1} + L_{de})$	5.12	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	47.4	
$PTSF_{pl} = PTSF_{d}[L_u + L_d + f_{pl,PTSF} + f_{pl,PTSF}]/2)L_{de}]/L_t$		
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	6.3	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	662.2	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.81	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
1. If LOS _d =F, passing lane analysis cannot be performed.		
2. If L _d <0, use alternative Equation 15-18.		
3. If L _d <0, use alternative Equation 15-16.		
4. v/c, VMT ₁₅ and VMT ₆₀ are calculated on Directional Two-Lane Highway Segment W	orksheet.	

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WORKSHEET General Information Site Information		
Analyst David Stoner	Site Information Highway of Travel	US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H EB
Date Performed 11/15/2011 Analysis Time Period PM Peak	Jurisdiction Analysis Year	Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Pla2j	Principals Teal	2033
Input Data		
Class highway Class Highway Class	l highway	
✓ Opposing direction		
Analysis direction —>		
L _u L _{pl} L _{de} L _d		
ŗ,	Show Heath A	Now
Shoulder width (ft)		1.0
Lane Width (ft)		12.0
Segment Length (mi)		1.2
l'otal length of analysis segment, L _t		1.2
Length of two-lane highway upstream of the passing lane, $\boldsymbol{L_u}$		0.0
Length of passing lane including tapers , L _{pl}		0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		42.1
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		75.1
Segment Worksheet)		75.4
.evel of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		D
Average Travel Speed		
ength of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing ane for avg travel speed, $L_d L_d = L_t - (L_u + L_{pl} + L_{de})$		-1.10
dj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-8)		1.11
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L_t) /		
$L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl,ATS}))$)		46.3
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)		81.1
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of		5.03
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		5.92
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following,		-5.32
$L_{d} = L_{l} - (L_{u} + L_{pl} + L_{de})$		

f _{pl,PTSF} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	46.7	
$PTSF_{\rho l} = PTSF_{d} \left\{ L_{u} + L_{d} + f_{\rho l, PTSF} L_{\rho l} + ((1 + f_{\rho l, PTSF})/2) L_{de} \right\} L_{l}$	40.7	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pf} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	4.3	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	658.4	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.81	
Bicycle level of service (Exhibit 15-4)	F	
Notes		
	F	7

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET	
General Information	Site Information
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035
Project Description: US 2 Badrock Canyon Corridor Pla¥7B	
Input Data	
Class I highway	highway
← Opposing direction ←	
Analysis direction —>	
L _{tt} L _{de} L _d	
Γ 4,	Show Heath Anow
Shoulder width (ft)	1.0
Lane Width (ft)	12.0
Segment Length (mi)	1.8
Total length of analysis segment, L _t	1.8
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0
Length of passing lane including tapers , L _{pl}	I.I
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	39.7
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	88.9
Segment Worksheet)	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	Е
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d L_d = L_t - $(L_u$ + L_{pl} + L_{de})	-1.00
Adj. factor for the effect of passing lane on average speed, ${\sf f_{\rm pl}}$ (Exhibit 15-28)	I.H
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_t) /$	
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$	43.7
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	79.4
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	3.60
Length of two-lane highway downstream of effective length of the passing	
ane for percent-time-following, L _d =L _t -(L _u + L _{pl} + L _{de})	-2.90
a tru plade	

f _{pl,PTSF} (Exhibit 15-26)	0.62	
Percent time-spent-following including passing lane ³ , PTSF _{pt} (%)		
PTSF _{pl} = PTSF _d [L _u +L _d +f _{pl,PTSF} L _{pl} +((1+f _{pl,PTSF})/2)L _{de}]/L _t	56.4	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	C	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	10.8	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	1046.2	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	6.04	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.



Appendix 4

Operational Analysis Worksheets

2035 4-3-4 Adjusted Annual Average Four-Lane RP 140.0 – RP 140.6 Three-Lane RP 140.6 – RP 141.2 Four-Lane RP 141.2 – 142.4

