

Badlands National Park
South Dakota

National Park Service
Department of the Interior



Environmental Assessment
Repair Cliff Shelf Landslide with a Buttress – Badlands Loop Road

June 2014



Environmental Assessment

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Badlands National Park

Summary

The Cliff Shelf Landslide is located along Badlands Loop Road, approximately four miles southwest of the Northeast Entrance Station and just west of the Cliff Shelf Trail Parking Lot in the Cedar Pass area. Badlands Loop Road, also known as State Route 240, is considered a scenic route and is the main road in the Park. This section of Badlands Loop Road was originally constructed in 1935, a few years before the Park achieved National Monument status. Although the Cliff Shelf Landslide was considered dormant with only a few localized areas exhibiting signs of movement, monitoring data in recent years shows the slide has remobilized and movement has accelerated. Landslide monitoring at one point within this location indicated a total lateral movement of 8.82 inches measured between April 1999 and April 2000 (~ 0.024 inches per day). From April 2000 to March 2001, the same point indicated additional movement of 18.39 inches (~0.06 inches per day) and 14.49 inches (~0.07 inches per day) from March 2001 to October 2001.

Recently, park staff encountered numerous tension cracks and large subsurface cavities that have extended near the roadway edge, with some that have extended downslope below the roadway. These cracks and cavities indicate the potential for failure at the toe of the slope below the roadway elevation that could severely affect public safety. In addition geotechnical engineers observed severe damage to the roadway in the Cliff Shelf Landslide area causing the roadway shoulder (within inches of the roadway edge) to drop approximately 6 inches. Much of the slide movements are attributed to the existence of plastic, cohesive soils saturated by several years of higher than normal precipitation levels.

This Environmental Assessment (EA) provides analysis of two alternatives. The first alternative is a no action alternative and the second is to construct a deep patch and buttress.

Public Comment

If you wish to comment on the EA, you may mail comments to the name and address below. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment- including your personal identifying information- may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. This EA will be on public review for 30 days. Please note that the names and addresses of people who comment become part of public record. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment. We will make all submissions from organizations,

businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses available for public inspection in their entirety.

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An electronic version of this document can be found on the National Park Service's Planning Environment and Public Comment (PEPC) website at <http://parkplanning.nps.gov>. This site provides access to current plans, environmental impact analyses, and related documents on public review. Users of the site can submit comments for documents available for public review.

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Environmental Assessment

Repair Cliff Shelf Landslide with a Buttress – Badlands Loop Road

Badlands National Park

PURPOSE AND NEED

Introduction

The National Park Service (NPS) in cooperation with the Central Federal Lands Highway Division of the Federal Highway Administration (FHWA) propose actions at Badlands National Park (Badlands or park) to stabilize a section of the Badlands Loop Road that is deteriorating, to ensure the safety of visitors on this vital transportation corridor. Stabilizing the roadway and slopes adjacent to the roadway would ensure a quality visitor experience, provide a safe transportation corridor, comply with federal highway standards, provide access for the local residents and reduce maintenance costs.

Background

Cliff Shelf Landslide is located just south of the Cedar Pass Landslide and encompasses a larger area (see figures 1 and 2). This slide was previously considered to be dormant with only a few localized areas exhibiting signs of movement. However, monitoring data recorded since 2010 shows the slide has remobilized and movement has accelerated. Park maintenance crews have encountered numerous wide and deep tension cracks and large subsurface cavities that have extended near the roadway edge and some extended downslope below the roadway, indicating possible slide toe failure below the roadway elevation that might severely affect the public safety. In addition geotechnical engineers observed severe damage to the roadway in the Cliff Shelf Landslide area causing the roadway shoulder (within inches of the roadway edge) to drop approximately 6 inches. Much of the slide movements are attributed to the existence of plastic, cohesive soils saturated by several years of higher than normal precipitation levels. Vehicular traffic, including those carrying heavy loads, may have contributed to shallow, localized slope failures, but roadway traffic is not considered to contribute substantially to the larger landslide movement. In December 2013 a temporary deep patch was put into place to secure the area until a long-term solution can be implemented.

Purpose and Need for the Proposed Action

Project Purpose

The purpose of the project is to stabilize a section of deteriorating roadway to ensure the safety of visitors on this vital transportation corridor. Stabilizing the roadway and slopes adjacent to the roadway would ensure a quality visitor experience, provide a safe transportation corridor,

comply with federal highway standards, provide access for the local residents and reduce maintenance costs.

Project Need

The proposed project is needed for the following reasons:

- The roadway is in poor condition due to the movement of the Cliff Shelf Landslide, which has opened deep tension cracks and large subsurface cavities adjacent to the roadway.
- The movement of the roadway's base has created a safety hazard to roadway visitors.
- The potential exists for a catastrophic failure of the roadway section.
- The northeast entrance over Cedar Pass provides access to the park for approximately 75% of the park's 1.2 million visitors annually.
- The roadway provides access to the residents of the Pine Ridge Indian Reservation.
- The roadway provides the shortest route between the Town of Interior and Interstate 90, resulting in approximately 1,000 trips per month primarily for farm to market purposes and students commuting to the area schools located in Wall and Kadoka.

Project Objectives

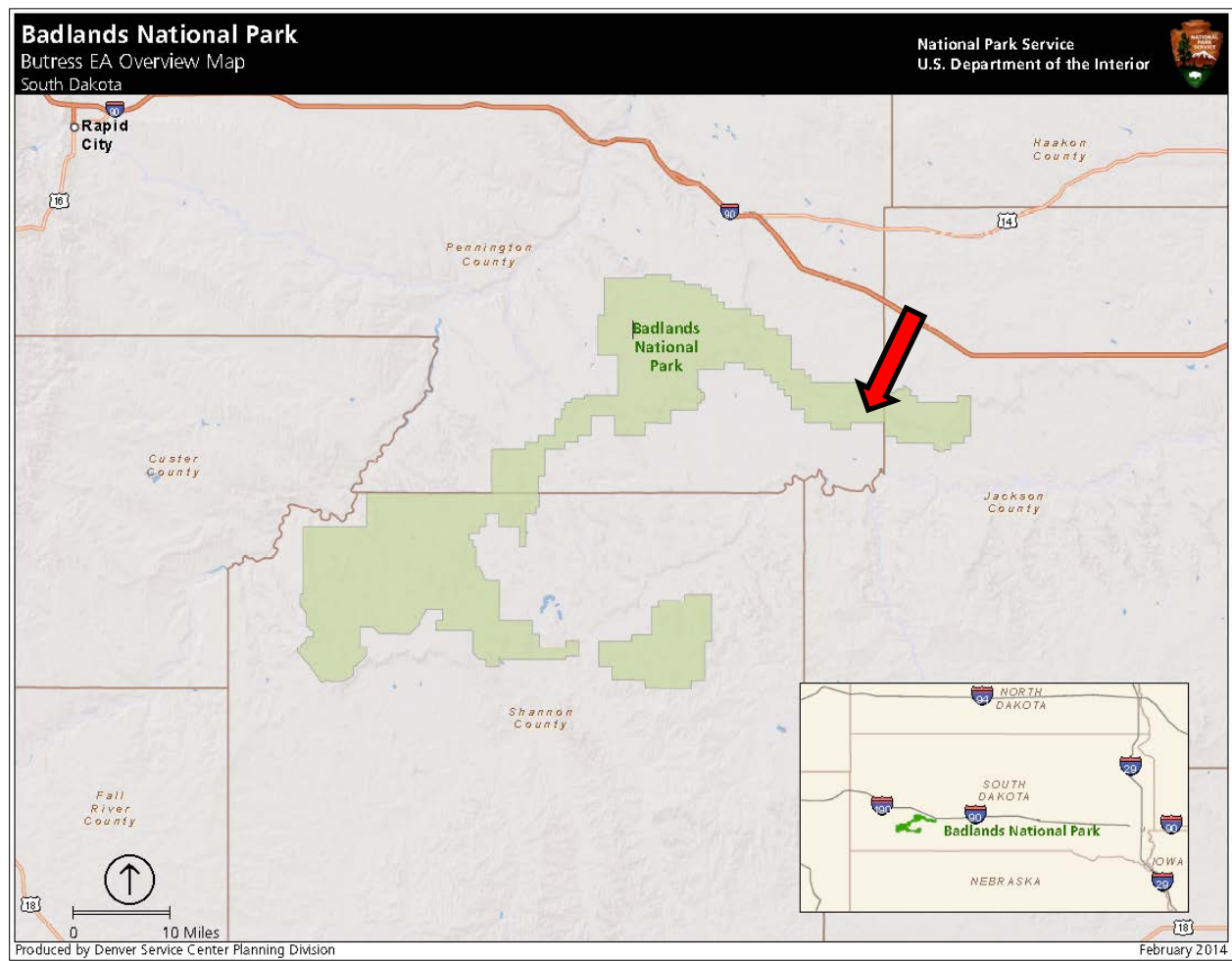
The proposed project has the following objectives:

