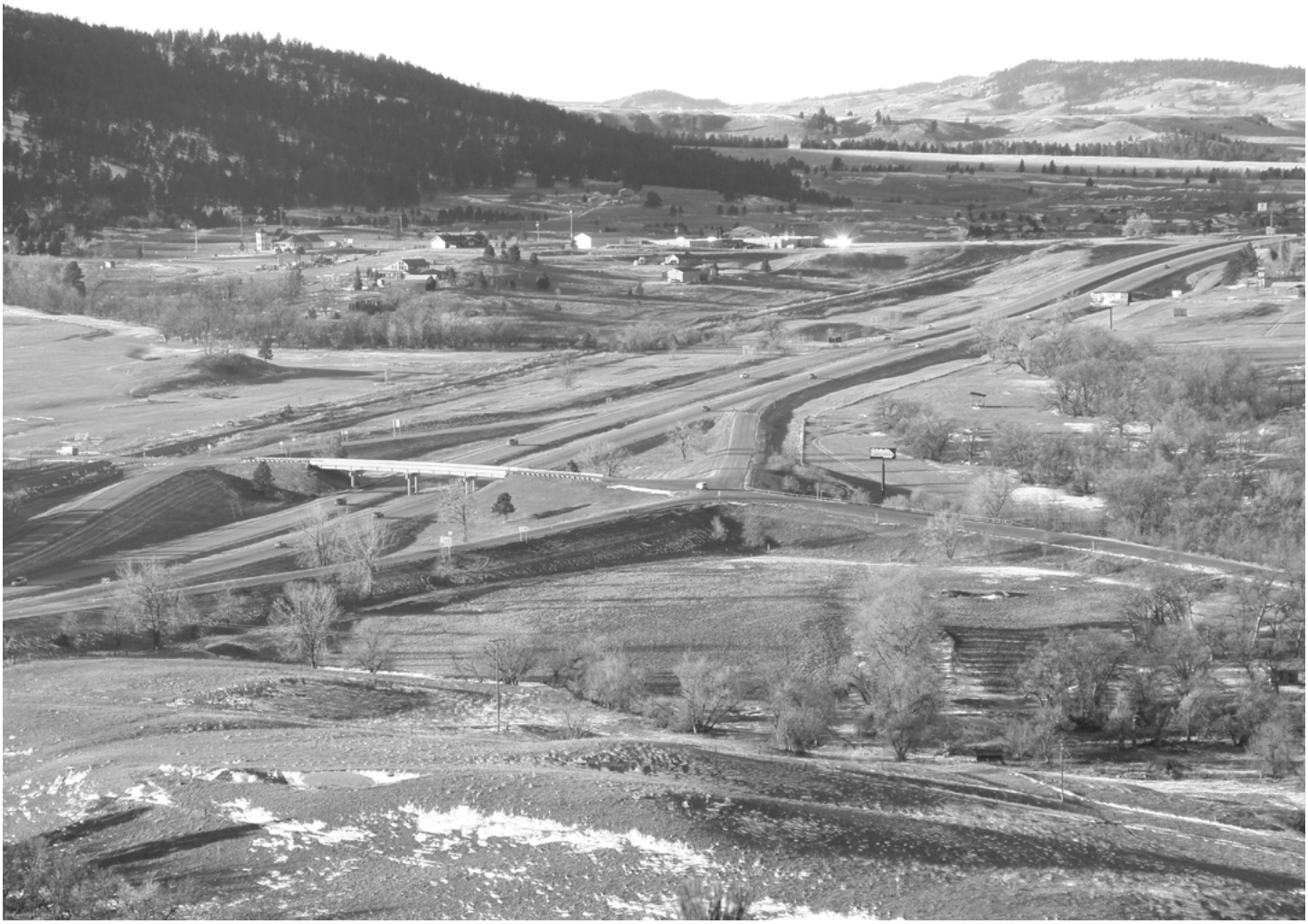

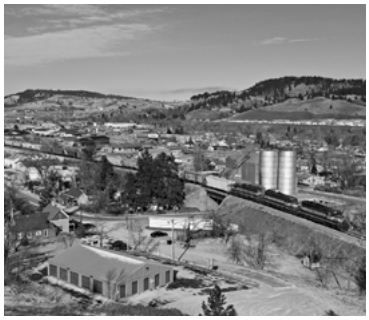

I-90 Exit 32 - 40
CORRIDOR REPORT

April 2020

Stantec

South Dakota DOT
Connecting South Dakota and the Nation

I-90 Exit 32-40
Corridor Report

April 2020

Prepared for:

South Dakota Department of Transportation (SDDOT)

Prepared by:

Stantec Consulting Services Inc.

Acknowledgments

The I-90 Exit 32-40 Corridor Study would not have been possible without the collaboration of SDDOT, Meade County, Federal Highway Administration, local agencies and tribal organizations, study advisory team members, consultant staff, and the general public. A special thanks to these team members for the dedication and effort they gave to make this study a success.

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List of Acronyms

ADT	Average Daily Traffic
AGR	Annual Growth Rate
ATIS	Advanced Traveler Information System
ATMS	Advanced Transportation Management System
AVI	Automatic Vehicle Identification
BHNC	Black Hills National Cemetery
BLM	Bureau of Land Management
CCTV	Closed Circuit Television
DMS	Dynamic Message Sign
DSRC	Dedicated Short-Range Communication
FHWA	Federal Highway Administration
GIS	Geographic Information System
GPS	Global Positioning System
HCM	Highway Capacity Manual
IMJR	Interchange Modification Justification Reports
iROC	Intelligent Roadside Operations Computer
ITS	Intelligent Transportation Systems
LOS	Level of Service
MASH	Manual for Assessing Safety Hardware
MRM	Mileage Reference Marker
NHD	National Hydrography Data
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
OBU	On-board Unit
OHWM	Ordinary High-water Mark
PIP	Public Involvement Program
RCPE	Rapid City, Pierre, Eastern Railroad
RWIS	Roadway Weather Information System
SAT	Study Advisory Team
SCI	Surface Condition Index
SDDOT	South Dakota Department of Transportation
SDHP	South Dakota Highway Patrol
SLC	Single Load Cell
TMC	Traffic Management Center
TPOE	Tilford Port of Entry
TSMO	Transportation System Management & Operations
USACE	US Army Corps of Engineers
USFW	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VSL	Variable Speed Limit
WIM	Weigh-in-Motion

Executive Summary

Background

The South Dakota Department of Transportation (SDDOT), in cooperation with Meade County and the Federal Highway Administration, is working to preserve the Interstate 90 (I-90) corridor between Exit 32 and 40. This section of I-90 serves as the primary connection between Sturgis and Rapid City and is heavily travelled during summer months as tourists visit the Black Hills and area attractions.

The SDDOT has determined the pavement in the eastbound lanes of I-90 between Exit 32 and 40 will require replacement within the next 6 years. Deficiencies such as deteriorating drainage structures, substandard roadway geometrics, and limited interchange capacities have also been identified throughout the corridor. As a result, the SDDOT has undertaken a comprehensive study to evaluate requirements along this segment of I-90 and develop feasible solutions to meet those needs.

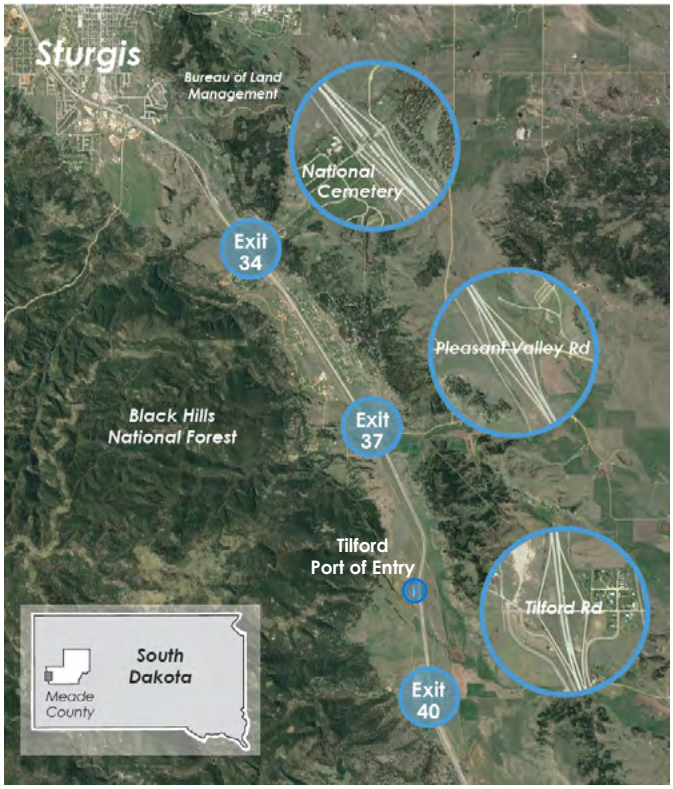
This study is a first step in addressing the existing roadway issues and planning for future needs within the corridor. The outcome of the study includes a comprehensive review of existing conditions, well-defined project needs, recommendations for phased construction projects within the study area, and a clearly outlined project process. Subsequent steps in the project development process will include interchange analysis and justifications, environmental documentation, and design plans. The study will also serve to initiate the FHWA Interchange Modification Justification process, which is required when access on the interstate system is added or modified.

Study Area

The study area consists of the Interstate 90 corridor from Exit 32 in Sturgis to Tilford and includes the following interchanges/exits:

- Exit 34 at Black Hills National Cemetery
- Exit 37 at Pleasant Valley Road
- Exit 40 at Tilford Road
- Tilford Port of Entry (located along I-90 between Exit 37 and 40)

Local roads and cross streets surrounding the three interchanges listed above are also included in the study.



Study Organization

This report is divided into five sections: Introduction, Existing Conditions, Environmental Overview, Year 2050 Traffic Conditions, and Solutions. The Existing Conditions section reviews current traffic operations, roadway geometry and infrastructure, bike and pedestrian travel, safety, and Intelligent Transportation Systems (ITS). This section provides a basis for defining the project need by defining the current conditions along the corridor.

The Environmental Overview provides a summary of the area resources and helps to define constraints that will shape development of alternatives. The Year 2050 Traffic Conditions section provides traffic forecasts for the opening year (2023) and design year (2050) that are used in developing solutions that will provide long-term benefits along the corridor. The last section, Solutions, outlines the study approach, alternatives development, and alternatives screening process. This section also includes a summary of the proposed design recommendations for the study corridor.

Recommendations

Recommendations for corridor improvements are provided at the end of the study which include the following design aspects:

- Determine the need of a future six lane facility
- Design alternatives for interchanges
- Traffic analysis for interchanges in compliance with the FHWA Interstate Access Policy
- Intelligent Transportation System (ITS) element recommendations

Through the cooperative screening process described in the Solutions section of this study, the SDDOT identified a series of phased construction projects aimed at meeting current and future corridor requirements within the constraints of the corridor.

Recommended improvements and suggested construction timing include:

- Exit 37 interchange reconstruction and Exit 40 ramp improvements - 2022
- Reconstruction of I-90 eastbound lanes from Exit 37 to the Tilford Port of Entry (TPOE), including the TPOE ramps and facility - 2023
- Exit 34 interchange reconstruction and local road connections – 2024
- Reconstruction of I-90 eastbound lanes between Exit 32 to Exit 37 - 2025
- ITS system installation - coordinated to occur with roadway construction

INTRODUCTION

Study Purpose and Background

The purpose of this corridor study is to examine current operations, identify existing deficiencies, determine future needs, and develop/analyze a range of solutions that meet the project requirements. The primary need along this corridor is the aging pavement in the eastbound segment of I-90 from Exit 32 to Exit 40 as identified by the SDDOT pavement management system. However, before rehabilitating or reconstructing I-90 mainline pavement, it is important to identify a typical section that will accommodate the anticipated traffic volume for the duration of the roadway's new service life. Previous studies undertaken by the SDDOT have indicated this segment of I-90 may require capacity improvements. Existing interchanges within the corridor do not meet current standards. Therefore, it is critical to identify future improvements for bridges and interchanges along the corridor so those needs can be accommodated. Knowing these requirements when the mainline pavement is replaced, will ensure that any planned improvements will accommodate anticipated future needs.

This planning and design process will include the following tasks:

1. Corridor Study: Determine the future traffic demand of the corridor, structure needs, and geometric deficiencies and provide conceptual improvements for the corridor and the interchanges within it to accommodate the projected traffic demand. A traffic evaluation analysis comparison will help to determine the recommended option.
2. Determination of Construction Projects: A construction feasibility review will determine assist in the selection of a recommended option and will provide a logical construction schedule sequence. Funding is available for the first project to be let in FY 2022.
3. Interchange Modification Justification Reports (IMJRs): IMJRs will be developed as needed for the proposed construction projects.
4. Environmental Study: The environmental review process will be followed for each of the proposed construction projects and documents will be developed as needed.
5. Construction Plans Development: Roadway design plans will be developed for the proposed projects for use in securing ROW and finalized for construction.

The SDDOT has retained the services of Stantec Consulting Services, Inc. (Stantec) to undertake the Corridor Study for I-90 Exit 32 to 40.

Study Area

The project area for this study includes the I-90 corridor from the crossover east of Exit 32 (MRM 32.99 + 0.039) to the on-ramp junction of the TPOE (MRM 39.32) — approximately 7.0 miles from Sturgis to the town of Tilford. A map of the study area is shown in Figure 1. Within the study area, the following sections will be evaluated for existing deficiencies and future needs:

- Mainline I-90 between Exit 32 and 40
- Exit 32 at Junction Avenue
- Exit 34 at Black Hills National Cemetery (Old Stone Road)
- Exit 37 at Pleasant Valley Road (County Highway 8)
- Exit 40 at Tilford Road
- Tilford Port of Entry on Eastbound I-90

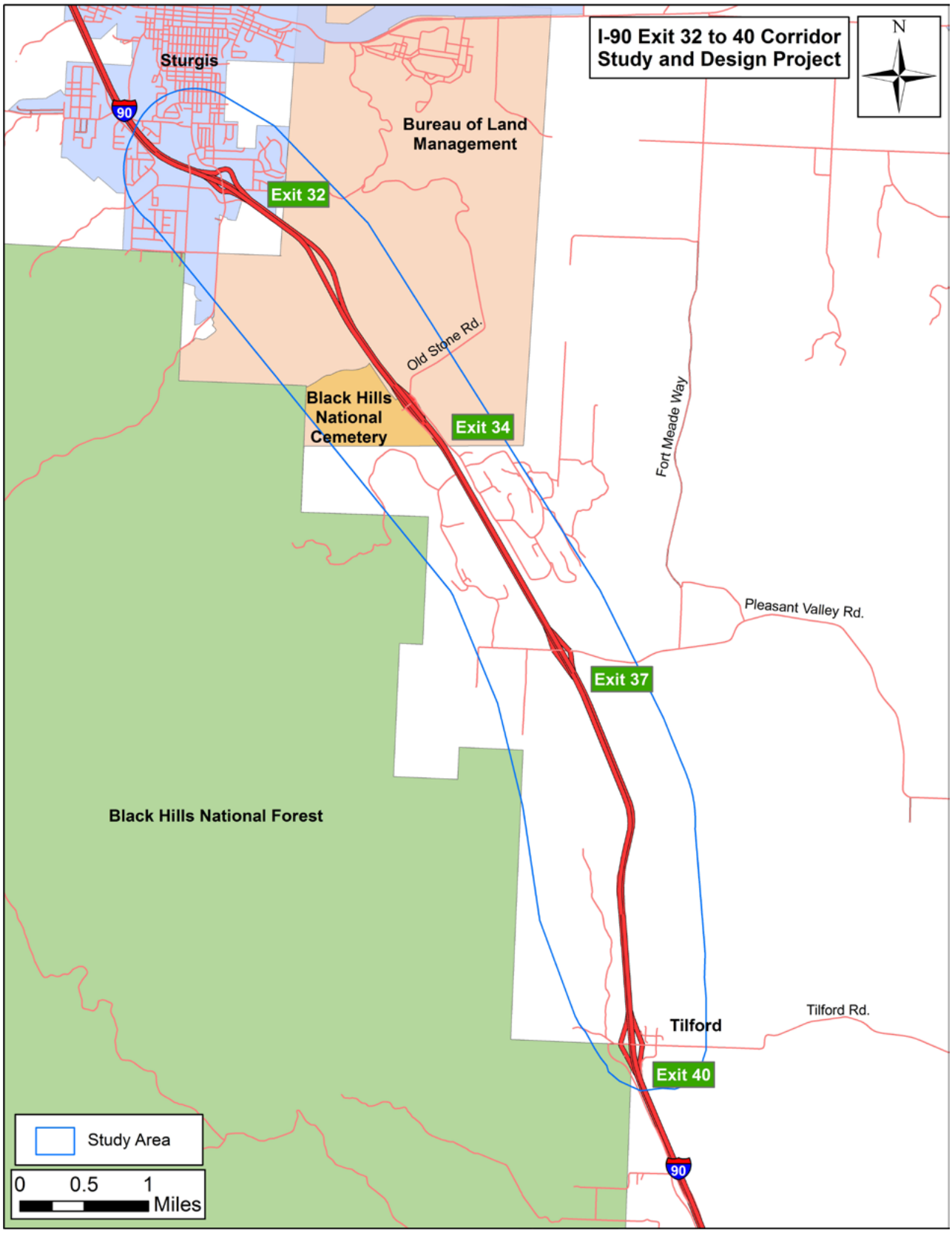


Figure 1: Study Area

Study Process

Public Involvement

A key goal throughout this project development process is to allow the SDDOT to make informed decisions that are in the public's best overall interest based on balanced consideration of the project purpose and need. A Public Involvement Program was developed to ensure that the public and agencies recognize what the SDDOT is working to accomplish with this study, and what the standards, procedures, and constraints are that SDDOT needs to consider while developing the proposed solutions. Keeping stakeholders informed is only one aspect of the Public Involvement Program. The SDDOT is also interested in gathering input and understanding concerns and issues that could affect the decision-making process and selection of feasible alternatives.