Direction 1 = Eastbound

Direction 2 = Westbound

MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description US 2 Bad			
Oper.(LOS)		Des. (N)	Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d) Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	398 I) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.93 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _p E _T	1.00 2.5	E _R f _{hV}	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	241 60.0 4.0 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			
I		1	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	214.0	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.21	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak ock Canyon Corridor Planning St	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description 03 2 Badi		Des. (N)	Plan. (vp)
Flow Inputs		D03. (N)	rtan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	250) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down %	0.87 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments	Number of Lanes	2
f _ρ Ε _Τ	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	Transport of the State of the S
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	162 60.0 2.7 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	143.7	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.00	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period Project Description US 2 Badr	David Stoner DOWL HKM 4/30/2012 Median Off-Peak ock Canyon Corridor Planning Stud	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Coper.(LOS)	• • • • • • • • • • • • • • • • • • • •	es. (N)	Plan. (vp)
Flow Inputs			, F/
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d	351	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R	0.91 6 4
Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	1.00	General Terrain: Grade Length (mi) Up/Down % Number of Lanes	Rolling 0.00 0.00 2
Calculate Flow Adjus	tments		
f _p E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	217 60.0 3.6 A	<u>Design (N)</u> Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	192.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.15	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period Project Description US 2 Badr	David Stoner DOWL HKM 4/30/2012 Median Off-Peak ock Canyon Corridor Planning Stu	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Coper.(LOS)		Des. (N)	Plan. (vp)
Flow Inputs			
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	306) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down %	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tmonte	Number of Lanes	2
f _p E _T	1.00	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	194 60.0 3.2 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			
I		I	

Directional demand flow rate in outside lane, $v_{ m OL}$ (Eq. 15-24) veh/h	171.9
Effective width, W _v (Eq. 15-29) ft	24.00 ,
Effective speed factor, S _t (Eq. 15-30)	4.79
Bicycle level of service score, BLOS (Eq. 15-31)	3.09
Bicycle level of service (Exhibit 15-4)	C

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description US 2 Badr	ock Canyon Corridor Plannir	<u> </u>	- Process
Flow Inputs		Des. (N)	Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	296) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments	***************************************	
f _p E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 62.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	62.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	187 60.0 3.1 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln Design LOS	n)
Bicycle Level of Service			120-02-20-00-00-00-00-00-00-00-00-00-00-0
		I	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	166.3	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.08	
Bicycle level of service (Exhibit 15-4)	С	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
[X]			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stud		
Flow Inputs	J L	Des. (N)	Plan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	491 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down %	0.91 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments	Number of Lanes	2
f _ρ E _T	1.00	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	304 60.0 5.1 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			***************************************

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	269.8	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.32	
Bicycle level of service (Exhibit 15-4)	C	

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DIRECTIONAL TWO-LANE HIGHWAY SEG WORK	MENT WORKSHEE SHEET	ET WITH PASSING LAN
General Information	Site Information	
Analyst David Stoner	Highway of Travel	US 2
Agency or Company DOWL HKM Date Performed 11/15/2011	From/To Jurisdiction	Columbia F to Hungry H EB
Analysis Time Period AM Peak	Analysis Year	Flathead County 2035
Project Description: US 2 Badrock Canyon Corridor Plaò ² ¤B		
Input Data		
Class I highway Class II highway Class II	l highway	
← Opposing direction ←		
Analysis direction		
L _{II} L _{do} L _d)
le		/
<u> </u>	Show Horth Art	ow
Shoulder width (ft)		1.0
Lane Width (ft)		12.0
Segment Length (mi)		1.2
Total length of analysis segment, L _t		1.2
Length of two-lane highway upstream of the passing lane, $\mathbf{L}_{\mathbf{u}}$		0.0
Length of passing lane including tapers, Lpl		0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		45.3
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		
Segment Worksheet)		70.4
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		D
Average Travel Speed		
ength of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing		
ane for avg travel speed, L _d L _d =L _t -(L _u +L _{pl} + L _{de})		-1.10
Adj. factor for the effect of passing lane on average speed, f _{p!} (Exhibit 15-		1.10
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L_t) /		
$L_{u}+L_{d}+(L_{p} f_{p!})+(2L_{de}/(1+f_{p!,ATS}))$		49.5
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)		89.9
Percent Time-Spent-Following		
ength of the downstream highway segment within the effective length of		
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		7.49
ength of two-lane highway downstream of effective length of the passing		35000 CO. C.
ane for percent-time-following,		-6.89
-d = L _t -(L _u + L _{pl} + L _{de})		-0.07
dj. factor for the effect of passing lane on percent time-spent-following,		

