Phase 2 Report

Butte Interstate Traffic Study

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EXECUTIVE SUMMARY

Project Background
Following the completion of the Phase 1 Report for the Butte Interstate Traffic Study, MDT elected to move forward into Phase 2. The second phase completes the comprehensive traffic engineering study of the interstate corridors within Butte by developing improvement options to address the existing deficiencies identified during Phase 1 of the study. During Phase 2 improvement options were developed, screened and prioritized ending in a final list of potential projects for the Butte Interstate system.

Phase 1 identified existing safety, operations, and geometric deficiencies for each interchange and mainline interstate segment. During Phase 2 an environmental overview scan of the study area was completed to help identify potential constraints to improvement options. The environmental scan identified the primary environmental resources that may affect development of options including, wetlands, parks and recreation, cultural and historic properties, hazardous materials, and noise.

Option Development
The option development process included developing schematic options for each interchange and identifying minor and safety type improvement elements. The minor and safety type elements included corridor wide elements and smaller type improvements for each interchange. Many of the corridor wide solutions included the use of Intelligent Transportation Systems (ITS) in combination with reduced speed limits. An option development workshop was held December 6, 2007 to review and modify the schematic options. Options were evaluated by the project team on reasonableness to address identified deficiencies.

Following the workshop 21 interchange improvement options were advanced to conceptual design. Conceptual designs were developed and reviewed at the April 16, 2008 design review meeting. At this meeting the options were screened based on both geometric and financial feasibility. A total of 17 interchange options were advanced as final options. As part of this final screening several partial improvement options were combined into complete improvement options, and many of the minor and safety type projects were combined into complete options or projects. This included ITS packages that focus on incident management, traffic management, and traveler information.

Prioritization and Final List of Potential Improvement Options
Thirty-one final improvement options were reviewed and prioritized. Improvement options were initially grouped based on anticipated implementation time frame and funding needs (near term, long range or ultimate), and then ranked against each other based on a high, medium or low priority. Prioritization was completed based on observed and potential safety issues followed by improving operations and geometry. A final list of improvement options was developed for use by MDT and Butte-Silver Bow to review developments; identify funding; program projects; and construct options to improve the Butte Interstate corridor. In addition to the final improvement options identified a list of add-on elements was completed for use by MDT. This study provides a long range planning document that is both detailed and flexible so that MDT can be ready to propose projects when funding is available.

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND AND OVERVIEW

The objective of the Butte Interstate Traffic Study is to complete a comprehensive traffic engineering study of the 12.2 mile interstate system including Interstates 15 (I-15), 90 (I-90), and 115 (I-115). The two part study includes an analysis of current and future operational, safety, and design issues of the existing interstate and interchanges (Phase 1) and development of improvement options to address existing and future deficiencies (Phase 2, this report). The Butte Interstate Traffic Study Phase 1 Report (Phase 1), completed in January 2007, identified existing deficiencies within the study area. The Montana Department of Transportation (MDT) elected to proceed with the study into the second phase to develop improvements options to address deficiencies. The study area includes the entire interstate system, and the following interchanges located in Silver Bow County and within the Butte urban limits:

- Rocker
- West Butte
- Excelsior Avenue
- Montana Street
- Harrison Avenue
- East Butte
- Continental

The scope of work for this phase includes developing schematic options, analyzing the schematic options and advancing reasonable options to conceptual design. Conceptual design of the options includes developing cost estimates, right of way requirements and potential environmental impacts. This Phase 2 Report is a summary document detailing the process to develop and prioritize options to improve safety and address deficiencies identified in Phase 1.

1.2 PROJECT GOALS AND INTENT OF PLAN

The goal of the project is to complete a comprehensive traffic engineering study for the Butte Interstate system. The final Phase 2 Report will provide a long-range planning document for use by the MDT, the Butte-Silver Bow local government, other governmental agencies and potential developers. This study includes a final list of potential improvement options that address all or most of the deficiencies at a specific site. MDT can identify potential projects developed as part of this study for future transportation funding and review development applications that might impact MDT facilities. The Butte-Silver Bow local government can use the study in a similar manner to review potential development applications, and to potentially identifying local funding to advance potential projects.

There are several programmed projects within the study area. These projects are not included in the final list of projects within this study since they are already included in MDT's construction program. The following projects are currently under development:

- Mount Highland-4-Mile Vu – UPP 1809 (completed in 2008)
- Excelsior –I-115 to Platinum – UPP 1801 (completed in 2008)
- Welcome Signs – Butte – STPE 1899(23) (anticipated construction in 2009)
- 2003-VMS-Butte East – HSIP 90-4(56)227 (anticipated construction in 2009)
- Butte Area Bridge Deck Repair – IM 0002(752) (anticipated construction in 2009)
- Harrison-Amherst to Front – Butte – STPP 29-4(26)87 (construction beyond 2008)

- Crack and Seat Pavement Rehabilitation - (anticipated construction in 2009)
- Butte Area Structures – IM 15-2 (81) 125, (construction beyond 2008)

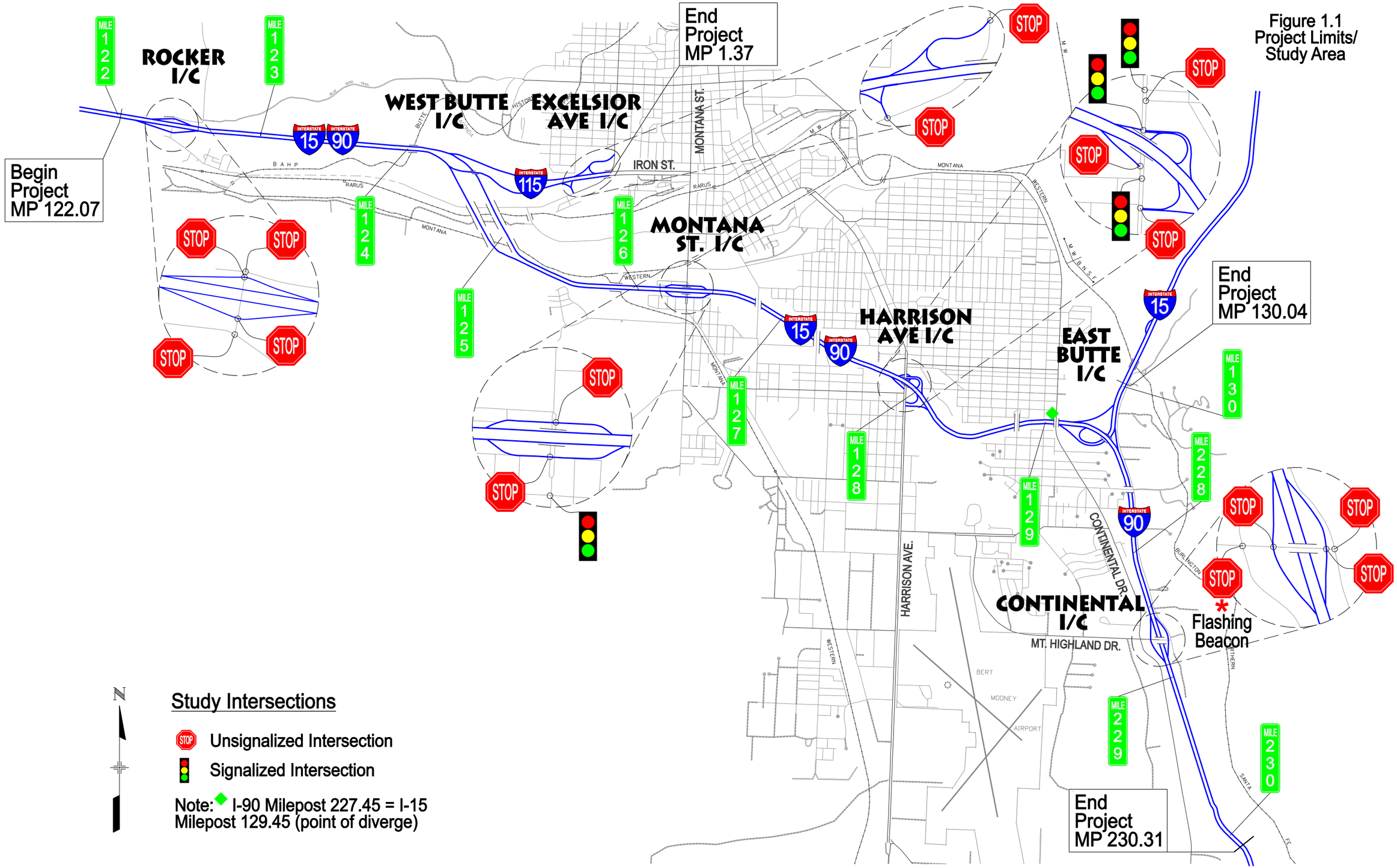
1.3 STUDY AREA

I-15 and I-90 are 4-lane interstates on the National Highway System that serve as local, regional and interstate freight trucking routes as well as regional primary routes for commuter, commercial, and recreation travel. I-115 serves as a local and regional primary route for commuter and commercial travel. I-15/90 plays an important role in the local traffic system network for commuting in and around Butte. The mainline segment between Montana Street and Harrison Avenue provides an important commuting link for local Butte residents and coincidentally carries some of the higher volumes of traffic on the interstate mainline within the study area.

The I-15/I-90 Interstate System and associated interchanges were constructed through Butte in the late 1960's and early 1970's. The Excelsior Avenue Interchange and I-115 spur were completed in 1986. The existing mainline concrete pavement is showing signs of degradation with many cracks and broken slabs. The riding surface is continually getting worse and field observations show commercial vehicles changing lanes to avoid certain stretches of rough pavement. MDT recently completed a rehabilitation project to improve the riding surface on the east end of the study limits, and has plans for a similar application from Montana Street to the East Butte Interchange.

The interstate facilities can be characterized by rolling to level terrain along a curvilinear alignment transitioning between rural and urban land uses. The posted speed limit on the I-15/90 mainline segments is 75 MH (65mph for trucks) for the entire study area. There are numerous structures along or over I-15/90 because of the many railroad tracks or interchanges in and around Butte. There are five interchanges on I-15/90, one interchange on I-90 and one interchange on I-115 within the study limits. Traffic control at the intersections of the interchange ramps is a mix of stop control and traffic signals. Figure 1.1 illustrates the study limits and study area intersections. A description of each interchange including configuration, and primary deficiencies are included in the following section.

Figure 1.1 Project Limits/ Study Area



Study Intersections

STOP Unsignalized Intersection

Signalized Intersection

Note: ◆ I-90 Milepost 227.45 = I-15 Milepost 129.45 (point of diverge)

2.0 EXISTING SETTING

2.1 EXISTING DEFICIENCIES

Phase 1 conducted an existing condition analysis for four main categories: geometric features, safety, traffic, and noise. The interstate corridor was divided into segments between interchanges for analysis purposes.

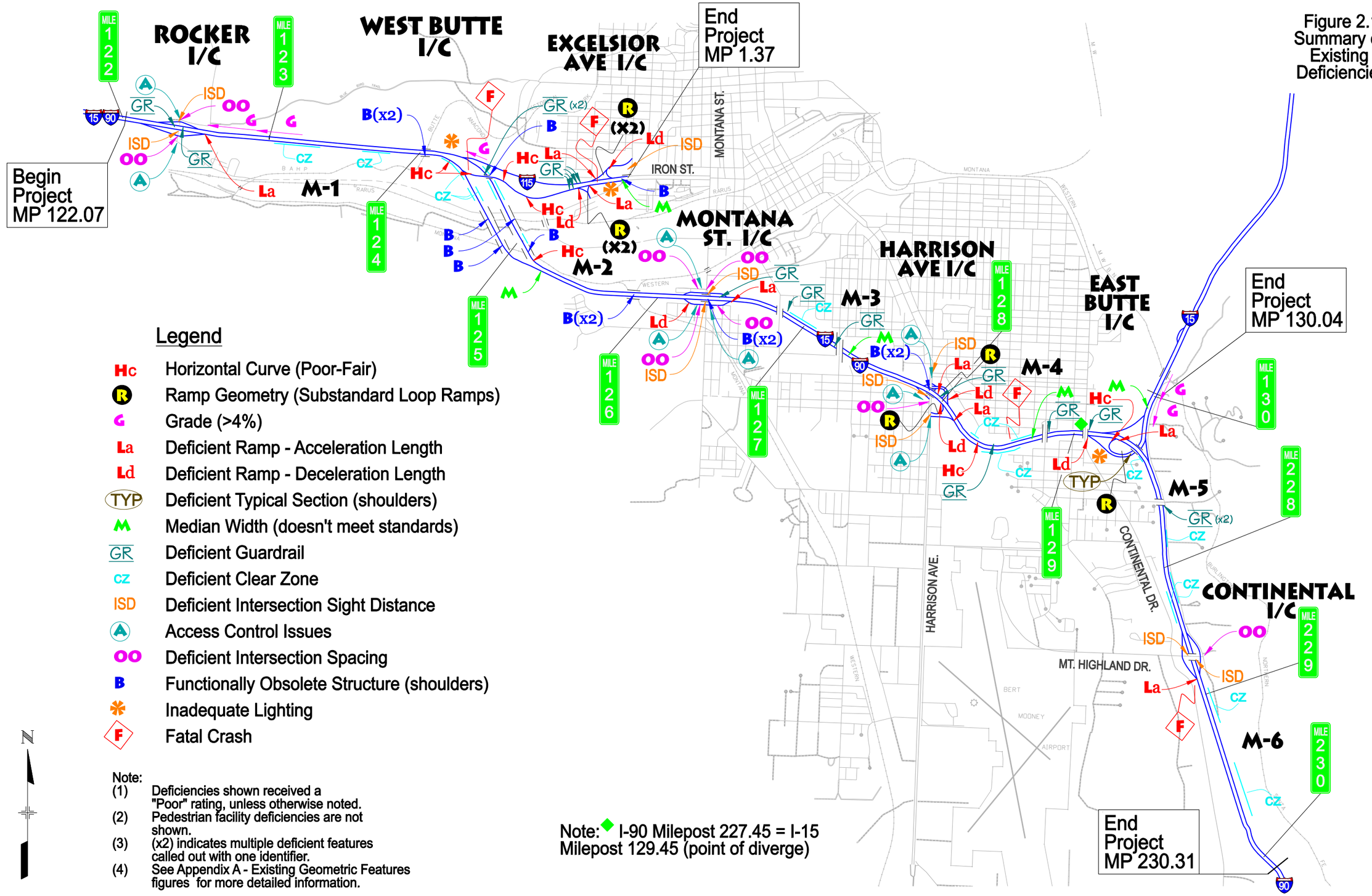
Geometric elements reviewed for the interstate mainline and at each interchange include cross section elements, horizontal and vertical alignment, ramp geometry, interchange/intersection spacing, adjacent access locations, turning movements, and intersection sight distance. Each of these elements was evaluated and ranked based on the study design criteria, and deficiencies were identified.

The safety analysis consisted of reviewing and summarizing historical crash information and inventorying existing highway lighting, signs and striping for conformance to current standards. Several high crash areas were identified including the West Butte Interchange, the Mainline Segment between West Butte and Montana Street, the Harrison Avenue Interchange, and the East Butte Interchange. High crash areas are defined as having a higher crash rate than the corridor average. Ramp terminal and cross road intersection crash analysis revealed high crash rates on Harrison Avenue and on the cross road at the Rocker Interchange.

Traffic operational analysis included the assessment of interstate mainline conditions, ramp merge and diverge, and local street intersections. These roadway components were analyzed separately and in relation to each other to assess traffic operations throughout the study area. The operational analysis results indicate that mainline sections and ramp sections operate at an acceptable level of service (LOS A or B) during all three peak periods of the day, for both existing and future (2025) conditions. The majority of the interchange intersections in the study area operate at an acceptable LOS in both existing and future conditions. However, the Montana Street and the I-15/90 eastbound ramp intersection and the Harrison Avenue and Amherst Avenue intersection operate at unacceptable LOS during some portions of the day under existing and/or future conditions. Some currently unsignalized intersections meet warrants for signalization; however, several of those were do to high right turn volumes.

The interstate systems were analyzed by interchange areas and mainline segments between interchanges. Most of the substantial safety and geometric deficiencies were found in the interchange segments. The most significant deficiencies on the mainline segments occur in Mainline Segment 2 between the West Butte and Montana Street interchanges. The four long bridges with minimal shoulders and the curvilinear alignment can be contributed to numerous single vehicle crashes. Deficiencies identified corridor wide include: non recoverable side slopes within the clear zone, deficient guardrail length, functionally obsolete structures, narrow medians, and deficient horizontal design speed. Specific conditions and primary deficiencies for each interchange are shown in the following paragraphs. Deficiencies are identified in Figure 2.1.

Figure 2.1 Summary of Existing Deficiencies



Legend

Hc	Horizontal Curve (Poor-Fair)
R	Ramp Geometry (Substandard Loop Ramps)
G	Grade (>4%)
La	Deficient Ramp - Acceleration Length
Ld	Deficient Ramp - Deceleration Length
TYP	Deficient Typical Section (shoulders)
M	Median Width (doesn't meet standards)
GR	Deficient Guardrail
CZ	Deficient Clear Zone
ISD	Deficient Intersection Sight Distance
A	Access Control Issues
OO	Deficient Intersection Spacing
B	Functionally Obsolete Structure (shoulders)
✱	Inadequate Lighting
F	Fatal Crash

Note:
(1) Deficiencies shown received a "Poor" rating, unless otherwise noted.
(2) Pedestrian facility deficiencies are not shown.
(3) (x2) indicates multiple deficient features called out with one identifier.
(4) See Appendix A - Existing Geometric Features figures for more detailed information.

Rocker Interchange – Exit 122

The Rocker interchange is a standard rural underpass type diamond configuration with stop controlled intersections. The interchange experiences a high volume of heavy truck traffic to the two large truck stops and the characteristics of a rural low-volume interchange do not accommodate current usage. Primary deficiencies include:

- Poor Ramp Geometry (intersection spacing, intersection sight distance, truck turning movement, access control)
- Deficient eastbound On-Ramp acceleration length due to steep EB mainline grade
- No Pedestrian facilities

West Butte Interchange – Exit 124 (City Center)

The West Butte Interchange is a partial system-to-system interchange between I-15/90 and I-115. The eastbound off-ramp to I-115 is a left-hand exit near a mainline I-15/90 eastbound curve. The interchange has considerable safety and geometric issues associated with the left hand off-ramp located on a curve. Primary deficiencies include:

- Poor Ramp Geometry (left-hand off-ramp, ramp horizontal alignment)
- Deficient mainline horizontal alignment
- Confusing signing and striping
- Inadequate lighting

Montana Street Interchange - Exit 126

The Montana Street Interchange is a standard underpass type diamond configuration, but three of the ramps converge with local frontage roads near the stop controlled ramp terminals. The shared ramp/frontage roads currently allow on-street parking. Montana Street is a four lane roadway with a raised median. The interchange shared ramp/frontage road has potential safety issues including several observed wrong way movements on the EB on-ramp. Primary deficiencies include:

- Deficient eastbound Off-Ramp deceleration and On-Ramp acceleration length
- Ramp operation issues – shared ramp/frontage roads
- Ramp terminal issues (intersection spacing, intersection sight distance, access control)
- Vertical curve over Montana Street
- Westbound Off-Ramp and Montana Street meets traffic signal Warrants 1 and 2

Harrison Avenue Interchange – Exit 127

The Harrison Avenue Interchange is an underpass type six-ramp partial cloverleaf configuration with two tight loop ramps on the east side. The loop ramps provide a northbound Harrison to westbound I-15/90 movement (on-ramp) and an eastbound I-15/90 to northbound Harrison movement (off-ramp). The cross road, Harrison Avenue, is a 6-lane principal arterial and the main north-south arterial in Butte. Ramp terminal traffic control consists of a mix of stop controlled and signalized intersections. This interchange handles the most traffic in Butte and can be characterized as having poor ramp geometry and numerous cross road and ramp terminal issues. Primary deficiencies include:

- Ramp geometry issues (horizontal curvature - loop ramps, insufficient acceleration/deceleration length)

- Ramp terminal issues (intersection spacing, intersection sight distance, truck turning movement, access control)
- Lane usage imbalance leads to periodic queuing and congestion issues on Harrison Avenue and approach roads Amherst Avenue and Dewey Blvd.