Stakeholders

I-90 Exits 32 to 40 Corridor Study and Design project includes the following public and private agency stakeholders:

- South Dakota Department of Transportation (SDDOT)
- Sturgis Emergency Services
- Meade County
- Landowners and business owners
- Federal Highway Administration (FHWA)
- Rapid City, Pierre, Eastern Railroad (RCPE)
- US Army Corps of Engineers (USACE)
- Lower Brule Sioux Tribe
- Bureau of Land Management (BML)
- Sisseton - Wahpeton Oyate
- Black Hills National Cemetery (BHNC)
- Standing Rock Sioux Tribe
- City of Sturgis
- Yankton Sioux Tribe
- Sturgis Chamber of Commerce
- Cheyenne River Sioux Tribe
- Sturgis Economic Development Corporation
- Oglala Sioux Tribe
- Meade School District
- Three Affiliated Tribes of ND
- Prairie Hills Transit
- Northern Arapaho Tribe of WY
- South Dakota Highway Patrol - Motor Carrier

Public Involvement Program
A Public Involvement Program (PIP) was developed to outline and help guide the process by which the SDDOT will communicate information and solicit and consider input from the public during the project development process. The PIP for the I-90 Exit 32 to 40 project consist of the following elements:

- Coordination with a Study Advisory Team
- A planned series of Public Meetings held at key points during project development
- Developing and maintaining a project website
- Document sharing using Listserv
- Public notification and contact using:
    - Direct mailings
    - Twitter
    - Facebook Live
    - Other social media platforms

Study Advisory Team
The SDDOT developed a Study Advisory Team (SAT) to provide direction and counsel throughout project development. The SAT will oversee the identification of transportation needs and the development of solutions. Two key responsibilities of the SAT members are: 1) to represent their respective functional groups or agencies, and 2) to promote community awareness of the project. SAT members will provide oversight and direction in developing a comprehensive and orderly means of involving local interests in the project. By representing many different interests and leveraging their experience, the SAT can help avoid conflicts between competing interests, and help resolve any conflicts that may arise.

The objectives of the SAT are to:

- Identify transportation deficiencies and needs
- Strengthen public understanding of the study process and its regulatory framework
- Discuss progress, work efforts, and activities
- Build consensus toward a preferred course of action
- Ensure that information is understandable to the public
- Provide clear and concise information to interested parties

Project Website
The project website launched in November 2017 (prior to the first public meeting), and will be maintained by Stantec throughout the project. The information on the website is organized to inform the public on the status of the study and provide public meeting announcements, presentations, and meeting summaries. The website will remain active for six months following the completion of the study to allow public access to the final report.

Public and Stakeholder Meetings
To collect comments and concerns related to the potential corridor improvements, a series of public and stakeholder meetings will be held throughout the project.

Public Information Meeting #1
The SDDOT hosted an open-house style public information meeting at the Sturgis High School on December 20, 2017. A formal presentation was given by Dale Grove. Informational boards available for viewing included a Welcome to the Project, Schedule + Study Process, Study Area Map, Crash History, Next Steps and Variable Speed Limit. Two identical roll plots were displayed highlighting known issues including sensitive land uses, geometric deficiencies, and snow build-up concerns. Approximately 50 people attended the meeting and were invited to provide comments. Written and oral comments were collected and noted.

Public Information Meeting #2
The SDDOT hosted a public information meeting on December 10, 2018 at Brown High School in Sturgis to share the project alternatives developed for the Corridor Study and gather input from the public. Approximately 60 people attended the meeting, including local, state and federal agency representatives, Meade County residents, landowners, and other stakeholders. Displays were provided for the public to review the alternatives, and SDDOT project team members were available to discuss issues and answer questions. Stantec employees Dale Grove and Theresa Maahs gave presentations highlighting project progress. Stakeholders were encouraged to submit written or oral comments, including website-based comments.

Stakeholder Meetings
The SDDOT held individual meetings with project stakeholders to discuss the I-90 improvement project, answer questions, collect data on known issues, and identify additional issues or concerns within the study corridor. The meetings were held at SDDOT offices on January 25 - 26, 2018. The meetings consisted of a review of the project description, schedule, purpose and need for the project, and existing conditions. Open conversation of the issues followed, allowing stakeholders to share their concerns.

SDDOT and the consultant team held a second round of stakeholder meetings on November 15-16, 2018 at the SDDOT's Rapid City Regional Offices. Individual meetings with eight stakeholders were held to discuss the project, review preliminary concepts, gather feedback, and answer questions. The meetings were informal to encourage open conversation. Each meeting began with introductions, followed by a project update. Participants reviewed early project concepts and were updated on the project schedule. Meetings then moved to an open conversation, allowing the stakeholders to share their concerns.

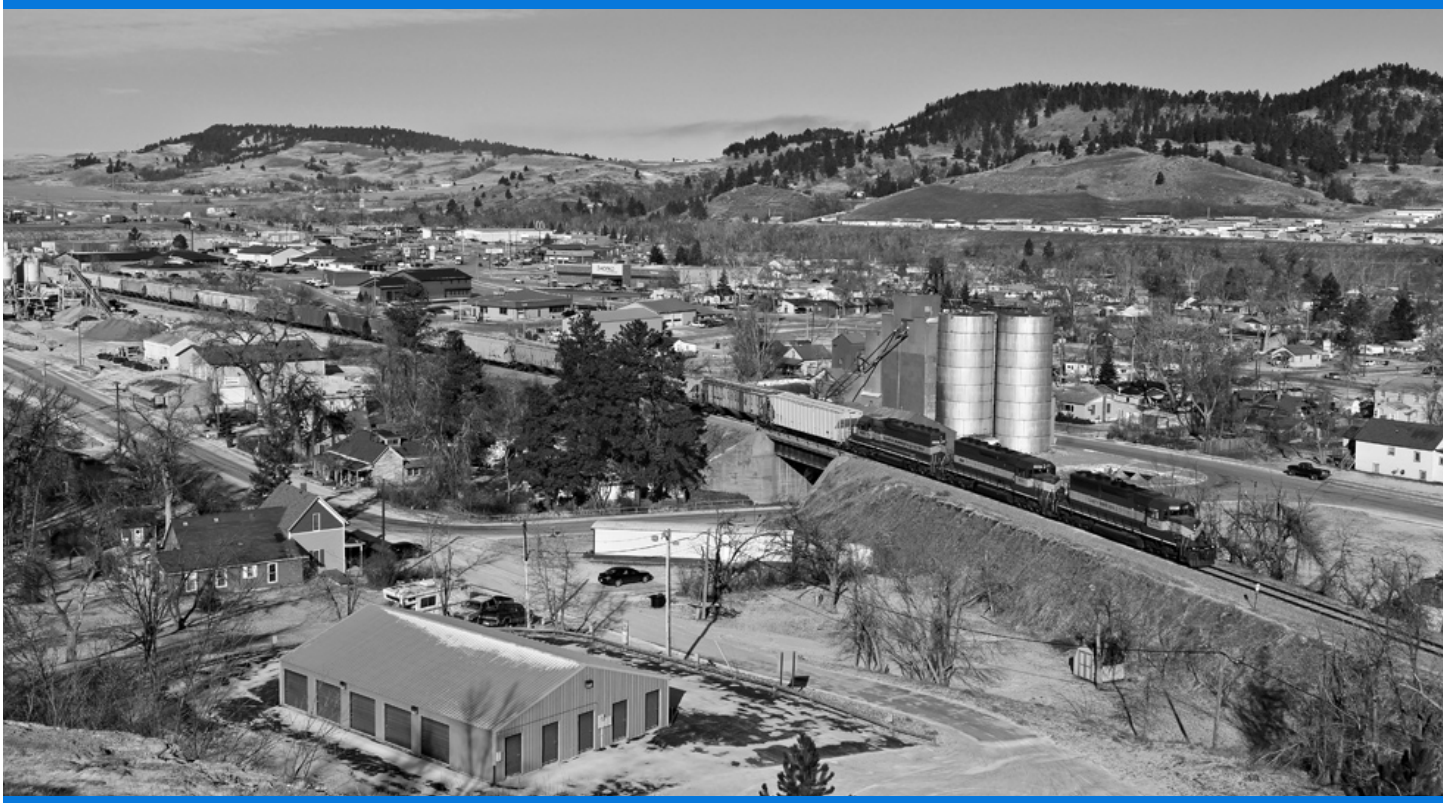
Environmental Analysis
Once a list of feasible build alternatives are selected, the project team will begin the environmental review process. The review process includes the detailed study of the physical, social, cultural, and economic impacts on the natural and human environment for the proposed projects under consideration. Analysis areas include environmental justice, wetlands and waterways, cultural resources, noise, floodplains and flood-prone areas, parks, wildlife and habitat, and regulated materials. Initial environmental research is included in later sections of this study. Once project concepts are developed, an evaluation process will provide an objective, quantifiable, and comprehensive approach to determining feasible build scenarios for the study corridor. Alternatives that are screened out will be supported by documentation in the form of reasoned arguments and matrices.

Planning Context and Prior Studies

The SDDOT has a history of studying the I-90 corridor. Several studies have previously been completed within or adjacent to the I-90 Exit 32 to 40 study area. These reports have been reviewed and information collected has been utilized as a starting point for this corridor study. The following are known previous or ongoing studies that are relevant to this study:

- I-90, Exit 32, Junction Avenue, Sturgis (**http://sddot.com/transportation/highways/planning/specialstudies/docs/I90Exit32justification.pdf**)
- I-90, Exit 44, Bethlehem Road, Meade County (**http://sddot.com/transportation/highways/planning/specialstudies/docs/I90Exit44IMJRFINAL.pdf**)
- 2000 Interstate Corridor Study (Phase 1 report available at **http://www.sddot.com/transportation/highways/planning/specialstudies/docs/Phase_I_Final_%20Report12_18.pdf**).
- 2010 Decennial Interstate Corridor Study (Phase I report available at **http://www.sddot.com/transportation/highways/planning/specialstudies/docs/09-104Phase1reportFINAL.pdf**).
- Interstate 90 Black Hawk to Sturgis Corridor Preservation Study (report available at **http://www.sddot.com/transportation/highways/planning/specialstudies/docs/03-241CorridorPreservReportfinal.pdf**)
- EA for I-90 From Exit 40 to Exit 51 (Available at **http://www.sddot.com/business/environmental/assessments/docs/MasterFinalEAandFONSISeptember292008.pdf**)
- Meade County Master Transportation Plan (report available at **http://www.sddot.com/transportation/highways/planning/specialstudies/docs/MeadeCountyTransportationPlanFinal.pdf**)
- Black Hills National Forest Travel Management Plan (report available at **http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/41877_FSPLT1_026126.pdf**)

EXISTING CONDITIONS



Roadway Network

The study area includes the following interchanges:

- Exit 32 at Junction Avenue (SD 79)
- Exit 34 at Pleasant Valley Drive/Blucksberg Drive/Old Stone Road
- Exit 37 at Pleasant Valley Road
- Exit 40 at 214th Street/Sturgis Road in Tilford
- The Port of Entry facility located along I-90 eastbound between Exit 37 and 40

A map of the study area roadway network and functional classification is shown in Figure 2. Interstate 90 is the only Principal Arterial through the study area. At Exit 32, Junction Avenue is functionally classified as a Minor Arterial through the interchange, then transitions to a Major Collector south of I-90 as it becomes Vanocker Canyon Road. Pleasant Valley Road (Exit 37) and Tilford Road (Exit 40) are Minor Collectors, and Pleasant Valley Drive (Exit 34) is a Local Road. All four interchanges are standard diamond service interchanges. The ramp terminals are unsignalized with STOP-control only on the exit ramp approaches. Temporary signals are installed at the Exit 32 ramp terminals during the annual Sturgis Motorcycle Rally.

Pavement Conditions

The SDDOT has established targets for overall pavement condition based the Surface Condition Index (SCI). The SCI is a value that takes into account roughness, rutting, faulting, and distress using a scale of 0 to 5. According to the SDDOT's 2018 Asset Management Plan, the ten-year target goal and minimum value for the statewide highway network are 3.90 and 3.55, respectively.

The SDDOT conducted a pavement condition survey for the section of I-90 from Exit 32 to Exit 40 in 2017. The SCI for was calculated. Figure 3 shows the average SCI for each pavement segment within the study area grouped by age. Approximately 55% of the pavement in the I-90 study corridor has been replaced in the last 15 years. These segments received a SCI greater than 4.00, which is considered to be in good condition and does not require replacement or resurfacing. The eastbound section of I-90 between the Tilford Port of Entry and the Exit 32 interchange roadway surface is about 35 years old and has an average SCI of 3.13, which is below the minimum value for a statewide highway.