43.5 B
В
В
2.6
428.0
13.00
4.79
5.59
F

If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LAND WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period AM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla?*B		
Input Data		
Class I highway Class II highway Class III	highway	
Analysis direction		
L _{ii} L _{pl} L _{do} L _d	Strow Heath Purow	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	1.8	
Total length of analysis segment, L _t	1.8	
Length of two-lane highway upstream of the passing lane, $\boldsymbol{L}_{\boldsymbol{u}}$	0.0	
Length of passing lane including tapers , L _{pl}	1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	45.9	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway Segment Worksheet)	56.6	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	C	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d L_d = L_l \cdot (L_u + L_{pl} + L_{de})$	-1.00	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.10	
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$	50.1	
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$ Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	91.0	
	71.0	
Percent Time-Spent-Following ength of the downstream highway segment within the effective length of		
- , ,	9.99	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		
ength of two-lane highway downstream of effective length of the passing		
ane for percent-time-following, L _d =L _t -(L _u + L _{pl} + L _{de})	-9.29	
a tru pi ge/		

pl,PTSF(Exhibit 15-26)	0.60	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
PTSF _{p!} = PTSF _d [L _u +L _d +f _{p!,PTSF} L _{p!} +((1+f _{p!,PTSF})/2)L _{de})/L _t	34.3	
evel of Service and Other Performance Measures ⁴		
evel of service including passing lane LOS _{pl} (Exhibit 15-3)	A	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	2.5	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	279.3	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	,
Bicycle level of service score, BLOS (Eq. 15-31)	5.37	
Bicycle level of service (Exhibit 15-4)	E	
Votes		

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

General Information	SHEET	
Analyst David Stoner	Site Information Highway of Travel	US 2
Agency or Company DOWL HKM	From/To	Columbia F to Hungry H EB
Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Jurisdiction	Flathead County
Project Description: US 2 Badrock Canyon Corridor Pla×A¥B	Analysis Year	2035
Input Data		
Class I highway Class II highway Class III	highway	
← Opposing direction ←		
→ Analysis direction →		
L_{II} L_{pl} L_{de} L_{d}		
ļ,	Show Hath A	non
Shoulder width (ft)		1.0
ane Width (ft)		12.0
Segment Length (mi)		1.2
Fotal length of analysis segment, $\mathbf{L}_{\mathbf{t}}$		1.2
ength of two-lane highway upstream of the passing lane, $\mathbf{L}_{\mathbf{u}}$		0.0
ength of passing lane including tapers , \mathbf{L}_{pf}		0.6
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Vorksheet)		46.3
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway		60.5
egment Worksheet)		69.5
evel of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Vorksheet)		С
Average Travel Speed		
ength of the downstream highway segment within the effective length of easing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70
ength of two-lane highway downstream of effective length of the passing		-1.10
ane for avg travel speed, L _d L _d =L _t -(L _u +L _{pl} + L _{de})		-1.10
dj. factor for the effect of passing lane on average speed, ${\sf f_{\rm pl}}$ (Exhibit 15-8)		1.10
werage travel speed including passing lane ² , $ATS_{pl} = (ATS_d^* L_l)$		
$L_{u}^{+}L_{d}^{+}(L_{\rho l}/f_{\rho l})^{+}$ (2 $L_{de}^{l}(1+f_{\rho l,ATS})$))		50.5
ercent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)		90.2
ercent Time-Spent-Following		
ength of the downstream highway segment within the effective length of	and the second s	
assing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		7.71
ength of two-lane highway downstream of effective length of the passing		
ne for percent-time-following,		-7.11
$_{d} = L_{t} - (L_{u} + L_{pl} + L_{de})$		

f _{pl,PTSE} (Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pt} (%)	42.9	
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2) L_{de}]/L_{l}$		
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	2.3	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	385.7	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.54	
Bicycle level of service (Exhibit 15-4)	F	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET			
General Information	Site Information		
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period Median Off-Peak	Highway of Travel From/To Jurisdiction Analysis Year	US 2 Columbia F to Hungry H WB Flathead County 2035	
Project Description: US 2 Badrock Canyon Corridor Plaqõ¥B			
Input Dala			
Class I highway Class II highway Class III	highway		
← Opposing direction ←			
Analysis direction ——>			
L _{t1} L _{de} L _d			
ļ.	Snow Haith Anow		
Shoulder width (ft)	AWAR	1.0	
Lane Width (ft)		12.0	
Segment Length (mi)		1.8	
Total length of analysis segment, L		1.8	
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}		0.0	
Length of passing lane including tapers , L _{p!}		1.1	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)		46.5	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway			
Segment Worksheet)		63.9	
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)		C	
Average Travel Speed			
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)		1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d L_d = L_t - $(L_u$ + L_{pl} + L_{de})		-1.00	
Adj. factor for the effect of passing lane on average speed, ${\sf f_{ m pl}}$ (Exhibit 15-28)		1.10	
Average travel speed including passing lane ² , $ATS_{p!} = (ATS_d^* L_t) / ($		50.8	
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1 + f_{pl,ATS})))$			
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)		90.6	
Percent Time-Spent-Following		and the second s	
ength of the downstream highway segment within the effective length of		e 20	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		8.20	
ength of two-lane highway downstream of effective length of the passing.			
ane for percent-time-following, L _d =L _t -(L _u + L _{pt} + L _{de})		7.51	
d t'u pl de/	4.5.000		