East Butte Interchange – Exit 129

The East Butte Interchange is a system-to-system interchange in a trumpet configuration with a tight loop ramp on the south side. I-15 and I-90 revert to separate alignments east of this interchange. This interchange configuration promotes I-90 as the major through movement while the I-15 movements take place on the ramps. This interchange is characterized by an extremely tight loop ramp with low operating speeds and steep grades on the I-15 mainline north of the interchange. Primary deficiencies include:

- Ramp geometry issues (horizontal curvature – loop ramps, insufficient acceleration length)
- Poor typical section on ramps (median, shoulders)
- Inadequate lighting

Continental Interchange – Exit 228

The Continental Drive Interchange is a standard rural overpass type diamond configuration with stop controlled ramp terminal intersections. The cross road, Mount Highland Drive/4-Mile Vue Road (U-1809), is a two lane minor arterial with no turn lanes. There are adjacent frontage road intersections that are closely spaced to the interchange ramp terminal intersections.
This interchange can be characterized as a typical rural interchange that currently handles relatively low traffic volumes. Primary deficiencies include:

- Ramp geometry issues (insufficient eastbound On-Ramp acceleration length)
- Ramp terminal issues (truck turning movement, intersection spacing, and intersection sight distance).

Excelsior Avenue Interchange – Exit 1

The Excelsior Avenue Interchange is an underpass type four leg button hook ramp configuration with stop controlled ramp terminal intersections. This interchange is characterized as a low volume interchange located on an interstate that is transitioning to a local road.

- Ramp Geometry (acceleration/deceleration length, horizontal curvature, typical section)
- I-115 Mainline design deficiencies (horizontal, vertical and typical section (median))
- Signing deficiencies
- No lighting at interchange

2.2 ENVIRONMENTAL CONDITIONS

A preliminary environmental scan was performed to identify the existing environmental conditions along the I-15/I-90 corridor. Research and analysis was conducted through site visits, contact with the Butte-Silver Bow planning and GIS departments, Montana Fish Wildlife and Parks (MFWP), the Natural Resource Information System (NRIS), U.S. Census, Natural Resources Conservation Services (NRCS) and windshield survey of the project area. This information has been provided to point out important resources of social or environmental concern that should be avoided and addressed in the decision-making process as potential projects are identified and move forward into National Environmental Policy Act/ Montana Environmental Policy Act (NEPA/MEPA) and preliminary design phases. The environmental scan memo is attached as Appendix A and includes overview figures of the entire corridor showing potential environmental resources.

As part of the environmental scan, existing social, physical and natural conditions were reviewed within the I-15/I-90 corridor including the following resources:

- Land Use and Socioeconomic Characteristics
- Environmental Justice
- Farmland
- Wetlands and Waters of the U.S.
- Threatened and Endangered Species
- Wildlife and Aquatic Species
- Noxious Weeds
- Parks and Recreation Resources
- Water Resources
- Hazardous Materials
- Noise
- Air Quality
- Cultural/Historic Properties
- Visual/Aesthetics

Based on the field conditions observed, several resources were identified as issues of potential concern that will require further analysis prior to implementing transportation improvements in proximity to the identified resources. These resource issues include: wetlands and waters of the U.S., threatened and endangered species, parks and recreation areas, hazardous materials and historic properties, as discussed in the self titled sections that follow.

2.2.1 Wetlands and Waters of the U.S.

A total of 53 individual locations comprising over 172 acres of potential wetlands were identified within the project area, most of which are located between the Montana Street and Harrison Avenue interchanges, in and around Silver Bow Creek and its tributaries. A total of 17 potential non-wetland waters of the U.S. were identified within the project area. Because they are mapped features, all 17 of the drainage features are preliminarily considered to be jurisdictional by the U.S. Army Corps of Engineers (Corps). However, further investigation and consultation with the Corps may increase or decrease the number of jurisdictional waters in the study area.

Due to the proximity of the interstate to Silver Bow Creek and its associated wetlands, there is a high potential that the recommended improvements would impact some of these jurisdictional waters or wetlands. Section 404 of the Clean Water Act requires that all practicable efforts must be taken to avoid or minimize harm to wetlands, specifically those with a surface connection to regulated waters. U.S. Executive Order 11990 protects isolated wetlands by requiring the same effort to avoid or minimize harm when federal funds are used. Both require mitigation for

wetland impacts that cannot be avoided. A Section 404 Permit would be required with the COE for impacts to wetlands or waters of the U.S under their jurisdiction. In addition, a Montana Stream Protection Act (124) notification would be required if the project affects the natural existing shape and form of any stream or its banks, and the work is completed by a Federal, State or Local Government. If private funds are used other permits may be required. Specific provisions included in these permits/notifications would be followed, and may include timing restrictions and/or design requirements in order to limit disturbances to aquatic species.

2.2.2 Threatened and Endangered Species

Based on the U.S. Fish and Wildlife Service (USFWS) statewide Montana County list (USFWS, 2007) and range/habitat descriptions found in technical literature, two listed species were identified as having potential to occur in the project area, the Gray wolf (*Canis lupus*, endangered) and Bull trout (*Salvelinus confluentus*, threatened). Further habitat evaluation and coordination with USFWS (likely in the form of a Biological Assessment) and Montana Fish and Wildlife Parks (MFWP) would be required as part of future environmental clearance for improvements to the highway.

The Gray wolf is currently protected under the Threatened and Endangered Species Act. However, due to the successful reintroduction of the species to Yellowstone National Park and central Idaho, the USFWS has proposed to de-list the Gray wolf from its protected status. Based on documented surveys, it is highly unlikely for the gray wolf occupy habitats in the project area.

The Bull trout was designated as threatened in 1998. Although no Bull trout have been documented in any of the streams that occur in the project area (MFWP, 2007), critical habitat for Bull trout does occur downstream in tributaries to the upper Clark Fork River. The closest tributary containing critical Bull trout habitat, Warm Springs Creek, is located approximately 18 miles downstream of the project area. Based on the known occurrence of Bull trout and the location of the project relative to designated critical habitat, Bull trout are not expected to be an issue for any future roadway improvements in the project area.

The Montana National Heritage Program (MNHP) lists 53 Sensitive Species of Special Concern as having habitat in Silver Bow County. Of these, 32 species are considered likely or somewhat likely to occur in the project area, based on habitat preferences, detailed in appendix A. The MNHP ranks each species based on population, geographic diversity, and other factors that relate to risk of species extinction. Further evaluation of potential impacts to preferred habitat of these species should be performed as part of future environmental clearance required for highway improvements.

2.2.3 Parks and Recreation Resources

The City and County of Butte-Silver Bow maintains numerous parks and recreational facilities throughout the region, three of which are located within or immediately adjacent to the project area. Several recreational trails also pass through the project area. These facilities include:

- C Street Park
- Father Sheehan Park
- High Altitude Park

- Ulrich-Schulte Nature Trail
- Rails to Trails Regional Trails

As publicly owned parks and/or recreation facilities, they are protected under the U.S. Department of Transportation Act of 1966, commonly known as "Section 4(f)." This Act provides that a use of land from such properties cannot be approved for transportation improvements unless it can be demonstrated that there is no other prudent and feasible alternatives to using that land and the action includes all planning to minimize harm to the property. Any improvements that impact these public facilities will require additional analysis and process to ensure avoidance or least harm.

In addition to protection under Section 4(f), Father Sheehan Park is also protected under Section 6(f) of the Land and Water Conservation Fund Act (LWCF). Because federal funding from the LWCF was obtained by Butte-Silver Bow County for the development of this park, Section 6(f) protects this property from development or conversion other than for public outdoor recreation uses. A land conversion may only be approved if a substitution of other recreation properties of equal or greater value and equivalent usefulness as the property being converted.

2.2.4 Hazardous Materials Sites

There are three Superfund sites within or adjacent to the project area: The Rocker Timber Framing and Treating Plant Operable Unit, the Montana Pole Site, and the Lower Area I Operable Unit. Although geographically separated, the Rocker and Lower Area I are both part of the Silver Bow Creek/Butte Area Superfund site. The Montana Pole site is separate, yet adjacent to Lower Area I and was listed as a Superfund site based on separate contaminants than the others. All three sites are considered in maintenance status with long-term monitoring programs in place. However, due to the volatility of the hazardous chemicals either stored on-site, ongoing maintenance, and/or remediation in progress, construction activity related to highway improvements may expose contaminants in the soils or groundwater during construction excavation.

The NRIS database also lists numerous other hazardous material sites throughout the project area consisting of storage tanks, of which some have reported leaks. These tank sites are clustered around the Montana Street and Harrison Avenue interchanges. If right of way acquisition would be required for future interchange improvements, Phase I site assessments would be required, at a minimum to determine potential contamination present in these areas.

2.2.5 Noise

A traffic noise study was conducted to identify existing and future traffic noise levels along I-15/90 through Butte, Montana as part of the Phase 1 report. This noise study was conducted in accordance with Montana Department of Transportation's (MDT) *Traffic Noise Analysis and Abatement: Policy and Procedure Manual, June 2001,* which is consistent with FHWA's procedures. A total of 83 noise-sensitive receptors representing up to 380 single-family residences, 14 mobile homes, 48 apartments, 3 hotels, 1 school, 1 park and 4-Ulrich-Schulte Nature Trail locations were identified within approximately 500 feet of the centerline of I-15/90. Based on the results of the initial noise study, some neighborhoods are currently impacted by traffic noise from the I-15/90 interstate facility. This represents over 80 individual single-family

residences. Future year (2025) forecast estimated that additional residences would exceed the noise levels as defined by FHWA and MDT guidelines. Noise abatement measures should be considered for future projects in areas that are practicing noise compatible land use planning and/or noise-mitigated developments.

2.2.6 Historic Properties

As a community with a rich culture and history, the majority of Butte's urban core is designated as a National Historic District. Originally designated in 1961, the district is nationally significant as it relates to its history in copper production and the formation of labor unions. In 2006 this district was expanded to include the areas of Walkerville, Anaconda, and the Butte/Anaconda and Pacific railroad bed. As a National Historic District, there are multiple properties within the district that contribute to its historic significance, some of which are likely located within the project area. A formal records search by the Montana Historic Society would be required to identify specific proprieties that are eligible for listing on the National Register of Historic Places. Under Section 106 of the Historic Preservation Act, these properties are protected and require consultation with the State Historic Preservation Office and full analysis of alternatives to avoid and minimize impacts to these properties that may result from interchange improvements.

Historic properties are also protected under the U.S. Department of Transportation Act of 1966, commonly known as "Section 4(f)." This Act provides that a use of land from such properties cannot be approved for transportation improvements unless it can be demonstrated that there is no other prudent and feasible alternatives to using that land and the action includes all planning to minimize harm to the property.

3.0 OPTION DEVELOPMENT

3.1 INITIAL OPTION DEVELOPMENT

3.1.1 Option Development Workshop

An Option Development Workshop was held on December 6, 2007, and was attended by the project team (representatives of MDT, Butte-Silver Bow and the consultant). The goal and objective of this workshop was to review deficiencies, develop and screen schematic options and advance all reasonable options to the concept design level. Schematic options were developed in advance of the workshop for each option as well as a list of minor and safety type projects. The workshop lasted all day and focused on the entire corridor as well as each individual interchange. At this stage the options were developed and reviewed based on reasonableness to improve deficiencies.

3.1.2 Minor and Safety Type Elements

A list of minor and safety type projects and elements was presented and discussed. This list included over 60 projects, and was divided by either a corridor wide option or site specific improvement (interchange or mainline interstate segment). Corridor wide projects are discussed in the next section. Minor and safety type elements included:

- Guardrail extensions and installation
- Minor earthwork to correct a non-recoverable side slope issue
- Access control elements (curb & gutter, channelization)
- Signing and striping improvements
- Lighting improvements
- Pedestrian improvements
- Anti-icing systems for functionally obsolete bridges
- Site specific ITS elements (speed reduction systems, DMS signs)

The full list of minor and safety elements that was carried forward from the workshop is included in Appendix D.

3.1.3 Corridor Wide Solutions

As part of the minor and safety type project list there was a corridor wide list of potential options. These corridor wide solutions focused on developing an incident management plan, reducing speed limits and installing ITS elements. ITS elements are discussed in detail later in this section. An incident management plan would be a good starting point for many of the corridor wide solutions. The study area includes two of the most important interstate corridors in the northwest, which carry a high volume of commercial motor vehicles. This high volume of truck traffic and the higher crash rate, particularly inclement weather point to the need for a coordinated approach to handle interstate incidents.

Reducing speed limits is a promising concept for several reasons, but as discussed further later may be challenging to implement. The corridor experiences high single vehicle and inclement weather crash rates, which can be attributed to speed and poor geometrics. Reducing the speeds through this curvilinear alignment either permanently or during inclement weather (variable speed limits) has the

potential to improve safety by reducing the speed differential between trucks and passenger vehicles and by slowing down traffic. The potential benefits of these applications are not without challenges that include gaining legislative approval, enforcing the measures and compliance with other guidelines and standards.

3.1.4 Interchange Solutions/Concepts

A total of 22 specific schematic interchange options where reviewed and several additional options were developed during the workshop. Interchanges options included designs to address identified deficiencies and also to bring an interchange up to full system level standards. Rocker, West Butte, Harrison and East Butte interchanges had three or more options. The Harrison Avenue Interchange presents the biggest challenge because of the current configuration and heavy cross road traffic volumes. A total of eight options where reviewed for the Harrison Interchange.

Table 3.1 represents full interchange improvement options that were carried forward to a conceptual design. Schematic graphics of each option carried forward and options that were dropped from further consideration are included in Appendix D.

Table 3.1
Potential Improvement Options Advanced to Conceptual Design

Option	Description	Remarks
Rocker Option 1 (R-1) – Roundabout ramp terminals	Replace ramp terminal intersections with roundabouts that combine the frontage road intersections	Accommodate WB-67 and analyze for high truck traffic
Rocker Option 2 (R-2) – Relocate the EB off-ramp	EB off-ramp will be relocated west and tie into the frontage road	EB truck ramp would be relocated to frontage road
Rocker Option 3 (R-3) – Single Point Urban Interchange (SPUI)	Reconfigure the interchange ramps to a SPUI configuration, requires replacing the bridges	SPUI would not meet traffic warrants
West Butte Option 1 (WB-1) – Short term WB off-ramp improvement	Relocate EB I-115 off-ramp to a right side exit on slightly improved mainline	Improvements to EB mainline and EB ramp only
West Butte Option 2 (WB-2) – High speed system level interchange	High speed system level interchange option based on min. design standards, including realigned mainline	Design based on high speed criteria and include all movements
West Butte Option 3 (WB-3) – Diamond type interchange	Diamond interchange on realigned I-15/90 mainline with I-115 reclassified to primary route	Include design on realigned mainline
Excelsior Avenue Option 1 (Ex-1) – Ramp improvements	Extend acceleration/deceleration length on all ramps. Based on I-115 remaining an interstate classification	Excelsior bridges may need to be widened or replaced
Montana Street Option 1 (M-1) – Signalized intersections	Signalize ramp terminals and modify shared frontage/ramp access. Improve acceleration/deceleration lengths to standards	Minor curb return and frontage road work is required.

Table 3.1
Potential Improvement Options Advanced to Conceptual Design

Option	Description	Remarks
Montana Street Option 2 (M-2) – Roundabout intersections	Use roundabouts at ramp terminals and modify shared frontage/ramp access. Improve acceleration/deceleration lengths to standards	Analyze single and two lane roundabouts
Harrison Avenue Option 1 (H-1) – SPUI configuration	Reconstruct the interchange to a SPUI configuration including replacing the bridges and raising the mainline	Requires raising mainline
Harrison Avenue Option 2 (H-2) – Tight diamond configuration	Reconstruct the interchange to a tight diamond configuration including widening Harrison for required left turn lanes	Requires raising mainline
Harrison Avenue Option 3 (H-3) – EB loop ramp option	Remove the EB off-ramp and lengthen the EB loop off-ramp deceleration to meet standards, signalize the EB loop off/on-ramp terminal	Requires widened or new bridge for lengthened deceleration lane
Harrison Avenue Option 4 (H-4) – Eliminate EB loop ramp	Remove the EB loop off-ramp and add a left turn lane and signal at the straight EB off-ramp	Check intersection turning movements
Harrison Avenue Option 5 (H-5) – WB off and on ramp improvements	Remove the WB loop on-ramp and realign the WB off-ramp, add a NB turn lane for the WB on-ramp	Requires signal and median modifications, limited storage space.
Harrison Avenue Option 6 (H-6) – Relocate WB on-ramps to Amherst Avenue	Remove the WB on-ramps and relocate the WB on-ramp to tie in w/Amherst Avenue, realign Harrison west so that third NB lane can be developed to Amherst along with a new NB left turn lane to the new WB on-ramps	Requires significant property acquisition
Harrison Avenue Option 7 (H-7) – Roundabout option	Replace ramp terminals with roundabouts, and remove loop ramps. Combine EB off-ramp and Dewey	Initially advanced, but later dropped due to feasibility issues
East Butte Option 1 (EB-1) – SB Flyover	Remove tight loop ramp and build new high speed flyover ramp for SB I-15 to EB I-90	Design to high speed criteria
East Butte Option 2 (EB-2) – Utilize existing configuration and improve acceleration deceleration lengths	Lengthen EB to NB deceleration length and SB to EB acceleration length, would require widening bridge	EB bridge will need to be replaced to accommodate widening for acceleration lane
East Butte Option 3 (EB-3) – Our Lady of the Rockies I/C	Our Lady of the Rockies off-set diamond interchange as shown in the Butte Transportation Plan	Traffic volumes do not justify interchange, carried forward to check geometric feasibility
Continental Option 1 (C-1) - Frontage Road Realignment	Relocate Eastside frontage road intersection	Right of way will be required
Continental Option 2 (C-2) – Roundabout Option	Add Roundabouts at each ramp terminal and adjacent frontage roads.	Investigate 2 scenarios (roundabout at each intersection (3), and combine EB ramps and Continental)

3.2 NON-TRADITIONAL PROJECTS

The option development workshop identified standard highway design and traffic signal improvements, and options on the leading edge of the industry techniques. These include ITS elements and roundabout intersection configurations. ITS elements include a wide variety of implementations discussed below.