- Repair damaged and cracked areas to the roadway caused by the landslide.
- Stabilize the landslide area adjacent to roadway to prevent further sliding and damage to the roadway.
- Extend the life of the roadway to provide visitors and staff with a safe and reliable means of traveling through the park.
- Provide overland transport for the rural and permanent town residents.

Current road conditions

In 2010, park maintenance crews encountered numerous wide and deep tension cracks and large subsurface cavities that extended near the roadway edge. Cracks also extended downslope below the roadway, indicating possible slide toe failure below the roadway elevation that might severely affect the public safety. In addition, geotechnical engineers from the FHWA Central Federal Lands Highway Division (CFL) observed severe damage to the roadway in the Cliff Shelf Landslide area causing the roadway shoulder (within inches of the roadway edge) to drop approximately 6 inches. Much of the slide movements are attributed to the existence of plastic, cohesive soils saturated by several years of higher than normal precipitation levels (see figures 3 and 4).

PROJECT LOCATION



PROJECT LIMITS

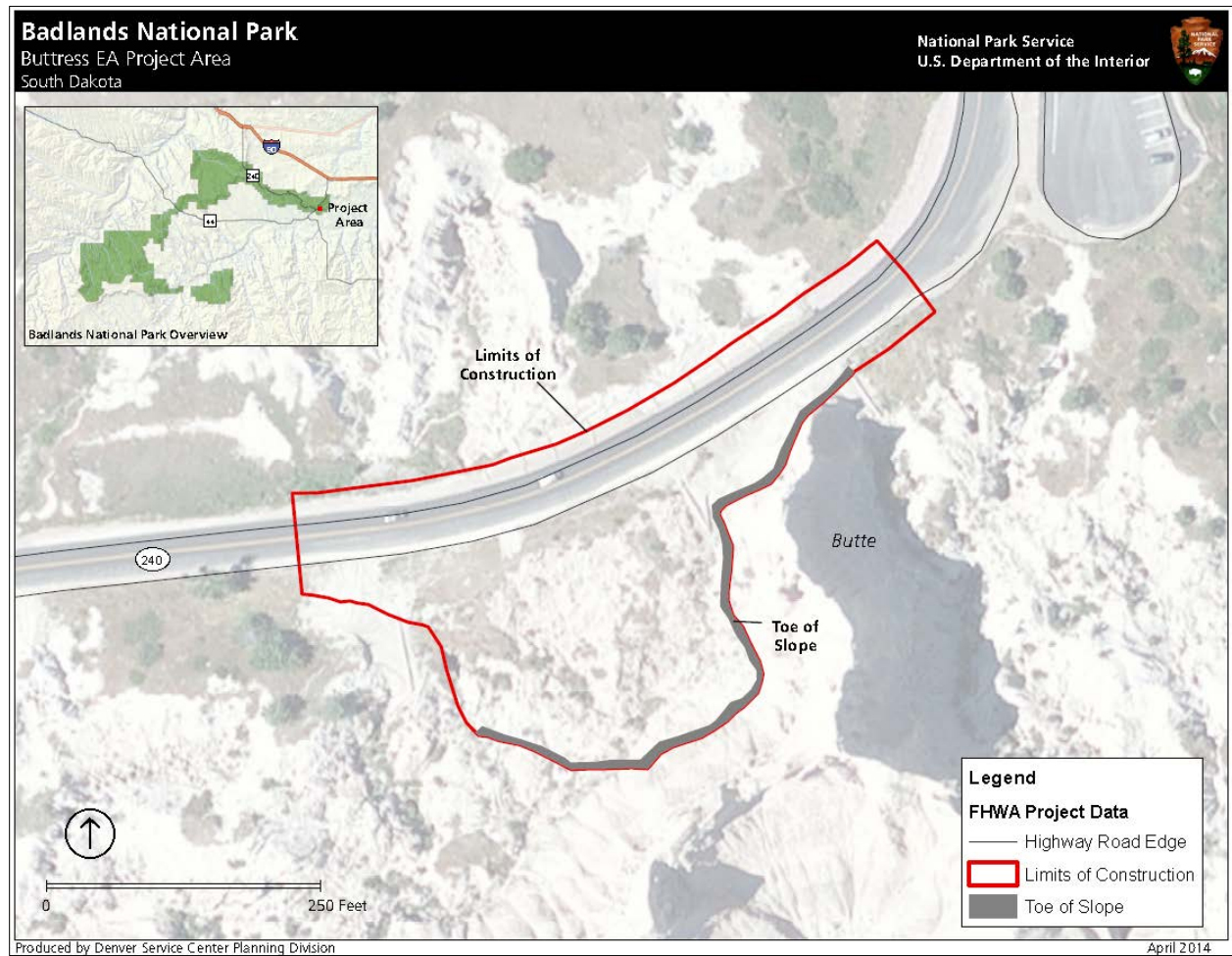


Figure 2. Project Limits



Figure 3. Tension Cracks (courtesy FHWA)



Figure 4. Tension Cracks Close-up (courtesy FHWA)

Purpose and Significance of the Park

The significance and unique characteristics of Badlands National Park are as follows:

- The park's geological and paleontological resources provide insight into climatic history, biological diversity, evolution, and geological processes particular to the boundary between the Eocene and Oligocene epochs.
- Fossil and geologic records provide a unique opportunity to trace the evolution of the prairie ecosystems of the Great Plains.
- The park contains places of spiritual and historical significance to the Lakota people.
- The harsh climate and extreme geography of the badlands region influenced both aboriginal use and contemporary settlement patterns of lands now administered by the National Park Service and directly contributed to the establishment of the park.
- The long history of research in the White River Badlands has contributed greatly to the science of vertebrate paleontology in North America.
- The park contains a substantial remnant of native mixed-grass prairie.
- The park contains large, protected prairie dog colonies that also provide for high quality habitat for the endangered black-footed ferret.
- The park contains spectacular scenery, predominantly highly eroded landforms that comprise a concentrated collection of rutted ravines, serrated towers, pinnacles, and precipitous gulches.
- The park contains 64,000 acres of designated wilderness made up of badlands and prairie that offer outstanding opportunities for exploration and solitude.