p _{I,PTSF} (Exhibit 15-26)	0.60	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)	38.8	NAME OF THE PROPERTY OF THE PR
PTSF _{pl} = PTSF _d [L _u +L _d +f _{pl,PTSF} L _{pl} +((1+f _{pl,PTSF})/2)L _{de}]/L _l Level of Service and Other Performance Measures ⁴	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	A	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	3.0	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	333.7	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.47	
Bicycle level of service (Exhibit 15-4)	E	
Votes		.,

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET		
General Information	Site Information	
Analyst David Stoner Agency or Company DOWL HKM Dale Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H EB Jurisdiction Flathead County Analysis Year 2035	
Project Description: US 2 Badrock Canyon Corridor Pla		
Input Data		
Class I highway P Class II highway Class III	highway	
✓ Opposing direction ✓		
Analysis direction		
L _{II} L _{de} L _d		
Į.,	Show Heath Auon	
Shoulder width (ft)	1.0	
Lane Width (ft)	12.0	
Segment Length (mi)	1.2	
Total length of analysis segment, $\mathbf{L_{t}}$	1.2	
Length of two-lane highway upstream of the passing lane, $\mathbf{L}_{\mathbf{u}}$	0.0	
Length of passing lane including tapers , \boldsymbol{L}_{pl}	0.6	
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	47.2	
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	60.2	
Segment Worksheet)		
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	c	
Average Travel Speed		
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70	
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d = L_t - (L_u + L_p) + L_{de}$)	-1.10	
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15-28)	1.10	
Average travel speed including passing lane ² , $ATS_{p1} = (ATS_d^* L_l) / I$	51.5	
$(L_{u}+L_{d}+(L_{\rho l}/f_{\rho l})+(2L_{de}/(1+f_{\rho l,ATS})))$		
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} /FFS)	90.3	
Percent Time-Spent-Following		
Length of the downstream highway segment within the effective length of	8.24	
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)		
Length of two-lane highway downstream of effective length of the passing		
lane for percent-time-following, $L_d = L_l^-(L_u^+ \; L_{pl}^+ \; L_{de})$	-7.64	
Adj. factor for the effect of passing lane on percent time-spent-following,		

f _{pl,PTSF} (Exhibit 15-26)	0.60	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%) $PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} + L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	36.6	
Level of Service and Other Performance Measures ⁴		
Level of service including passing lane LOS _{pl} (Exhibit 15-3)	A	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	1.9	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	332.6	
Effective width, W _v (Eq. 15-29) ft	13.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	5.46	
Bicycle level of service (Exhibit 15-4)	E	
Notes		

^{1.} If LOS_d=F, passing lane analysis cannot be performed.

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^{2.} If L_d <0, use alternative Equation 15-18.

^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET			
General Information	Site Information		
Analyst David Stoner Agency or Company DOWL HKM Date Performed 11/15/2011 Analysis Time Period PM Peak	Highway of Travel US 2 From/To Columbia F to Hungry H WB Jurisdiction Flathead County Analysis Year 2035		
Project Description: US 2 Badrock Canyon Corridor Play¢B			
Input Data			
Class I highway Class II highway Class III	highway		
← Opposing direction ←			
Analysis direction			
L _{tt} L _{de} L _d			
[l] [l]	Show Heath Anon		
Shoulder width (ft)	1.0		
Lane Width (ft)	12.0		
Segment Length (mi)	1.8		
Total length of analysis segment, L _t	1.8		
Length of two-lane highway upstream of the passing lane, \boldsymbol{L}_{u}	0.0		
Length of passing lane including tapers , L _{pl}	1.1		
Average travel speed, ATS _d (from Directional Two-Lane Highway Segment Worksheet)	44.6		
Percent time-spent-following, PTSF _d (from Directional Two-Lane Highway	74.6		
Segment Worksheet)	7110		
Level of service ¹ , LOS _d (from Directional Two-Lane Highway Segment Worksheet)	D		
Average Travel Speed			
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L _{de} (Exhibit 15-23)	1.70		
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, $L_d = L_l - (L_u + L_{pl} + L_{de})$	-1.00		
Adj. factor for the effect of passing lane on average speed, f _{pl} (Exhibit 15- 28)	1.10		
Average travel speed including passing lane ² , ATS _{pl} = (ATS _d * L _l) /			
$(L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl,ATS})))$	48.7		
Percent free flow speed including passing lane, PFFS _{pl} = (ATS _{pl} / FFS)	88,5		
Percent Time-Spent-Following			
Length of the downstream highway segment within the effective length of	Z 00		
passing lane for percent time-spent-following, L _{de} (Exhibit 15-23)	6.89		
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following,			
$L_{d} = L_{l} - (L_{u} + L_{pl} + L_{de})$	-6.19		
Adj. factor for the effect of passing lane on percent time-spent-following,			