3.2.1 ITS Elements

As part of the option development workshop many alternatives for improving the safety and operations of the I-90 corridor were proposed. Many of the suggestions can be categorized as ITS options. Intelligent Transportation Systems (ITS) is a general term for a range of process control, communication and electronics applied to the transportation system. It can also include advanced approaches to traffic management. ITS options may be among the most cost effective solutions available on this corridor. ITS options can be implemented in the short term but with long term benefits. Individually, many ITS components have specific benefits that address issues on the corridor. Collectively, the application of many ITS components would have far greater benefits in mitigating many of the corridor's issues. ITS is capable of providing MDT information with which to better plan and operate the corridor; it can provide travelers with better information to improve their driving performance and enhance their traveling experience.

ITS Regional Architecture
As a preliminary step in developing the ITS project scopes, the Montana Department of Transportation (MDT) Regional Architecture was reviewed to determine if the elements being considered were consistent with the plan. MDT recognizes ITS is an effective tool which can be utilized to support operation as well as traveler information needs. To foster the planning and development of statewide ITS applications, MDT developed and published (March, 2005) an ITS regional architecture.

As part of the investigation to develop the Regional Architecture Plan, external stakeholders participated in the crafting of an ITS Strategic Plan. As part of that process, they were asked to ascertain the challenges in Montana. Some of the challenges acknowledged are as follows.

Long emergency response times was recognized as an issue in rural areas resulting from lengthy first response team travel distances often being affected by inclement weather and the inability to identify the location of the emergency or to gather sufficient information before arrival to assess incident response resource requirements.

Inattentive driving was identified because of the long drive segments between populated areas and the posted high speeds highlighting the vulnerability to inattentive driving. Inattention can be caused by many factors including drowsy driving, driving under the influence or lack of familiarity to surroundings.

Inclement weather created problems often resulting in road closures. Accurate real-time information on weather, road conditions and road closures for motorists was considered important to the external stakeholders along with the ability to inform the travelers upstream of the road closure so services such as lodging were not overloaded by the motorists.

Commercial vehicle size/weight restrictions raised a flag because of the increased number of overweight trucks from Canada in addition to industry efforts to increase the legal size and weight of commercial vehicles. While not noted per se, the trend in increased commercial vehicle size/weights also has an affect on the application of existing roadway design safety factors such as ramp alignment criteria.

It is noted that these challenges which were identified statewide are clearly issues that affect safety and operations in the I-90 study corridor

Common Project Elements
The following provides a listing of potential ITS projects identified in Phase 1 of the study which will be expanded upon that can address or improve the safety and operations aspects on the Interstate System through the study area. The proposed projects include ITS field devices for the general functions of incident management, traveler information, and traffic management. The identified ITS field device installations, including closed circuit television (CCTV), dynamic message signs (DMS), highway advisory radio (HAR), roadway weather information systems (RWIS), speed display signs, speed reduction systems, variable speed limits (VSL), have features that can be applied to all these general functions.

- **ITS Option 1** – Develop an Incident Management Plan - Install DMS, CCTV, RWIS, HAR elements to support the implementation of the plan
- **ITS Option 2** – Traffic Management ITS Package - Implement VSL through out the corridor, install speed display signs at key areas, add additional RWIS, and install active warning/speed reduction signs at loop ramps
- **ITS Option 3** – Traveler Information ITS Package - Install and utilize DMS, CCTV, HAR, RWIS Elements for the purpose of improving traveler information.
- **ITS Option 4** – Site Specific ITS Elements - Install DMS sign near Rocker I/C, Install speed reduction systems at the Harrison I/C and East Butte I/C Loop Ramps

The technologies that have been identified by this study for further consideration are not necessarily limited to a specific operational deployment but can be utilized to support multiple requirements and are not new to Montana's ITS implementation plan with the exception of speed management techniques.

3.2.2 Roundabout Options

Many of the deficiencies identified at interchange ramp terminals are related to inadequate intersection spacing, limited sight distance and designs that don't accommodate appropriate turning movements. Standard options such as realigning approach roads can be very costly. Over the last decade more and more transportation agencies have found roundabouts as a cost effective option to improve oddly configured ramp terminal intersections. Several schematic options developed and discussed at the option development workshop included roundabout intersections.

Roundabouts have been used in America for over 100-years, however, early designs, traffic circles and rotary style intersections, did not have the same safety benefits of the current modern

roundabouts. The modern roundabout is a type of circular intersection where traffic enters in a one-way direction around a circular center island. Traffic entering the intersection has to yield to traffic within the roundabout until an appropriate gap is available. This yield control and the entrance curvature of the requiring traffic to slow down are the primary differences between the modern roundabout and earlier traffic circles or rotary intersections. Appropriately designed roundabouts have been shown to be safer than standard stop and signal controlled intersections. Studies show fewer crashes and significantly lower injury and fatality crashes. The safety benefits can be attributed to reducing traffic speed through the intersection and eliminating the potential for right angle crashes. Roundabouts also have the potential to provide environmental benefits by reducing vehicle idling time at intersections. The improved operations for vehicular traffic can cause challenges in providing safe access for bicycles and pedestrians. Bicycle and pedestrian access should be carefully analyzed during the design of a roundabout to ensure safe movement of both traffic and pedestrians. The success of any modern roundabout is related to the appropriate design and implementation.

The modern roundabout concept is relatively new to Montana, but is being considered more and more at intersections that are meeting signal warrants and in transportation plan updates. Roundabouts have recently been constructed on MDT facilities in Kalispell and Helena, and several more are in the design phase in Missoula and Billings. Specific to this study roundabouts were considered at the Rocker Road, Montana Street, Harrison Avenue and Continental interchanges. The roundabout option at Harrison Avenue was initially carried forward at the option development workshop, but initial layout and operational analysis indicated that roundabouts were not feasible in this corridor because of the traffic volumes and approach road configurations. Similar traffic analysis at Montana Street indicated that single lane roundabout configurations would not achieve the LOS standard of C, but the two lane roundabout option is feasible. A roundabout option for Rocker, Montana and Continental interchanges was carried forward to the final potential project list.

3.2.3 Single Point Urban Interchange (SPUI)

A single point urban interchange (SPUI) is a variation of a standard diamond interchange where the ramp terminals are aligned into one intersection at the cross road (as opposed to two on a standard diamond). This allows left turns from the ramps and from the cross road to proceed simultaneously. Benefits of the SPUI configuration include eliminating a signalized intersection on the cross road, improved operating characteristics on heavily signalized corridors, and reduced right of way. Disadvantages include the potential for confusion at the single intersection and increased costs due to longer bridges, more retaining walls and wider cross roads. The use of SPUI's has become more common in urban areas in the western United States over the past ten years. Currently there is only one SPUI in Montana, King Avenue and I-90 in Billings.

3.3 INSTITUTIONAL ISSUES

During the option development workshop several potential options discussed were proposed that may require a Transportation Commission action or possibly a change in state statute in order to be implemented. Institutional issues that might impact one or more of the proposed options include Interstate speed limits, variable speed limits, reclassifying I-115, and the use of roundabouts. Additionally the growing movement for energy conservation could have a future impact on the Butte Interstate corridor. Each of these issues is discussed below.

3.3.1 Interstate Speed Limits

Safety analysis in Phase 1 revealed that crash data from 2001 through 2005 showed 81% of the crashes involved a single vehicle and 58% where weather related. These statistics indicate that the combination higher speed and poor geometry could be factors in crashes. Because of this one of the first corridor wide options discussed was lowering the speed limit to 65 mph or lower. Lowering the speed limit to 65 mph is possible within the current Montana statutes, but it would require a supporting study justifying the change. Information on current statutes on speed limits is discussed in the following paragraphs.

The primary Montana statute related to speed limits is Montana Code Annotated (MCA) 61-8-303 Speed restrictions, sets the parameters for speed limits on the Interstate System. This statute specifies that for Interstate highways outside urbanized areas with populations of 50,000 or more the speed limit is 75 miles an hour at all times. If an urbanized area has more than 50,000 then the speed limit is 65 miles an hour. Butte currently has a population of around 33,000. MCA 61-8-303 also references other statutes that could specify a speed limit. Montana statute MCA 61-8-309, establishment of special speed zones, is applicable to this study. This statute specifies that the Transportation Commission may set a reasonable and safe speed limit at location that they determine through a traffic engineering investigation that the speed limit set by MCA 61-8-303 is too high (reasonable and safety) for the existing conditions (curves, dangerous locations) on a stretch of highway that is less than 50 miles in length. Additionally Montana statute MCA 61-8-312 Special speed limitations on trucks, truck tractors, and motor-driven cycles, specifies that on interstate highways the speed limit for trucks and tractor truck of more than 1 ton is 65 miles an hour.

The current state statutes do provide some flexibility in setting speed limits. In order to change the speed limits within the study area a case could be made that the combination of high truck traffic, curvilinear alignments, high number of interchanges (compared to other Montana cities), and sub-standard interchange geometry lead to high single vehicle and weather related crashes, and reduced speeds could potentially reduce the crashes. Speed data would need to be collected and evaluated showing that existing traffic is traveling well below the posted 75 mph speed limit.

3.3.2 Variable Speed Limits

Variable speed limits (VSL) is a traffic management concept in which the speed limit of a facility is changed based on time of day, traffic conditions, weather or pavement conditions, and construction or maintenance activities. Europe has used variable speed management for years; however until recently the technique has been little used in the United States outside of school zones. VSL zones have been tested successfully in several states including Washington and Oregon. Many of these applications include applying variable speed management during adverse weather, snow or fog. In Washington VSL are used across Snoqualmie Pass on I-90. Successful use of VSL includes appropriate signing indicating the current speed limit and the ability to enforce the current speed limit.

The National Cooperative Highway Research Program commissioned a report published in March 2002 titled *Judicial Enforcement of Variable Speed Limits*, to review current state laws and judicial decisions and enforcement of VSL zones. This report concluded that where an agency (transportation or other administrative agency) is given authority with appropriate

limitations speed limits that are established maybe enforced without the fear of a legal challenge. The report also suggests language to support VSL and requirements for implementing the VSL. The report indicates that many states have language that would allow a speed limit to be changed based on engineering or traffic investigations, Montana included, but the actual steps to change the speed limit take a long time. In order for a variable speed limit zones to work, the NCHRP report suggests that the authority to make the decision to change the speed limit needs to be transferred to the local transportation agency maintaining the facility.

In order to establish a variable speed zone within the study area it appears a legislative action would be required to first establish the variable speed zone limits and then delegate the authority to activate the variable speed limits to person in responsible charge within the area. A variable speed zone in Butte could potentially reduce crashes related to inclement weather conditions.

Current Montana state statutes, as described above in Section 3.3.1, may allow for VSL under certain interpretations. However, a legal review by a qualified legal practitioner is advisable before action is taken regarding the design and implementation of VSL.

Should VSL be considered and deemed advisable, the efficient initiation and administration of a VSL zone within the study area may require a legislative action. A primary activity in getting a VSL program initiated is the development of condition rules by which the selection of the appropriate speed limit is, essentially, predetermined. A reduction in speeds on I-90, may result from the implementation of a variable speed zone in Butte, could potentially reduce crashes related to inclement weather conditions.

3.3.3 Reclassifying I-115

Interstate 115 is 1.19 miles long or 0.10% of the nearly 1200 centerline miles of interstate highways within Montana. I-115 is an interstate principal arterial that functions like an extended ramp between the I-15/90 West Butte Interchange and the point it turns into a principal arterial, Iron Street. Additionally I-115 is signed as Business Loop 15/90 eastbound and Interstate 15 and Interstate 90 westbound. Discussion for improving the West Butte interchange and reviewing potential projects identified in the Butte Transportation Plan lead to the discussion of reclassifying I-115 from the Interstate System to the Primary System. This would allow for more flexibility for improvement options to the West Butte interchange. It would also allow an at-grade intersection for the Montana Tech back door access (Iron Street access) proposed by the Butte Transportation Plan.

Note that reclassifying I-115 may not necessarily be required for some improvements to occur at the West Butte Interchange. It may be possible to implement full movement ramp connectivity by utilizing stop control at ramp termini.

I-115 is part of the Interstate System. To facilitate a systems action from Interstate to Primary would require formal actions by the Transportation Commission and FHWA as well as the appropriate level of involvement with the local governments. This change would have to comply with all State and Federal laws and rules regarding reclassification. The main consequences of pursuing this alternative could include loss of Interstate Maintenance funds eligibility, payback of Federal-Aid and the reuse of the facility and property. It is important to note that if I-115 is

reclassified a separate action would be required to make any access changes as the full access control right of way would remain in place. This could be done through a normal access request.

Although the I-115 is designated as an Interstate, FHWA may consider it more of an interchange feature of the mainline interstate than a separate system. If this is the case the change in the system level may be "irrelevant to further development of mainline design modification proposals". The change in the system designation and numbering may be just a technical adjustment accompanying the approval of the major improvements to the mainline. So if the request was made as part of a modification to the West Butte Interchange the process might be more streamlined procedurally.

Based on the available information, reclassifying an interstate segment has significant challenges. It has never been done in Montana with the possible exception of I-215, but reclassifying a short segment like I-115 does appear possible. The benefits of redesignating I-115 as a Primary System route would be the ability to utilize service level interchange designs at the West Butte interchange and the potential to implement the Butte-Silver Bow local agency Montana Tech backdoor access project.

3.3.4 Roundabouts

Montana statute MCA 61-8-327 defines a roundabout as circular intersection where all entering traffic must yield to the vehicles within the intersection. This is the only state statute related to the use of roundabouts. In the 2005 Montana Legislative session a joint house resolution (HJ12) was passed that formally introduced roundabouts to Montana. The resolution discussed safety benefits of roundabouts, the use of roundabouts in other western states, and that the operation of commercial motor vehicles should be considered when roundabouts are designed. Officially the resolution states that:

> *That the Department of Transportation and cities and towns in their respective jurisdictions be encouraged to construct more roundabouts instead of signalized, right-angle intersections.*

Since this resolution was passed the MDT has planned and installed modern roundabouts, as previously discussed, and all indications are that roundabouts will continue to be an intersection option considered by MDT.

3.3.5 Energy Conservation

Driven by rising energy and fuel costs there has been a growing public and private movement to be more conscious of energy consumption. The "green" movement has led many agencies to review energy use and look at ways to reduce their consumption of energy and fossil fuels. This movement along with rapidly increasing prices of crude oil could have a direct impact on the Butte Interstate corridor through either MDT policies or national regulations. In the mid-1970's, due to the oil embargo, congress enacted legislation creating a national speed limit of 55 MPH. Studies have shown that vehicular gas efficiency decreases above 60 MPH. Specific to this plan the potential for policies or regulations specific to energy conservation could promote some of the reduced speed limit options previously discussed.

3.4 PUBLIC OUTREACH

Comments on existing conditions and input on potential improvement options was sought from the residents and businesses of Butte through open house meetings as part of Phase 2 of the Butte Interstate Traffic Study.

3.4.1 Butte Transportation Coordination Committee

An overview presentation of the Butte Interstate Traffic Study – Phase 1 Report was given to the Butte Transportation Coordinating Committee (TCC) on September 26, 2007. The presentation focused on the findings from Phase 1 and the outline for Phase 2. There were no comments or questions.

3.4.2 Public Open House #1

A public open house held on October 23, 2007 at the Butte Civic Center lobby. Study exhibits were available for review and project team members were on hand to answer questions. PBS&J delivered a brief presentation detailing the goals of the project and the deficiencies identified in Phase 1. Following the presentation a brief question and answer session was held. Nine people signed in at the public open house and it was estimated that overall 12 to 15 people attended the meeting. A total of four written comments were received. In general the meeting attendees were interested in the project and looked forward to seeing potential improvement options.

Comments and questions presented at the public meeting include:

- Harrison and Dewey is a dangerous intersection, in particular the NB left turn operation
- Consideration should be given to a new interchange for Our Lady of the Rockies off of I-15 to help spur economic development
- Look at enhancing Front Street sidewalks as part of upcoming project
- Concern on noise impacts with any proposed projects
- Removal of concrete and soundwalls would be great
- West Butte interchange should be improved at the left hand off-ramp
- The Town Pump at the Rocker interchange has created a safety issue on the road for passenger vehicles. Semi-trucks often park on the road and have no regard for road right of way often crossing into the opposite lane of traffic. The big issues are trucks parking on the road, trucks entering and exiting the gas station and disregard for stop signs.

3.4.3 Public Open House #2

The second public open house was held on September 17, 2008 at the Butte Civic Center lobby. Study exhibits were available for review and project team members were on hand to answer questions. PBS&J delivered a brief presentation detailing the options developed during Phase 2. Following the presentation a brief question and answer session was held. Eleven people signed in at the public open house. One written comment was received. In general the meeting attendees were interested in the project and were supportive of potential improvement options.

4.0 OPTION SCREENING

4.1 SCREENING PROCESS

An Option Review meeting was held on April 16, 2008 to review design options advanced from the Option Development workshop. The goal of this meeting was to review and further advance options based on feasibility, both geometric and financial. A total of 23 individual interchange design options were discussed. In addition to the interchange specific options the minor and safety element project list was reviewed.

Interchange options that were dropped from further consideration and the reasons they were dropped include:

- Rocker Option R-1B (roundabouts) – Option R-1A provides better operations and improves the access to and from the adjacent truck stops
- Rocker Option R-2 (relocate EB off-ramp) – Doesn't address WB ramp terminal issues
- Rocker Option R-3 (SPUI) – Dropped because of high costs and urban operations, however, the EB on-ramp auxiliary lane was carried forward as a separate mainline segment 1 project
- Rocker Option R-4 (tight diamond) – Dropped due to truck operation issues at 3-way stop controlled intersections
- West Butte Option WB-2 (High speed system level) – Dropped due to high costs and low potential for traffic to use added movements
- West Butte Option WB-3 (Diamond I/C on realigned mainline) – The realigned mainline section 2 was dropped and replaced with a new individual mainline segment 2 option to improve geometry and replace the functionally obsolete bridges.
- Harrison Option H-5 (relocated WB on-ramp) – Dropped due to r/w requirements and split ramp operations
- East Butte Option 1 EB-1 (SB to EB flyover) – EB-1 was dropped as an individual project, however, the flyover was carried forward as part of EB-3
- East Butte Option 4 EB-4 (New Our Lady of the Rockies access I/C) – The proposed Our Lady of the Rockies interchange was determined to be un-feasible at the proposed location (north of East Butte) because of geometric issues. The ramps would have grades of 10-12% and the spacing between the ramps would not meet standards. Other options are being considered to provide access to the Our Lady of the Rockies site.
- Continental Option C-1 (Realigned frontage road) – Dropped due to r/w requirements
- Continental Option C-2A (roundabouts) – Option C-2B will allow phased implementation (one intersection at a time), which would work better with potential development arrives

In addition to the mainline segment 1 and segment 2 options that were pulled out as separate projects a new partial Harrison Avenue option was identified during this screening meeting. This option would improve westbound loop ramp and acceleration length (H-9) for Harrison Avenue. A total of seventeen individual full improvement options were advanced for further consideration and packaging. A complete list of conceptual designs and option designs advanced and dropped are included in Appendix E.