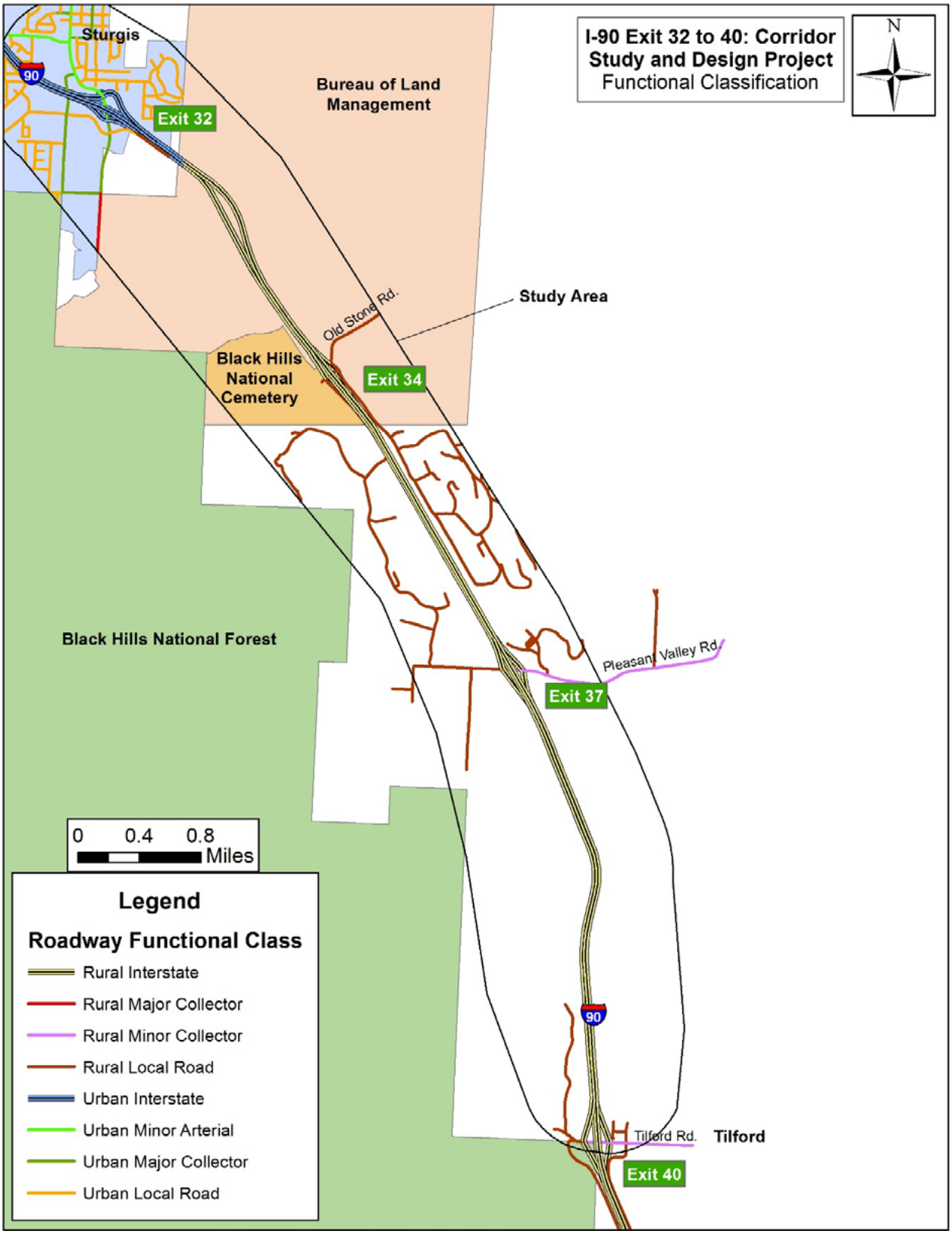


Figure 2: Study Area Roadway Network and Functional Classification

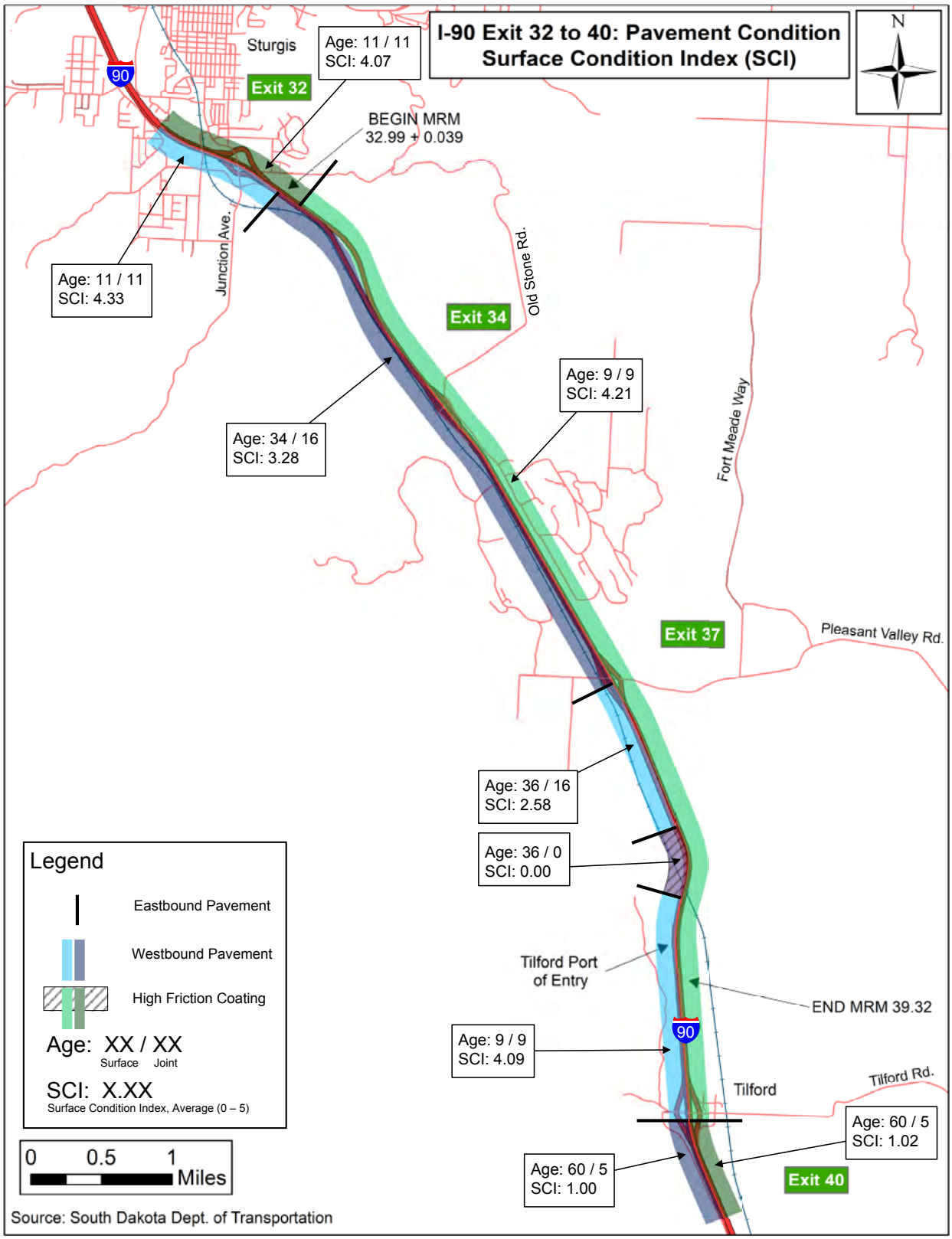


Figure 3: Pavement Conditions

Existing Guardrail Conditions

Traffic barrier is present along the I-90 project corridor between Exit 32 and 40. On the north end of the project corridor, barrier is predominantly used for slope protection as traffic on I-90 negotiates the initial curve south of Sturgis (between MRM 33 and MRM 34). Barrier systems protecting bridge ends and structure openings within the 30-foot clear zone are located intermittently throughout the corridor. Several types of traffic barrier systems are present:

- CASS 3 Cable (high tension)
- 3 Cable Guardrail (low tension)
- Thrie Beam
- W Beam

Currently, only highway safety hardware must comply with the Manual for Assessing Safety Hardware (MASH) for new permanent installations. After the year 2020, full replacement will be required. Existing guardrail within the I-90 study corridor will need to be updated to comply with the MASH TL-3 crash test standard.

Traffic Volumes

Year 2017 traffic volumes were obtained from two sources:

1. 24-hour directional volumes were collected for the Interstate 90 mainline at permanent Automatic Traffic Recorder (ATR) stations. Traffic counts were obtained for the week of September 11-14, 2017 and included vehicle classification data.
2. The consultant team collected hourly intersection turning movement counts on two occasions: August 8-9, 2017 during the Sturgis Motorcycle Rally, and again on September 12, 2017. The counts collected during the rally (between 9:00 a.m. and 9:00 p.m.) were collected for reference purposes only and were provided to SDDOT to supplement turning movement counts collected during the rally from previous years. The counts obtained on September 12, 2017 were collected from 6:30 a.m. to 7:00 p.m. and were used as inputs to the intersection analyses. Both sets of counts included vehicle classification data.

The I-90 directional counts were corrected for daily and seasonal variation based on factors developed by the SDDOT from data collected at the weigh-in-motion station within the corridor (“WIM 901”). These are scaling factors that equate traffic counts by month of the year for which they are collected to an annual average daily traffic volume. Year 2017 average daily traffic volumes (ADT) for I-90 mainline study segments are shown in Figure 4.

Peak hour a.m. and p.m. intersection turning movements for study area intersections during the motorcycle rally are shown in Figure 5. Likewise, peak hour a.m. and p.m. intersection turning movements collected in September and used in the analyses are shown in Figure 6.

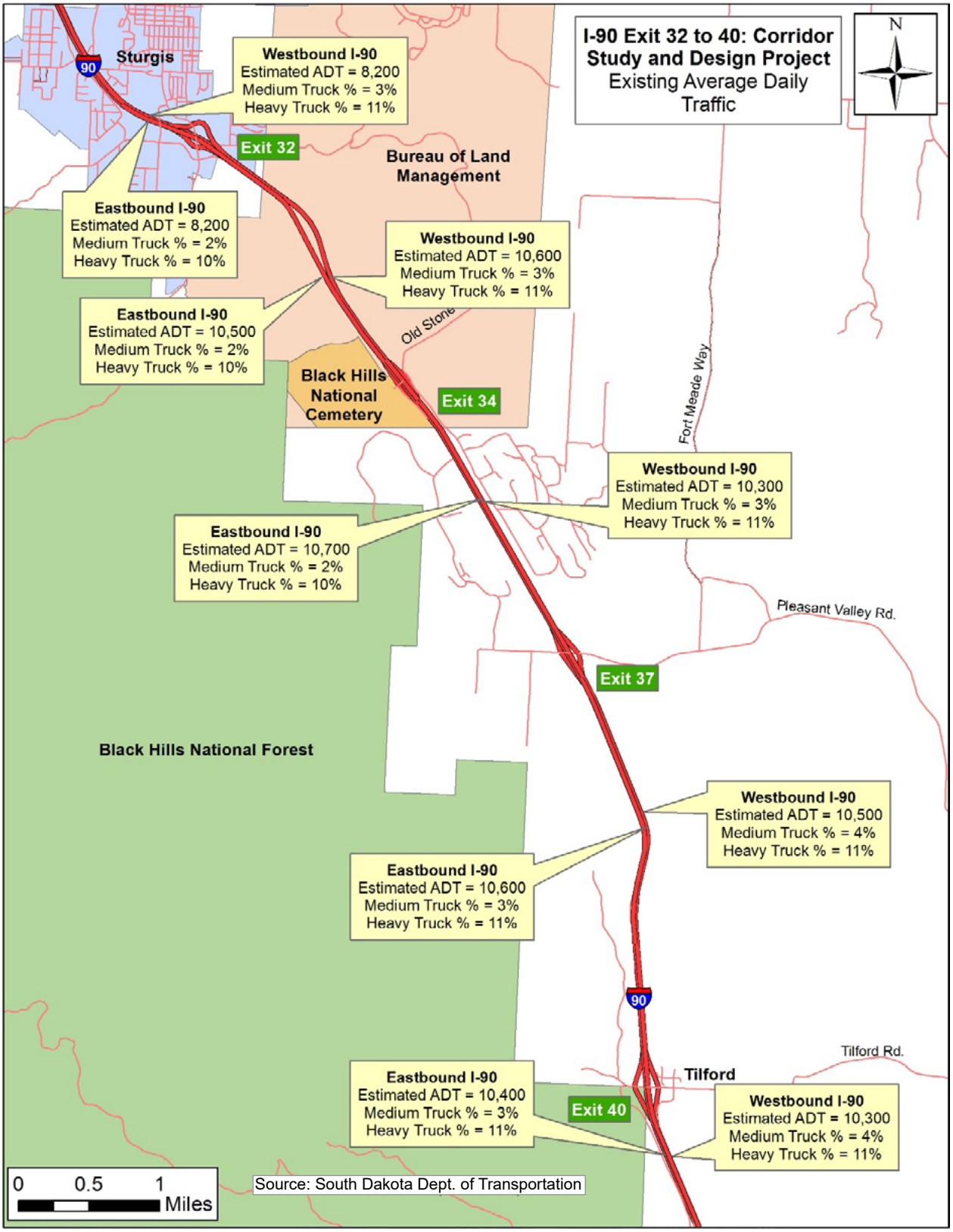


Figure 4: Existing Average Daily Traffic and Truck Percentages

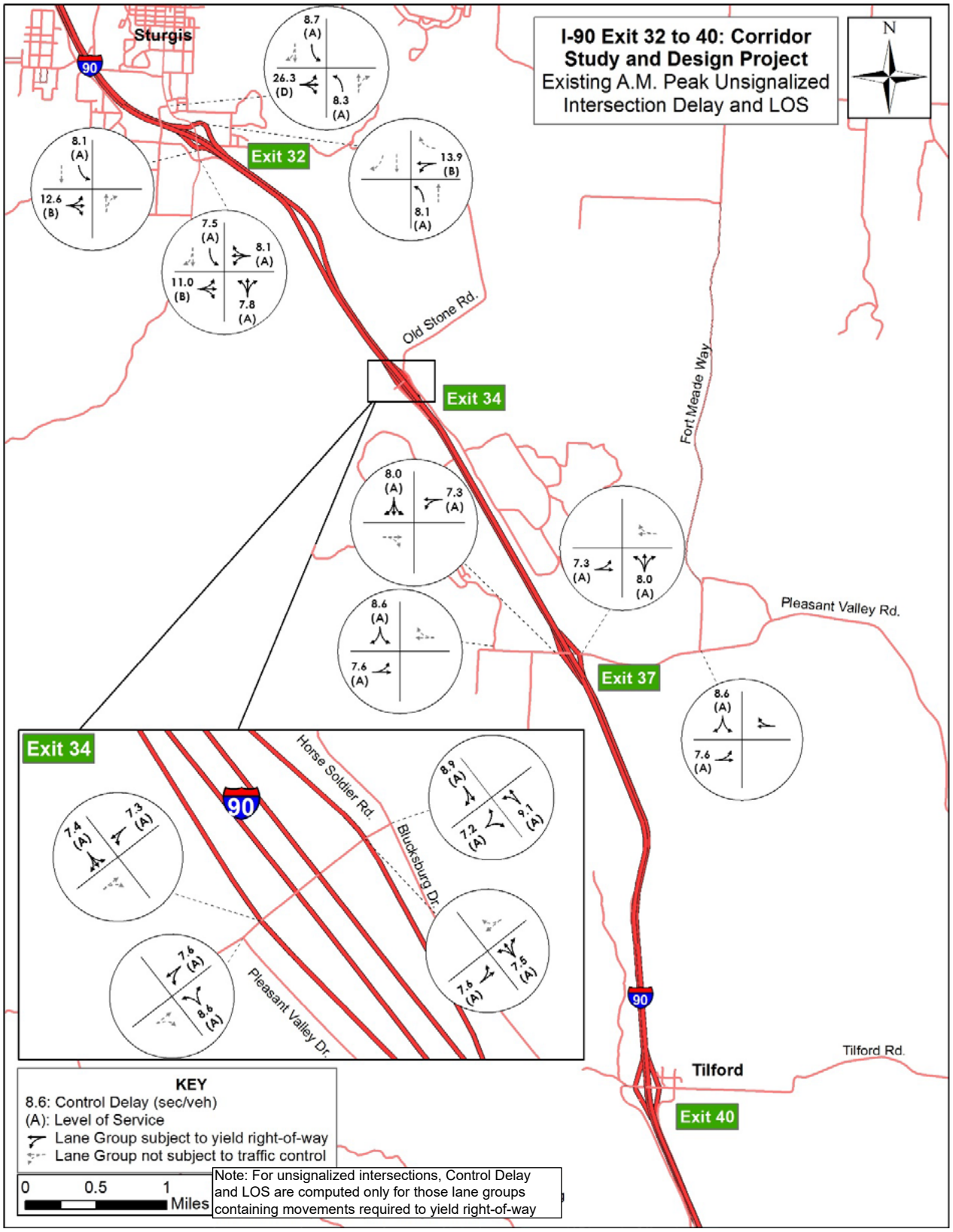


Figure 5: Existing Unsignalized Intersection Traffic Operations – A.M. Peak

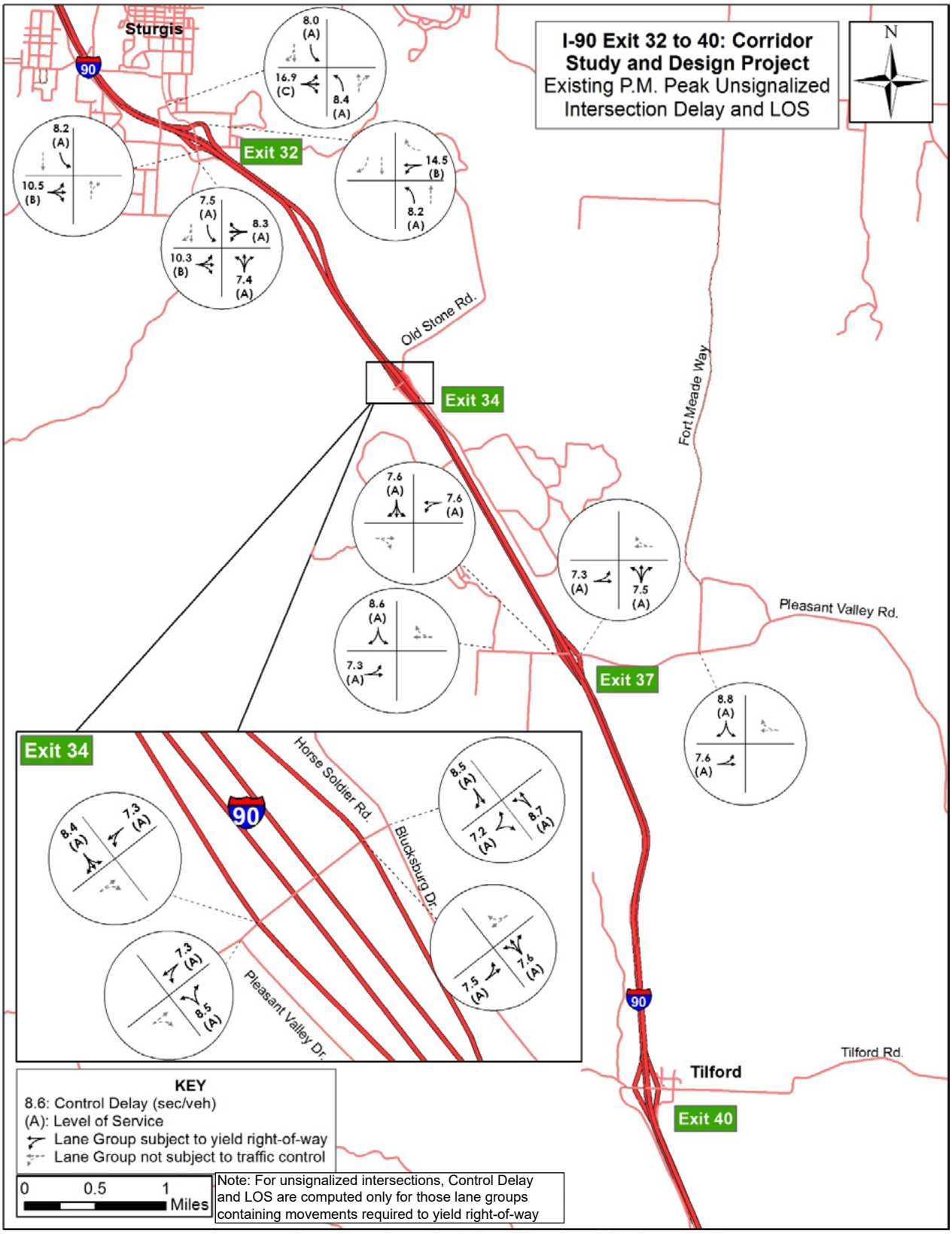


Figure 6: Existing Unsignalized Intersection Traffic Operations – P.M. Peak

Traffic Operations

I-90 is the only primary north-south roadway serving Sturgis between Exit 32 and 40. With only one highway and no service or frontage road, there are no alternate routes to relieve congestion on I-90. The consultant team conducted an analysis of existing traffic operations to determine the functionality of intersections and freeway along the I-90 corridor. The analysis found no existing capacity deficiencies for the mainline, the interchange ramps, or the crossroads.

Exit 34

The entrance to the Black Hills National Cemetery (BHNC) is located adjacent to the Exit 34 interchange. During large services and frequently on patriotic holidays, queues form while waiting to enter the cemetery causing vehicles to back up onto the ramp and even the interstate, disrupting I-90 traffic. BHNC staff indicated traffic rarely backs onto the interstate, but more frequently queues can back up onto the railroad corridor creating a hazardous rail-vehicle conflict.

Exit 37

Residents are concerned about the high volume of truck traffic that travels on Fort Meade Way. This road is used as an alternate route to Sturgis, SD Highway 34, and SD Highway 79. The road is unpaved and is not designed to handle large trucks. Residents are not opposed to the truck traffic, but they would like to see upgrades to the road to accommodate heavy vehicles. A sign currently in place on the eastbound entrance to County Highway 8 reads “local trucks only.”

Tilford Port of Entry on Eastbound I-90

Trucks preparing to exit I-90 for the TPOE typically need to reduce speed relative to through traffic, sometimes causing slowdowns on I-90. There is no deceleration lane to allow trucks to clear the I-90 mainline. The off-ramp to the TPOE is short and does not have the capacity to contain the queue of trucks during weigh times. Queues often spill into the main lanes or occupy the shoulder. Adjustments to the TPOE ramps could affect traffic flow and function within the site, prompting a review of the existing facility.