ol, PTSF(Exhibit 15-26)	0.61	
Percent time-spent-following including passing lane ³ , PTSF _{pl} (%)		
$PTSF_{pl} = PTSF_{d}[L_{u} + L_{d} + f_{pl,PTSF} L_{pl} + ((1 + f_{pl,PTSF})/2)L_{de}]/L_{t}$	46.1	
evel of Service and Other Performance Measures ⁴		
evel of service including passing lane LOS _{pl} (Exhibit 15-3)	В	
Peak 15-min total travel time, TT ₁₅ (veh-h) TT ₁₅ = VMT ₁₅ /ATS _{pl}	4.8	
Bicycle Level of Service		
Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	523.1	
ffective width, W _v (Eq. 15-29) ft	13.00	
iffective speed factor, S _t (Eq. 15-30)	4.79	
licycle level of service score, BLOS (Eq. 15-31)	5.69	
Sicycle level of service (Exhibit 15-4)	F	
loles		

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^{3.} If L_d<0, use alternative Equation 15-16.

^{4.} v/c, VMT₁₅ and VMT₆₀ are calculated on Directional Two-Lane Highway Segment Worksheet.



Appendix 4

Operational Analysis Worksheets

2035 Four-Lane Peak Season

Direction 1 = Eastbound

Direction 2 = Westbound

MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stud		
Oper.(LOS)	J	Des. (N)	Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	791) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.93 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _p E _T Speed Inputs	1.00 2.5	E _R f _{HV} Calc Speed Adj and I	2.0 0.885
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/ml) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	480 60.0 8.0 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			
		I	j

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	425,3	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.55	
Bicycle level of service (Exhibit 15-4)	D	

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General Information Site Information	
Agency or Company DOWL HKM From/To CO Date Performed 4/30/2012 Jurisdiction F Analysis Time Period AM Peak Analysis Year 2:	IS 2 Columbia Falls to Hungry Horse lathead County 035
Project Description US 2 Badrock Canyon Corridor Planning Study	
Flow Inputs	Plan. (vp)
Volume, V (veh/h) 502 Peak-Hour Factor, PHF 0 AADT(veh/h) %Trucks and Buses, P _T 6 Peak-Hour Prop of AADT (veh/d) %RVs, P _R 4 Peak-Hour Direction Prop, D General Terrain: R DDHV (veh/h) Grade Length (mi) 0	Rolling 1.00
Calculate Flow Adjustments	
	.0 .885
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) 12.0 f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h)	0.0
Operations Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) 5.4 LOS Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	288.5	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.36	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off Peak Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
Project Description US 2 Badr	ock Canyon Corridor Planning		
Oper.(LOS)		Des. (N)	Plan. (vp)
Volume, V (veh/h) AADT(veh/h)	704	Peak-Hour Factor, PHF %Trucks and Buses, P _T	0.91 6
Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	1.00	%RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	4 Rolling 0.00 0.00 2
Calculate Flow Adjus	stments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
<u>Operational (LOS)</u> Flow Rate, v _p (pc/h/ln) Speed, S (mi/h)	437 60.0	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h)	
D (pc/mi/ln) LOS	7.3 A	Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	386.8	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	1101111
Bicycle level of service score, BLOS (Eq. 15-31)	3.51	
Bicycle level of service (Exhibit 15-4)	D	*****