Related Projects and Plans

Cliff Shelf Landslide Geotechnical Design Report (2013)

This report presents the findings of a subsurface investigation and provides geotechnical recommendations to support the development of design alternatives for the stabilization of the Cliff Shelf Landslide.

Environmental Assessment: Rehabilitate Badlands Loop Road, Phases III and IV (2006)

This assessment analyzed the effects of bringing the entire Loop Road into compliance with NPS Road Standards and extending the serviceable lifespan of the roadway.

Badlands National Park General Management Plan (2006)

Badlands National Park currently operates under the direction of the approved 2006 General Management Plan (GMP) for the North Unit. Management objectives identified within the GMP direct the maintenance and upgrading of roadways in order to provide for a positive visitor experience and to ensure effective parkway operations. The purpose and need for this project are consistent with these objectives.

Management Policies 2006

NPS *Management Policies 2006* provides guidance for management of all national park units. Road systems are addressed in section 9.2.1, which states “park roads will be well constructed, sensitive to natural and cultural resources, reflect the highest principles of park design, and enhance the visitor experience.”

The purpose of park roads is to enhance visitor experience by providing access to park facilities, resources, and recreational opportunities. Park roads are not intended to provide fast and convenient transportation, but rather to access areas of recreation while being sensitive to the natural and cultural resources in the area (section 9.2.1.1 *Management Policies 2006*). Park roads provide access for the protection, use, and enjoyment of the resources that constitute the park. East and West Rim drives provide important connections to scenic vistas and recreation areas throughout the park and access connections to other spur roads in the park, as well as regional connections to other state highways and communities.

Environmental Assessment: Stabilization of Loop Road over Cedar Pass (2000)

This document analyzed the environmental effects of stabilizing the section of Loop Road that crosses Cedar Pass (adjacent to the Cliff Shelf Landslide) to allow continued access and address safety and maintenance issues for the roadway. Similar to the Cliff Shelf area, the Cedar Pass area contains an active landslide, whose safety and maintenance implications were addressed by constructing a buttress in the EA’s preferred alternative.

1984 NPS Park Roads Standards

The 1984 NPS Park Roads Standards state that roads in national parks serve a distinctly different purpose from most other road and highway systems. Among all public resources, those of the national park system are distinguished by their unique natural, cultural, scenic, and recreational qualities. Park roads are to be designed with extreme care and sensitivity to

provide access for the protection, use, and enjoyment of the resources that constitute the national park system.

Director's Order-87A: Park Roads and Parkways

Director's Order 87A states that park roads are constructed only where necessary to provide access for the protection, use, and enjoyment of the natural, historical, cultural, and recreation resources that constitute our national park system. Park roads should enhance the visitor experience while providing safe and efficient accommodation of park visitors and to serve essential management action needs. Park roads are designed with care and sensitivity with respect to the terrain and environment through which they pass.

Other related projects include the installation of a temporary deep patch that would be replaced as part of this project. The temporary deep patch was constructed in December 2013 and designed to meet immediate operation and safety requirements on a short-term basis. The preferred alternative in this EA would expand the length of the temporary deep patch by 100' on either side, as well as provide a long-term solution in conjunction with the buttress installment.

Scoping

Scoping is the process to identify the resources that may be affected by a project proposal, and to explore possible alternative ways of achieving the proposal while minimizing adverse impacts. The park conducted internal scoping with appropriate NPS staff to identify potential issues, impact topics, and alternative ways to meet project needs. The park also conducted external scoping with the public, interested groups, and other government agencies.

Impact Topics Retained for Further Analysis

Impact topics carried forward for detailed analysis are listed in table 1, along with the reasons each topic is retained. Issues and impact topics for this project have been identified based on federal laws and regulations; NPS Director's Orders (DO); *NPS Management Policies 2006*; NPS knowledge of resources at the park, as well as the questions and comments brought forth during public scoping.

Table 1. Impact Topics Retained for Further Analysis and Relevant Laws, Regulations and Policies

Impact Topic	Reasons for Retaining Impact Topic	Relevant Laws, Regulations, and Policies
Geological resources	Erosion impacts to unstable soils in an active landslide area would occur during construction. Project activities necessary to keep the road passable may result	<i>NPS Management Policies 2006.</i>

Impact Topic	Reasons for Retaining Impact Topic	Relevant Laws, Regulations, and Policies
	in altering the geological processes of natural landslide movement.	
Vegetation	Construction activities would disturb vegetation adjacent to the roadway. In addition, the staging area and access routes used during construction would temporarily disturb some vegetation.	<i>NPS Management Policies 2006.</i>
Paleontological resources	Earth moving activities have the potential to disturb the park's abundant fossil resources.	<i>NPS Management Policies 2006.</i>
Wildlife	This project area is located within a wildlife corridor that supports habitat for bighorn sheep. These animals would experience temporary displacement due to noise and construction activities. There would be some permanent habitat loss.	<i>NPS Management Policies 2006</i>
Visitor experience	Visitors would experience temporary noise, dust and traffic near the construction area. Road construction delays would occur for travel in the Cedar Pass area, including heavy truck traffic.	<i>NPS Management Policies 2006.</i>
Socioeconomic environment	Local communities would experience short term travel delays and possibly short term closures of the roadway during construction.	<i>NPS Management Policies 2006.</i>
Archeology	The area immediately south of the project area has not been inventoried for archeological resources and archeological resources may	<i>NPS Management Policies 2006. National Historic Preservation Act.</i>

Impact Topic	Reasons for Retaining Impact Topic	Relevant Laws, Regulations, and Policies
	exist should there be a need to modify or expand the project area.	
Park operations	Construction activities could result in delays for park staff carrying out official duties, such as law enforcement activities, accessing work sites and other administrative functions.	<i>NPS Management Policies 2006.</i>

Impact Topics Dismissed from Further Analysis

Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations" requires federal agencies to incorporate environmental justice into their missions. Agencies must identify and address disproportionately high and adverse human health or environmental effects on minorities and low income populations and communities. Although these populations exist in the project vicinity, they would not be disproportionately affected by the proposed actions. These populations would be temporarily affected by the proposed actions, including travel delays due to detours and potential roadway closures during construction. Detours may cause delays for people accessing services such as health care, grocery stores, schools, and work places. However, these impacts would temporarily affect all residents within the project vicinity and would not disproportionately affect low income or minority populations. Therefore environmental justice was dismissed as an impact topic.