Level of Service

The ‘Freeway Facilities’ traffic analysis is a method that provides a level of service (LOS) analysis for freeway facilities. The Freeway Facilities method is a directional analysis which produces performance measures for individual segments. Freeway Facilities analyses of existing conditions along the corridor were performed for the a.m. peak period (7:00 a.m. – 8:30 a.m.) and for the p.m. peak period (4:00 p.m. – 5:30 p.m.), as determined from the traffic counts. The following performance measures are reported: average travel speed (mph), density (pc/mi/ln), LOS, and demand-to-capacity ratio (D/C). According to the Highway Capacity Manual (HCM), studies on LOS perception by rural travelers indicate the presence of lower-density thresholds in comparison to urban freeway travelers. The majority of the I-90 study section is located outside Sturgis city limits, thus the entire corridor was evaluated as a rural facility.

The results indicate, both at the segment level and at the facility level, the study section of I-90 operates at an acceptable level of service during typical weekday a.m. and p.m. peak hours. For this analysis, “typical” means no inclement weather, incidents, work zone activities, or special events. Overall facility results are presented in Table 1.

Table 1: Level of Service - Overall Facility Results

Analysis Direction	Mean Speed (mph)	Average Travel Time	Density (pc/mi/ln)	LOS
A.M. Peak				
Eastbound	70.1	9.3 minutes	1.4	A
Westbound	71.3	9.4 minutes	1.4	A
P.M. Peak				
Eastbound	70.0	9.4 minutes	1.7	A
Westbound	71.0	9.4 minutes	1.6	A

Existing Roadway Needs

Currently, no capacity deficiencies exist for the I-90 mainline or the crossroads that form its service interchanges within the study area. For typical weekday a.m. and p.m. peak periods, all facilities (with one exception) operated at a LOS B or better. The one exception was the STOP-controlled minor street approach of eastbound Vanocker Canyon Road at Junction Avenue. This intersection operates at LOS D during the a.m. peak and LOS C during the p.m. peak.

Existing Pedestrian and Bicycle Facilities

The consultant team reviewed resources provided by federal and state agencies, Meade County, and the City of Sturgis to gain a thorough understanding of the existing pedestrian and bicycle facilities within the project corridor.

City of Sturgis Trails

The City of Sturgis has five designated non-motorized trails within the City limits. The closest one to the project limits is a North/South trail called Deadman Trail, approximately one-half mile north of Exit 32. Other bike paths within the City are Ball Park Drive Trail, Centennial Bike Path, Connector, and Moose Drive Bike Path.

Centennial Trail

Centennial Trail is a 111-mile-long hiking, horseback riding, mountain biking, and intermittent automotive trail. It starts near Bear Butte State Park and continues through the Black Hills until it reaches Wind Cave National Park near Hot Springs. The trail is managed through a partnership between the US Forest Service, the Bureau of Land Management (BLM), the National Park Service, and the South Dakota Department of Game, Fish, and Parks. The trail crosses the project area just north of Exit 34 and continues to the Alkali Creek Trailhead approximately one-half mile east of the Exit 34 interchange. The section of Centennial Trail starting at the Alkali Creek Trailhead up to Highway 34 in Sturgis is designated as a National Backcountry Byway. Vehicle travel is allowed on the five-mile segment of gravel road.

Safety

Crash Summary

Historical crash data were collected along the study area for the five-year period between 2012 and 2016 which constitutes the “Analysis Period” for this report. A total of 423 crashes occurred over the Analysis Period within study area. Two of the crashes resulted in fatalities, 21 resulted in incapacitating injuries, and 46 resulted in non-incapacitating injuries. 131 crashes were designated as ‘wild animal hit’ crashes.

To better understand the corridor crash history, crash types were examined based on the ‘Manner of Collision’ field in the crash reports. Single vehicle crashes were the most common crash type (281 crashes, 66%) and are predominately run-off-the-road incidents. Animal collisions were the second most commonly reported crash type, however many of these collisions were coded as single vehicle crashes. As illustrated in Table 2, crashes were evenly distributed along the segments of I-90 included in the study. However, several 0.3-mile “hot-spots” with a high concentration of crashes also exist. The spot with the highest number of crashes (43) is located between Exit 32 and Exit 34 (MP 33.0 + 0.000-33.3). The next highest crash location (34) is found between Exit 34 and Exit 37 (MP 36.0-36.3).

Table 2: Crash Summary (2012-2016)

Segment	Route	Description	Begin MRM	End MRM	Length (mi.)	Number of Crashes (2012-2016)	ADT (veh./day)	Actual Crash Rate	Statewide Average Crash Rate	Facility Type
								(Annual Crashes/ 100 million VMT)		
1	I-90	West of Exit 32	31.50	32.41	0.9104	39	15,800	149	302	Urban Interstate
2	I-90	Between Exits 32 & 34	32.41	34.81	2.400	79	20,300	89	302/129	Urban/Rural Interstate
3	I-90	Between Exits 34 & 37	34.81	37.01	2.200	83	20,200	102	129	Rural Interstate
4	I-90	Between Exits 37 & 40	37.01	40.20	3.190	95	20,200	81	129	Rural Interstate
5	I-90	East of Exit 40	40.20	41.00	0.8004	37	19,900	127	129	Rural Interstate

Safety Analysis

The consultant team conducted an analysis to identify safety issues, suggest contributing factors, and propose countermeasures to improve safety for a curved segment of I-90 between reference mile-points 38.0 and 38.7.

A horizontal curve on I-90 between reference mile-points 38.0 and 38.7 experienced 34 crashes between the years 2012-2017. The predominant crash type at this location was run-off-the-road (ROR) crashes (74%, 25 crashes). This area ranked first in terms of crash severity with two incapacitating injuries and five non-incapacitating injuries. When compared to other segments within the corridor of similar length, this location observes the highest proportion of single vehicle crashes.

Contributing factors to ROR crashes typically include inadequate lane width, slippery pavement, inadequate median width, poor delineation, and excessive speed. Of the 25 recorded ROR crashes, 18 cases involved excessive speeds. Weather related crashes accounted for 60% of ROR crashes along the curve segment. While most ROR crashes did not involve a collision with a fixed object, the crash data contained 10 incidents of overturning vehicles, resulting in severe injuries to occupants. Due to the consistency of ROR and overturning crashes along this segment, countermeasures to reduce crash frequency and severity are warranted.

Location-Specific Safety Concerns

Exit 34

This bridge at this location is considered ‘critical’ since it carries mainline interstate traffic. Bridge columns under I-90 mainline are very close to the cross-street lanes of travel and do not have protective barriers in place. If these columns are struck, the bridge could become structurally compromised. This happened in 2009 and the bridge columns received repairs that same year.

Exit 40

A high number of guardrail crashes occur during snowy or icy conditions around the interchange at Exit 40. In a previous study conducted for SDDOT eight of 32 crashes that occurred at the interchange between July 2006 and July 2009, were guardrail crashes. Six of eight guardrail crashes occured during snowy or icy conditions. Guardrails are in place on both sides of the overpass on Tilford Road, and under the overpass protecting the bridge columns on I-90. Of the more severe crashes, 75% occurred during snowy or icy conditions.

Tilford Point of Entry on Eastbound I-90

Lighting is provided to illuminate the port along the facility’s on and off ramps. According to the most recent maintenance inspection report, the lighting infrastructure is in good condition.

Existing Safety Needs

The consultant team analyzed crash data for the 5-year period from January 1, 2012 through December 31, 2016. All segments of I-90 between Exit 32 and 40 had annual average crash rates below the statewide average for similar facilities. However, five 0.3-mile spots were identified as candidates for further study of potential safety improvements. The most frequent types of crashes within the corridor were related to run-off-the-road occurrences and collisions with animals.

Intelligent Transportation Systems (ITS) Infrastructure

The SDDOT does not currently have a Traffic Management Center (TMC), but is interested in building one should the Federal Highway Administration make operational funding available in the future, nor do they currently have a centralized Advanced Transportation Management System (ATMS) for managing the various ITS devices located around the state. The majority of the ITS equipment throughout the State is maintained by the SDDOT Office of Research with some routine items being handled by each of the four (4) regions in the state. Each ITS device or system is controlled by the manufacturer's proprietary software for doing routine tasks such as posting messages to a Dynamic Message Sign (DMS) or viewing a Closed-Circuit Television (CCTV) camera. Besides access from each of the regions, all of the devices that have a communications connection can be accessed from the DOT headquarters in Pierre, SD. The SDDOT does have an Advanced Traveler Information System (ATIS) located at **https://www.safetravelusa.com/sd/**,and the corresponding 511 System that provides existing roadway conditions and information to the traveling public. The existing ITS devices in the study corridor are described below.

Dynamic Message Signs (DMS)

There is one DMS within the project limits which is located on westbound I-90 at approximately mileage reference marker 35.04 + .5 as shown in Figure 7. This sign is used for posting warnings and traveler information to the public.

Closed Circuit Television (CCTV)

One CCTV camera with pan-tilt-zoom capabilities within the study corridor is used for monitoring roadway conditions. It is co-located on the DMS on westbound I-90 at reference mileage marker 35.04 + 0.5 as shown in Figure 8.

Road Closure Gates and Signs

SDDOT operates snow gates to close roadways during severe inclement weather conditions around the state. Within the project limits, gates are located at Exit 32 in Sturgis as shown

Figure 7: Dynamic Message Sign


Figure 8: Closed Circuit Television

Figure 9: Road Closure Gate

in Figure 9. Advanced warning signs are also located at each of the closure points. There are also advance warning signs at each closure location, as shown in Figures 10 and 11. Both the gates and signs are currently activated manually. When South Dakota Highway Patrol and SDDOT agree on the Interstate closure time, a SDDOT employee is sent out to flip the advanced warning signs activation switch. After the signs are activated the gates are manually lowered to close the roadway via a handcrank. The handcrank can be seen in Figure 9 on the right-hand side of the pole just above the base.

If additional ITS functionality and communications backbone are added along this corridor, SDDOT would consider automating both of these functions. As a part of this automation, a CCTV camera or other form of positive verification would need to be installed to verify that the signs indeed were activated. Additional upstream signage with beacons need to be added (dynamic or static) to warn the oncoming motorists about the automatic freeway closure (fully automatic closure without the need of a police or maintenance vehicle with flashing lights blocking the roadway and closing the gates). Other proactive advanced warnings may include deploying a CB-Radio based traveler information and warning system and/or other emerging safety technologies such as Dedicated Short Range Communications (DSRC) equipment at these locations to alert the truck drivers and other motorists in advance preparing them for a smooth slow down and exit.

Electronic Screening & Traffic Monitoring

The SDDOT and SDHP operate an electronic screening system at the Tilford Port of Entry on eastbound I-90 at mileage reference marker 38. For westbound I-90, SDDOT only collects volume, speed, classification, and weight information from the in-pavement monitoring equipment. There is no physical weigh station for overweight vehicles in this direction. The in-pavement collection equipment for westbound I-90 is shown in Figure 12.

In the eastbound direction, SDDOT and SDHP operate a full Electronic Screening and Traffic Monitoring system for the Tilford Port of Entry that supports e-screening to allow trucks with in-cab transponders to by-pass the inspection station, reducing emissions associated with the truck's deceleration/acceleration. This system also includes a license plate reader to identify vehicles that may not have a transponder but are pre-approved. It can be seen in Figure 13. The Electronic Screening and Traffic Monitoring system consists of a single load cell (SLC) weigh-in-motion (WIM) mainline sorter system with automatic vehicle identification (AVI), an over-height detector, piezoelectric tracking sensors, side-view camera, scale house operator electronics and an intelligent Roadside Operations Computer (iROC). The transponder readers, over-height detector, and side view camera can be seen in Figure 13.

Figure 10: Advance Road Closure Sign

Figure 11: Road Closure Sign at Closure Point


Figure 12: 1-90 Traffic Data Collection Loops & Scales


Figure 13: I-90 Weigh-in-Motion Equipment

Trucks that do not have in-cab transponders or legible license plates (or the ones that are randomly selected for a safety or log-book check) are required to enter the weigh station. Two message boards direct vehicles to enter the inspection station, as shown in Figure 14. SDDOT uses the Drivewyze commercial vehicle program to screen on credentials as well, but currently it does not have weight information. SDDOT is currently seeking a Federal Motor Carrier Safety Administration grant to integrate vehicle weight information into the system.

Similar to the WB I-90 direction, SDDOT uses this Electronic Screening and Traffic Monitoring station to collect speed, volume, classification and weight information. If the roadway is reconstructed and the WIM equipment is reinstalled, SDDOT would consider additional ITS related safety technologies at the Tilford Port of Entry.

ITS Needs

The SDDOT has considered installing several new ITS elements throughout the state, including this project study corridor. To enhance the functionality of the planned ITS elements, and to manage the existing capability, the SDDOT may consider a Traffic Management Room (TMR) at the Rapid City Region maintenance office or a portable virtual Traffic Management Center (TMC) utilizing various applications operating on a secure phone or tablet based upon number and location of the devices as well as the system architecture.

Future ITS improvements are discussed in the Year 2050 Traffic Conditions section of this report. The potential ITS systems/devices do not represent all the SDDOT's needs to enhance the corridor's level of service considering the extreme weather and heavy traffic volumes. Further identification and investigation of stakeholders' user needs will be developed in the ConOps workshop to be scheduled at a later date. Each strategy developed will be checked against the current SDDOT Transportation System Management & Operations plan to ensure that it is compatible with identified business processes and institutional capabilities. This step will help SDDOT lay the groundwork for future TSM&O Statewide ITS Deployment plan development.

Figure 14: I-90 Weigh Station Bypass Dynamic Signs

ENVIRONMENTAL OVERVIEW

Study Process

The environmental review process is undertaken to ensure the proposed project satisfies user needs while maintaining or improving existing area resources. The process also provides a mechanism for disclosing environmental impacts and gives the decision makers the appropriate information to make a sound choice among alternatives. Public and agency scoping has begun for the I-90 corridor project including agency coordination letters, tribal consultation letters, stakeholder meetings, and public information meetings.

The SDDOT's environmental process is in accordance with rules set by the National Environmental Policy Act (NEPA), as well as other related federal, state, and local requirements. Early in the NEPA process, SDDOT will determine which of the three basic "classes of action" is most appropriate for documenting the projects based on the location, extent, and potential for impact on the human environment. The class of action defines the level of environmental review required to make a determination. An independent utility and logical termini analysis will be completed to determine whether these projects are single, stand-alone projects and will not trigger other actions potentially requiring environmental review. The termini for these projects will be selected in accordance with FHWA Technical Guidelines for termini development.

Documenting the environmental review process will include the detailed study of the physical, social, cultural, and economic impacts on the natural and human environment for the proposed projects under consideration. This information guides alternative development that avoids or minimizes impacts. Where impacts cannot be avoided, comprehensive environmental review along with public involvement and agency coordination will help identify potential mitigations to be evaluated and integrated into the projects as appropriate.

Documentation also provides a report of the environmental process undertaken by the SDDOT, relates the results of the SDDOT's analysis to the public, and allows for an opportunity to provide input and comment. Once the appropriate document is selected, a draft report will be developed. If an Environmental Assessment (EA) is prepared, the document will be distributed for public comment. The EA provides sufficient environmental documentation to determine the need for an Environmental Impact Statement (EIS) or that a Finding of No Significant Impact (FONSI) is appropriate.

Environmental Overview

Floodplains

The current Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) have been reviewed for this project (Map Numbers 46093C1167F, 46093C1188F and 46093C1525F in Meade County, South Dakota dated September 16, 2011). No part of the project is located within a base flood (100-year or Zone A) floodplain boundary.

Historic Resources

The consultant team studied historic and cultural resources throughout the project corridor to understand existing conditions and potential impacts. This process began with a Class I Literature Search. The objective of the literature search and windshield survey was to obtain information regarding archaeological surveys that had been completed in the project area, identify recorded archaeological sites and architectural resources within the project limits, and provide recommendations for additional cultural resource surveys.

Portions of the project area have been subject to Class III survey during the last 20 years. Thirty-four previously recorded archaeological sites are located within the project area and were identified during previous cultural resource survey efforts. Of these 34 sites, two are listed on the National Register of Historic Places (NRHP) and are 39MD0082 and 39MD3002. Three sites have been determined eligible for listing on the NRHP and are 39MD0572, 39MD0628 and 39MD2003. Two sites (39MD0760 and 39MD0872) have been recommended eligible by the surveyor but have not been formally determined eligible by the SHPO. Nine sites have been determined not eligible, and two additional sites have been recommended not eligible but do not have formal SHPO determinations. Fourteen sites have not been evaluated. One of the unevaluated sites, 39MD0136, has had additional testing conducted by the BLM and is noted as having significant intact deposits. One site (39MD0022) is documented as a Ute burial site.

The Black Hills National Cemetery and the Fort Meade Historic District are both listed on the NRHP. All of the other previously recorded historic structures or bridges within the project area have been determined Not Eligible for listing on the NRHP and no further work is recommended. Based on the windshield survey and historic maps review it appears that approximately 12 individual structures would need to be recorded as historic architectural resources. There are approximately eight structures along Dickinson Drive including three houses, two commercial buildings, and some metal sheds. One house along Vanocker Canyon Road and a house and outbuildings within the RV Parks would require recordation although most of the structures in the campground are more recent and do not meet the age criteria for recordation. The VFW Memorial Chapel is located at Exit 34 across from the Black Hills Cemetery. In addition to the individual resources noted during the windshield survey, the Town of Tilford may require recordation as a historic district.

Three eligible structures are located outside the project limits but within a mile of the project area and include the Beug House (MD50), the McMillan House (MD213), and the CNW Passenger Depot (MD348). All three of these resources are located within the town of Sturgis and do not have current visibility of the project area.