4.2 PACKAGING OF OPTIONS

As part of the option design review and screening project elements from the minor and safety type project list were combined into logical project packages as corridor wide or specific interchange projects. The minor and safety type packages include four ITS projects, two corridor wide safety projects, four bridge related projects (full replacement and anti-icing systems) and a minor improvement project for the Rocker, West Butte, Harrison and East Butte interchanges. The partial Harrison Avenue options (H3-H9) were combined to make four complete project options. By packaging option components into complete projects it will be possible to prioritize and compare options for the entire corridor and at each interchange.

4.3 PRIORITIZATION PROCESS

The prioritization of projects developed as this project was done by potential implementation time frame and then through a qualitative ranking related to the deficiencies corrected. Due to the uncertainty of available funding for the Butte Interstate corridor projects were not ranked and prioritized in a numerical order. Instead projects were put into ranked groups based first on addressing safety issues followed by operations or design standards. This will allow MDT to use the final list of options as guidance for potential improvements that could be programmed for construction.

Improvement options were first broken into anticipated implementation time frame. Three time frames for implementation were identified, near term, long range and ultimate based on the following guidelines:

- **Near Term** - Improvement options with a high potential to be programmed and implemented within the next seven years. These improvements are generally smaller short term improvements with estimated costs below $3 M, and some could be completed through regular maintenance activities. Improvement options within this time frame would focus on improving safety throughout the corridor.
- **Long Range** - Improvement options likely to be programmed and completed within the twenty year planning horizon. These improvements generally require more pre-planning activities (environmental clearances, right of way, etc.) and have estimated costs over $3M.
- **Ultimate** – Improvement options that would modify an interchange to the ultimate probable configuration. These improvements include upgrading interchanges to high speed system level or full movement interchanges where current and twenty year traffic volumes do not justify the upgrade.

After each improvement options anticipated implementation time frame was identified options were ranked relative to one another. Three priority levels were use high, medium or low based on the following guidelines:

- **High** – Improvement options that improve a documented safety issue or improve a location with a high potential for a serious crash.
- **Medium** – Improvement options that provide improvements to deficient geometric conditions or improve traffic operations.
- **Low** – Improvement options that improve a location to meet current design standards.

To help prioritize the improvement options a comparative analysis of the deficiencies identified during Phase 1 was performed based on observed and potential safety issues. This analysis identified the following locations as having the highest observed safety issues:

- West Butte EB off ramp and EB horizontal curvature
- Harrison EB off-ramp and Dewey Intersection spacing
- Mainline Segment 2 (caused by functionally obsolete bridges/lack of shoulders)

And the following locations were identified as having the highest potential safety issues (potential for serious crashes):

- Rocker EB on-ramp acceleration length up grade
- Montana Street access issues
- East Butte loop ramp and deficient acceleration length
- Harrison Loop Ramps and deficient acceleration and deceleration length

5.0 TRAFFIC OPERATIONS

5.1 TRAFFIC OPERATIONAL ANALYSIS

Traffic engineers commonly use level of service (LOS) to measure traffic operations of freeways, freeway ramp junctions, arterials, and intersections. LOS is an operational analysis rating system defined in the *2000 Highway Capacity Manual* (HCM). Operations are affected by several variables including speed, delay, travel time, and the freedom to maneuver. There are six LOS (refer to Table 5.1) ranging from "A" to "F". LOS A is defined as being ideal flow conditions with little or no delays. Conversely, LOS "F" is defined as conditions where extreme delays are encountered. Each LOS describes traffic flow in terms of delay, travel time, and/or speed experienced by motorists.

Table 5.1
Basic Level of Service Descriptions

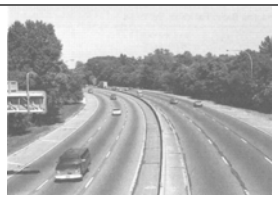
	**LOS A.** Represents the best operating conditions and is considered free flow. Individual users are virtually unaffected by the presence of others in the traffic stream.
	**LOS B.** Represents reasonably free flowing conditions with some influence by others.
	**LOS C.** Represents a constrained constant flow below speed limits, with additional attention required by drivers to maintain safe operations. Comfort level of the driver noticeably declines.
	**LOS D.** Represents traffic operations approaching unstable flow with high passing demand and limited passing capacity. Maneuverability of the driver is severely restricted. LOS D is an acceptable condition for arterial and collector roadways in the community.
	**LOS E.** Represents unstable flow near capacity. LOS E often quickly changes to LOS F because of disturbances (road conditions, accidents, etc.) in traffic flow.

Table 5.1
Basic Level of Service Descriptions

	**LOS F.** Represents the worst conditions with heavily congested flow and traffic demand exceeding capacity. LOS F is characterized by stop-and-go traffic, poor travel time, low comfort and convenience, and increased accident exposure.

Phase 1 analyzed all of the existing mainline segments and ramp terminal intersections for the future condition (2025) and with the exception of Montana Street and Harrison Avenue all of the intersections operated at LOS A or B. For Phase 2 only options that would improve the deficient intersections were analyzed (i.e., Montana Street and Harrison Avenue). Traffic operational analysis was completed for the AM Peak (7:00-9:00 AM), noon peak (11:00 AM-2:00 PM) and the PM Peak (3:00-6:00 PM) periods. *Synchro* software was used to determine the LOS for signalized intersections, *Highway Capacity Software (HCS)* was used to determine the LOS for unsignalized intersections, and *RODEL* software was used to determine the LOS for roundabout intersections.

Montana Street
Traffic Operational analysis was completed for two options on Montana Street, signalizing or constructing roundabouts for the ramp terminals. As shown in Table 5.2 and Figure 5.1 and Figure 5.2, both options operate at acceptable LOS. Because Montana Street has the potential for more aggressive growth than what is accounted for in the 2025 traffic volumes a sensitivity analysis was completed increasing 2025 through traffic on Montana Street. With this increase in traffic the signalized intersections still operate at LOS B or better.

Table 5.2
Future (2025) Traffic Operations on Montana Street Options

Main Street	Cross Street	AM		Noon		PM	
		Delay	LOS	Delay	LOS	Delay	LOS
Montana Street Option 1 - Signalized	Westbound Ramps	9.7	A	7.1	A	6.7	A
	Eastbound Ramps	7.1	A	6.2	A	6.9	A
	Rowe Road	19.6	B	23.2	C	22.1	C
Montana Street Option 2 - Roundabout	Westbound Ramps ®	5.4	A	6.4	A	10.1	B
	Eastbound Ramps ®	5.6	A	6.9	A	10.3	B
	Rowe Road	27.2	C	27.0	C	25.2	C

® Roundabout intersection

Harrison Avenue
Traffic operational analysis for Harrison Avenue was completed on multiple options. Initially the analysis was completed on two full reconstructions (H1 and H2) and several partial options (H3-H9). After it was determined that the partial options would operate at acceptable LOS combination options were run together to analyze traffic operations. As Table 5.3 and Figure 5.3 through Figure 5.9, show all of the options under consideration operate at acceptable LOS, except at the Harrison Avenue and Amherst Avenue intersection. This intersection is outside of

the limits of each interchange alternative improvement, but within the study area. The only improvement option for the Harrison Avenue and Amherst Avenue intersection is the H-31 option, which includes adding a NB right turn lane and changing the access on the west leg from a full movement to a right-in/right-out configuration. By adding the right turn lane the lane balance issues observed in the field would be reduced and the change to the commercial access on the west side would eliminate a signal phase in the traffic signal operation, which can be attributed to the improved intersection operations for this option.

Table 5.3
Future (2025) Traffic Operations on Harrison Avenue Options

Main Street	Cross Street	AM		Noon		PM	
		Delay	LOS	Delay	LOS	Delay	LOS
Harrison Ave. Option 1 – SPUI	Amherst Avenue	17.0	B	43.5	D	21.4	C
	Cornell Avenue*	8.9	A	9.6	A	9.9	A
	WB & EB On/Off-Ramps	16.8	B	14.6	B	23.7	C
	Dewey Boulevard	8.5	A	13.5	B	11.0	B
Harrison Ave. Option 2 – Tight Diamond	Amherst Avenue	19.0	B	108.7	F	22.6	C
	Cornell Avenue*	10.5	B	12.0	B	10.7	B
	Westbound Ramps	4.7	A	6.5	A	11.7	B
	Eastbound On/Off Ramps	5.6	A	5.8	A	9.1	A
	Dewey Boulevard	8.0	A	12.6	B	11.2	B
Harrison Ave. Option 20 – EB & WB Loop Improvements (H3 & H9)	Amherst Avenue	17.4	B	92.5	F	22.5	C
	Cornell Avenue*	9.9	A	10.1	B	9.2	A
	Westbound On/Off-Ramps	5.1	A	7.9	A	7.0	A
	Dewey Boulevard	9.8	A	14.0	B	11.7	B
	Eastbound On/Off Ramps	7.4	A	6.8	A	10.1	B
Harrison Ave. Option 21 – Eliminate Loop Ramps (H4 & H6)	Amherst Avenue	19.8	B	59.1	E	22.6	C
	Cornell Avenue*	10.5	B	12.3	B	10.8	B
	Westbound Ramps	4.2	A	7.2	A	18.0	B
	Eastbound Off Ramp*	11.4	B	14.8	B	10.2	B
	Dewey Boulevard	9.4	A	12.9	B	12.7	B
	Eastbound On Ramp	9.7	A	0.9	A	0.9	A
Harrison Ave. Option 22 – EB Loop Imp. / Eliminate WB Loop (H3 & H6)	Amherst Avenue	17.9	B	92.7	F	23.2	C
	Cornell Avenue*	10.5	B	12.0	B	10.7	B
	Westbound On/Off-Ramps	7.3	A	11.2	B	17.2	B
	Dewey Boulevard	7.6	A	11.1	B	9.5	A
	Eastbound On/Off-Ramps	7.2	A	5.9	A	9.3	A
Harrison Ave. Option 23 – WB Loop Imp. / Eliminate EB Loop (H4 & H9)	Amherst Avenue	21.5	C	63.3	E	25.1	C
	Cornell Avenue*	9.9	A	10.1	B	9.2	A
	Westbound On/Off-Ramps	5.1	A	9.3	A	8.1	A
	EB Off-Ramp	12.6	B	17.2	B	18.0	B
	Dewey Boulevard	9.4	A	12.9	B	12.6	B
	Eastbound On-Ramp	9.7	A	0.9	A	0.9	A
Harrison Ave. Option 30– Restripe to 4-Lanes	Amherst Avenue	20.6	C	74.4	E	37.3	D
	Cornell Avenue*	10.7	B	10.4	B	11.7	B
	Westbound Ramps	3.6	A	6.7	A	6.1	A
	Eastbound Off Ramp*	13.2	B	14.1	B	16.2	C
	Dewey Boulevard	10.4	B	22.1	C	24.0	C

Table 5.3
Future (2025) Traffic Operations on Harrison Avenue Options

Main Street	Cross Street	AM		Noon		PM	
		Delay	LOS	Delay	LOS	Delay	LOS
	Eastbound Ramps*	12.3	B	15.9	C	18.3	C
Harrison Ave. Option 31 – Harrison & Amherst Imp.	Amherst Avenue	13.2	B	20.8	C	14.8	B
	Cornell Avenue*	10.5	B	9.6	A	12.4	B
	Westbound Ramps	3.8	A	6.2	A	6.1	A
	Eastbound Off Ramp*	12.8	B	14.1	B	15.2	C
	Dewey Boulevard	10.1	B	19.6	B	24.0	C
	Eastbound Ramps*	12.2	B	15.9	C	18.3	C