Prime and Unique Farmland

In 1980, the Council on Environmental Quality (CEQ) directed federal agencies to assess the effects of their actions on Prime and Unique Farmlands. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS) is responsible for identifying prime and unique farmlands. According to the NRCS, there are no prime or unique farmlands associated with the project area. Therefore, the topic of prime and unique farmland was dismissed as impact topic in this document.

Special Status Species

The project team consulted informally with the United States Fish and Wildlife Service (USFWS) in January 2014 concerning federally listed sensitive species that may be near the project area boundaries (see appendix A). According to the USFWS *Species by County Report*, there are two federally endangered; one proposed endangered; one proposed threatened; and one candidate species in Jackson County, which encompasses the project area. Of these species, park resource

staff indicates that only the black-footed ferret is known to reside within the park. The park has not recorded any observations of black-footed ferret or habitat for this species in the immediate project area. The USFWS did not return any comments during scoping for this EA. Therefore special status species were dismissed as an impact topic in this document. The black-footed ferret, along with the peregrine falcon and swift fox, are the only known state-listed species that reside in the park, but their abundance in the park is rare and they do not inhabit the project area (South Dakota Game, Fish and Parks (SDGFP) 2014).

Wetlands

Executive Order (EO) 11990 and NPS Management Policies 2006 direct that wetlands be protected, and that wetlands and wetland functions and values be preserved. Subject to federal and state agency review and verification, wetlands are considered “waters of the U.S.” and are under the jurisdiction of the United States Army Corps of Engineers (USACE) pursuant to the Clean Water Act §404; 33 U.S.C. 1344. In addition to meeting USACE jurisdictional requirements, the NPS is the regulatory agency for land it administers and NPS standards are defined by DO 77-1.

Prairies of the Badlands are braided with intermittent streams, and such streams exist near the project area. According to the classification scheme of Cowardin, et al. (1979) these streams are riverine intermittent streambed with a water regime of intermittently flooded, meaning they carry water for brief periods after snow melts and following rainstorms. The streambeds are primarily gravel beds with little or no vegetation. The project area itself does not contain intermittent streams and therefore does not contain a jurisdictional wetland pursuant to USACE regulations. Similarly, a Statement of Findings (SOF) would not be required per DO 77-1. For these reasons, wetlands were dismissed as an impact topic in this document.

Floodplains

Executive Order 11988, “Floodplain Management” requires all federal agencies to avoid construction within the 100-year floodplain unless no other practicable alternative exists. Similarly, NPS Management Policies 2006 and DO-77-2 (Floodplain Management) requires the NPS to preserve floodplain values and minimize hazardous floodplain conditions. Federal Emergency Management Agency (FEMA) floodplain data were reviewed for this site and the proposed project is not located within a 100-year floodplain. Therefore this topic has been dismissed from further analysis in this EA.

Air Quality

The Clean Air Act of 1963 (42 USC 7401 et seq.) was established to promote public health and welfare by protecting and enhancing the nation’s air quality. The act establishes specific programs that provide special protection for air resources and air quality-related values associated with national park system units. Section 118 of the Clean Air Act requires a national park system unit to meet all federal, state, and local air pollution standards. In addition, the Clean Air Act provides that the federal land manager have an affirmative responsibility to protect air quality-related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse pollution impacts. There would be temporary increases in localized air pollution as a result of dust and equipment emissions

during construction. There would be adverse impacts to local air quality during construction, as well afterwards by vehicle use, but these impacts would be negligible. Therefore, air quality has been dismissed from further analysis in this EA.

Climate change

Climate change refers to any significant changes in average climatic conditions (such as mean temperature, precipitation, or wind) or variability (such as seasonality and storm frequency) lasting for an extended period (decades or longer). Recent reports by the U.S. Climate Change Science Program, the National Academy of Sciences, and the United Nations Intergovernmental Panel on Climate Change provide evidence that climate change is occurring as a result of rising greenhouse gas (GHG) emissions and could accelerate in the coming decades. While climate change is a global phenomenon, its impacts vary based on regional and local factors.

Construction activities for the buttress installation would contribute to increased GHG emissions, but such emissions would be short-term. The buttress construction impacts on climate change would be so low, they would not be detectable. Therefore this topic has been dismissed from further analysis in this EA.

Natural Soundscapes

In accordance with NPS Management Policies 2006 and DO-47: Sound Preservation and Noise Management, an important part of the NPS mission is preservation of natural soundscapes associated with national park system units. Natural soundscapes exist in the absence of human-caused sound. The natural ambient soundscape is the aggregate of all natural sounds that occur in park system units, together with the physical capacity for transmitting natural sounds. Natural sounds occur within and beyond the range of sounds that humans can perceive and can be transmitted through air, water, or solid materials. The frequencies, magnitudes, and durations of human-caused sound considered acceptable varies among park system units, as well as potentially throughout each park system unit, being generally greater in developed areas and less in undeveloped areas. Traffic along the roadway is the primary source of artificial noise in the unit. Construction-related activities from equipment, vehicles, and workers would introduce dissonant sounds, but such sounds would be temporary. Construction noise would be audible above typical background noise and therefore adverse, however it would be localized, short-term and minor. Therefore, this topic has been dismissed from further analysis in this EA.

Cultural Landscapes

Section 106 of the NHPA of 1966, as amended (16 USC 470, et seq.) and its implementing regulations under 36 CFR 800 require all federal agencies to consider the effects of federal actions on cultural properties, including cultural landscapes, eligible for or listed in the national register. The section of Badlands Loop Road analyzed in this EA was constructed in 1935 and is a historic property. However, this section of roadway has not been formally designated a cultural landscape and has been repaired multiple times since its construction. The preferred alternative would provide a beneficial effect for its preservation and would retain the historic route. Consultation with the South Dakota Office of the State Historic Preservation Officer (SHPO) concurred that the preferred alternative will have “no adverse effect” on historic properties (South Dakota Office of the State Historic Preservation Officer, Paige Olson, Review and Compliance Coordinator, Pierre, SD, letter to Eric Brunnemann, National Park Service,

Interior, SD, October 24 , 2013). Therefore, cultural landscapes have been dismissed as an impact topic in this EA.

Ethnographic Resources

The NPS defines ethnographic resources as any “landscape, objects, plants and animals, or sites and structures that are important to a people’s sense of purpose or a way of life.” There are no known ethnographic resources in the project area. American Indian Tribes traditionally associated with the lands of the park were notified of the proposed project and asked to identify any known ethnographic resources of concern by letter (“Government-to-Government Section 106 Consultation, Badlands National Park to Initiate Scoping Process for Proposed Road Repairs/Buttress Installment”, January 21, 2014). No comments from the tribes were received during the scoping period. Appropriate steps would be taken to protect any human remains, funerary objects, sacred objects, or objects of cultural patrimony inadvertently discovered. If subsequent issues or concerns are identified, additional consultations would be undertaken. Copies of the EA will be forwarded to each associated American Indian tribe for review and comment. Therefore, ethnographic resources have been dismissed from further analysis in this EA.