Hazardous Materials

Excavation for roadway widening or interchange configurations can provide a potential for exposure of contaminated soils and regulated materials. A Phase I ESA will be performed for the study area. If recommended in the Phase I ESA, a Phase II may be performed to determine the extent of suspected contamination.

Wetlands & Waters of the US

The consultant team conducted a wetland and waterway review to determine if any jurisdictional wetlands exist within the project corridor. This included a desktop analysis followed by a field delineation to verify the findings of the desktop analysis. The desktop delineation was completed in spring 2018 followed by the field work in summer 2018. The desktop and field reviews found the following resources along the corridor:

- Alkali Creek, a beneficial use stream for:
    - Domestic water supply waters
    - Coldwater marginal fish life propagation waters
    - Limited-contact recreation waters
- Bulldog Creek
- Forested (PFO) Wetlands
- Freshwater Emergent (PEM) Wetlands

Impacts to the above resources will require coordination with the U.S. Army Corps of Engineers (USACE). Impacts to USACE jurisdictional wetlands will require the analysis of the alternatives under consideration to determine the Least Environmentally Damaging Practicable Alternative (LEDPA) as part of the permitting process as required by the 404(b)(1) guidelines. To be selected as the LEDPA, a project alternative must result in the least impact to aquatic resources while being practicable after taking into consideration cost, existing technology, and logistics—while also considering the overall project purpose. The methods used for wetland and waterway delineations are included in the following sections as well as the findings from those processes.

Methodology

Wetlands Methods

Wetland determinations were based on the criteria and methods outlined in the U.S. Army Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1 (1987) and subsequent guidance documents (USACE 1991, 1992), and the Regional Supplement to the Corps of Engineers Wetlands Determination Manual: Great Plains Region Version 2.0, Technical Report ERDC/EL TR-10-1 (2010).

The wetland determination involved using available resources to assist in the assessment such as U.S. Geological Survey (USGS) topographic maps, U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) soil survey, U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) mapping, US Geological Survey National Hydrography Data (NHD), and recent and historic publicly available aerial photography.

The consultant team completed routine level 2 on-site wetland determinations using the three criteria (vegetation, soil, and hydrology) and technical approach defined in the USACE 1987 Manual and applicable Regional Supplement. According to procedures described in the 1987 manual and applicable regional supplement, areas that under normal circumstances reflect a predominance of hydrophytic vegetation, hydric soils, and wetland hydrology (e.g., inundated or saturated soils) are considered wetlands.

Additionally, as climate plays an important role in the formation and identification of wetlands, the consultant team reviewed antecedent precipitation in the months leading up to the field investigations. The current year's precipitation data was compared to long-term (30-year) precipitation averages and standard deviation to determine if precipitation was normal, wet, or dry for the area using a WETS analysis as developed by the NRCS.

In areas where the wetlands were connected by a culvert under the roadway, a sample point transect was completed on only one side of the road assuming that the wetlands on either side of the roadway would exhibit the same criteria. If the wetland type was different, then a new set of transects was completed.

Sample points were placed in all areas identified as being an NWI-mapped wetland or a whole unit hydric soil. If sample points did not meet wetland criteria, data were recorded to document non-wetland conditions. In study areas where neither NWI or hydric soils were mapped and hydric vegetation or surface hydrology was not observed, photos were taken to document the lack of wetland or waterway criteria.

Waterways Methods
The ordinary high-water mark for waterways was determined and surveyed along with culverts, and/or other connections to off-site wetland or aquatic features that may be under federal or state authority using a Global Positioning System (GPS) and mapped using Geographic Information System (GIS) software. Waterbodies (i.e., ponds, creeks, streams, rivers) were identified by the presence of an ordinary high-water mark (OHWM). Common identifiable indicators of an OHWM include open water or evidence of a clear, natural line visible on the bank, shelving, changes in soil characteristics, destruction of terrestrial vegetation, the presence of litter and debris, and watermarks on structures that are inundated during normal high-water conditions. Streams were classified as perennial, intermittent, or ephemeral based on field observations and review of depth to water table and flood frequency data available from the USDA NRCS. The OHWM typically represents the potential limits of the USACE jurisdiction. The USACE has full discretion in determining the jurisdictional status of referenced wetlands and waterbodies.

Existing Conditions Findings

Wetlands

Nine wetlands were delineated within the study area, and descriptions of each wetland are summarized in Table 3. All culvert locations were located with a GPS capable of sub-meter accuracy.

Table 3: Summary of Wetlands Delineated within the Study Area

Wetland ID	Approximate MRM	Latitude	Longitude	Side of Road	Cowardin Class	Preliminary Assessment Jurisdictional Status	Acres
WL-1	33.34	44.38934060	-103.4890465	East	PEMB	Jurisdictional	0.182
WL-2	33.48	44.38704636	-103.4879032	Median	PEMC	Jurisdictional	0.186
WL-3	35.00	44.37139846	-103.4719110	East	PEMB	Not Jurisdictional	0.030
WL-4	35.04	44.36902897	-103.4720416	West	PEMC	Not Jurisdictional	0.029
WL-5	35.40	44.36722760	-103.4695841	West	PEMC	Jurisdictional	3.800
WL-6	37.28	44.34272419	-103.4477676	West	PEMA	Jurisdictional	0.145
WL-7	37.80	44.33423489	-103.4408175	Both	PEMA/PEMC	Jurisdictional	2.508
WL-8	38.00	44.33210527	-103.4378368	East	PEMA	Jurisdictional	0.217
WL-9	36.14	44.35537925	-103.4569543	East	PEMC	Not Jurisdictional	0.089
WL-10	40.20	44.30111694	-103.4357746	West	PSS	Not Jurisdictional	0.297
WL-11	35.50	44.36309917	-103.4657118	West	PEMA/PEMC	Jurisdictional	0.853
						Total	**8.336**

Upland

Upland within the study area consisted of road ditch, hay land, and pasture. Common species seen at sample points within the study area included: smooth brome (Bromus inermis), Kentucky bluegrass (Poa pratensis), western wheatgrass (Pascopyrum smithii), western snowberry (Symphoricarpos occidentalis), prairie rose (Rosa arkansana), common dandelion (Taraxacum officinale), and prairie sage (Artemisia ludoviciana). Typically, the slope of the upland areas eliminated the possibility of ponding, which subsequently effectively eliminated any potential for wetland conditions to exist within the upland areas. No whole unit hydric soils were mapped by the NRCS within the study area according to the Meade County Soil Survey.

Waterways
Eleven waterways were identified within the study area. The waterways are described below and summarized in Table 4. All culvert locations were located with a GPS capable of sub-meter accuracy.

Table 4: Summary of Waterways Delineated within the Study Area

Waterway ID	Name	Latitude	Longitude	Type	Preliminary Jurisdictional Status	Length	Acres
ST-1	Vanocker Creek	44.39626181	-103.5034393	Intermittent	Jurisdictional	274’	0.165
ST-2	Unnamed tributary	44.38897817	-103.4921817	Ephemeral	Jurisdictional	160’	0.004
ST-3	Unnamed tributary	44.38801114	-103.4870749	Intermittent	Jurisdictional	523’	0.027
ST-4	Unnamed tributary	44.34505285	-103.4522841	Intermittent	Jurisdictional	75’	0.097
ST-5	Alkali Creek	44.37568297	-103.4830099	Intermittent	Jurisdictional	5192’	1.365
ST-6	Unnamed tributary	44.37132197	-103.4715165	Intermittent	Jurisdictional	358’	0.021
ST-7	Unnamed tributary	44.34843135	-103.4522904	Intermittent	Jurisdictional	874’	0.206
ST-8	Unnamed tributary	44.34862695	-103.4503317	Ephemeral	Jurisdictional	172’	0.004
ST-9	Unnamed tributary	44.34895397	-103.4506180	Ephemeral	Jurisdictional	40’	0.001
ST-10	Pleasant Valley Creek	44.33955227	-103.4428329	Intermittent	Jurisdictional	436’	0.020
ST-11	Unnamed tributary	44.31411599	-103.4366898	Intermittent	Jurisdictional	788’	0.455
ST-12	Unnamed tributary	44.31099118	-103.4346002	Intermittent	Jurisdictional	427’	0.093
ST-13	Unnamed tributary	44.34574093	-103.4466259	Ephemeral	Jurisdictional	103’	0.014
ST-14	Unnamed tributary	44.34461091	-103.4446858	Intermittent	Jurisdictional	2123’	0.271
					Total	**13,161’**	**3.002**

Wildlife/Threatened & Endangered Species

The consultant team reviewed available USFWS and SDGFP Database Information (NatureServe) to determine the existence of wildlife, threatened and endangered species, and related habitat. The following species were determined to exist within the study area:

- Least tern
- Red knot
- Whooping crane
- Northern long eared bat

No designated critical habitat was found, however possible effects to fish, wildlife, plant communities, and known threatened and endangered species include possible acoustic and habitat impacts from construction and clearing. Interchange construction will include tree clearing of terrestrial habitat that could result in direct and permanent impacts to the northern long eared bat habitat. Tree removal areas will require coordination with the US Fish and Wildlife Service to determine if impacts are anticipated, and to work through mitigation if needed. Impacts to rare species, rare native plant communities, trees, shrubs, or other notable vegetation are not anticipated, however, typical erosion control and native reseeding practices should be implemented.

Section 4(f)

After the effective date of the Federal-Aid Highway Act of 1968, the Secretary shall not approve any program or project (other than any project for a Federal lands transportation facility) that requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, State, or local significance as determined by the Federal, State, or local officials having jurisdiction thereof, or any land from an historic site of national, State, or local significance as so determined by such officials unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such program includes all possible planning to minimize harm to such park, recreational area, wildlife and waterfowl refuge, or historic site resulting from such use.

The consultant team reviewed the corridor for Section 4(f) properties within one mile of the project and the following resources were identified:

- No designated Wild and Scenic Rivers within Meade County
- No FWS National Wildlife Refuges or easements
- No FWS Waterfowl Production Areas or easements
- No FWS Wetland Management Districts
- Nearest state park is Bear Butte over one mile away
- Fort Meade Historic District: Area of Critical Environmental Concern (ACEC)
- The U.S. Forest Service has jurisdiction over Centennial Trail that runs through BLM property and alongside Alkali Creek. The trail may be realigned if necessary, but must be approved by the BLM and the U.S. Forest Service.

Additional resources include the Historic and Archaeological properties located along the project corridor, which would also be subject to Section 4(f). Coordination will be required with the official with jurisdiction over the affected property. Impacts will be minimized where possible and if found to be unavoidable, the 4(f) process will be undertaken. 4(f) can be a lengthy coordination process, but there are several programmatic options for processing, dependent upon the impact and the resource that will be evaluated if needed.

Section 6(f)

The project has been reviewed for potential Section 6(f) involvement. The project will not cause the conversion of any land acquired, planned, or developed with funds from the Land, and Water Conservation Fund (LAWCON). Therefore, there will not likely be Section 6(f) involvement as part of the corridor improvements. However, the SDGFP will be contacted as part of the environmental documentation process to confirm the proposed project(s) would not impact Section 6(f) properties.

Noise

Anticipated sensitive land uses encountered in the study—as categorized by FHWA Noise Abatement Criteria (NAC)—include: residences, churches, schools, parks, places of worship, cemeteries (particularly the Black Hills National Cemetery, which is planned for expansion), and recreation areas/campgrounds. Several campground sites occur between Exit 34 and 37.

Identified resources include:

- Black Hills National Cemetery
- No Name RV Park
- Katmandu RV Park
- Vanocker Campground
- Kickstand Campground
- Rush No More RV Resort and Campground

Per SDDOT guidance, existing sound levels will be established by performing field measurements within all noise sensitive areas in the project area. The consultant team will prepare a noise analysis report that identifies noise impacts based on FHWA Noise Abatement Criteria (NAC). If impacts are identified, study limits may need to be expanded to determine extent of impact, and further TNM 2.5 analysis will be conducted to investigate additional impacts and/or evaluate potential structural noise abatement options (berms/barriers).

Cultural Resources

A Phase I study included a records review, windshield survey, and additional information provided by the Bureau of Land Management (BLM). The Phase I identified portions of the project area of potential effect (APE) having the potential to contain intact archaeological resources. The following resources were identified:

- Ute burial ground avoidance area and scatter sites
- BLM archaeological features
- Recommended eligible sites
- National Register listed sites
- Railroad (segments are historic)
- BHNC gates
- BHNC property
- Fort Meade Historic District
- Fort Meade Archaeological site

Avoidance areas were identified as initial concepts were developed. As the project moves through the environmental documentation phase, a Phase II cultural resources investigation involving shovel testing will be used to assess the potential for buried archaeological resources within the APE.

Environmental Justice

Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," dated February 1, 1994, requires that environmental justice be addressed in all federal planning and programming activities. The purpose of EO 12898 is to identify, address, and avoid disproportionately high and adverse human health or environmental effects of programs, policies, and activities on minority populations and low-income populations. The proposed project has a potential for federal permit requirements and will utilize federal funding. As such, it is considered a federal project for the purpose of compliance with this Executive Order. EO 12898 requires that the proposed actions be reviewed to determine if there are "disproportionately" high or adverse impacts on minority or low-income populations. "Disproportionate" is defined in two ways: the impact is "predominantly borne" by the minority or low-income population group, or the impact is "more severe" than that experienced by non-minority or non-low-income populations.

The steps for defining environmental justice impacts include the following:

- Step 1: Determine if an identifiable low income and/or minority population exists in the project area
- Step 2: Determine if there are potentially high and adverse environmental impacts disproportionately borne and appreciably greater for the low-income and/or minority populations
- Step 3: If the determination in Step 2 is 'Yes," then determine if further mitigation is possible to avoid or reduce the adverse effect to the population; or are other alternatives to avoid or reduce impacts practicable

The consultant team will review proposed actions along the corridor to determine whether the improvements will introduce high levels of adverse impacts that would have disproportionately high and adverse human health or environmental effects to any minority population or low-income population.

Cumulative Impacts

Cumulative impacts are defined as "impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or persons undertakes such actions." The geographic areas considered are those areas directly adjacent to and near the I-90 Exit 32 to Exit 40 corridor. The project impacts defined during the environmental documentation for the I-90 project may include impacts to wetlands, floodplains, cultural resources and increased stormwater runoff.

Past actions in the project vicinity include decades of agricultural, residential and commercial development and transportation infrastructure improvements. All these have resulted in the current built environment surrounding the I-90 corridor, which is generally rural development. The Black Hills National Cemetery is expected to expand in the next decade. An EA is being completed for the expansion and impacts will be discussed as part of the environmental documents for the I-90 project. Based on conversations with property owners, further future development may occur at the Exit 40 interchange, however no plans are in place. No future development opportunities in the surrounding area have been identified.

Planning documents will be used to identify applicable projects including South Dakota's final 2016-2019 State Transportation Improvement Plan (STIP), and existing city and county comprehensive plans and capital improvement plans.

YEAR 2050 TRAFFIC CONDITIONS

Future Roadway Needs: Travel Growth Projections

Approach

The consultant team developed average daily traffic forecasts for the opening year (2023 for Exit 37-40 and 2025 for Exit 32-37) and design year (2050). These forecasts are needed to establish appropriate design criteria for potential geometric improvements and as an input for pavement design. Future year a.m. and p.m. peak hour traffic forecasts were developed for:

- I-90 mainline directional segments (for use in the HCM Freeway Facilities analysis)
- Intersection turning movements (for use in HCM Unsignalized Intersection analysis)

Seasonal Adjustments

Seasonal adjustment factors provided by the SDDOT for Weigh-in-Motion (WIM) Station 901 (MRM 38.185) were applied to directional counts collected on Tuesday, September 12th and Wednesday, September 13th in 2017. The adjustment factor for Tuesdays (1.043) and Wednesdays (1.036) in September were averaged (1.039) and this value was applied to the two-day average of the mainline counts. The seasonally adjusted average daily traffic (ADT) volumes were the basis for developing future year traffic forecasts. These factors were also applied to intersection turning movement counts conducted during that same time frame.

Growth Factors

Growth factors developed by the SDDOT Inventory Management Office were the primary basis for developing future year traffic forecasts. These growth factors, shown in Table 5, are broken down into 20-, 25-, 30-, and 35-year values for both rural and urban interstates. The opening year forecasts were developed by computing an average annual growth rate (agr) from the 20-year growth factors, then projecting that agr for six years (2017 to 2023) for Exit 37 to Exit 40 and eight years (2017 to 2025) for Exit 32 to Exit 37. The growth factors used in developing the opening year and design year forecasts are summarized in Table 6.

Table 5: SDDOT Growth Factors

Area/Facility Type	20-year	25-year	30-year	35-year
Rural Interstate	1.267	1.325	1.390	1.455
Rural Arterials/Collectors/Locals	1.339	1.425	1.510	1.595
Urban Interstate	1.407	1.500	1.600	1.700
Urban Arterials/Collectors/Locals	1.235	1.300	1.360	1.420

Table 6: Summary of Growth Factors

Area/Facility Type	Annual Growth Rate	Year 2023 Growth Factor*	Year 2025 Growth Factor*	Year 2050 Growth Factor*
Rural Interstate	1.19%	1.074	1.100	1.429
Rural Arterials/Collectors/Locals	1.47%	1.092	1.124	1.561
Urban Interstate	1.72%	1.108	1.146	1.660
Urban Arterials/Collectors/Locals	1.06%	1.065	1.088	1.396

* Applied to 2017 traffic volumes adjusted for day of week and month

Projected Traffic Conditions

Corridor Traffic Forecasts

Mainline Forecasts

Mainline average daily traffic forecasts were developed by applying the 2023, 2025 and 2050 growth factors to existing traffic volumes adjusted for day of week and month. These forecast volumes are shown in Table 7 and in Table 8 and also are presented in Figure 15, Figure 16 and Figure 17.