** - Maximum side-street delay reported for unsignalized intersection*

Figure 5.1
Future (2025) LOS for Montana Street Option 1

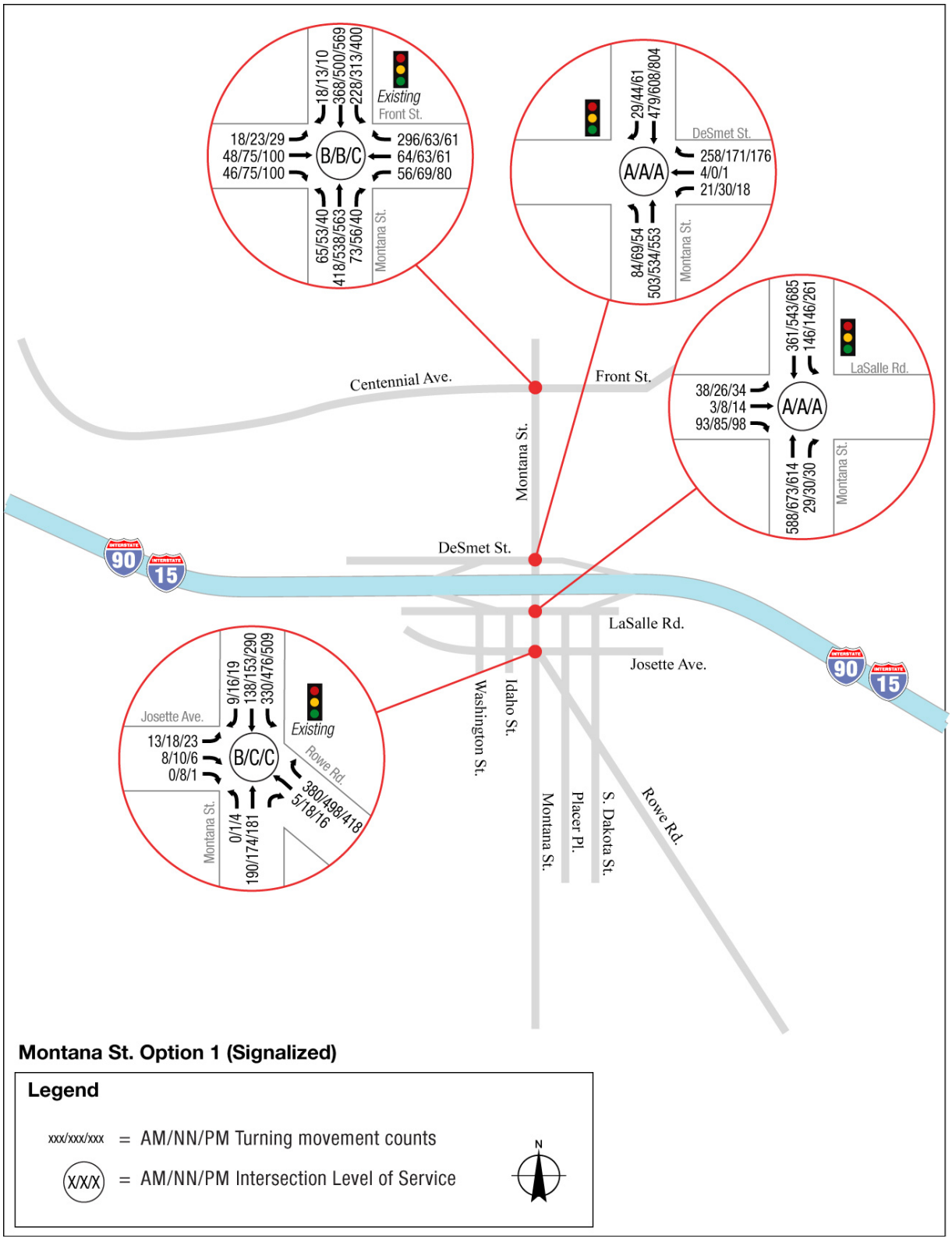


Figure 5.2
Future (2025) LOS for Montana Street Option 2

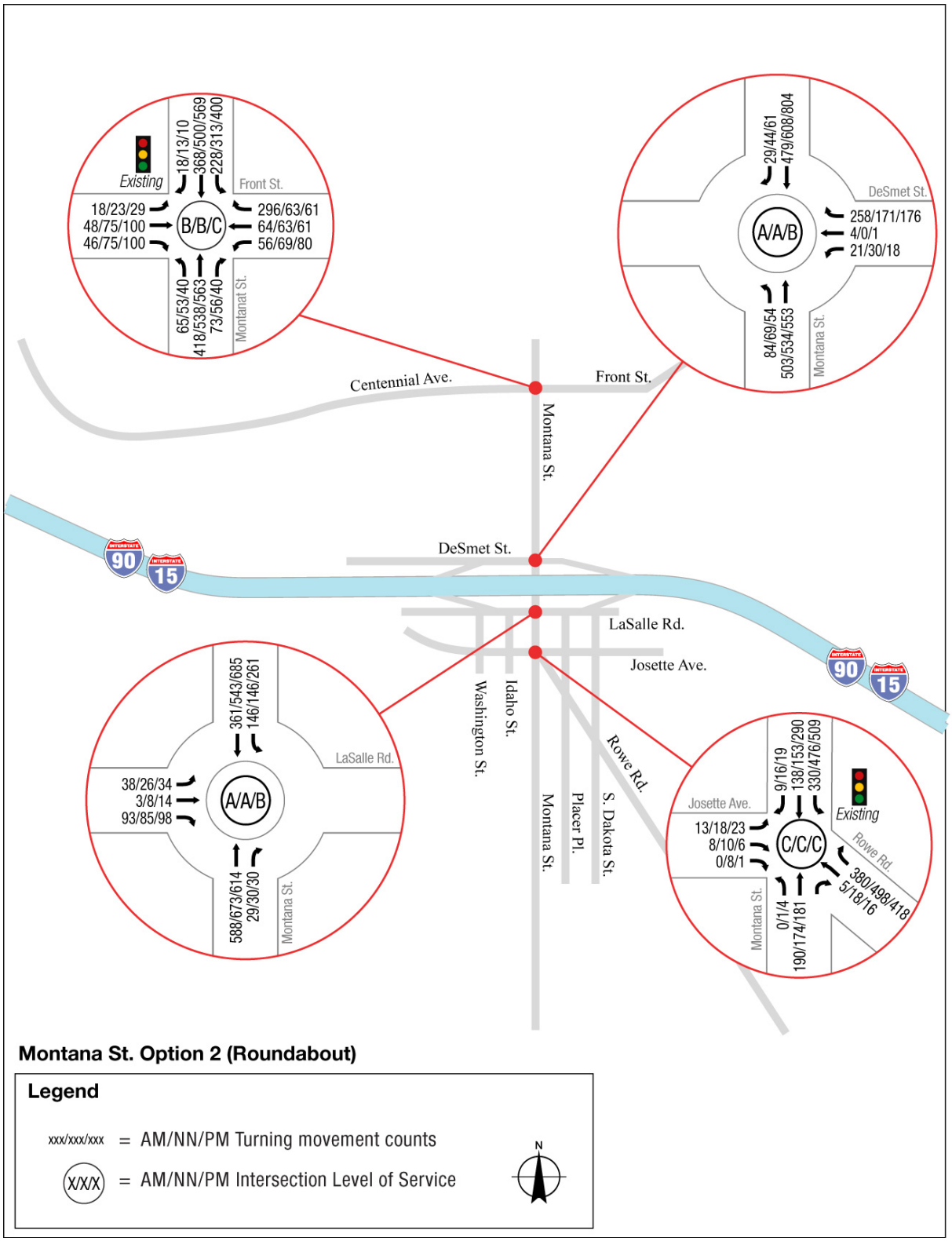


Figure 5.3
Future (2025) LOS for Harrison Option 1

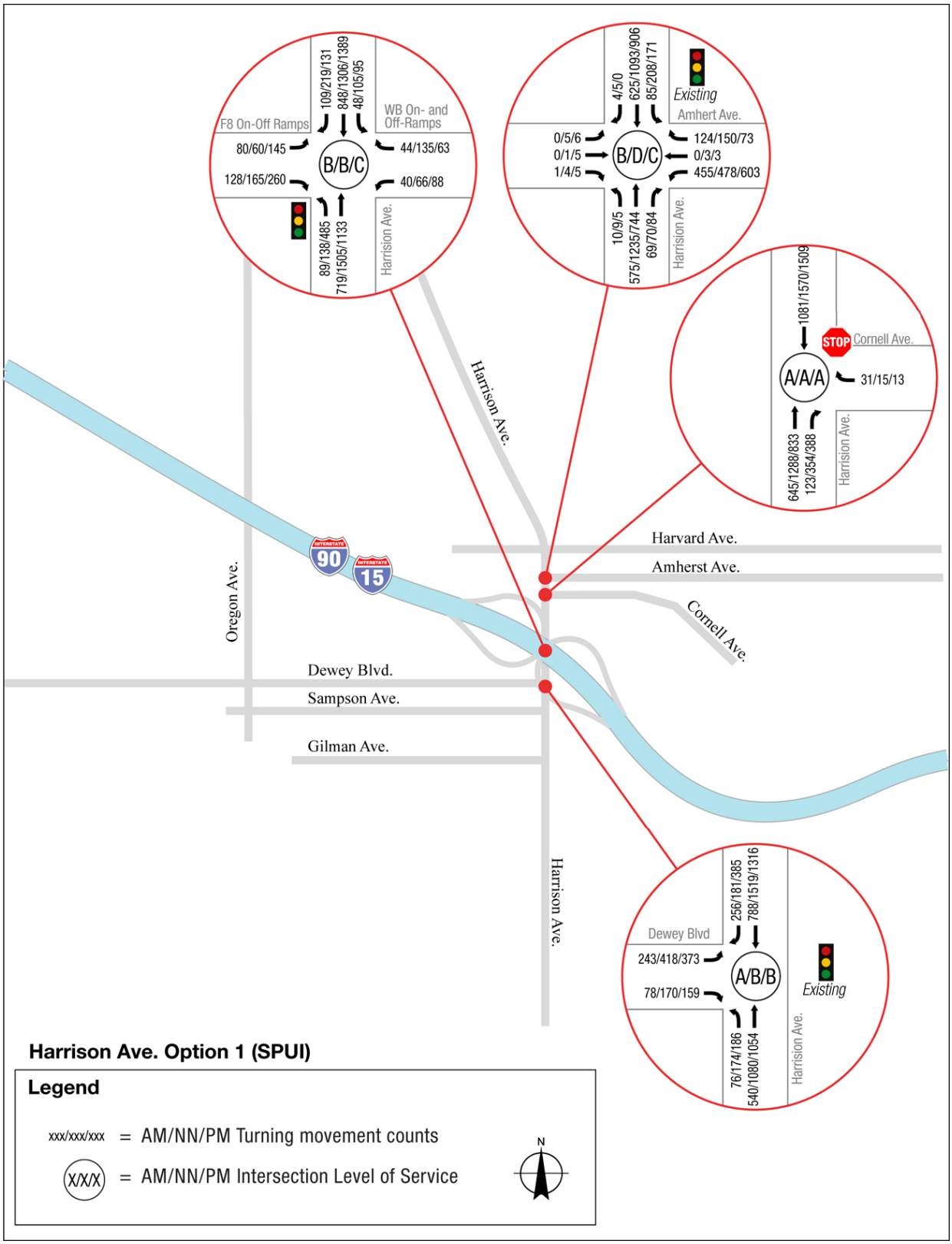


Figure 5.4
Future (2025) LOS for Harrison Option 2

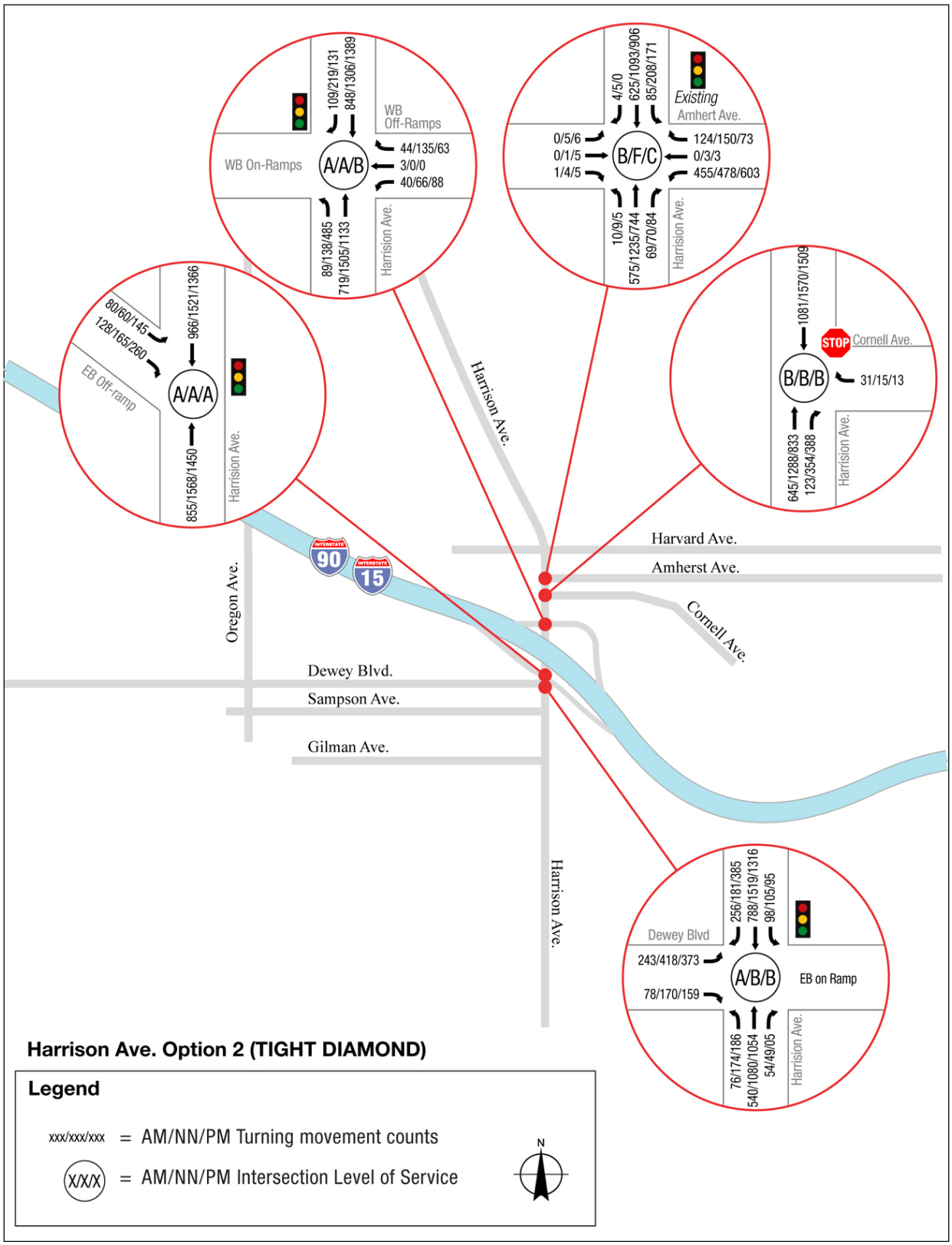


Figure 5.5
Future (2025) LOS for Harrison Option 20

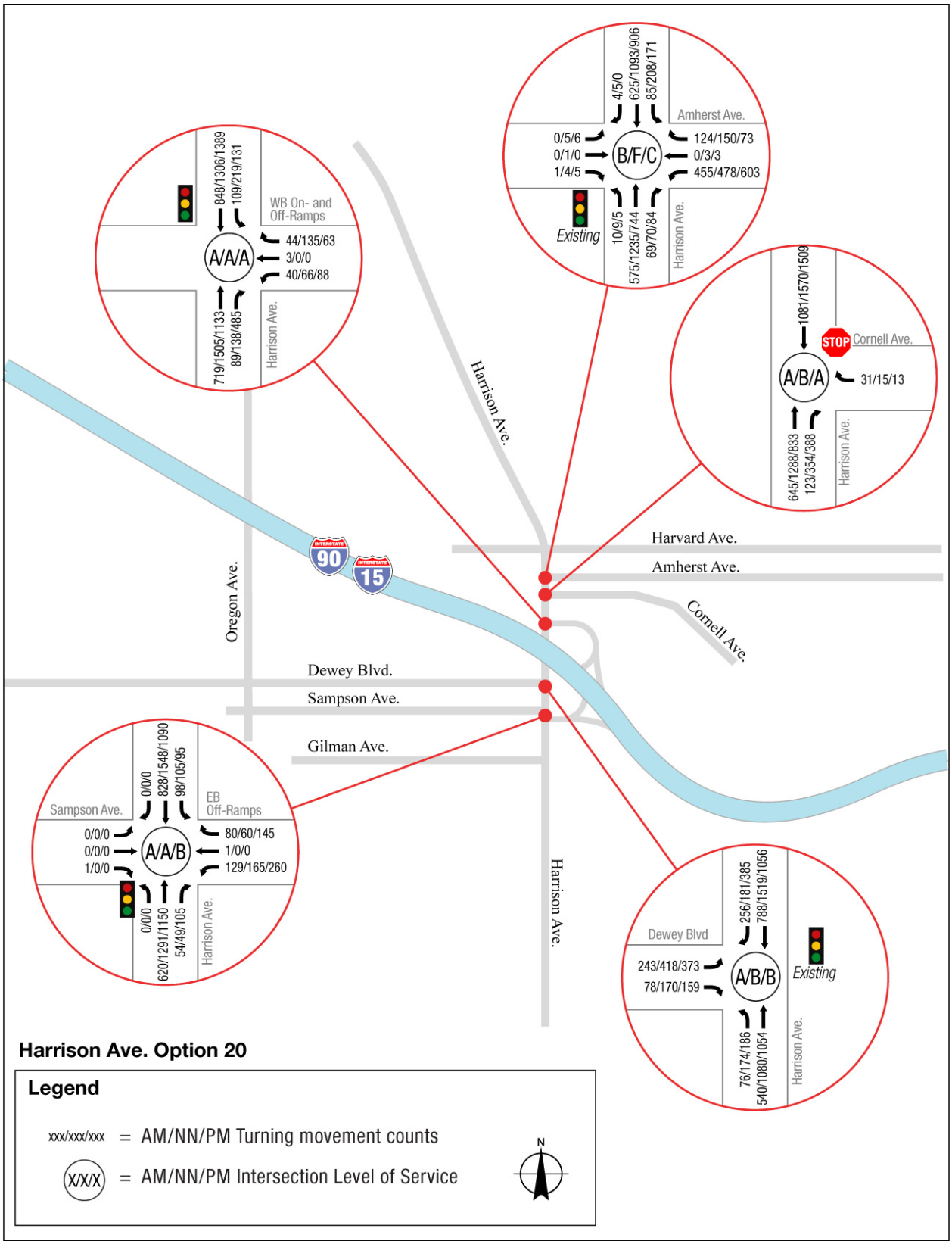


Figure 5.6
Future (2025) LOS for Harrison Option 21

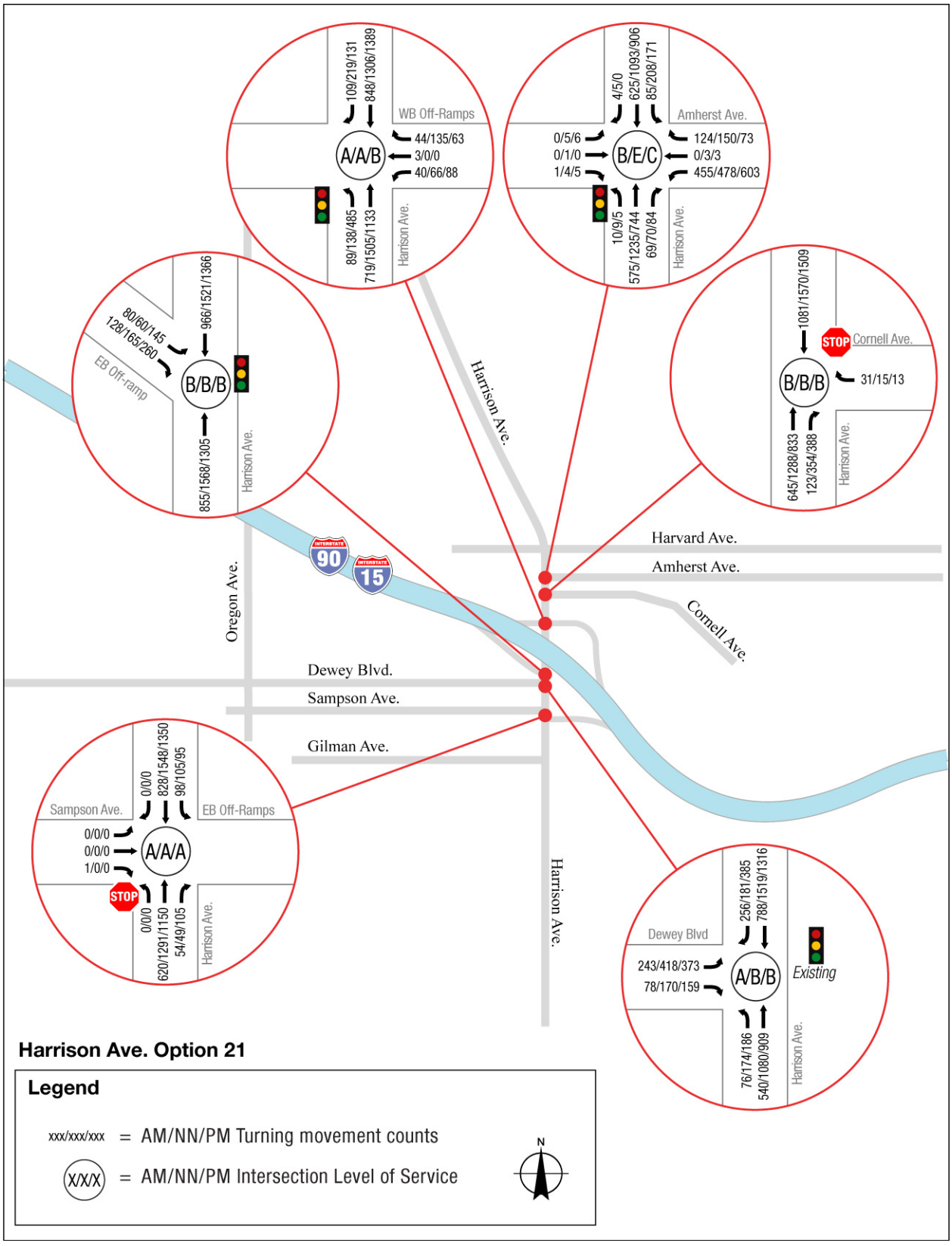


Figure 5.7
Future (2025) LOS for Harrison Option 22

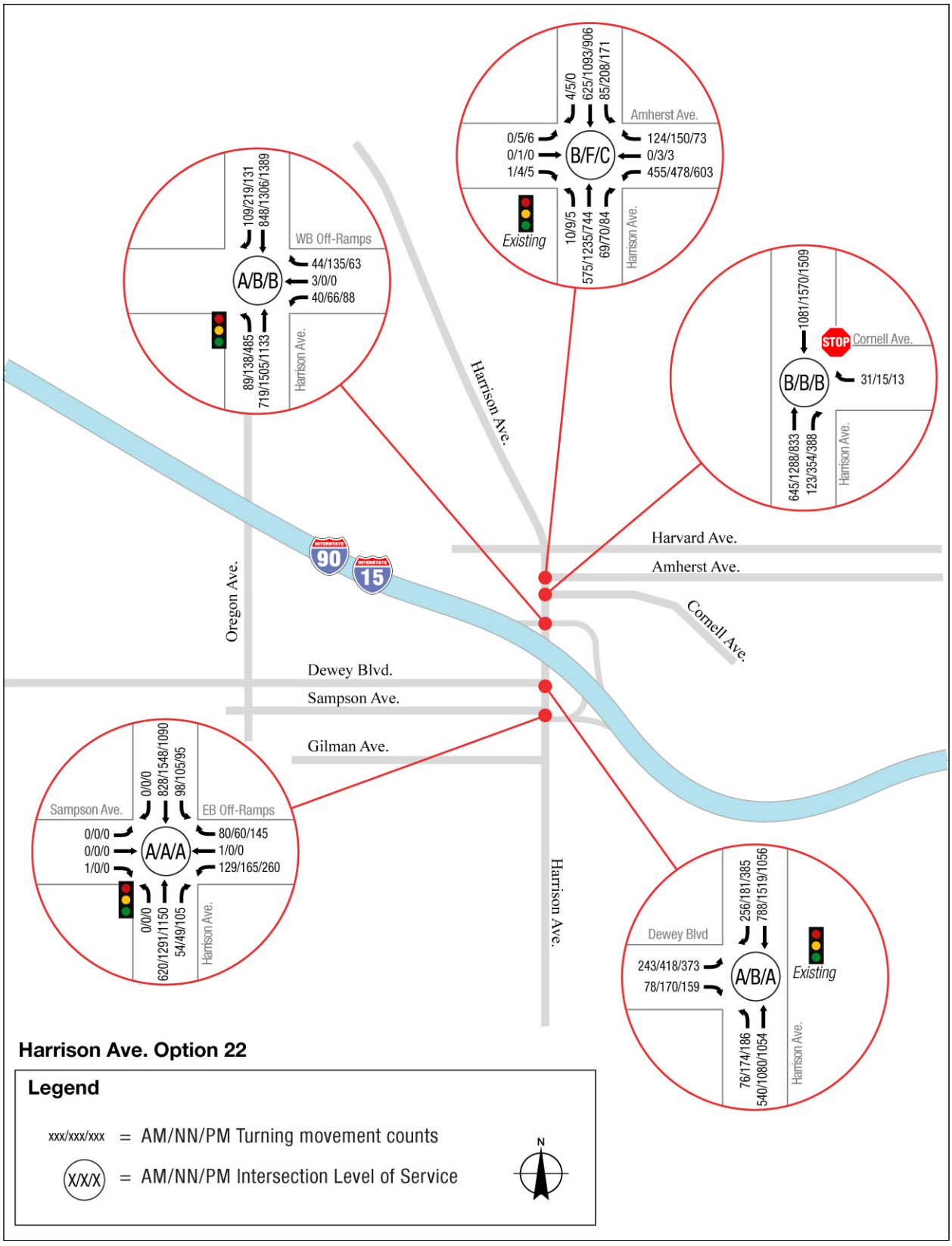


Figure 5.8
Future (2025) LOS for Harrison Option 23

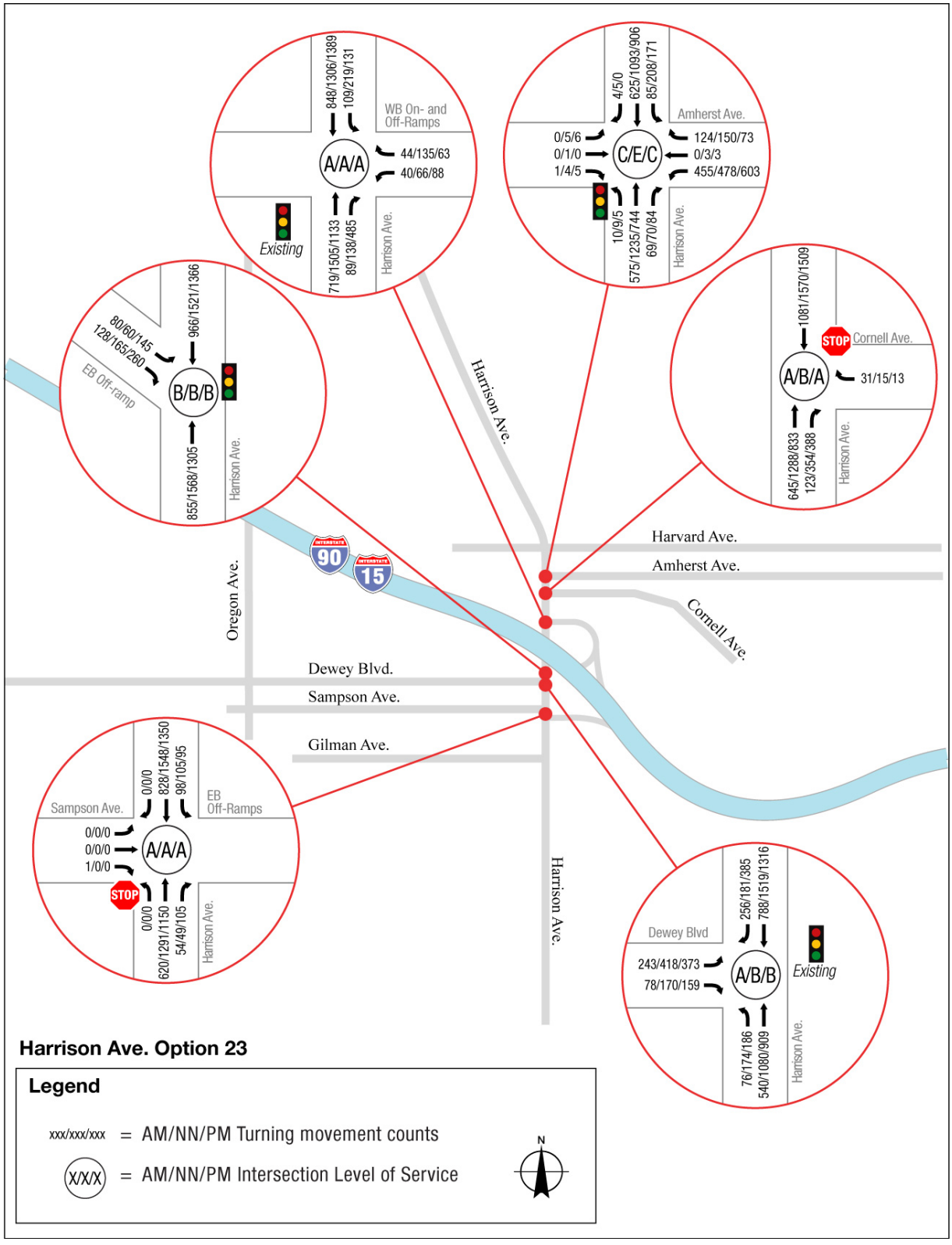
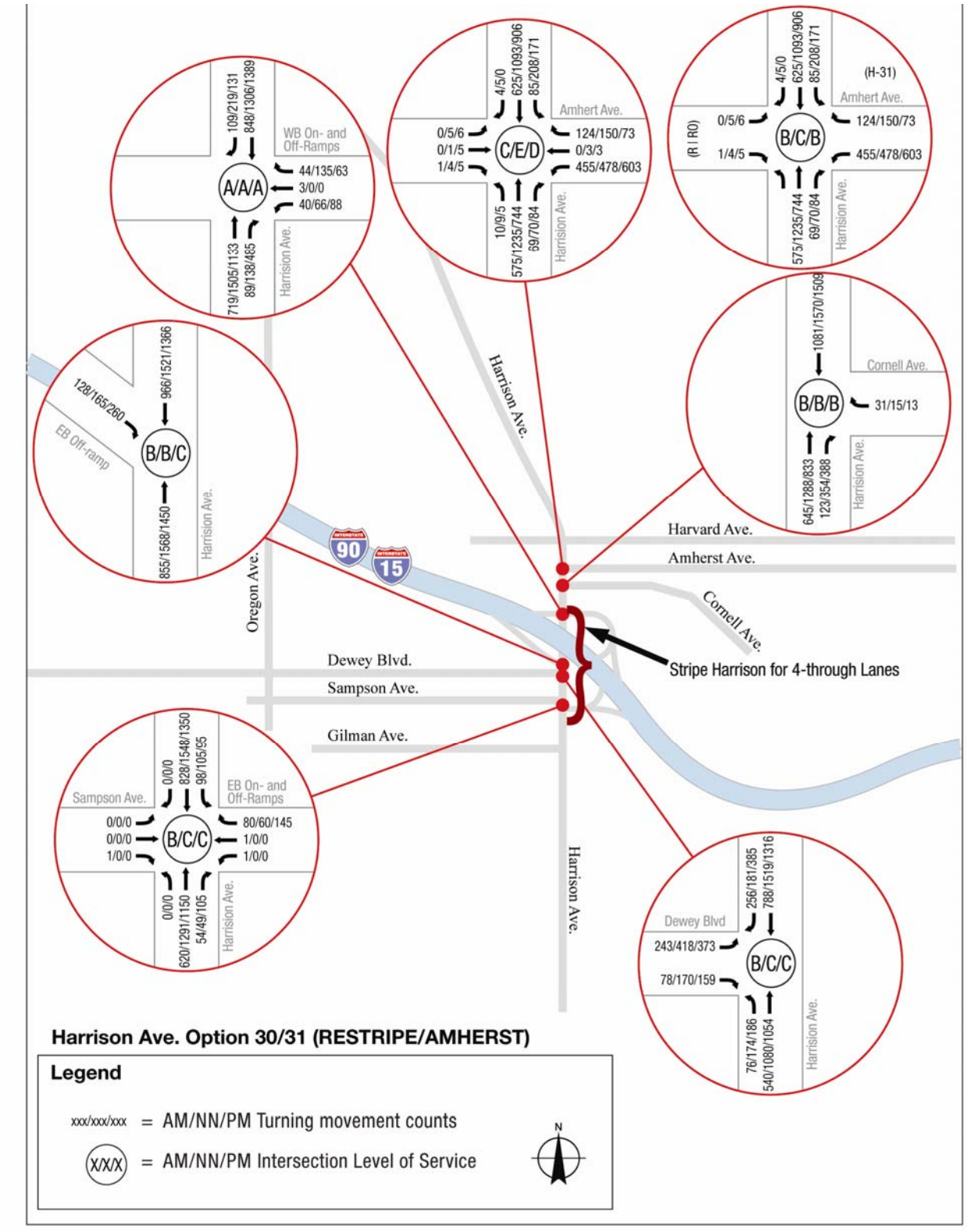


Figure 5.9
Future (2025) LOS for Harrison Option 30 and 31



6.0 FINAL OPTION DESCRIPTIONS

6.1 OPTIONS DESCRIPTIONS

Specific information about each improvement options is described below. Costs shown are based on 2008 cost estimates. Additionally graphical exhibits are shown in the Final Option Exhibit section for all of the options.

6.1.1 Individual ITS Component Descriptions

Several near term improvement options have been identified and recommended for implementation that consist of multiple ITS components. This section describes the individual components, including:

- closed circuit television (CCTV)
- dynamic message signs (DMS)
- highway advisory radio (HAR)
- roadway weather information systems (RWIS)
- speed display signs
- speed reduction systems
- variable speed limits (VSL)

Closed Circuit Television (CCTV)
Description: System of cameras and other electronic equipment used to monitor and/or record a remote site, and to transmit a signal to a specific, limited set of monitors. Cameras are typically connected to a communications network to transmit the signal to a traffic operations center. A traffic operation center can vary greatly in terms of the level of technology and use. A rural traffic operation center can be as simple as a workstation within a district or maintenance office that is tied to the ITS elements and operated during specified incidents such as major events, construction or inclement weather.

Component Benefits: Provides the ability to remotely monitor and observe traffic and weather conditions.

Estimated Cost: $7,000 per camera

Dynamic Message Signs (DMS)
Description: An electronic highway sign used to give travelers information about road and traffic conditions and other special events. These signs can be mounted on the side of the road, in the median or cantilevered over the roadway.

Component Benefits: Provides a primary source of information to travelers, including the ability to warn of upcoming dangerous conditions.

Estimated Cost: $100,000 per sign

Highway Advisory Radio (HAR)
Description: Low powered, local radio transmitters used to convey messages regarding highway conditions to travelers. These transmitters are used in conjunction with static or dynamic signs to alert drivers of the availability of information via the radio.

Component Benefits: Provides a source of information to travelers, including the ability to warn of upcoming dangerous conditions. Capable of conveying much more information than can be displayed on static or dynamic signs

Estimated Cost: $40,000-$50,000 per location

Roadway Weather Information Systems (RWIS)
Description: A system of sensors placed roadside, adjacent to and/or in the pavement, capable of detecting weather related information such as precipitation, temperature (both ambient and surface), and wind, and connected to a communications network to transmit the information to a traffic operations center.

Component Benefits: The system provides information to operators so that better informed decisions can be made regarding surface treatment during inclement weather, and road and weather information can be conveyed to travelers.

Estimated Cost: $40,000-$50,000 per location

Speed Display Signs
Description: A sign which displays a vehicles speed, determined by using radar, to give drivers feedback and make them more aware of how fast they are going. With solar power, these can be stand alone devices.
Component Benefits: Provides a traffic calming effect by making drivers more aware of their speed. Especially beneficial when used in areas with reduced speed limits, such as construction zones.

Estimated Cost: $15,000 per sign

Speed Reduction Systems
Description: A system used to convey warnings to drivers who may be exceeding safe speed requirements, such as on the approach to a low speed ramp. It consists of a vehicle speed detection component (inductive loops, radar, laser, microwave, video, or acoustic sensors, for example); a vehicle characteristic detection component to determine vehicle class, size, and/or weight; a processor with an appropriate algorithm; and a display of some type to warn drivers, such as a static sign with flashing beacons.

Component Benefits: Slows drivers down, if they are going too fast, before they enter a critical location.

Estimated Cost: $60,000 per location

Variable Speed Limits (VSL)
Description: A system used to adjust advisory or enforceable speed limits based on criteria such as inclement weather, sight visibility restrictions, time of day, detected prevailing traffic speed, the presence of an incident, etc. It consists of a speed limit signs which are fully dynamic or hybrid static/dynamic that are connected to a communication network so that the desired speed limit can be implemented remotely. The information used to determine appropriate speeds typically comes from the implementation of other ITS components such as RWIS and CCTV. The decision to implement appropriate speeds is typically made at a traffic operations center.

Component Benefits: Provides a potential safety and operation benefit by controlling speeds and matching them to prevailing conditions. Safety is enhanced by reducing speeds when adverse conditions are present. Operations are enhanced by minimizing speed variation when pockets of congestion exist.

Estimated Cost: $5,000 per sign

6.1.2 Option Descriptions

The following improvement option descriptions provide detailed information on proposed improvements, potential impacts and estimated costs (2008 estimates) that complement the exhibits shown at the end of this report (Final Option Exhibits).

Incident Management Support Option 1 (ITS-1)
Description: Develop Incident Management Plan and Install DMS, CCTV, RWIS, and HAR Elements to support the implementation of the plan. *(See figure ITS-1, 2 & 3, exhibit 6-2)*

ITS Project 1 has been defined as a planning option to address the development of specific incident management plans by multi-agencies. Incident Management is particularly critical within the target area because of the convergence of two major interstate routes, I-15 and I-90 (with the shared alignment identified as I-15 through the developed segment of the City of Butte), highlighting the need for safe, quick incident clearance. It is recognized that timely response and quick clearance is necessary to minimize the effects of major crash and spill events, as well as weather related events, reducing the exposure risk for first responders and the traveling public. Traffic Incident Management (TIM) plans provide preplanned response procedures for first responders so that the safety of the responder and those involved in the incident is secured, and so that the most effective and efficient clearance procedures are employed to minimize delay and inconvenience to travelers. TIM plans identify protocols related to chain of command, communication, and alternate routes.