Historic Structures

Section 106 of the NHPA of 1966, as amended (16 USC 470, et seq.) and its implementing regulations under 36 CFR 800 require all federal agencies to consider the effects of federal actions on cultural properties, including historic structures, eligible for or listed in the national register. The section of Badlands Loop Road analyzed in this EA was constructed in 1935 and is a historic structure based on the definition provided in DO-28:

A constructed work . . . consciously created to serve some human activity. Historic structures are usually immovable, although some have been relocated and others are mobile by design. They include buildings and monuments, dams, millraces and canals, nautical vessels, bridges, tunnels and roads, railroad locomotives, rolling stock and track, stockades and fences, defensive works, temple mounds and kivas, ruins of all structural types, and outdoor sculpture.

As of December 2013, most buildings in the Cedar Pass area are included in the park’s List of Classified Structures (LCS). The Loop Road has been on the LCS for years. However, the section of roadway within the project area has been repaired multiple times since its construction. The preferred alternative would help preserve the roadway and retain the historic route. South Dakota Office of the State Historic Preservation Officer (SHPO) concurred that the preferred alternative will have “no adverse effect” on historic properties (South Dakota SHPO, Paige Olson, Review and Compliance Coordinator, Pierre, SD, letter to Eric Brunnemann, National Park Service, Interior, SD, October 24 , 2013). Therefore, historic structures have been dismissed as an impact topic in this EA.

Indian trust resources

Secretarial Order 3175 requires that any anticipated impacts on Indian trust resources from a proposed project or action by Department of the Interior agencies be explicitly addressed in environmental documents. The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources,

and treaty rights. The order represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. The land comprising the project area is not an Indian trust resource according to this definition. Therefore this topic has been dismissed from further analysis in this EA.

ALTERNATIVES

Introduction

This chapter describes the range of alternatives considered to address the problems described in Chapter 1. The “no action” alternative (alternative 1) is considered, in order to establish a baseline against which the effects from the action alternatives can be compared. One action alternative (the preferred alternative) is analyzed in this EA.

Should the no action alternative be selected, the NPS would continue to manage, operate and maintain the road at the landslide site. Landslide mitigation options would not be considered. There would be no further repairs implemented and the deep patch that was constructed in December of 2013 would provide temporary stabilization of the slope.

The preferred alternative would construct a buttress at the toe of slope to support and extend the life of the roadway for approximately 50 years. Approximately 15,000 – 20,000 cubic yards (CY) of native backfill material would be needed to stabilize the slope. Construction activities and equipment would be restricted to the approximately 1.35-acre project limit area to ensure protection of park resources (see figure 4). The preferred alternative would also expand the temporary deep patch by extending the patch’s length approximately 100’ on both the east and west sides of the project area and replace the patch’s cold fill material with hot fill material. The cold patch was used as a temporary patch and a necessity at the time of construction due to winter temperatures being cold enough to not facilitate asphalt laydown. The cold patch does not provide a consistent structural section, nor does it provide the same level of smoothness as a traditional hot asphalt concrete pavement. Removing the cold patch and tying into existing pavement beyond the limits of the buttress repair would provide a smoother roadway surface.

Alternative Development

Existing Conditions Analysis

Alternative 1 - No Action Alternative

The no action alternative would call for maintenance operations (including the temporary deep patch repair completed in December 2013) at the landslide site to continue as they have been for the last 10 years, but substantial landslide mitigation options would not be considered. Communication with park staff indicates that approximately \$1 million has been spent on repair and rehabilitation projects on Cedar Pass Hill over the last 10 years. Only a portion of this cost can be attributed directly to the landslide site. These projects have been mainly focused on keeping safe traffic flow while dealing with secondary cases of landslide movement, including crack sealing, asphalt overlays, and sub-excavation of soft areas. While this scenario would make the road passable for a continued length of time, it does not relieve the risk of significant

landslide movement, creating an emergency repair situation beyond the scope of current maintenance operations.

Alternative 2 - Repair Cliff Shelf Landslide with a Buttress (Preferred Alternative)

The preferred alternative would replace the previously constructed patch with a permanent deep patch. The permanent deep patch would parallel the construction of a support buttress providing long-term stabilization of the landslide and roadway area. The deep patch would extend approximately 100' on either side of the previously constructed patch. The buttress would be designed with sufficient mass to resist landslide movements and applicable safety requirements.

The buttress would have a top width of 25' and would be constructed of native backfill material. Aggregate (gravel) material would be used for road base and paving purposes. There is potential under the preferred alternative to use previously stockpiled native material from the park's 1998 sewer lagoon replacement project if the contractor hired for the buttress installation cannot obtain an adequate quantity of native backfill material. The contractor would secure a borrow pit source that meets all of the requirements identified in the construction contract, including that the source be weed-free, not include seeds of exotic invasive plants, and approved by the NPS.

Approximately 15,000-20,000 cubic yards of material would be required for the construction of the buttress. The foreslope of the buttress would have a maximum of a 50 percent slope and would extend to the intersection with natural ground, resulting in various slope heights. The toe would be accessed and constructed using standard embankment construction techniques (compacted in lifts). A portion of the native slope would be excavated to provide a bench and interlock the native slope with the new embankments. The design for the buttress also includes an internal drainage system to collect and disperses of any subsurface water that may buildup. In addition to the internal drainage system, curbing will be added to the inside and outside of the roadway edges through and along the curve. This buttress would be very similar to the buttress that was constructed to stabilize the adjacent Cedar Pass landslide, which has performed well over the last 10 years.

Construction Materials

The preferred alternative would require the use of the following equipment: excavator, dozer, compactor, wheel loader, dump trucks, grader, and paving equipment (laydown, rollers). Any material excavated for access roads or benching requirements would be placed back within the embankment following completion. Aggregate materials would likely come from nearby Rapid City or the Sampson Ranch.

Temporary Access Road

The preferred alternative would require access to the toe of the buttress. A 12-14' wide temporary access road needed to build the buttress would be excavated into the slope surface to allow passage of construction equipment (e.g. excavator, bulldozer, trucks). Constructing the access road would be completed by cutting the road into the slope with a bulldozer and placing aggregate base for stability. The access road would avoid all badland buttes adjacent to the project area and would be located within the construction limits of the project area. No additional overland access routes would be required. A switchback would be used to prevent grades greater than 25%, to allow the safe passage of construction equipment. The access road would be backfilled and compacted as construction progresses from the toe of the slope upward to the roadway grade. The park would develop and follow specific protocol in a revegetation plan for the site. Topsoil would be retained and reclaimed areas would be monitored after construction to determine if reclamation efforts are successful or if additional remedial actions are necessary. Remedial actions could include installation of erosion control structures, reseeding, or replanting the area, and controlling exotic plant species¹.

Staging Areas

The paved Cliff Shelf parking area located just east of the slide area would provide a staging area for equipment, etc. The contractor would use only a portion of the parking area, while leaving an open area for visitors and staff.

Road Detour/Lane Closures

The majority of construction would be completed without closing the road to traffic, as equipment would operate well below the roadway. However, as construction proceeds and the buttress nears the roadway grade, one lane of Loop Road may be closed for up to four weeks and it is possible that both lanes of the road may be closed for one to two weeks for final grading and surfacing work. In the case of a full roadway closure, a viable detour route would use the other portion of Badlands Loop Road (from the visitor center to the Wall entrance – Exit 110 on Interstate 90). Much of the local commercial traffic comes from Interior, through the park, and onto Interstate 90 at the Interior interchange (Exit 131 on Interstate 90). Visitors to the park would still be able to access the park via SR 240 with access to the visitor center. All construction would be conducted during daytime hours. Some night work may be necessary.