Table 7: Opening Year 2023 and 2025 Average Daily Traffic Forecasts

Location	Type	Direction	2017 Adjusted ADT	2023			2025		
				ADT	Medium Truck %	Heavy Truck %	ADT	Medium Truck %	Heavy Truck %
West of Exit 32	Urban Interstate	Eastbound	8,200	9,100	2%	10%	9,400	2%	10%
		Westbound	8,200	9,100	3%	11%	9,400	3%	11%
Between Exit 32 & 34	Rural Interstate	Eastbound	10,500	11,300	2%	10%	11,600	2%	10%
		Westbound	10,600	11,400	3%	11%	11,700	3%	11%
Between Exit 34 & 37	Rural Interstate	Eastbound	10,700	11,500	2%	10%	11,800	2%	10%
		Westbound	10,300	11,100	3%	11%	11,300	3%	11%
Between Exit 37 & 40	Rural Interstate	Eastbound	10,600	11,400	3%	11%	11,700	3%	11%
		Westbound	10,500	11,300	4%	11%	11,600	4%	11%
East of Exit 40	Rural Interstate	Eastbound	10,400	11,200	3%	11%	11,400	3%	11%
		Westbound	10,300	11,100	4%	11%	11,300	4%	11%

Table 8: Design Year 2050 Average Daily Traffic Forecasts

Location	Type	Direction	2017 Adjusted ADT	2050		
				ADT	Medium Truck %	Heavy Truck %
West of Exit 32	Urban Interstate	Eastbound	8,200	13,600	2%	10%
		Westbound	8,200	13,600	3%	11%
Between Exit 32 & 34	Rural Interstate	Eastbound	10,500	15,000	2%	10%
		Westbound	10,600	15,100	3%	11%
Between Exit 34 & 37	Rural Interstate	Eastbound	10,700	15,300	2%	10%
		Westbound	10,300	14,700	3%	11%
Between Exit 37 & 40	Rural Interstate	Eastbound	10,600	15,100	3%	11%
		Westbound	10,500	15,000	4%	11%
East of Exit 40	Rural Interstate	Eastbound	10,400	14,900	3%	11%
		Westbound	10,300	14,700	4%	11%

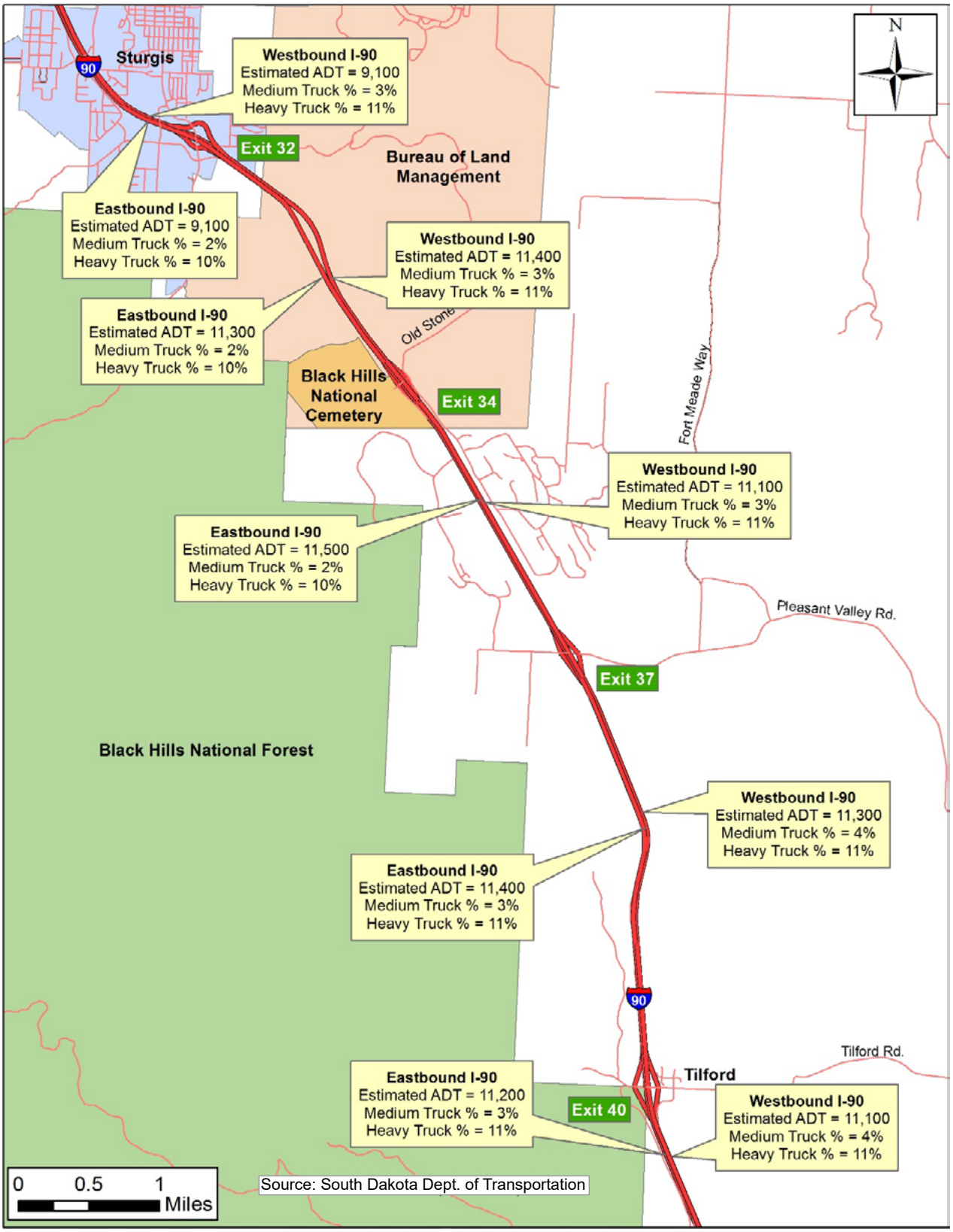


Figure 15: Opening Year Exit 37 to Exit 40 - 2023 Average Daily Traffic Forecasts

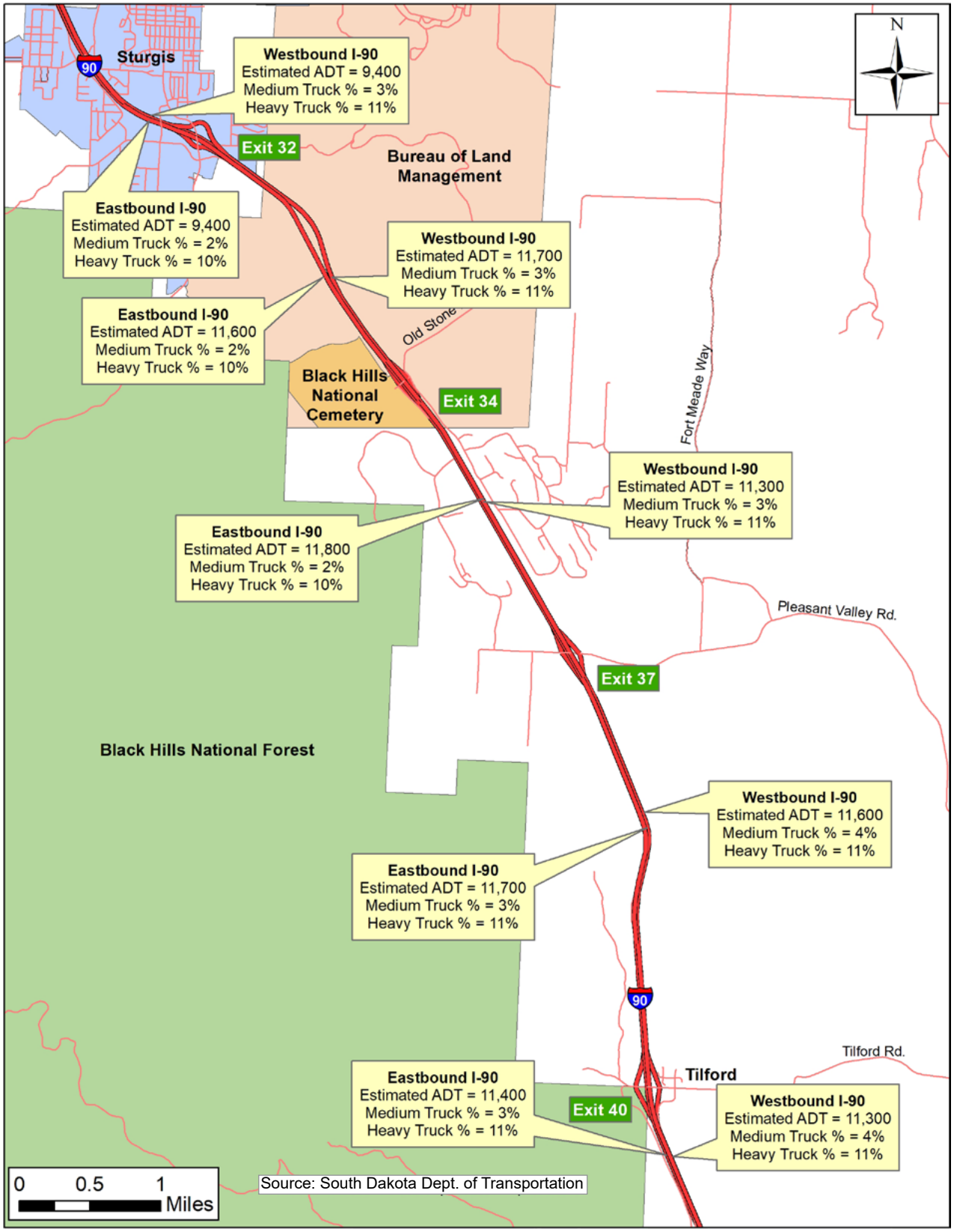


Figure 16: Opening Year Exit 32 to Exit 37 - 2025 Average Daily Traffic Forecasts

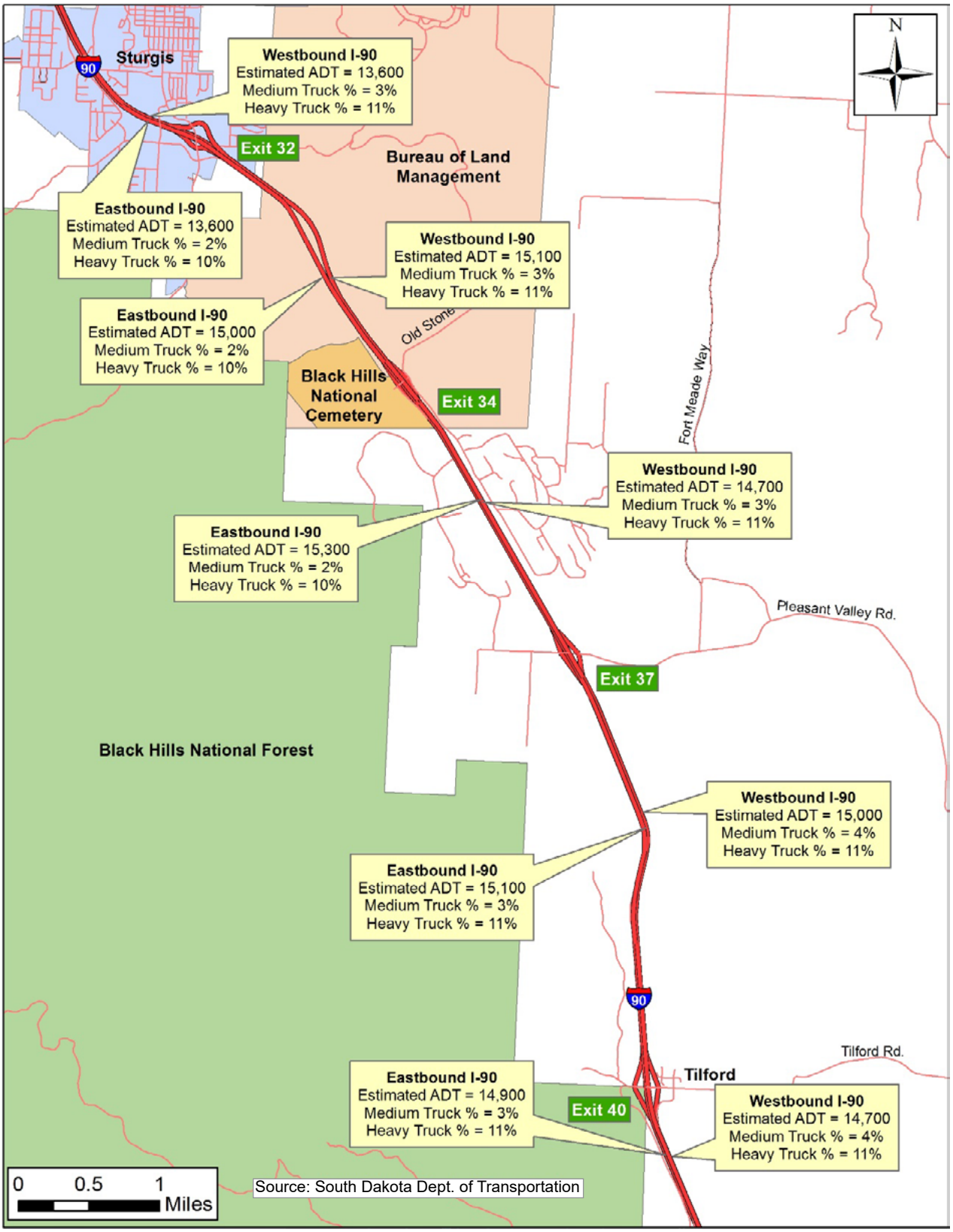


Figure 17: Design Year - 2050 Average Daily Traffic Forecasts

Peak Hour Forecasts
Year 2023, 2025 and Year 2050 a.m. and p.m. peak hour traffic forecasts were developed for:

- I-90 mainline directional segments
- Intersection turning movements

In both cases, existing (September 2017) traffic counts were adjusted for day of week and month based on 2017 seasonal adjustment factors developed by SDDOT for WIM Station 901. These adjusted volumes then were multiplied by the corresponding growth factors shown previously. For turning movements at I-90 ramp intersections with cross streets, the application of different growth factors to different approaches (interstate ramp vs. arterial or collector) resulted in "unbalanced" intersection volumes (i.e. entering and departing traffic volumes were not in agreement). Forecasts are included in Tables 9 and 10 below.

Table 9: Opening Year 2023 and 2025 I-90 Facility Results

Analysis Direction	Mean Speed (mph)		Average Travel Time		Density (pc/mi/ln)		LOS	
	2023	2025	2023	2025	2023	2025	2023	2025
A.M. Peak								
Eastbound	70.1	69.9	9.3 minutes	9.4 minutes	7.2	7.4	B	B
Westbound	71.2	70.9	9.4 minutes	9.4 minutes	7.2	7.4	B	B
P.M. Peak								
Eastbound	69.1	69.0	9.5 minutes	9.4 minutes	7.9	7.9	B	B
Westbound	71.2	70.9	9.4 minutes	9.4 minutes	8.3	8.5	B	B

Table 10: Design Year 2050 I-90 Facility Results

Analysis Direction	Mean Speed (mph)	Average Travel Time	Density (pc/mi/ln)	LOS
A.M. Peak				
Eastbound	70.1	9.4 minutes	9.6	B
Westbound	71.2	9.4 minutes	9.5	B
P.M. Peak				
Eastbound	69.0	9.5 minutes	10.5	B
Westbound	70.9	9.4 minutes	10.2	B

Future Pedestrian and Bicycle Network

Meade County has identified a list of non-motorized projects in its 2040 Transportation Plan. Three of these projects are within the project area, and two specifically deal with pedestrian and bicycle improvements. The first is a 11.9-mile bicycle wayfinding route, including bike route signing and pavement markings on Vanocker Canyon Road from Pineview Drive to the County Line. The second is an improved trail head at Pleasant Valley Road and BLM Road (Exit 34). Improvements include parking, facilities signage, and wayfinding for access to the FMRA. The final improvement listed is for a Park-n-Ride facility at Tilford Road (Exit 40) for future use by Prairie Hills Transit. With funding for non-motorized projects limited, Meade County suggests improvements to the non-motorized network be integrated into roadway projects where applicable.

Future Intelligent Transportation System (ITS) Improvements

As noted earlier in this report, the SDDOT has planned to install several new ITS elements throughout the state, including within this project study corridor. These new ITS elements are described in the following sub-sections.

Variable Speed Limits (VSL)

The SDDOT plans to pursue legislation in the 2020 Legislative session to allow a Variable Speed Limit (VSL) system along the I-90 corridor within the project limits. This stretch of I-90 has intense and quickly changing winter weather conditions that produce icy roadways with blowing and drifting snow, causing crashes, fatalities, and road closures. The primary intent of the VSL is to improve roadway safety and reduce the need for winter road closures by harmonizing the traffic speed to adverse weather and surface conditions. The VSL implementation could also help SDDOT lower speed limits during hazardous traffic conditions resulting from a major incident or congestion.

The VSL system will require the installation of a Roadway Weather Information System (see Section 3.1.2) along the corridor which feeds both meteorological and roadway conditions (traffic volumes, speed and headway) into the VSL algorithms for speed limit recommendations. This recommended speed limit could be manually changed based on other real time field observations from maintenance crews and images from additional CCTV cameras along the corridor. VSL signs will have to be installed at each on-ramp interchange to advise motorists of the roadway speed limit, to comply with the Manual of Uniform Traffic Control Devices.

Dynamic Messages signs or static roadway signs may have to be installed near the beginning and ending of VSL corridors to inform travelers of an activated corridor. Additional messages could be sent to the travelers via DSRC communications to reinforce and remind the driver of the recommended speed limits as well as when the limits have returned to normal. This information should also be posted on the SDDOT 511 Traveler Information Service, **www.safetravelusa.com/sd/**, mobile applications, social media, and conventional media outlets for periods of extreme weather.