ITS can provide tools to first responders aiding all aspects of incident management by facilitating detection, remote assessment, monitoring changing conditions, and disseminating information to responders as well as the traveling public but effectiveness is predicated on institutional relationships and defined roles and responsibilities.

CCTV applications provide the ability to remotely identify and evaluate responder needs as well as to monitor the changing incident scene and provide for ongoing information including traffic impacts. Local or corridor information distribution is normally supported by DMS signs and

HAR broadcasts placed at critical decision points as well as being available through internet applications, 511 and the public media.

MDT also has a robust statewide weather and RWIS data collection system; implementing some additional sites to include the more susceptible locations such as the interchanges/overpasses and identified ramps along this corridor may also help to reduce exposure to potentially hazardous conditions.

Option Benefits: Provides a quicker and more efficient response to incidents, a safer environment for first responders and crash victims, reduced delay and inconvenience to travelers, reduces diverted traffic, reduced queues on the freeway, reduces secondary incidents.

Potential Impacts: No anticipated right of way or environmental impacts

Estimated Cost: $250,000 to develop a regional traffic incident management plan. ITS components to support the use of the plan are priced as described in the individual ITS component section above.

Traffic Management ITS Package (ITS-2)

Description: Implement variable speed limits through out the corridor, install speed display signs at key areas, add additional RWIS, and install active warning/speed reduction signs at loop ramps. *(See figure ITS-1, 2 & 3, exhibit 6-2)*

ITS applications have been proposed to address specific operational conditions dealing with techniques to affect not only the overall corridor speed given prevailing conditions (such as weather or incidents) but also to add emphasis at specific locations where geometric configurations such as the horizontal and vertical alignment warrant the reduction of speed for safety considerations.

Variable Speed Limits (VSL)

One of the recommended approaches, variable speed limits, has not yet been universally implemented so there may be some legal considerations which must be reviewed or legislated. There is also the caveat that the ITS devices conveying this type of information must always be in working order to be effective.

This corridor is a viable candidate for the application of variable speed limits, i.e. the adjustment of advisory or enforceable speed limits based on criteria such as inclement weather, sight visibility restrictions, time of day, detected prevailing traffic speed, incident presence, etc. This application would then possibly override the individual ITS warning systems proposed on the other projects.

The key features of a variable speed limit deployment would include at minimum:

- Message signs as specified by the FHWA
- Operating parameters such as minimum and maximum display speed, and update frequency

- On-site data processing for speed limit display and storage for time log of speed limit displayed
- Wireless modem access for remote data retrieval for later analysis and functional check
- RWIS
- A notification system that can be used by enforcement personnel to determine the speed limit displayed by any sign in the system

Leasing a system and implementing a pilot project to minimize the capitol investment and establish a comfort level for the technology application is an option for consideration.

Speed Reduction Systems

Speed reduction systems share the same common elements as a VSL system but are designed to relate a warning to drivers violating safe speed requirements with the goal of slowing down the violator prior to entering the critical location. The system works using detection of some type, processing the appropriate algorithm and then triggering a warning system to the particular driver violating the prescribed safety tolerance to negotiate the ramp, curve, etc.

Even if it is decided not to implement VSL along the corridor, certain specific locations (EB/NB and WB/SB) I-15/I-90 at Bridges and Curves and the Loop Ramps (EB Off ramp and WB On Ramp at MP127) require similar but less complex technology implementation that can utilize static signing with flashing beacons activated by a processing unit based on defined detection criteria. In these situations, the trigger for the warning beacons to flash is proposed to be based on RWIS information but could also be speed / vehicle classification / weather based or some combination.

Speed Display or Advisory Speed Signs

An alternate application is the use of speed radar detection with the associated speed display. This is a widely accepted application used not only by transportation agencies but also law enforcement to improve driver compliance with the posted regulatory and advisory speed limits. There are a number of fairly sharp horizontal curve locations along this corridor at the approximate east and westbound locations at the Rocker Interchange; MP 124; between MP 127 and 129; and the E to N and S to E connectors at the East Butte interchange; and WB I-115 where these applications would be appropriate.

Option Benefits: Reduce number of crashes involving speed, speed reduction and improved compliance with posted speeds, reduction in proportion of speeding vehicles, increase in community concern and support, behavioral changes

Potential Impacts: No anticipated right of way or environmental impacts

Estimated Cost: Estimated costs for ITS packages will vary depending on the number and type of elements installed. Individual packages could range from $500 k to $1.5 M or all of the ITS packages could be installed for $2 to $3 M.

Traveler Information ITS Package (ITS-3)

Description: Install and utilize DMS, CCTV, HAR, wireless, RWIS Elements for the purpose of improving traveler information. *(See figure ITS-1, 2 & 3, exhibit 6-2)*

Butte provides key services including lodging, gas and food to travelers along this corridor. Three main truck stops cater to the large volume of heavy truck traffic. Partnership with these private facilities as well as those providing lodging, etc. to provide travel information including CCTV views, RWIS information, and traveler advisories at the service sites or by local Highway Advisory Radios and DMS can also help to provide drivers with the necessary information to make improved travel decisions. Having such knowledge can help eliminate confusion, indecision and disperse the traffic/travel demands as necessary.

Truck parking seems to be a critical element, and this may be desirable information to provide direction as to alternate egress when facilities are full or difficult to access because of the street parking demands. Additionally, MDT has a state 511 system so additional data collection can only add value to this traveler information distribution component.