Resource Protection Measures (Mitigation)

To prevent and minimize potential adverse impacts associated with the alternatives, mitigation measures would be implemented during the construction and post-construction phases of the

¹ Other eligible revegetation activities may be implemented for parks (such as Badlands National Park) with upcoming or ongoing Federal Lands Highways (FLHP) road construction projects. Examples of eligible revegetation activities include weed removal; topsoil removal, storage, and replacement; ground preparation; plant propagation; and monitoring.

project (see table 2). Best Management Practices (BMPs) would also be utilized (see appendix C).

Table 2. Resource Protection Measures (Mitigation)

Resource Area / Mitigation
<p>General Considerations</p> <p>No badland buttes will be disturbed during the excavation process. A construction monitor will be on site during all excavation work to ensure that no badland formations will be disturbed and fossils are protected.</p>
<p>Water Quality</p> <p>The requirements for a stormwater pollution prevention plan would be addressed by the contractor during the construction contract and would meet all statutory NPS standards. All National Pollutant Discharge Elimination System (NPDES) requirements would be met.</p>
<p>Vegetation</p> <p>Inventories for existing populations of nonnative species would occur in all project and staging areas and would be treated before construction, as deemed necessary by the park's vegetation program manager. As design plans develop, they would be cross-referenced with existing vegetation survey information to ensure that no new survey is necessary before work starts. A supervisory biologist would also spot-check work in progress.</p> <p>Revegetation and recontouring of disturbed areas in the buffer zone would take place following construction and would be designed to minimize impacts on native vegetation and deter the possible spread of invasive species. Revegetation efforts would strive to reconstruct the natural spacing, abundance and diversity of native plant species found in similar vegetated landscapes of the park. All disturbed areas surrounding constructed pullouts would be restored as nearly as possible to pre-construction conditions shortly after construction activities are completed.</p> <p>A revegetation plan would be developed by the park's vegetation program manager in consultation with a landscape architect. Any revegetation efforts would use site-adapted native species and / or site-adapted native seed, and park policies regarding revegetation and site restoration would be incorporated. The plan would consider, among other things, use of native species, plant salvage potential, nonnative vegetation management, and pedestrian barriers. Topsoil would be retained and reclaimed areas would be monitored after construction to determine if reclamation efforts are successful or if additional remedial actions are necessary. Remedial actions could include installation of erosion control structures, reseeding, or replanting the area, and controlling exotic plant species. Policies related to revegetation would be referenced from the <i>NPS Management Policies 2006</i>.</p>
<p>Paleontological Resources</p> <p>A qualified paleontologist would be on site to monitor for paleontological resources before and during construction. If paleontological resources are found on site during construction, all work would stop in the immediate area until the paleontologist can fully document and mitigate the discovery. Efforts would be made to avoid fossil resources during the construction process. In addition, a paleontological monitor would need to be on site if borrow is excavated at the</p>

Resource Area / Mitigation
Sampson Ranch.
<p>Wildlife</p> <p>Ongoing monitoring activities as well as pre and post-construction monitoring for bighorn sheep would be required. Efforts would be made to schedule construction and maintenance activities outside of sensitive times of the year for bighorn sheep, such as the breeding season (November and December) and lambing season (May and June).</p>
<p>Visitor Use and Experience</p> <p>A traffic control plan would be developed in conjunction with the construction documents for use during the construction period(s) associated with roadway, entrance station, overlooks, and parking area improvements. The plan would be provided by the contractor to the park superintendent for review and approval before implementation. Traffic delays could be possible, however, emergency vehicle access would be provided immediately.</p> <p>Parking areas may be closed on a short-term basis on limited occasions. Such closures would be for the minimal time required to complete the work.</p>
<p>Park Operations</p> <p>The NPS would develop a monitoring program in advance of implementing the first phase of construction. The monitoring program would use conventional benchmarking tools to track progress and would be updated on a regular basis. It would be used to assess the plan's effectiveness on an ongoing basis and to aid managers in making decisions as to when to implement subsequent phases of construction. The monitoring program would track the park's success in meeting quantitative goals, such as parking occupancy in lots, the incidence of unauthorized / overflow parking, traffic volumes, and the total accumulation of vehicles. It would also assess conformance with qualitative standards such as ease of access to key visitor destinations, and the popularity of new shuttle routes. If plan objectives were not being reached, park managers could then decide to implement other actions identified in this plan as part of future work phases.</p> <p>The NPS would actively manage shuttle and tour bus loading / unloading operations and if necessary, would prepare a management strategy for these operations in cooperation with the park concessioner.</p>
<p>Historic Structures</p> <p>All existing historic features that comprise the Loop Road would be protected from construction activities and any rehabilitation of an existing historic stone masonry feature would be in accordance with the Secretary of the Interior Standards for the Treatment of Historic Properties.</p> <p>The existing road alignment would not be changed by construction activities.</p>

Alternatives Considered but Dismissed from Detailed Analysis

An alternative was considered to realign a section of the current roadway. The realignment would follow a historic section that would move the roadway higher on the landslide mass to more stable ground and away from the active portions of the landslide. While the realigned portion of the roadway provides increased stability from landslide movements in the near term, there is a risk to future landslide movements impacting this realigned section of the roadway. This option certainly presents the largest area of impact with respect to engineering and environmental studies required to prepare design drawings suitable for construction.

Another alternative considered but dismissed entailed using a bulldozer to push existing slide material (rocks and soil) from the toe of the slope upward to temporarily halt landslide movement. While this alternative would avoid the need to import rock and gravel and would be less costly than the preferred alternative, it was dismissed because it would not provide a long-term solution to stabilize the project area section of Loop Road and ensure the safety of visitors on this transportation corridor.

Environmentally Preferable Alternative

According to the DOI regulations implementing NEPA (43 CFR 46.30), the environmentally preferable alternative is the alternative that causes the least damage to the biological and physical environment and best protects, preserves, and enhances historical, cultural, and natural resources. The environmentally preferable alternative is identified upon consideration and weighing by the Regional Director, of long-term environmental impacts against short-term impacts in evaluating what is the best protection of these resources. In some situations, such as when different alternatives impact different resources to different degrees, there may be more than one environmentally preferable alternative.

The preferred alternative is also the environmentally preferable alternative. The preferred alternative would cause the least damage to the biological and physical environment and would best protect, preserve, and enhance park resources by stabilizing the roadway and preventing a catastrophic landslide on the slopes adjacent to the roadway.

By contrast, although the no action alternative would not involve the same level of ground-disturbing activities as the preferred alternative, this alternative would not protect park resources in the long term as the landslide would continue to deteriorate the roadway. In addition, the no action alternative would continue to have high maintenance requirements that would not be as cost effective or efficient compared to the preferred alternative. The benefit-cost analysis (BCR) comparing the no action alternative to the preferred alternative, for example, indicated a higher BCR for the preferred alternative. The analysis also demonstrated that a sudden and significant landslide would have significant repair costs and could render the

roadway within the project area impassable in the next 10-25 years based on the accelerated ground movements observed at the site in recent years (FHWA 2013).