Environmental Sensor Stations (ESS)

SDDOT currently deploys environmental sensor stations (ESS) throughout the state. None are currently installed along this section of I-90 between Sturgis and Tilford. As part of the VSL implementation, several ESS installations would be needed to provide information on temperature, humidity, wind speed and direction, precipitation, visibility, and presence of moisture, snow, or ice, to help determine whether the speed limits should be lowered. Traffic sensors would also be required to support speed limit recommendations as the current speed limit algorithms that are based on speed levels and dispersion.

Tire Anomaly and Thermal Brake Inspection System

As part of the SDDOT and SDHP Commercial Vehicle Safety Enhancement program, SDDOT may install an automated tire anomaly and thermal brake inspection system along with the Electronic Screening and Traffic Monitoring systems at the various Ports of Entry in South Dakota. If I-90 is reconstructed at the Tilford Port of Entry, this enhanced safety system could be installed with the reconstructed Electronic Screening and Traffic Monitoring equipment. These two new systems will interface with the e-screening system at the Tilford Port of Entry's Electronic Screening and Traffic Monitoring station.

For tire anomaly detection, additional sensors would be installed in the mainline to detect flat and underinflated tires. If a problem is detected, an alarm is generated, and the truck is directed into the weigh station for further inspection (bypass is denied).

An Automated Thermal Brake Inspection system (Figure 14) has permanently mounted thermal cameras on each side of the entrance lane to the weigh station. High resolution thermal images are captured for each axle's wheel set (both left and right). The system automatically processes the captured images to detect thermal anomalies such as inoperative or locked brakes, overheated brakes, failed bearings, underinflated or damaged tires. This information and associated images are shown on the system display. This system expedites safety inspection and can reduce queuing on the inbound ramp to the weigh station.

For the commercial vehicles that may be flagged for additional inspection, it would be extremely beneficial to the SDHP to have a physical inspection building to be provided at the Tilford Port of Entry in order to carry out these additional enhanced safety inspections.

Snow Gates and Warning Sign Activation for Closures

As part of the ITS corridor improvements, the SDDOT may be interested in automation of the advanced road closure signs' warning beacons and the snow gate (lowering and raising). To automate the gate movement, a CCTV camera or traffic sensors would be needed to ensure that no vehicle is present during the downward movement. Additional advance warning signs (static with beacons or dynamic signs) and possibly Highway Advisory Radio (HAR), CB-Radio based notification system, or the utilization of DSRC systems could also be considered to alert motorist to roadway conditions ahead. The HAR and CB-Radio based notifications have been widely used in the past, but those technologies have limited reach and effectiveness.

Deer/Elk/Animal Intrusion Alerts

Two identified locations have a high number of animal / vehicle crashes along this stretch of I-90. SDDOT is interested in exploring possibilities for a wildlife detection system that warns the approaching motorists of animals entering the roadway. Some systems combine thermal imaging with radar to detect encroachment into a defined area and activate beacons on static roadside signs. With the increasing presence of connected vehicles on the roadways, an alert could be sent directly to the driver's onboard unit (OBU) via DSRC.

High Wind Advisory Alerts

SDDOT is deploying a high wind warning system on US18 at the Ft. Randall Dam. This location has geographic characteristics similar to the I-90 corridor between Sturgis and Tilford project limits. The roadway is often hit with high wind gusts blowing from southwest to northeast or northeast to southwest, depending on the season. It would be helpful to have a system that detects gusty wind conditions and activates static road sign beacons to warn road users who are towing camping trailers, empty tractor trailers, or any other high-profile vehicle vulnerable to a strong crosswind. As with the animal intrusion system mentioned above, the warning can be transmitted, to connected vehicles/trucks with DSRC equipped OBUs.

Additional Dynamic Message Signs

With enhanced ITS communications along this corridor additional DMS signs can be installed to support the traffic management, safety, and variable speed limit system along the corridor. The additional DMS(s) will increase the amount of traveler information to be disseminated to motorists using the corridor.

Additional CCTV Corridor Coverage

With enhanced ITS communications along this corridor additional pan-tilt-zoom CCTV cameras can be installed. These additional CCTVs will increase the visual coverage of the corridor in addition to current CCTV installed on the westbound DMSs. The spacing and placement of these additional CCTV should provide visual coverage of corridor critical locations, at a minimum, such as known vehicle hot spots, locations with high animal strikes etc.

Queue Warning System

With enhanced ITS communications along this corridor additional vehicle detection stations can be installed at the exit ramps where it is known that traffic may spill back onto the I-90 mainlanes, such as an event at the National Cemetery or the exit to Sturgis during the annual motorcycle rally, to send safety messages upstream to approaching traffic about slowing or stopped traffic. These messages could be posted to the additional corridor DMS or sent out via HAR or DSRC to approaching vehicles warning of the conditions ahead. This information could also be sent to the Congestion / Event Management System described below to recommend suggested traffic responsive actions for SDDOT to implement.

Congestion/Event Management

With enhanced ITS communications along this corridor and additional CCTV coverage, vehicle detectors could be installed in addition to the ones required for the VSL system to support advanced decision making and congestion / event management algorithms. These congestion / event management algorithms would support enhanced safety operation of the corridor and manage the congestion during events such as the annual Sturgis motorcycle rally, national cemetery events, and other emergencies and occasions. These congestion / event management strategies suggested from the algorithms could then be broadcast via the DSRC technologies to traveling public to support any messages placed on the DMSs.

Dedicated Short Range Communications (DSRC)

With the increasing number of connected vehicles and commercial trucks in the traffic stream, the SDDOT is interested in adding DSRC radios to future ITS deployments to advance to a connected transportation network. For this project study corridor, DSRC radios can provide several important safety alerts to the public travelers. This information would be beyond the Basic Safety Messages (BSM) and could include VSL operation, icy roadway, and animal intrusion warnings.

This technology, along with the newly deployed ITS devices and systems, could help SDDOT significantly improve the study corridor's safety and mobility and be applied to other SDDOT corridors around the state.

Communications Backbone

SDDOT is interested in including conduit with optical fiber along the study corridor to serve existing ITS equipment and planned devices and systems. This would move away from the current leased fiber connection and provide SDDOT with timely control and management of a future VSL system.

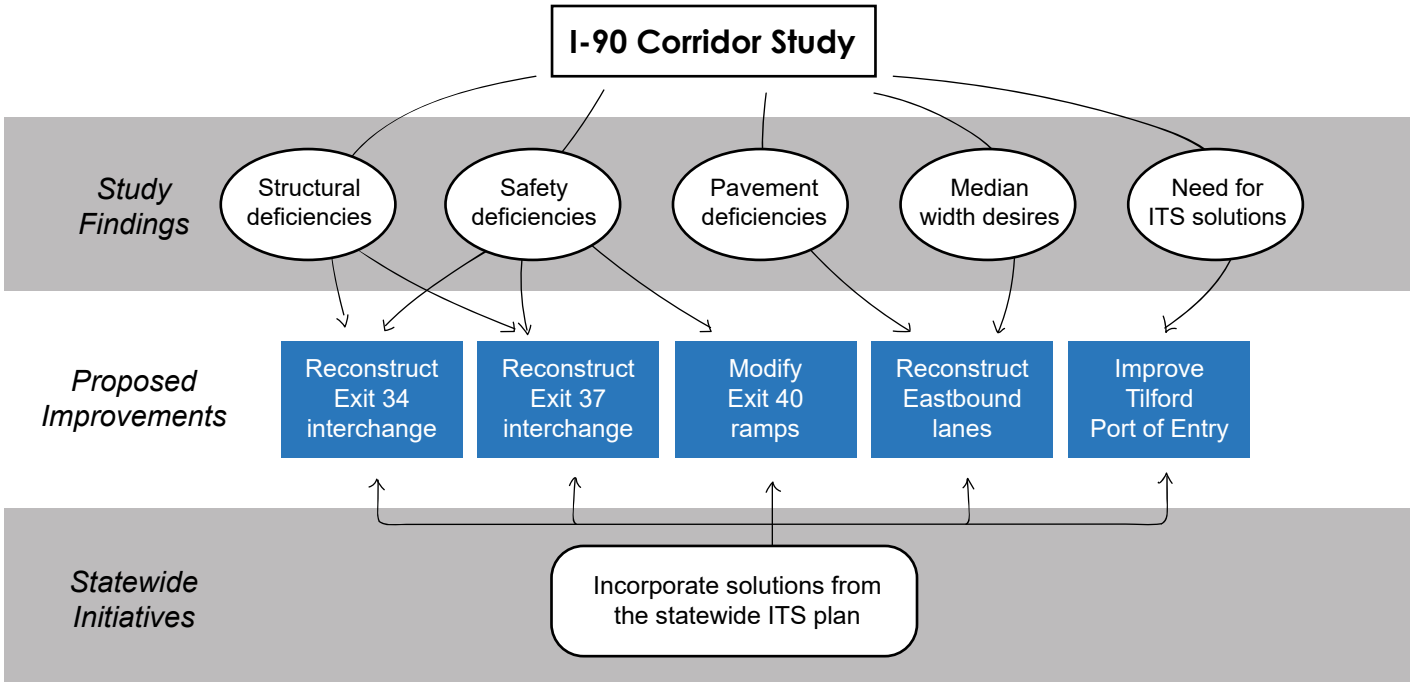
+ SOLUTIONS

Alternatives Analysis

Alternative concepts were developed for potential improvements at Exit 34 and Exit 37, modifications to Exit 40, and alignment and profile modifications to I-90 from Exit 32 to Exit 40. These concepts were evaluated through a collaborative decision-making process with the SAT. The alternative analysis process used weighted screening criteria to review and evaluate the project alternatives. This chapter describes the study approach, alternatives development, and alternatives screening process.

The findings developed in the corridor study were used to identify and document key issues to be considered in development and analysis of the proposed improvements. Statewide initiatives, such as planned ITS improvements also contribute to development of the full solution.

The following flow chart explains the triggers and solutions for each of the proposed improvements.



Project Scoping

The SAT conducted a project brainstorming session as an initial step in the alternatives development process. Building on previous planning efforts (such as the Interstate 90 Black Hawk-Sturgis Corridor Preservation Study) and existing and future traffic conditions, the brainstorming session focused on a variety of issues along the corridor. In this half- day brainstorming session, the SAT expressed interest in review/evaluation of the following needs within the corridor and the surrounding area.

- Bringing the I-90 corridor and associated interchanges and local road connections to current design standards
- Determine what upgrades are needed at the Tilford Port of Entry
- Evaluate Exit 34 to determine the preferred location and interchange configuration
- Evaluate Exit 37 to determine the preferred interchange configuration
- Review the need to upgrade eastbound exit and westbound entrance ramps at Exit 40 to match improvements made on the south side of the interchange
- Determine the need and, if necessary, provide appropriate accommodations for a future six-lane facility
- Evaluate ITS solutions and determine what specific solutions to implement

Screening Criteria

The SAT used project goals and prioritized criteria to evaluate each of the alternatives along the corridor. The consultant team established a list of evaluation criteria that fell into one of the categories listed in Table 9 below. The criteria were developed to address key issues documented during the existing conditions stage of this study. Although it is important to consider the suitability of an alternative in terms of each criterion, it is also useful to establish an overall composite score by determining appropriate weighting (relative importance) among the criteria. Each evaluation criterion was assigned a weight by the SAT to represent its relative importance to the other criteria. A ranking of 1 to 5 was provided for each criterion with 5 being the most important and 1 being the least important. These criteria and weightings were used to develop the overall project Alternatives Evaluation Matrix. The criteria and its application to each of the corridor improvements is summarized in Table 11 below.

Table 11: Alternatives Evaluation Criteria

Criteria	Application	Rank
Traffic and Level of Service	Does the alternative provide for an acceptable level of service for the design year?	3.9
Geometric Needs	Do the improvements meet the current design standards for the interstate and local roads?	4.5
Environmental Impacts	What are the impacts to known environmental receptors including floodplains, wetlands, historic and archaeological sites, noise, environmental justice, regulated materials and animal migration?	4.4
Right of Way Impacts	How does each alternative impact the need for permanent and temporary right of way?	3.3
Safety Improvements	How does each alternative reduce crashes along the corridor?	4.7
Utility Impacts	How does each alternative impact existing private and public utilities?	1.9
Bicycle Facility Enhancements	Do the improvements provide access for bicycles and connections to existing facilities?	2.0
Impact to existing land use or new development including access	Do the improvements accommodate access to the existing businesses along the corridor or known future development?	3.4
Cost	What are the costs for each of the alternatives?	4.0
Constructability	What is the complexity of construction for each alternative? Can the construction be staged efficiently and provide continuous access during construction?	3.8
Flexibility to accommodate future improvements or land use changes	Do the improvements accommodate future development and are future local road improvements accommodated?	3.2

Alternative Development and Screening

Initial Alternative Development and Screening

Once the brainstorming workshop was complete, the SAT developed a set of initial alternatives along the corridor based on the detailed summary of comments compiled from the workshop. Concepts were developed specifically related to Exits 34, 37, and 40. Although comments were received related to the TPOE, discussions following the meeting led to the reconstruction of the ramps and the port of entry facility.

The initial alternatives and screening process considered a wide range of alternatives utilizing thick line sketches over aerial photos to easily assess the impacts of each alternative to the surrounding area. In total, nine interchange alternatives and three local road connections were prepared for Exit 34; three interchange alternatives were prepared for Exit 37; and one interchange ramp modification alternative was developed for Exit 40. These alternatives are described in Table 12 and an image of each alternative is provided in Appendix A: Alternatives Screening.

A SAT meeting was held to provide an initial review of these alternatives. Due to the nature of the area along this segment of I-90, project area constraints would prevent some of these alternatives from moving forward in the selection process. The SAT's comments related to each of the alternatives are summarized in Table 12.

Table 12: Initial Alternatives and Concept Screening

Interchange	Alternative	Possible Improvement	SAT Comments
34	34-1	Offset Single Point Diamond Interchange	The three bridges and realignment of I-90 make this an expensive option. The previous I-90 Black Hawk-Sturgis Corridor Preservation Study recommended a single point urban interchange. The alternative was dismissed during the environmental documentation process because the traffic volumes did not warrant signalization. The SAT recommended developing a compressed diamond interchange option with roundabouts at each ramp terminal. The two roundabouts would be approximately 400 feet apart and could operate as two roundabouts or as one peanut shaped roundabout. **A new option will be developed using the SAT's recommendations.**
	34-2	Standard Folded Diamond Interchange	Due to the large footprint required for this interchange a substantial cut into the hillside on the east side of I-90 will be required which makes this too costly and unfeasible. This option will be removed from consideration.
	34-3	Modified Folded Diamond Interchange	This option appears to fit within the physical constraints of the surrounding area. This option would require a new multi-plate railroad pipe which is not recommended by the SDDOT Bridge Office due to the cost and maintenance issues they have had with similar structures. The Rapid City Regional Office likes the concept and would like to carry this forward. **This option will be carried forward.**
	34-4	Shifted Standard Diamond Interchange	Due to the large footprint required for this interchange, a substantial cut into the hillside on the east side of I-90 would be required, making this option too costly and unfeasible. This option will be removed from consideration.
	34-5	Westbound Button-Hook Interchange	The SDDOT has had problems with a similar button hook interchange located in Sioux Falls. The Sioux Falls interchange will be removed in the future and the SDDOT does not intend to install any button hook interchanges in the future. This option will be removed from consideration. Note: A new option will be created that removes the button hook and provides a partial folded diamond.
	34-6	Trumpet Interchange	The SDDOT Bridge Office does not want horizontal curves on bridges. This is also a costly option with the curved bridge and realignment of I-90. This option will be removed from consideration.
	34-7	Partial Roundabout Interchange	The SAT likes this concept. **This option will be carried forward.**
37	37-1	Standard Diamond Upgrade	This option helps to move the existing west ramp intersection further away from the existing at-grade railroad crossing. It also provides further separation between the two ramp terminal intersections. **This option will be carried forward.**
	37-2	Bridge Skew Upgrade	This option removes the existing skew of Pleasant Valley Road and shortens the bridge over I-90, which requires replacement. **This option will be carried forward.** Note: A third option will be developed for Exit 37 that will realign I-90 further east providing greater separation from the railroad.
40	40-1	Standard Diamond Upgrade	This option matches what has already been constructed on the southeast side of the interchange. **This option will be carried forward.**
Options A, B, C (Local Roads)	N/A	Local road connection north-west of Alkali Creek to the existing local road southeast of the Black Hills National Cemetery.	Provides for a local road connection northwest of Alkali Creek to the existing local road southeast of the Black Hills National Cemetery. These options are required for Interchange options 34-1 to 34-6. **These options will be carried forward.**

Note: In addition to the recommendations presented in Table 12, the frontage road on the east side of I-90 at Exit 34 will include an alternative that parallels I-90. This will require a box culvert for the crossing of Alkali Creek.

Exit 34 Refinement of Alternatives

Additional analysis and concepts were developed for Exit 34 throughout this process to further clarify options moving forward. Once the three concepts highlighted in Table 12 were selected, each option was developed to a level with sufficient detail to complete a decision matrix. The matrix used project goals and prioritized criteria to score the alternatives and was used to assist decision makers in making a fully informed choice for the preferred alternate. An example of the decision matrix can be seen in Figure 18. The results of the ranking were presented to the public at an open house, and comments received were largely in favor of shifting the interchange south of the existing (Alternative 34-7) rather that to the north (Alternative 34-1B or Alternative 34-3). A tentative decision was made to select Alternative 34-7 as the preferred alternative to move forward with environmental documentation.