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General Information Site Information	
Analyst David Stoner Agency or Company DOWL HKM Highway/Direction to Travel US 2 From/To Columbia Falls to Hungry H Date Performed 4/30/2012 Jurisdiction Flathead County Analysis Time Period Median Off Peak Peak Analysis Year 2035	rse
Project Description US 2 Badrock Canyon Corridor Planning Study	
Coper.(LOS) Des. (N) Plan. (vp)	
Volume, V (veh/h) 614 Peak-Hour Factor, PHF 0.89 AADT(veh/h) %Trucks and Buses, P _T 6 Peak-Hour Prop of AADT (veh/d) %RVs, P _R 4 Peak-Hour Direction Prop, D General Terrain: Rolling DDHV (veh/h) Grade Length (mi) 0.00 Driver Type Adjustment 1.00 Up/Down % 0.00 Number of Lanes 2	
Calculate Flow Adjustments	
fp 1.00 ER 2.0 ET 2.5 fHV 0.885 Speed Inputs Calc Speed Adj and FFS	
Lane Width, LW (ft) 12.0 f _{LW} (mi/h) Total Lateral Clearance, LC (ft) 12.0 f _{LC} (mi/h) f _{LC} (mi/h)	
Operations Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) 389 Speed, S (mi/h) 60.0 D (pc/mi/ln) 6.5 LOS A Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service	

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	344,9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.45	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
·	rock Canyon Corridor Planning St		
Oper.(LOS)		Des. (N)	Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/o Peak-Hour Direction Prop, D DDHV (veh/h)	586 i)	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain:	0.89 6 4 Rolling
Driver Type Adjustment	1.00	Grade Length (mi) Up/Down % Number of Lanes	0.00 0.00 2
Calculate Flow Adjus			
f _p E _T	1.00 2.5	E _R	2.0 0.885
	2.0	f _{HV}	
Speed Inputs	40.0	Calc Speed Adj and	FF3
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 62.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	62.0
Operations		Design	111111111111111111111111111111111111111
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	372 60.0 6.2 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	329.2	
Effective width, W _v (Eq. 15-29) ft	24,00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.42	
Bicycle level of service (Exhibit 15-4)	C	MW

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General Information Analyst Agency or Company Dowl HKM Date Performed Analysis Time Period Project Description US 2 Badrock Canyon Corridor Planning Study Coper.(LOS) Plan. (vp) Flow Inputs Volume, V (veh/h) AADT(veh/h) Site Information Highway/Direction to Travel US 2 From/To Columbia Falls to Hungry Jurisdiction Flathead County Analysis Year 2035 Plan. (vp) Flow Inputs Volume, V (veh/h) 981 Peak-Hour Factor, PHF 0.91 AADT(veh/h) %Trucks and Buses, P _T 6	MULTILANE HIGHWAYS WORKSHEET(Direction 2)				
Analyst David Stoner Agency or Company DOWL HKM Date Performed 4/30/2012 Jurisdiction Flathead County Analysis Time Period PM Peak Project Description US 2 Badrock Canyon Corridor Planning Study Coper.(LOS) Desc. (N) Plan. (vp) Flow Inputs Volume, V (veh/h) 981 Peak-Hour Factor, PHF 0.91		•			[]
Agency or Company DOWL HKM From/To Columbia Falls to Hungry Date Performed 4/30/2012 Jurisdiction Flathead County Analysis Time Period PM Peak Project Description US 2 Badrock Canyon Corridor Planning Study Oper.(LOS) Des. (N) Plan. (vp)	General Information Site Information				
Coper.(LOS) Des. (N) Plan. (vp) Flow Inputs Volume, V (veh/h) 981 Peak-Hour Factor, PHF 0.91	Horse	Columbia Falls to Hungry Ho Flathead County	From/To Jurisdiction Analysis Year	DOWL HKM 4/30/2012 PM Peak	Agency or Company Date Performed Analysis Time Period
Flow Inputs Volume, V (veh/h) 981 Peak-Hour Factor, PHF 0.91					
Volume, V (veh/h) 981 Peak-Hour Factor, PHF 0.91		l Plan (vp)	Des. (N)		
Peak-Hour Prop of AADT (veh/d) %RVs, P _R 4 Peak-Hour Direction Prop, D General Terrain: Rolling		6 4	%Trucks and Buses, P _T %RVs, P _R		Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d
DDHV (veh/h) Grade Length (mi) 0.00 Driver Type Adjustment 1.00 Up/Down % 0.00 Number of Lanes 2		0.00 0.00	Grade Length (mi) Up/Down %		DDHV (veh/h) Driver Type Adjustment
Calculate Flow Adjustments					
f_{p} 1.00 F_{R} 2.0					
E _T 2.5 f _{HV} 0.885				2.5	
Speed Inputs Calc Speed Adj and FFS		<u>FFS</u>	Calc Speed Adj and I		
Lane Width, LW (ft) 12.0		60.0	f _{LC} (mi/h) f _A (mi/h) f _M (mi/h)	12.0	Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured)
Operations Design			Design		Operations
Operational (LOS) Flow Rate, v _p (pc/h/ln) 609 Speed, S (mi/h) 60.0 D (pc/mi/ln) 10.1 LOS A Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	111100		Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln)	60.0 10.1	Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln)
Bicycle Level of Service					Bicycle Level of Service