Alternatives Comparison

Comparing the two alternatives, the preferred alternative best fulfills the project objectives by addressing safety and preventing further landslide issues. The no action alternative would call for maintenance operations at the landslide site to continue as they have for the last 10 years, and landslide mitigation options would not be considered. This alternative would make the road passable in the short term, but it would not reduce the risk of significant landslide movement and emergency repairs may be required periodically.

By comparison, the preferred alternative would replace the previously constructed patch with a permanent deep patch. The permanent deep patch would parallel the construction of a support buttress providing long-term stabilization of the landslide and roadway area. The deep patch would extend approximately 100' on either side of the previously constructed patch. The buttress would be designed with sufficient mass to resist landslide movements and meet applicable safety requirements.

Impact Summary

Table 3 summarizes the anticipated environmental impacts for each alternative. Only those impact topics that have been carried forward for further analysis are included in the table. The "Affected Environment and Environmental Consequences" chapter provides more detail related to these impacts.

Table 3. Environmental Impact Summary by Alternative

Impact Topic	No Action Alternative	Preferred Alternative – Deep Patch with Buttress
Geological resources	<ul style="list-style-type: none"> • Temporary deep patch construction (completed December 2013) would minimize landslide movement for approximately 10 years. • Impacts would be non-existent in the short term and potentially catastrophic if the landslide fails. 	<ul style="list-style-type: none"> • Buttress installation would alter the movement of a natural landslide to stabilize the roadway, having long term impacts to the natural geological processes of landslide movement. • Slope topography would be slightly altered by construction activities, but would be largely unnoticeable as the slope angle would remain similar to its existing angle.

Impact Topic	No Action Alternative	Preferred Alternative – Deep Patch with Buttress
Vegetation	<ul style="list-style-type: none"> • Ongoing maintenance activities would be limited to previously disturbed areas along the roadway. • Small areas of vegetation may be impacted along the edges of the road. • Impacts would be local and long-term 	<ul style="list-style-type: none"> • Construction activities would result in a loss of sparse vegetation and compaction of soils within the immediate deep patch and buttress installation site as well as areas adjacent to the roadway. • Impacts would be long-term and relatively small in size.
Paleontological resources	<ul style="list-style-type: none"> • Construction activities would be confined to the existing roadway and no localized impacts to paleontological resources are expected. 	<ul style="list-style-type: none"> • The project area is not thought to be a primary fossil locality in the park, however excavation activities would lead to the long-term, localized loss of fossil resources if they exist.
Wildlife	<ul style="list-style-type: none"> • Ongoing roadway maintenance would result in short term disturbances to the Cedar Pass sub-population of bighorn sheep, which find habitat in the project vicinity during the late fall breeding season and during the winter months. • Bighorn sheep would be disturbed by noise and activities associated with ongoing maintenance activities and would be temporarily displaced. 	<ul style="list-style-type: none"> • Construction through the fall and into the winter months would disturb bighorn sheep distribution and habitat use and temporarily displace sheep from the project area.
Visitor experience	<ul style="list-style-type: none"> • December 2013 deep patch repair would minimize landslide movement, but does not provide long-term visitor safety from sudden and substantial landslide movement. 	<ul style="list-style-type: none"> • Some construction would be completed during normal visitor traffic conditions; however lane closures would be required as construction proceeds. • A partial closure would close a single lane for up to four weeks. • Full closure of both lanes may be required for one to two weeks to complete final grading and surfacing work.

Impact Topic	No Action Alternative	Preferred Alternative – Deep Patch with Buttress
		<ul style="list-style-type: none"> A portion of the Cliff Shelf parking would be closed to visitors during construction.
Socioeconomic environment	<ul style="list-style-type: none"> Continued slope deterioration could lead to potential roadway failure, which would result in long-term impacts to local residents who would have to seek alternative routes to Interstate 90. 	<ul style="list-style-type: none"> Local communities would experience a long-term benefit as stabilization activities would allow the road to remain a safe and passable transportation corridor to Interstate 90. In the short term, these communities would experience travel delays and potential roadway closures during construction.
Park operations	<ul style="list-style-type: none"> Maintenance needs would increase as the roadway deteriorates, and would escalate substantially if the deep patch repair fails and the roadway becomes unusable. 	<ul style="list-style-type: none"> Construction activities could delay park staff carrying out official duties, such as law enforcement activities, accessing work sites, and other administrative functions, resulting in a temporary, parkwide effect.
Archeology	<ul style="list-style-type: none"> Recorded archeological sites are located outside the project area and would not be affected by ongoing maintenance activities in the project area. 	<ul style="list-style-type: none"> The project team would reinitiate consultation with the South Dakota SHPO and the NPS Midwest Archaeological Center (MWAC) if the Area of Potential Effect (APE) changes, if new borrow areas are identified, or if there is an inadvertent archeological discovery. Impacts would be long term and localized if an inadvertent archeological discovery is made within the project area.

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter provides a description of the resources potentially impacted by the alternatives and the likely environmental consequences. It is organized by impact topics drawn from internal scoping. Impacts are evaluated based on context, duration, and whether they are direct, indirect, or cumulative. The “Affected Environment” section describes only those environmental resources that are relevant to the proposed action in this document that would be affected by implementation of an alternative. NPS policy also requires an evaluation of potential impairment of park resources. More detailed information on resources in the park may be found in the GMP for the North Unit (NPS 2006).

General Methods

This section discussed the environmental impacts, including direct and indirect effects, for each alternative. The analysis is based on the assumption that the mitigation measures and BMPs identified in the “Resource Protection Measures” section of this EA would be implemented for the preferred alternative. The NPS based these impact analyses on a review of existing literature and park studies, as well as information provided by subject matter experts, other agencies, and public input.

The following terms are used in the discussion of environmental consequences to assess the impacts associated with each alternative.

Type: Impacts can be beneficial or adverse. Beneficial effects are those that would result in a positive change to the resource when compared to the existing conditions. Adverse effects would cause an unfavorable result to the resource when compared to existing conditions.

Context: Context is the setting within which an impact would occur, such as local (areas near the proposed project) or regional (Jackson County, South Dakota).

Duration: Duration of impact is analyzed independently for each resource because impact duration is dependent on the resource being analyzed. Depending on the resource, impacts may last for the construction period, a single year or growing season, or longer. For the purposes of this analysis, impact duration is described as short-term or long-term.

Direct and Indirect Effects: Effects can be direct, indirect, or cumulative. Direct effects are caused by an action and occur at the same time and place as the action. Indirect effects are caused by the action and occur later or farther away, but are still reasonably foreseeable.

Cumulative Effects

Cumulative effects are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person

undertakes such other actions” (40 CFR 1508.7). Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time. The CEQ regulations that implement NEPA require assessment of cumulative impacts in the decision-making process for federal projects.

Methods for Assessing Cumulative Effects

Cumulative effects were determined by combining the impacts of either the preferred alternative or no action alternative with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects that might contribute to cumulative effects. The geographic scope of the analysis includes actions near the project area, as well as other actions in the park or surrounding lands where overlapping resource impacts are possible. The temporal scope includes past actions that have influenced the current condition of the resource and reasonably foreseeable actions within a range of approximately 10 years in the future.