As the selected preferred alternative to be carried forward for refinement and additional study, Alternative 34-7 was reviewed by the SDDOT functional groups and management to determine feasibility. During this review process, two items were noted; concerns were raised regarding the use of a roundabout at the ramp terminals and an issue was noted with the Control of Access (COA) provided between the interchange ramp terminal and the connection to the local frontage road in the previously reviewed alternatives. Per the SDDOT Design Manual, a minimum of 660 feet between interchange ramps and local roads is recommended. The SDDOT determined that further refinement of the preferred alternative would be needed. A total of sixteen options were developed and reviewed. The new alternatives at the preferred interchange location south of existing were reviewed against the same criteria used in the previous analysis. These new alternatives are included as Appendix B - Refined Interchange Alternatives. Again, each of the 16 options carried into the alternatives analysis were developed to a level with sufficient detail to complete a decision matrix and a qualitative assessment was conducted by tabulating the advantages and disadvantages of each alternative based upon the scale of potential impacts. The refined alternative evaluation matrix for these sixteen alternatives is included as Appendix C - Refined Alternative Evaluation Matrix . Three concepts (Alternative 34-3, 34-10B, and 34-19) were selected as desirable by the SAT. These options are described below and shown in the decision matrix in Figure 18 and Preliminary Alternatives in Figure 19.

Alternative 34-3:
Alternative 34-3 stays on the mainline I-90 alignment but shifts the Exit 34 interchange north of Alkali Creek. This folded diamond alternative has two standard long ramps and two loop ramps, which consolidates the ROW impacts on the north side of the proposed interchange. The exit ramp from eastbound I-90 follows the curve of the westbound entrance ramp to avoid impacts to the railroad. This folded design avoids ramp impacts to Alkali Creek and the railroad while handling traffic volumes. An east frontage road would be constructed to connect the interchange to Old Stone Road.

Alternative 34-10B: This alternative is a modification of alternative 34-7 and shifts the Exit 34 interchange south of existing and provides a stop-controlled intersection with Blucksberg Drive with a 200-foot separation from the interchange terminals. However, this option has the local road elevated to cross over the I-90 mainline and over the railroad providing a grade separated crossing.

Alternative 34-19: Alternative 34-19 constructs a new interchange at the same location, providing lengthened interchange ramps to meet standards. The connection to Blucksberg Drive will require a large retaining wall to allow for vertical curve corrections. In this alternative, the local connecting road crosses under the raised lanes of I-90 and results in an at-grade crossing of the railroad.

Alternatives Evaluation

After this initial screening, the new options as noted in Table 12 were developed and included in the next round of screening. For this screening process an Alternatives Evaluation Matrix (Figure 18) was developed which included refined screening criteria and weighting. This evaluation matrix was presented and updated cooperatively by the SAT at the Concept Review and Project Identification Workshop. As noted above, this decision matrix process was conducted twice for Exit 34, with the resulting three desirable concepts.

The results of the screening are shown in the Alternatives Evaluation Matrix on the following page.

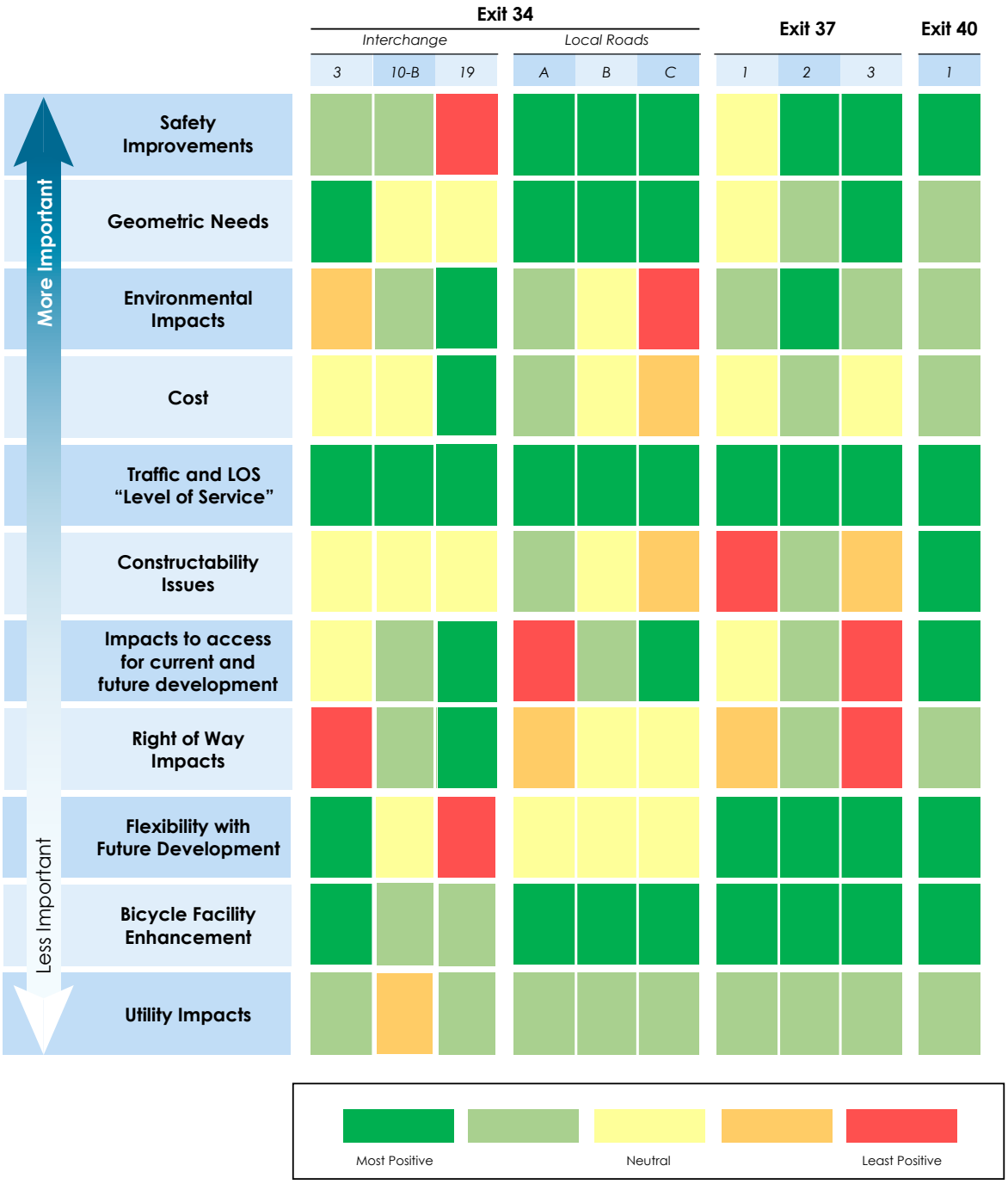


Figure 18: Alternatives Evaluation Matrix and Scoring

Evaluation Findings: Exit 34
Option 34-10B scored the highest (Figure 19 on pages 55 and 56) at Exit 34. Key criteria include:

- Greater safety improvements
- Greater flexibility to accommodate future improvements or land use changes
- Low environmental impact
- Low Right of Way impacts

Of the Local Road Connection alternatives at Exit 34, option B scored the highest (Figure 20 on page 56). However, if alternative 34-10B or 34-19 move forward as the preferred option, the local road connection is removed from the consideration as it is not needed for those alternatives.

Evaluation Findings: Exit 37
At Exit 37, option 37-2 scored the highest (Figure 21 on page 57). Key criteria include:

- Safety is improved with the removal of the skew on Pleasant Valley Road
- Fewer wetland impacts
- Less permanent right-of-way required, reducing right-of-way costs
- Fewer constructibility issues; new bridge can be constructed while existing interchange is being used
- Less impact to existing land use

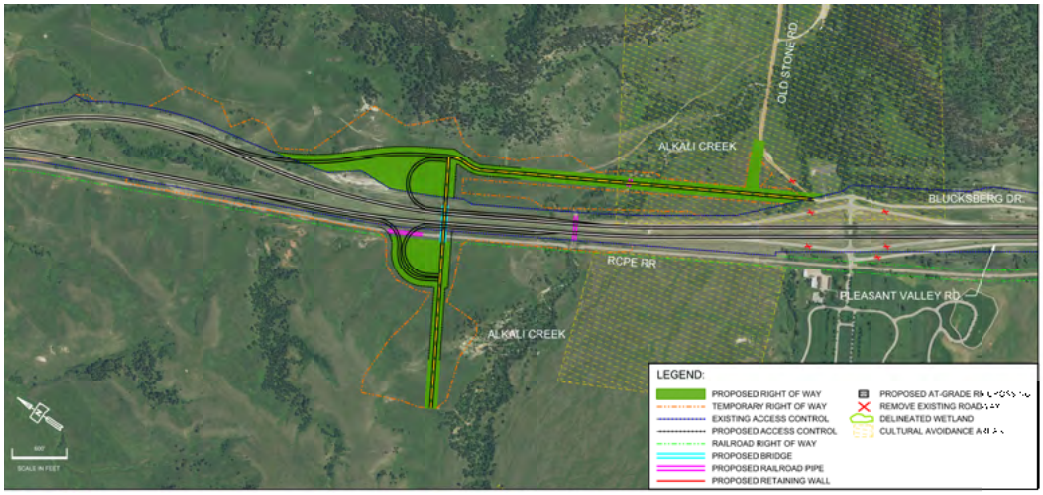
Evaluation Findings: Exit 40
Only one alternative was evaluated for Exit 40, shown in Figure 22 on page 58.

Corridor Solutions

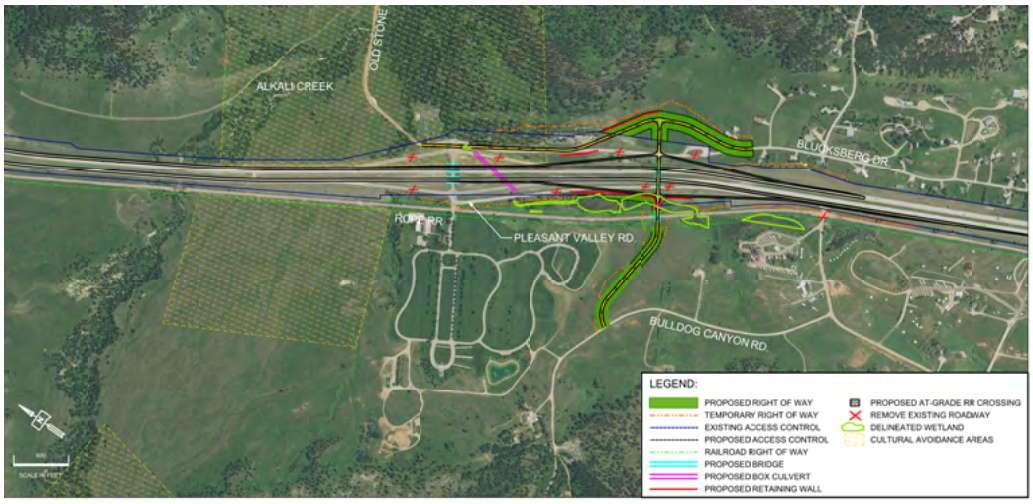
In addition to the need to develop alternatives for the interchanges along I-90, future I-90 widening options were considered. The SDDOT plans to reconstruct the eastbound mainline pavement from Exit 32 to Exit 40, with the exception of MRM 38.67 + 0.068 to MRM 40.31 + 0.010, which was recently reconstructed. The westbound pavement will remain in place. Where the eastbound I-90 lanes are reconstructed, the project will provide for a median width meeting the current design standard.

As other segments of I-90 have been reconstructed, the SDDOT has been grading for a six-lane freeway to provide for future widening. This study reviewed the need to continue this wider grading section along this segment from Exit 32 to Exit 40. The study provided an analysis of the existing traffic, 20-year design traffic, and 50-year projections. Based on the traffic analysis and LOS, a six-lane freeway will not be needed along this segment of I-90 for over 50 years. Therefore, the SDDOT has determined that the segment will accommodate for a six-lane section however it is not necessary to provide grading for the six-lane section.

Alternative 34-3: Modified Folded Diamond



Alternative 34-10B: 200' COA on East Crossroad and Railroad Bridge



Alternative 34-19: Lengthened Interchange

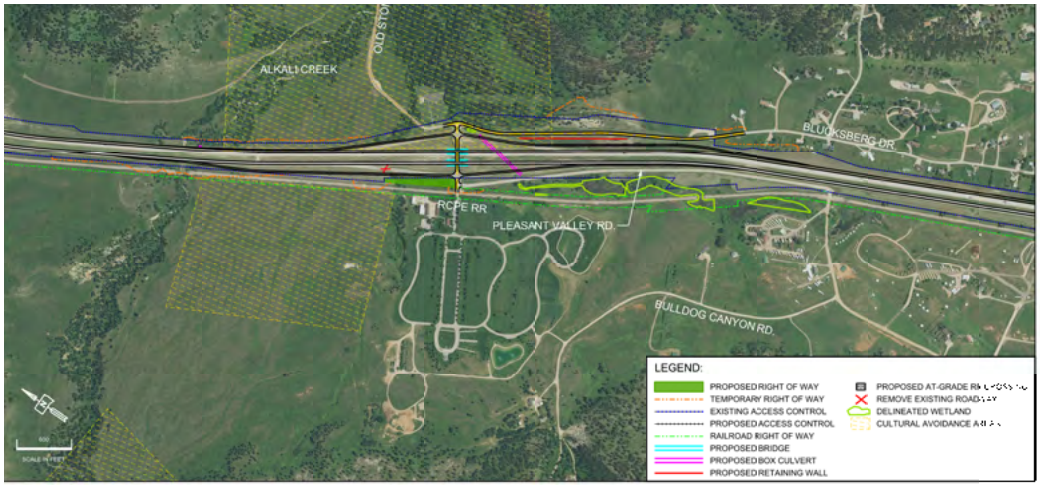


Figure 19: Exit 34 Preliminary Alternatives

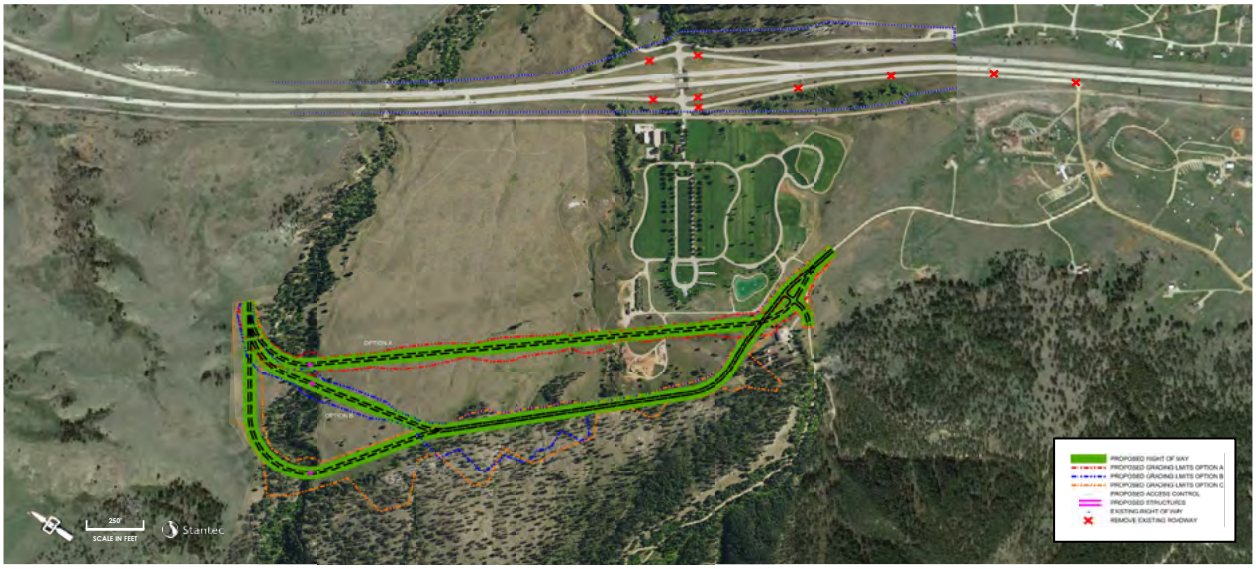
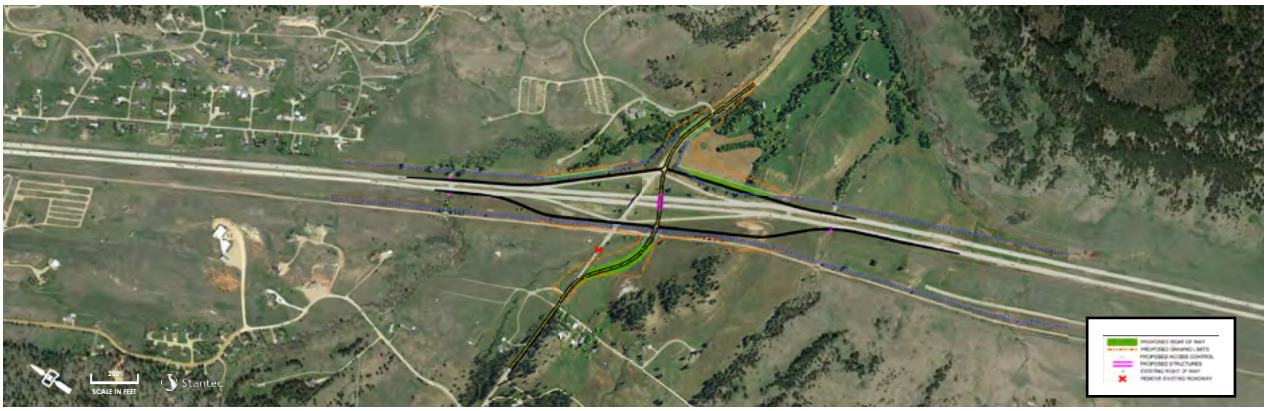


Figure 20: Alternative 34-3 Local Road Connections

Alternative 37-1: Ramp Upgrade

Alternative 37-2: Squared Up Structure



Alternative 37-3: I-90 Realignment

Figure 21: Exit 37 Preliminary Alternatives

Figure 22: Exit 40 Preliminary Alternative