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	539.0	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.67	
Bicycle level of service (Exhibit 15-4)	D	

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Appendix 4

Operational Analysis Worksheets

2035 Four-Lane Adjusted Annual Average

Direction 1 = Eastbound

Direction 2 = Westbound

MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 AM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stu		
Flow Inputs	1 [Des. (N)	Plan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d) Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	398) 1.00	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.93 6 4 Rolling 0.00 0.00 2
Calculate Flow Adjus	tments		
f _p E _T	1.00	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 60.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	60.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	241 60.0 4.0 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	214.0	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.21	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst	David Stoner	Highway/Direction to Travel	US 2
Agency or Company	DOWL HKM	From/To	Columbia Falls to Hungry Horse
Date Performed	4/30/2012	Jurisdiction	Flathead County
Analysis Time Period	AM Peak	Analysis Year	2035
Project Description US 2 Badr	ock Canyon Corridor Planning Stud	dy	
☐ Oper.(LOS)	<u> </u>	Des. (N)	Plan. (vp)
Flow Inputs			
Volume, V (veh/h)	250	Peak-Hour Factor, PHF	0.87
AADT(veh/h)		%Trucks and Buses, P _T	6
Peak-Hour Prop of AADT (veh/d	i)	%RVs, P _R	4
Peak-Hour Direction Prop, D		General Terrain:	Rolling
DDHV (veh/h)	1.00	Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down % Number of Lanes	0.00
Calculate Flow Adjus	tments	Trumpor of Editos	4
		· · · · · · · · · · · · · · · · · · ·	00
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft)	12.0	f _{LW} (mi/h)	
Total Lateral Clearance, LC (ft)	12.0		
Access Points, A (A/mi)	0	f _{LC} (mi/h)	
Median Type, M		f _A (mi/h)	
FFS (measured)	60.0	f _M (mi/h)	
Base Free-Flow Speed, BFFS		FFS (mi/h)	60.0
Operations	- Constant of the Constant of	Design	
Operations			
Operational (LOS)		Design (N)	
Flow Rate, v _p (pc/h/ln)	162	Required Number of Lanes, N	
Speed, S (mi/h)	60.0	Flow Rate, v _p (pc/h)	
D (pc/mi/ln)	2.7	Max Service Flow Rate (pc/h/ln)	
LOS	A.	Design LOS	
H-V-V	^		
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	143.7	
Effective width, W _v (Eq. 15-29) ft	24.00	1111111111
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.00	
Bicycle level of service (Exhibit 15-4)	С	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
[
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off-Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stud		
Project Description 03 2 Bauti		Pes. (N)	Plan. (vp)
Flow Inputs	J L	700. (14)	i riali. (VP)
Volume, V (veh/h) AADT(veh/h)	351	Peak-Hour Factor, PHF %Trucks and Buses, P _T	0.91 6
Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h)		%RVs, P _R General Terrain: Grade Length (mi)	4 Rolling 0.00
Driver Type Adjustment	1.00	Up/Down % Number of Lanes	0.00
Calculate Flow Adjus	tments		
f _p	1.00	E _R	2.0
E _T	2.5	f _{HV}	0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M	12.0 12.0 0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h)	
FFS (measured) Base Free-Flow Speed, BFFS	61.0	f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
		Design (N)	***************************************
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h)	217 60.0	Required Number of Lanes, N Flow Rate, v _p (pc/h)	
D (pc/mi/ln) LOS	3.6 A	Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	192.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.15	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)			
×			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 Median Off-Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning Stu	-	mar Dian ()
Flow Inputs		Des. (N)	Plan. (vp)
Volume, V (veh/h) AADT(veh/h) Peak-Hour Prop of AADT (veh/d) Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	306	Peak-Hour Factor, PHF %Trucks and Buses, P _T %RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	0.89 6 4 Rolling 0.00 0.00
Calculate Flow Adjus	tments		
f _P E _T	1.00 2.5	E _R	2.0 0.885
Speed Inputs		Calc Speed Adj and I	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 61.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	61.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	194 60.0 3.2 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	171.9	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.09	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)			
X			
General Information		Site Information	
Analyst Agency or Company Date Performed Analysis Time Period	David Stoner DOWL HKM 4/30/2012 PM Peak	Highway/Direction to Travel From/To Jurisdiction Analysis Year	US 2 Columbia Falls to Hungry Horse Flathead County 2035
	ock Canyon Corridor Planning St		
Oper.(LOS)		Des. (N)	Plan. (vp)
Flow Inputs Volume, V (veh/h) AADT(veh/h)	296	Peak-Hour Factor, PHF %Trucks and Buses, P _r	0.89 6
Peak-Hour Prop of AADT (veh/d Peak-Hour Direction Prop, D DDHV (veh/h) Driver Type Adjustment	1.00	%RVs, P _R General Terrain: Grade Length (mi) Up/Down % Number of Lanes	4 Rolling 0.00 0.00 2
Calculate Flow Adjus	tments		***************************************
f _p E _T	1.00 2.5	E _R f _{HV}	2.0 0.885
Speed Inputs		Calc Speed Adj and	FFS
Lane Width, LW (ft) Total Lateral Clearance, LC (ft) Access Points, A (A/mi) Median Type, M FFS (measured) Base Free-Flow Speed, BFFS	12.0 12.0 0 62.0	f _{LW} (mi/h) f _{LC} (mi/h) f _A (mi/h) f _M (mi/h) FFS (mi/h)	62.0
Operations		Design	
Operational (LOS) Flow Rate, v _p (pc/h/ln) Speed, S (mi/h) D (pc/mi/ln) LOS	187 60.0 3.1 A	Design (N) Required Number of Lanes, N Flow Rate, v _p (pc/h) Max Service Flow Rate (pc/h/ln) Design LOS	
Bicycle Level of Service			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	166.3	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _f (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.08	
Bicycle level of service (Exhibit 15-4)	C	