The CCTV, DMS and RWIS installations that are proposed to support incident management will also support the data collection and dissemination of information useful for traveler information. The region may wish to consider possible private/public partnership of the HAR installations with the local commercial businesses such as the truck stops, opening the opportunity to provide messages on lodging and fuel availability, the best ramps for commercial vehicles to access, parking information, etc. to facilitate traffic flow.

CCTV

Recommendation is to place CCTVs spaced approximately 1 mile along the study area to provide full coverage (12.2 miles of subject interstate). Additional CCTV installations may be needed to provide complete visual coverage for the critical interchanges based on refined sight distance analysis. Fixed installations are the least costly and will provide basic visibility, but consideration of the ability to control camera views may provide additional benefit to first responders. However, it is proposed that the CCTV installations be included as part of the existing MDT CCTV/RWIS network supported by the Department of Information Technology.

DMS

Recommendation is to place DMS (roadside T mount) at least ¼ mile from critical decision points and/or optional detour routes with priority for the East Butte and Rocker Rd. Interchanges.

HAR

The normal range of an AM HAR system is approximately 6 to 10 miles when operating under ideal conditions (flat terrain, no buildings, etc.). There are licensing requirements but most vendors will handle the application process. While the AM radio band is available in almost all vehicles, local reception is subject to interference from overriding AM broadcasts. HAR associated with flashing beacons can emit more detailed messages than can be placed on a DMS signs with the caveat that the performance of the installation can be limited based on terrain and vehicle radio reception issues. Recommendation for placement to ensure good coverage is for 3 sites (within the project limits and an intermediate location). The proposed DMS signs can be

used to alert motorists to tune to the HAR for messages but there are 3 locations where static signing/flashing beacon installations will be needed to notify of urgent messages being broadcast on the HAR system. Static signage can be used to inform motorists of routine messaging.

RWIS

There are no RWIS installations within close proximity to the East Butte Interchange or the interstates through the urbanized area of Butte. Recommendation of placement should at least be at the major interstate interchange and at the identified exit/entrance ramps. The state's RWIS network is supported by the Department of Information Technology and it is proposed to include these installations as part of the existing system. It is recommended that the installations be located at the West Butte, East Butte, Rocker Road, Harrison Avenue and the Montana Street interchanges. If RWIS is not installed at the exit/entrance loops at Harrison Avenue, then it is suggested that an installation covering the Harrison Bridge also be considered. Estimated number of installations is assumed as a stand alone implementation and does not account for utilization of other proposed notification systems.

Option Benefits: While traveler information is difficult to measure because of its unique intrinsic value to each user, there are some areas where improvements are likely:

- Travel time reliability
- Customer satisfaction
- Perception of quality of service
- Minimization of delay
- Safety
- Operational efficiency
- Reliability
- Queue lengths

Potential Impacts: No anticipated right of way or environmental impacts

Estimated Cost: Estimated costs for ITS packages will vary depending on the number and type of elements installed. Individual packages could range from $0.5 M to $1.5 M or all of the ITS packages could be installed for $2 to $3 M.

Site Specific ITS Package (ITS-4)

Description: Install site specific ITS components at specific locations within the corridor, including a DMS sign west of Rocker and speed reduction systems on the Harrison and East Butte interchange loop ramps. An additional DMS sign located in advance of the Rocker interchange could be tied to the planned interstate gate closure project at the Continental interchange. This sign could alert travelers when I-90 is closed, which would allow semi-trucks to exit at Rocker and utilize the truck stops. *(See figure ITS-1, 2 & 3, exhibit 6-2)*

Option Benefits: Provides potential safety improvements at loop ramps and adds a DMS sign in a key truck location for truck information without a full ITS implementation effort.

Potential Impacts: No anticipated right of way or environmental impacts.

Estimated Cost: Estimated costs for ITS packages will vary depending on the number and type of elements installed. Individual packages could range from $500 k to $1.5 M or all of the ITS packages could be installed for $2 to $3 M.

Guardrail Package of Improvements (CW-1)

Description: This improvement option would include extending and replacing guardrail at numerous locations throughout the corridor to meet current standards. Additionally this would include installing a median guardrail system in areas where the median width is less than 50-feet wide, between the Montana Street and East Butte interchanges. The use of the newer cable barrier technology is being used more and more by state departments of transportation because of its proven safety benefits and ease of maintenance. *(See figure CW-1, 2 &3, exhibit 6-3)*

Option Benefits: Potential to improve safety and upgrade corridor to current standards.

Potential Impacts: No anticipated right of way or environmental impacts.

Estimated Cost: $0.3M to $1M depending on final scope of work.

Earthwork Package of Improvements (CW-2)

Description: This improvement option would include performing minor grading work to improve sideslope conditions at numerous locations throughout the corridor. Grading would include slope flattening, ditch regrading, or minor widening to widen shoulders. The most critical areas for this work are in the WB direction just west of the Sheridan overcrossing. This area may require foreslope flattening and adding a drainage system to meet clear zone requirements. Typical cross sections and details should be developed for each area. *(See figure CW-1, 2 &3, exhibit 6-3)*

Option Benefits: Potential to improve safety through improved roadside geometrics. Would provide safe recovery areas where they do not currently exist.

Potential Impacts: No anticipated right of way, standard environmental requirements for minor grading within MDT right of way.

Estimated Cost: $0.5M to $1.5M depending on the final scope of the work.

Bridge Anti-Icing System Option (CW-3)

Description: This improvement option would install automatic anti-icing systems on functionally obsolete bridges that experience a higher than corridor average crash rate. This includes the four long bridges located in mainline segment 2, Harrison Avenue overcrossing, and the East Butte interchange overcrossing. Similar systems have been installed by MDT at the West Laurel interchange, and have operated well to date. *(See figure CW-1, 2 &3, exhibit 6-3)*

Option Benefits: Potential to improve safety during inclement weather periods through improved maintenance of the travel way.

Potential Impacts: No anticipated right of way or environmental impacts.

Estimated Cost: $2.5 – 3.5 M

Rocker Minor Improvement Option (R-10)

Description: The Rocker Interchange Minor Improvement Option would include short term solutions to existing deficiencies. This would include constructing curb and gutter along both truck stop gas stations to channelizing truck traffic accesses and eliminate uncontrolled access. Additional minor widening to accommodate truck turning movements and restriping would be included. *(See figure R-10, exhibit 6-4)*

Option Benefits: This option improves the cross road operations by consolidating access and channelizing movements.

Potential Impacts: No anticipated right of way or environmental impacts.

Estimated Cost: $0.30 M to $0.5M

West Butte Minor Improvement Option (WB-10)

Description: The West Butte Interchange Minor Improvement Option would include short term solutions to existing deficiencies. This would include changing the overhead signing so that the I-15/90 corridor is more prominent and changing the next destination to regional cities, Helena and Billings, instead of local interchanges. Additional roadside signage providing directional information for Montana Street and Harrison Avenue Interchange should be investigated. The left side off-ramp would be restriped from the existing 24' width to a standard 15' width, which will help channelize the off-ramp movement. Additional lights would also be installed near the ramp merge area. *(See figure WB-10, exhibit 6-5)*

Option Benefits: This option would remove confusion associated with the left side off-ramp and unclear signing, and provides better lane delineation for the off-ramp.

Potential Impacts: No anticipated right of way or environmental impacts.

Estimated Cost: $0.1M to $0.2 M

Harrison Avenue Minor Improvement Option (H-30)

Description: The Harrison Avenue Interchange Minor Improvement Option would include short term solutions to existing deficiencies. This could include restriping Harrison Avenue back to a 2-through lanes in each direction with an 8' outside shoulder and right turn lanes at Cornell and the West Butte On-Ramp. This striping change would help with some of the truck turning issues at Harrison and Dewey and at the EB On-Ramp by providing more room to turn from the outside turn lane. If the restriping is not included as part of this project improvement to the EB on-ramp curb return should be completed, including increasing the radius and relocating the highway sign and hotel sign. Additionally an anti-icing system for the bridge over Harrison and a speed reduction system for the EB off-ramp loop ramp could be included. The project could also include installing ADA ramps that meet current standards throughout the corridor. *(See figure H-30/H-31, exhibit 6-6)*

Option Benefits: This option has the potential to improve truck operations on Harrison Avenue and potentially eliminate the disproportionate number of sideswipe crashes in the NB direction at the EB On-Ramp.

Potential Impacts: No anticipated right of way would be required with the restriping, however minor right of way would be required to improve the EB On-Ramp curb return. No environmental impacts are anticipated.

Estimated Cost: $0.1M to $1.5M depending on the final scope of the project.

Harrison Avenue and Amherst Avenue Improvement Option (H-31)

Description: The Harrison Avenue and Amherst Avenue Improvement Option would reconfigure the intersection to improve traffic operations. Currently with the third NB through lane dropping at Cornell a heavy lane unbalance occurs approaching Amherst Avenue. By extending the third NB lane to Amherst and dropping the lane as a right turn this balance issue would potentially be improved. Amherst Avenue carries a substantial amount of traffic similar to Dewey Boulevard. The difference at this intersection is the west leg, which provides retail access. When vehicles occupy the west leg of this access the signal phasing goes to a split phase, which causes this intersection to operate below acceptable LOS. By changing the commercial access to a right-in/right-out movement the intersection would operate at acceptable LOS. For this option it is recommended that the west approach be modified to a right-in/right-out movement. *(See figure H-30/H-31, exhibit 6-6)*

Option Benefits: This option would improve traffic operations to an acceptable LOS standard and has the potential to improve safety by reducing the heavy lane unbalance issue in the NB direction.

Potential Impacts: No anticipated environmental impacts. Right of way would be required from the strip mall on the east side between Cornell and Amherst. The parking lot for these businesses would also need to be modified.

Estimated Cost: $0.7M to $1.2M

East Butte Minor Improvement Option (EB-10)

Description: The East Butte Interchange Minor Improvement Option would include short term solutions to existing deficiencies. This would include installing a potential speed reduction system on the SB to EB loop ramp, anti-icing system on the East Butte bridges and installing new lighting at the merge and diverge areas to a partial interchange lighting standard. *(See figure EB-10, exhibit 6-7)*

Option Benefits: This option improves the cross road operations by consolidating access and channelizing movements.

Potential Impacts: No anticipated right of way or environmental impacts.

Estimated Cost: $1.0M to $2.0M

Rocker Roundabout Option 1 (R-1)

Description: The Rocker Road interchange consists of two roundabouts, the north and south sides of I-15/90. The on/off-ramps and frontage roads would be realigned into one roundabout on either side of the interstate. Both roundabouts have a 180 ft inscribed diameter. To accommodate a WB-67 design vehicle, the north roundabout has a 16 ft truck apron and the south roundabout has a 20 ft truck apron. This option does a better job of eliminating the issues associated with the closely spaced frontage roads by combining the intersections into one roundabout. The access along each frontage road will also be improved to provide better access controlled by channelizing access points. A new sidewalk would be included on the east side of Rocker road between the north side and south side frontage roads. *(See figure R-1, exhibit 6-9)*

Option Benefits: This option improves the cross road operations by consolidating access and channelizing movements.

Potential Impacts: No anticipated right of way or environmental impacts.

Estimated Cost: $2.4 M

Mainline Segment 1 Auxiliary Lane Options (M-1)

Description: This improvement option will provide a continuous auxiliary acceleration lane from the EB on-ramp to the crest of the hill. The current acceleration lane length for EB I-15/90 is insufficient for trucks that frequent the truck stops on Rocker Road. The auxiliary lane will extend 4,000 ft to allow vehicles to accelerate up the hill to the appropriate running speed before merging into the mainline. *(See figure M-1, exhibit 6-10)*

Option Benefits: This option provides a safer merge operation by providing a lane for truck traffic to accelerate to a safe speed before merging. This will eliminate the substantial speed differential that currently exists in this area.

Potential Impacts: Minor right of way is required and standard environmental requirements for earthwork grading will be required.

Estimated Cost: $1.9 M

West Butte EB Off-Ramp Option (WB-1):

Description: The West Butte Option 1 is the realignment of the I-115 EB exit ramp to the right side where it will follow a new alignment and fly over both mainlines of I-15/90. The deficient EB mainline curve will be improved to a 75 mph design speed. This option will remove the problem of the left-side off-ramp and the confusing signing and striping. *(See figure WB-1, exhibit 6-11)*

Option Benefits: This option has the potential to improve safety through the elimination of the confusing left side off-ramp and improving the mainline curvature.

Potential Impacts: Right of way is required on the south side of the interstate and there is a potential for wetland impacts in the same area.

Estimated Cost: $8.2 M

West Butte Diamond I/C Option (WB-3):
Description: The West Butte Option 3 would reconstruct the interchange to a diamond configuration providing full movement at this location, which currently only provides partial access. This option is based on reclassifying I-115 from Interstate System to the Primary System. The EB mainline curve will be reconstructed to a minimum design speed of 70 mph. This option in combination with the reclassifying I-115 to the Primary System would provide the potential for Butte-Silver Bow to develop the backdoor access to Montana Tech shown in the *Butte Transportation Plan*. *(See figure WB-3, exhibit 6-12)*

Option Benefits: This option would provide a full movement interchange at the West Butte location.

Potential Impacts: Right of way would be required and there is a potential for wetland impacts on the south side of the interstate.

Estimated Cost: $15.6 M

Mainline Segment 2 Option (M-2):
Description: The Mainline Segment 2 Option would include replacing the four long bridges over the railroads and realigning the mainline curves in this area to a 75 mph design speed. The new bridges would have standard shoulder widths matching the remaining sections of the mainline. *(See figure M-2, exhibit 6-12)*

Option Benefits: This option has the potential to improve safety in this area by providing improved horizontal curvature and wider shoulders.

Potential Impacts: No anticipated right of way or environmental impacts.
Estimated Cost: $28.5 M

Excelsior Avenue Option (EX-1):
Description: The improvements proposed for the Excelsior Avenue interchange consist of the extension of acceleration and deceleration lengths on all ramps. This design assumes I-115 remains an interstate classification. These ramp length extensions would meet current design standards. The existing I-115 bridge over Excelsior would have to be replaced to accommodate the ramp extensions. *(See figure EX-1, exhibit 6-13)*

Option Benefits: This option brings the interchange geometry up to standard.

Potential Impacts: No anticipated right of way or environmental impacts.

Estimated Cost: $3.25 M

Montana Street Signal Option (MT-1):
Description: The Montana Street Signal Option will provide delineation separating the shared ramp and frontage road configurations. Traffic signals will be installed at the intersections of the EB and WB On/off-ramps and Montana Street, if warranted and justified. This option will solve the intersection operation deficiencies and should eliminate the potential observed safety issue of wrong way travel on the shared ramp/frontage roads. This option would require changes to several properties access and the loss of on-street parking at several locations. *(See figure MT-1, exhibit 6-14)*

Option Benefits: This option would improve traffic operations for the ramps and eliminate the potential for conflict between the local frontage road operations and the ramps.

Potential Impacts: No anticipated right of way or environmental impacts

Estimated Cost: $1.75 M

Montana Street Roundabout Option (MT-2):
Description: The Montana Street Roundabout Option will slightly realign the EB and WB On/off-ramps and includes constructing roundabout intersections at the ramp terminals. The roundabouts would be two lanes to match the existing number of lanes on Montana Street. The realignment of the ramps and roundabout would be done in combination with construction of curb and gutter to delineate access changes on the frontage roads. This option will solve the intersection operation deficiencies and should eliminate the potential observed safety issue of wrong way travel on the shared ramp/frontage roads. This option would require changes to several properties access and the loss of on-street parking several locations. *(See figure MT-2, exhibit 6-15)*

Option Benefits: This option improves the cross road operations by consolidating access and channelizing movements

Potential Impacts: No anticipated right of way or environmental impacts

Estimated Cost: $2.38 M

Harrison Avenue SPUI Option (H-1):
Description: This option would include reconstructing the interchange to a single-point urban interchange (SPUI) design that will consolidate all of the ramp terminal intersections on Harrison Ave to one. This will eliminate many of the access issues along Harrison Avenue and will correct the acceleration and deceleration length deficiencies associated with the loop ramps. This option reduces the number of intersections on Harrison Avenue. A double left turn lane in the NB direction will be required at the SPUI, which is constrained by the Dewey Boulevard intersection location. This option will also replace the functionally obsolete mainline bridge structures. A longer bridge is required for the SPUI so the interstate mainline will need to be raised several feet. *(See figure H-1, exhibit 6-16)*

Option Benefits: This option improves the entire interchange complex including the cross road operations.

Potential Impacts: Minor right of way will be required. Wetland impacts within the loop ramps and wetland and section 4(f) impacts along the bicycle path are anticipated.

Estimated Cost: $24.1 M

Harrison Avenue Tight Diamond Option (H-2):

Description: This option would include reconstructing the interchange to tight diamond configuration. This design consolidates ramp terminal intersections on Harrison Avenue and will improve the spacing between the EB off-ramp and Dewey Boulevard. The EB off-ramp will be relocated as the east leg of the Dewey Boulevard intersection. A double left turn lane will be required in the NB direction for the WB on-ramp. This will eliminate many of the access issues along Harrison Avenue and will correct the acceleration and deceleration length deficiencies associated with the loop ramps. This option also involves replacing the functionally obsolete mainline bridge structures. A longer bridge is required for this option so the interstate mainline will need to be raised several feet. *(See figure H-2, exhibit 6-17)*

Option Benefits: This option improves the entire interchange complex including the cross road operations.

Potential Impacts: Minor right of way will be required. Wetland impacts within the loop ramps and wetland and section 4(f) impacts along the bicycle path are anticipated.

Estimated Cost: $18.5 M

Harrison Avenue Loop Ramp Improvement Option (H-20):

Description: The Harrison Ave Option 20 would include eliminating the straight EB off-ramp WB on-ramp and improving the existing loop ramps and associated acceleration/deceleration lengths. The acceleration lane length of the WB loop on-ramp will be extended to provide the required distance for entering vehicles. This will require replacing the WB mainline bridge to accommodate the widening over Harrison Avenue. The deceleration lane length of the EB loop off-ramp will be separated from the mainline by the constructing a parallel off-ramp and another structure over Harrison Avenue. This separation will allow adequate distance for vehicles to comfortably slow down separate from the mainline traffic. A new signal will be required at the shared EB On/off-ramp intersection. A new SB left turn lane will be constructed within the existing median for the WB On/off-ramp. This improvement includes the option to reconstruct the EB mainline bridge structure over Harrison Avenue. *(See figure H-20, exhibit 6-18)*

Option Benefits: This option improves the entire interchange complex including the cross road operations.

Potential Impacts: No anticipated right of way or environmental impacts.

Estimated Cost: $10.75 M

Harrison Avenue Eliminate Loop Ramp Option (H-21):

Description: Harrison Ave Option 21 would include the elimination of both loop ramps. The EB off-ramp would be widened to include a left turn lane and a new signal would be added on Harrison Avenue to allow the left turn to NB Harrison. The Dewey Boulevard and EB off-ramp intersections would be operated as one intersection by the traffic signals. Pedestal signals would be required to provide adequate sight distance for the EB off-ramp intersection. The EB on-ramp would be widened to improve turning radiuses from Harrison Avenue. This option would include a new NB left turn lane for the WB on-ramp. The WB off-ramp would be aligned to improve geometry. This option would add a signal to Harrison Avenue, however, by adding traffic signal control to the off-ramp the queue on the EB off-ramp and issue with the turning radii caused by the proximity to Dewey Boulevard can be managed better. *(See figure H-21, exhibit 6-19)*

Option Benefits: This option improves the most significant interchange deficiencies (acceleration/deceleration) without completely reconstructing the interchange. The deficient acceleration and deceleration issues are eliminated and the operation issues on Harrison Avenue are mitigated with additional traffic signal control.

Potential Impacts: No anticipated right of way is required. Wetland impacts within the WB off-ramp area are anticipated.

Estimated Cost: $1.75 M

Harrison Avenue EB Loop Improvement Combination Option (H-22):

Description: This option includes the eastbound improvements discussed in option H-20 (improved EB loop ramp) and the westbound options discussed in H-21. This option provides similar benefits as H-20 without the significant costs associated with the WB loop ramp improvements. The close spacing of the EB off-ramp and Dewey Boulevard intersection is eliminated. *(See figure H-22, exhibit 6-20)*

Option Benefits: This option improves the major interchange deficiencies (acceleration and deceleration) and provides improved access on Harrison Avenue.

Potential Impacts: No anticipated right of way is required. Wetland impacts within the WB off-ramp area are anticipated.

Estimated Cost: $5.38 M

Harrison Avenue WB Loop Improvement Combination Option (H-23):

Description: This option includes the eastbound improvements discussed in option H-21 and the westbound options discussed in H-20 (improved WB loop ramp). This option provides similar benefits as H-20 without the significant costs associated with the WB loop ramp improvements. The close spacing of the EB off-ramp and Dewey Boulevard intersection is eliminated. *(See figure H-23, exhibit 6-21)*

Option Benefits: This option improves the major interchange deficiencies (acceleration and deceleration) and provides improved operations on Harrison Avenue by utilizing a loop ramp for the highest ramp volume and improving the EB off-ramp and Dewey Boulevard operation issue via additional traffic signal control.

Potential Impacts: No anticipated right of way or environmental impacts

Estimated Cost: $7.5 M

East Butte Loop Improvement Option (EB-2):

Description: This option would include extending the I-15 SB to I-90 EB acceleration length and the I-15/90 EB to NB deceleration length. Extending the acceleration length will require replacing the EB East Butte Bridge. The extension of the acceleration length coming off of the tight loop ramp will provide a safe location for vehicles to accelerate before merging with the mainline traffic. This option also includes a speed reduction system for the SB to EB loop ramp. *(See figure EB-2, exhibit 6-22)*

Option Benefits: This option provides the potential for improved operations and safety.

Potential Impacts: No anticipated right of way or environmental impacts

Estimated Cost: $3.3 M

East Butte High Speed Interchange Option (EB-3):

Description: The East Butte Option 3 is a full interchange reconstruction to a full high speed system level interchange configuration. This will include a new I-15/90 to NB I-15 flyover and a new I-15 SB to I-90 EB flyover. All ramps will have a design speed of 55 mph or greater. The mainline curve would be improved to a 75 mph design speed. This option would also require reconstructing the Continental Drive overpass. This option is not currently justified based on traffic volumes, but represents a true system level interchange concept that two interstates like I-15 and I-90 can require. *(See figure EB-3, exhibit 6-23)*

Option Benefits: This option improves the entire interchange complex including to a high speed system level interchange standard

Potential Impacts: Significant right of way including about six residential relocations is required. There would be several potential environmental impacts including, wetlands, visual, and noise impacts.

Estimated Cost: $38.5 M

Continental Interchange Roundabout Option (C-2):

Description: The Continental Roundabout Option includes the construction of roundabouts at each of the three intersections. This option will combine the WB on/off ramps and adjacent frontage road, but the EB on/off-ramps and the Continental and Four Mile Road would be separate roundabouts. Each roundabout is designed with a 160 feet inscribed diameter and

contains a 16 feet travel lane with a 16 feet truck apron. The combination of two roundabouts used on the west side will allow the interchange to be constructed in phases, as development occurs in the area. The use of roundabouts at this intersection would mitigate any potential need to widen the existing bridge at this intersection if traffic volumes substantially change. *(See figure C-2, exhibit 6-24)*

Option Benefits: This option would mitigate existing deficiencies if the areas around this interchange change.

Potential Impacts: No anticipated right of way or environmental impacts

Estimated Cost: $1.75 M

Individual Bridge Replacement Options (M-20, MT-11, H-32):

Description: Initially the Butte Area Structures project included replacing most of the functionally obsolete bridges within the corridor. Since this project has been scaled back many of the candidate bridges are not programmed for replacement. The individual bridge options have been included to identify bridges that are deficient and need to be replaced. *(See figure M-20, MT-11, & H-32, exhibit 6-8)*

Option Benefits: Potential for improved safety with the addition of wider shoulders on the new bridges.

Potential Impacts: No anticipated right of way or environmental impacts

Estimated Cost: $~20M – M-20, $3.6M – MT-11, and $5.7M – H-32

7.0 PLAN IMPLEMENTATION

7.1 IMPLEMENTATION STRATEGY

The Butte Interstate Traffic study is intended as a long range in such that MDT can use the plan to review development options and also program future construction projects by reviewing improvement options identified in this study annually during their program update process. Because available funding for the Butte Interstate corridor is uncertain there is no defined implementation strategy for the Butte Interstate Traffic Study. This study identifies the existing deficiencies (Phase 1) and developed a wide range of improvement options (Phase 2), that MDT can pick and choose to program for future construction, based on what funding is available. This study provides information on the amount of additional funding needed to improve specific interchanges and the entire corridor.

In addition to the improvement options identified within this study a list of add-on elements was developed so that MDT can review the list when maintenance activities or already programmed projects are being planned and implemented. When possible some of these add-on elements could be included as maintenance or additions to existing projects.

7.2 PRIORITIZED LIST OF IMPROVEMENT OPTIONS

Using the time frame and prioritization level criteria previously discussed each of the potential improvement options were reviewed and assigned a time frame and priority status. The final list of options for the Butte Interstate system is shown in the following table.

Table 7.1
Prioritized list of Options

Option I.D. (Fig. #)	Location	Option Name	Components	Priority Level
Near Term Projects				
ITS-1	Corridor wide	Incident Management Support Project	• Incident Management Plan • Install DMS, CCTV, RWIS, HAR Elements to support the plan	High
M-1	Rocker I/C & Mainline Segment 1	EB Auxiliary Acceleration Lane	• Continuous auxiliary lane to crest of hill in EB direction beginning at on-ramp merge point	High
WB-10	West Butte I/C	West Butte Minor Improvements	• Restripe EB off-ramp to narrow the off-ramp lane, install new overhead signs and add additional lighting on off-ramp	High
ITS-4	Corridor wide	Site specific ITS Elements	• Install DMS sign near Rocker I/C, Install speed reduction systems at the Harrison I/C and East Butte I/C Loop Ramps	High
R-10	Rocker I/C	Rocker Minor Improvement Project	• Improve access control along frontage roads; add a sidewalk on the east side of Rocker road between the frontage roads.	High

Table 7.1
Prioritized list of Options

Option I.D. (Fig. #)	Location	Option Name	Components	Priority Level
MT-1	Montana St I/C	Montana Street Option 1 – Signalized Intersections	• Signalize ramp terminals and modify shared frontage/ramp access. Improve acceleration/deceleration lengths to standards (If warranted & justified)	High
MT-2	Montana St I/C	Montana Street Option 2 – Roundabout Intersections	• Use roundabouts at ramp terminals and modify shared frontage/ramp access. Improve acceleration/deceleration lengths to standards	High
CW-3	Corridor wide	Bridge Anti-icing Systems	• Install bridge anti-icing system on eight bridges (4 long bridges on M-2, 2-bridges at Harrison Avenue and 2-bridges at East Butte)	High
ITS-2	Corridor wide	Traffic Management ITS Package	• Implement variable speed limits through out the corridor, install speed display signs at key areas, add additional RWIS, and install active warning/speed reduction signs at loop ramps	Medium
H-30	Harrison Ave I/C	Harrison Minor Improvement Project	• Options include; restriping Harrison for 2-through lanes in each direction. Install new ADA ramps along Harrison. Install speed reduction system on loop ramps. Potentially reconfigure SE corner at Harrison & EB on-ramp.	Medium
H-31	Harrison Ave I/C	Harrison Avenue and Amherst Avenue Intersection Improvements	• Extend 3rd NB through lane to end at Amherst Avenue. Requires right of way from adjacent business.	Medium
EB-10	East Butte I/C	East Butte Minor Improvement Project	• Project includes: adding lighting to interchange. Install speed reduction system at loop ramp and bridge anti-icing system.	Medium
CW-1	Corridor wide	Guardrail Package of Improvements	• Extend guardrail lengths at various areas to meet standards, replace damaged sections and install current standard end treatments throughout corridor	Medium
CW-2	Corridor wide	Earthwork Package of Improvements	• Perform minor sideslope grading to improve slopes to meet clear zone requirements throughout the corridor.	Medium

Table 7.1
Prioritized list of Options

Option I.D. (Fig. #)	Location	Option Name	Components	Priority Level
Long Range Projects				
H-20	Harrison Ave I/C	Loop Ramps - Improve EB Loop Off-ramp and WB Loop On-ramp (comb. of H3 and H9)	• Eliminate straight ramps and improve loop ramps	High
H-21	Harrison Ave I/C	Eliminate Loop Ramps - Eliminate both EB Off-ramp and WB on-Ramp, Improve straight ramps (comb. of H4 and H6)	• Eliminate Loop Ramps & improve straight ramps	High
H-23	Harrison Ave I/C	Improve WB Loop On-ramp and Eliminate EB Loop Off-ramp (comb. of H4 and H9)	• Improve WB Loop On-ramp, eliminate other WB on-ramp and EB Loop off-ramp	High
H-22	Harrison Ave I/C	Improve EB Loop Off-Ramp and Eliminate WB Loop Off-Ramp (comb. of H3 and H6)	• Improve EB Loop Off-ramp; eliminate straight EB off-ramp (to SB Harrison). Eliminate WB Loop On-ramp and add NB Left turn to WB On-ramp	High
H-1	Harrison Ave I/C	Harrison Avenue Option 1 – SPUI configuration	• Reconstruct the interchange to a SPUI configuration including replacing the bridges and raising the mainline	High
H-2	Harrison Ave I/C	Harrison Avenue Option 2 – Tight Diamond configuration	• Reconstruct the interchange to a tight diamond configuration including widening Harrison for required left turn lanes	High
WB-1	West Butte I/C	West Butte Option 1 – Short Term WB off-ramp improvement	• Relocate WB off-ramp to a right side exit on slightly improved EB mainline	High
M-2	Mainline Segment 2	Improve Mainline Segment 2 – WB Butte to Montana Street	• Improve Horizontal Curvature and Replace FO mainline bridges	High
R-1	Rocker I/C	Rocker Option 1a – Roundabout Ramp Terminals	• Replace ramp terminal intersections with roundabouts that combine the frontage road intersections, includes auxiliary acceleration lane EB.	High

Table 7.1
Prioritized list of Options

Option I.D. (Fig. #)	Location	Option Name	Components	Priority Level
EB-2	East Butte I/C	East Butte Option 2 – Utilize existing configuration and improve acceleration lengths	• Lengthen EB to NB deceleration length and SB to EB acceleration length, would require widening bridge	Medium
H-32	Harrison Ave I/C	Replace Harrison Avenue I/C bridges	• Replace the EB and WB mainline functionally obsolete bridges over Harrison Avenue	Medium
M-20	Mainline Segment 2	Replace 4-Mainline Bridges	• Replace 4-long EB and WB mainline functionally obsolete bridges over the railroad tracks	High
C-2	Continental I/C	Continental Option 1 - Roundabout Ramp Terminals	• Construct Roundabouts at each intersection, (1) WB on/off-ramp, (2) EB on/off-ramp and (3) Continental/Mount Highland Drive intersection	Low
MT-11	Montana St I/C	Replace Montana Street I/C bridges	• Replace the EB and WB mainline functionally obsolete bridges over Montana Street	Low
EX-1	Excelsior I/C	Excelsior Avenue Option 1 – Ramp Improvements	• Extend acceleration / deceleration lengths on all ramps. Replace I-115 bridge over Excelsior	Low
Ultimate Projects				
EB-3	East Butte I/C	East Butte Option 3 – High speed system level interchange	• Reconstruct to high speed system level standards	Low
WB-3	West Butte I/C	West Butte Option 3 – Diamond type interchange w/ improved mainline	• New cross road overpass. Construct 4-new ramps. Improve EB mainline curvature • Reclassify I-115 to primary route	Low

7.3 ADD-ON LIST OF ELEMENTS

In addition to the individual improvement options described above a list of improvement elements has been developed. The improvement elements should be reviewed when planning maintenance activities, and compared to existing or future projects under development to determine if any of these elements could be included. Utilizing this list of potential improvement elements will ensure that every opportunity is captured to improve the Butte Interstate corridor.

Table 7.2
Potential Add-On Improvement Elements

Project Type	Project Description	Location
Corridor Wide		
Landscape	Consider landscape elements for all future projects within corridor to improve aesthetics at interchanges	Interchanges corridor wide
Rocker Interchange		
ITS	Additional DMS sign tied to road closure gate project at Continental Drive	West of Rocker I/C
Access Control	Provide curb/delineation to define specific access points	Town Pump property
Access Control	Provide curb/delineation to define specific access points	Flying J property
Sidewalk	Construct a five foot sidewalk on the east side of Rocker Rd from Frontage Rd to Frontage Rd (include curb ramps and marked crossings)	Eastside of Rocker Rd
Guardrail	Extend Guardrail on at bridge on inside lane	EB I-15/90 Bridge over Rocker
Guardrail	Extend Guardrail on at bridge on inside lane	WB I-15/90 Bridge over Rocker
Mainline Segment 1		
Guardrail	Extend Guardrail to cover non-recoverable sideslopes	NB/EB I-15/90 (various locations)
Structure	Remove bridges and replace with large steel plate culvert. Maintaining rails to trail path	Replace Bridges over abandoned RxR w/Culvert
West Butte Interchange		
Guardrail	Extend guardrail on both sides at bridge	EB I-115 over WB/SB I-15/90
Bridge	Install new bridge to current standards	EB I-115 over WB/SB I-15/90
Mainline Segment 2		
ITS	Install advisory warning signs with flashing beacons triggered by RWIS system	EB/NB and WB/SB I-15/90 @ Bridges & Curves
Maintenance	Install anti-icing systems on each bridge	EB/NB and WB/SB I-15/90 @ Bridges
Bridges	New bridge to current standards	EB/NB and WB/SB I-15/90 Bridges (x2)
Excelsior Avenue Interchange		
Guardrail	Extend guardrail on both sides at CBC	WB I-115 @ major drainage crossing
Guardrail	Extend guardrail on both sides at CBC	EB I-115 @ major drainage crossing
Sidewalk	Construct a five foot sidewalk on the east side of Excelsior Rd from Access to residences (just west of EB Ramp Terminal to Platinum St)	Eastside of Excelsior Road
Montana Street Interchange		
Access	Use curb to change/channelize shared frontage road and ramp, eliminating local access, modify business access as needed	EB off/on-ramps and WB on-ramp

Table 7.2
Potential Add-On Improvement Elements

Project Type	Project Description	Location
Access	Eliminate on street parking within Access Control line	EB off/on-ramps and WB on-ramp
Pedestrian	Install ADA compatible curb ramps and cross walk markings	EB & WB off/on ramp terminals
Guardrail	Extend guardrail on both sides at bridge	EB/NB & WB/SB I-15/90 over Montana Street
Bridges	Widen or install new bridge to current standards	EB/NB & WB/SB I-15/90 over Montana Street
Geometry	Extend length of acceleration lane to appropriate safe length	EB/NB Acceleration Lane Extension
Geometry	Extend length of deceleration lane to appropriate safe length	EB/NB Deceleration Lane Extension
Mainline Segment 3		
Guardrail	Install a median barrier system	Median Barrier
Guardrail	Extend guardrail at bridge on outside lane to appropriate length	EB/NB at Oregon Avenue
Guardrail	Extend guardrail at bridge on outside lane to appropriate length	WB/SB at Lexington Avenue
Minor Earthwork	Perform grading to increase runoff area to proper clear zone width	WB/SB between Lexington Ave & Oregon Ave
Harrison Avenue Interchange		
ITS	Install a Speed Reduction system	EB off-ramp & WB on-ramp (Loop ramps)
Access	Remove/Change hotel sign and OH Sign and improve curb return radiuses, modify gas station access as needed.	EB on/off-ramps terminals at Harrison
Maintenance	Trim bushes along Harrison Avenue to improve sight lines near the EB on/off-ramp	Harrison Avenue
Pedestrian	Install ADA compatible curb ramps and cross walk markings	Ramp Terminals and Intersections
Maintenance	Trim bushes near exit signs to improve visibility	WB/SB off-ramp near diverge
Striping	Restripe Harrison back to 2-lanes with right turn lanes at specific locations. Improve turn radii with striping (Cornell to Mall entrance)	Harrison Avenue
Guardrail	Extend guardrail on both sides at bridge	EB/NB & WB/SB I-15/90 over Harrison Avenue
Bridges	Widen or install new bridge to current standards	EB/NB & WB/SB I-15/90 over Harrison Avenue
Mainline Segment 4		
Guardrail	Install a median barrier system	Median Barrier
Guardrail	Improve Median Guardrail	Median of I-15/90
Guardrail	Extend guardrail at bridge on outside and inside lane to appropriate length	WB/SB at Sheridan Ave
Guardrail	Extend guardrail at bridge on outside and inside	WB/SB I-15/90 near drainage

Table 7.2
Potential Add-On Improvement Elements

Project Type	Project Description	Location
	lane to appropriate length	crossing
Guardrail	Extend Guardrail to cover non-recoverable sideslopes	WB/SB (west of Sheridan Avenue)
Guardrail	Extend Guardrail to cover non-recoverable sideslopes	EB/NB (west of Sheridan Ave to Continental)
East Butte Interchange		
ITS	Install a Speed Reduction system	SB I-15 off-ramp to EB I-90 (Loop ramp)
ITS	Install advisory warning signs with flashing beacons triggered by RWIS system	SB I-15 off-ramp to EB I-90 (Loop) & Mainline
Maintenance	Install anti-icing systems on each bridge	EB/NB and WB/SB I-15/90 @ Bridges
Guardrail	Extend guardrail at bridge on outside lane to appropriate length	WB/SB at Continental
Lighting	Install lights at ramp merge/diverge areas	Ramp Merge/Diverge
Mainline Segment 5		
Guardrail	Extend guardrail at bridge on outside and inside lane to appropriate length	WB I-90 at Burlington St.
Continental Interchange		
Geometry	Extend length of acceleration lane to appropriate safe length	SB Acceleration Lane Extension