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)				
1000				
General Information		Site Information		
Analyst	David Stoner	Highway/Direction to Travel	US 2	
Agency or Company	DOWL HKM	From/To Jurisdiction	Columbia Falls to Hungry Horse	
Date Performed Analysis Time Period	4/30/2012 PM Peak	Analysis Year	Flathead County 2035	
Project Description US 2 Badrock Canyon Corridor Planning Stud		es. (N)	☐ Plan. (vp)	
Flow Inputs	ı U	OO. (14)) Flail. (VP)	
Volume, V (veh/h)	491	Peak-Hour Factor, PHF	0.91	
AADT(veh/h)		%Trucks and Buses, P _T	6	
Peak-Hour Prop of AADT (veh/d)	%RVs, P _R	4	
Peak-Hour Direction Prop, D		General Terrain:	Rolling	
DDHV (veh/h) Driver Type Adjustment	1.00	Grade Length (mi)	0.00	
Driver Type Adjustition	1.00	Up/Down % Number of Lanes	0.00	
Calculate Flow Adjus	tments	1144111201 01 2411100		
f _p	1.00	E _R	2.0	
Ε _τ	2.5	f _{HV}	0.885	
Speed Inputs		Calc Speed Adj and I		
Lane Width, LW (ft)	12.0			
Total Lateral Clearance, LC (ft)	12.0	f _{LW} (mi/h)		
Access Points, A (A/mi)	0	f _{LC} (mi/h)		
Median Type, M	· ·	f _A (mi/h)		
FFS (measured)	60.0	f _M (mi/h)		
Base Free-Flow Speed, BFFS	00.0	FFS (mi/h)	60.0	
Operations	1	Design		
		Design		
		Design (N)		
Operational (LOS)		Required Number of Lanes, N		
Flow Rate, v _p (pc/h/ln)	304	Flow Rate, v _p (pc/h)		
Speed, S (mi/h)	60.0	Max Service Flow Rate (pc/h/ln)		
D (pc/mi/ln)	5.1	Design LOS		
LOS	Α	9		
Bicycle Level of Service				
	· · · · · · · · · · · · · · · · · · ·			

Directional demand flow rate in outside lane, v _{OL} (Eq. 15-24) veh/h	269.8	
Effective width, W _v (Eq. 15-29) ft	24.00	
Effective speed factor, S _t (Eq. 15-30)	4.79	
Bicycle level of service score, BLOS (Eq. 15-31)	3.32	
Bicycle level of service (Exhibit 15-4)	С	

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