Past, present, and reasonably foreseeable future actions were then assessed in conjunction with the impacts of the alternatives to determine if they would have any added adverse or beneficial effects on a particular resource, park operation, human health and safety, or visitor use. The impact of reasonably foreseeable actions would vary for each of the resources. Cumulative effects are considered for each alternative and are presented in the environmental consequences discussion for each impact topic.

Past Actions

Landslide movements within the project vicinity were first detected in the late 1950s when Loop Road was originally graded and paved (FHWA 2013). Major stability problems didn’t arise until the early 1990s, when several surges of slope movement in the Cedar Pass area and subsequent geotechnical investigations called for stabilization projects. An effort to stabilize Loop Road over Cedar Pass in 2000 with a buttress was the most intensive effort to date to solidify the roadway and prevent catastrophic slope failure. However, the adjacent Cliff Shelf Landslide, previously considered dormant with only localized signs of movement, has shown greatly accelerated movement in recent years. Concerns of catastrophic slope failure led to the emergency deep patch repair in December 2013, which added gravel backfill to reinforce the slope and an underdrain to remove subsurface water along the roadway and temporarily minimize landslide movement.

Current and Future Actions

No current or other reasonably foreseeable actions were identified in the vicinity of the project area that would potentially contribute to cumulative effects.

Geological Resources

Affected Environment

Badlands National Park is located in western South Dakota. The rocks of western South Dakota consist of a thick sequence of sedimentary rocks overlying an ancient crust of igneous and

metamorphic rocks similar to those exposed in the core of the Black Hills. Over time some of the areas have subsided forming basins, while others have risen, forming domes and plateaus. Shallow seas have advanced and retreated many times across the region. The park's geology, topography, and soils set the area apart from other portions of the prairie region. Streams and rivers from the Black Hills transported sediments eastward depositing the rocks that make up the Badlands. The Brule Formation, in particular, is comprised of claystones, mudstones, sandstone, siltstone, freshwater limestone, and some volcanic ash. Although the major period of deposition ended 28 million years ago, significant erosion of the Badlands did not begin until a mere half a million years ago. Sediment erosion rates are generally high and estimated to be as much as 1 inch per year (FHWA 2013).

The Badlands Loop Road follows an escarpment that separates the dissected lowland along the White River to the south from the uneroded upland to the north known as the Badlands Wall. The road intersects the wall at Cedar Pass as it cuts through the Brule Formation and both the Cedar Pass Slide and the Cliff Shelf Slide are on an active slump block (see figures 5 and 6). The Loop Road is built on soils comprised of bentonitic clays, which lose shear strength when they are wet and have a high potential for swelling or increasing in volume (FHWA 2013). Added to the relative lack of abundant vegetation, the project area's steep slopes allow short, intense rainfall events to produce flash floods.

The Loop Road is built on several active landslides within the Brule Formation, requiring constant repair and maintenance. Slide movement on the Cliff Shelf Landslide has accelerated over the past six years (see figures 7 and 8). This accelerated movement is related to an ongoing wet cycle that is particularly active during annual spring time saturation periods (NPS 2000; personal communication with Badlands National Park Physical Science Technician Ellen Starck). Landslide monitoring at one point within this location indicated a total lateral movement of 8.82 inches measured between April 1999 and April 2000 (approximately 0.024 inches per day). From April 2000 to March 2001, the same point indicated additional movement of 18.39 inches (approximately 0.06 inches per day) and 14.49 inches (approximately 0.07 inches per day) from March 2001 to October 2001 (FHWA 2013).

Groundwater and precipitation rates are significant contributing factors to the Cliff Shelf Landslide reactivation. Groundwater most likely flows along the interface between the clay, siltstone, and claystone layers. During periods of above normal precipitation, groundwater saturates the clay level, which can cause movement among the layers. Previous periods of slide movement (1998, 2011) were immediately preceded by "above normal" precipitation levels leading to a definitive correlation between high precipitation levels and landslide movement².

² There is likely a time lag between measured precipitation levels and ground movement, as it may take months for the fine-grained soils at the site to become saturated, lose strength, and cause movement (FHWA 2013).



Figure 5. Failing Embankment in Project Area (looking upslope), August 2012 (courtesy FHWA)



Figure 6. Failing Embankment in Project Area (looking downslope), August 2012 (courtesy FHWA)



Figure 7. Landside Material South of Project Area (courtesy FHWA)



Figure 8. Topography Immediately North of Project Area (courtesy FHWA)

Environmental Consequences

No Action Alternative

Direct and Indirect Impacts: The deep patch construction, completed in December 2013 would minimize landslide movement and settlement from impacting the roadway for approximately 10 years. However, the deep patch would not be able to resist significant subsurface distress or prevent landslide failure. The no action alternative would limit ongoing road maintenance activities to previously disturbed areas, limiting impacts to geological resources. However, the potential exists for slope failure under this alternative and the construction activities necessary to keep the roadway passable may result in altering the topography. If slope and roadway failure is substantial, permanent alteration to topography may result.

Cumulative Impacts: Deep patch construction and ongoing maintenance activities have impacted geological resources in the park. This project has permanently altered geological processes in response to the landslide movements. Implementation of the no action alternative in combination with the deep patch construction and maintenance activities would result in continuing adverse cumulative impacts that would last for years, until a permanent solution is implemented.

Conclusion: Implementation of the no action alternative would cause impacts to continue for years until a permanent solution is implemented; the necessary ongoing maintenance activities, would be mainly confined to previously disturbed areas. If slope and roadway failure occurs, this alternative may result significant changes to the geological resources of the area that would take an extensive amount of time exceeding multiple years.

Preferred Alternative

Direct and Indirect Impacts: The preferred alternative would impact geological processes of the area by altering the movement of a natural landslide to stabilize the roadway. The mass of commercial borrow material for the buttress installation and enhancements to the deep patch repair would resist continued landslide movements for up to 50 years, which would permanently alter the geological processes of the landslide's natural movement. Approximately 1.35 acres, which represents the project's construction limits, could be altered by earth moving equipment. Approximately 15,000 – 20,000 CY of native backfill material would be needed to stabilize the slope (see figure 9).

Adding a temporary contribution to the geological impacts of importing material for the buttress, the 12-14' wide temporary access road needed to build the buttress would be excavated into the slope surface to allow passage of construction equipment (e.g. excavator, bulldozer, trucks). Constructing the access road would be completed by cutting the road into the slope with a bulldozer and placing aggregate base for stability. The access road would begin somewhere within the limits of construction and would cut into the slide material on the south side of the roadway, traversing downward across the middle of the slope. Switchbacks would

be used to prevent grades greater than 25% to allow the safe passage of construction equipment. The access road would be completely within the construction limits of the buttress area and no additional overland access routes would be required. The access road would be backfilled and compacted as construction progresses from the toe of the slope upward to the roadway grade. No additional disturbance to the project area's topography would be noticeable from the access road after construction, backfilling, and reseeding activities are completed.

Cumulative Impacts: The preferred alternative would result in long-term impacts to geological resources through the alteration of the natural geologic processes of the landslide. The importation of 15,000 – 20,000 CY of native backfill material and enhancements to drainage within the buttress and at the toe of the slope, would improve the overall stability of the slope and support long term stability of the roadway. These actions would have long term beneficial impacts for roadway stability, but would permanently alter the natural geologic processes of landslide movement.

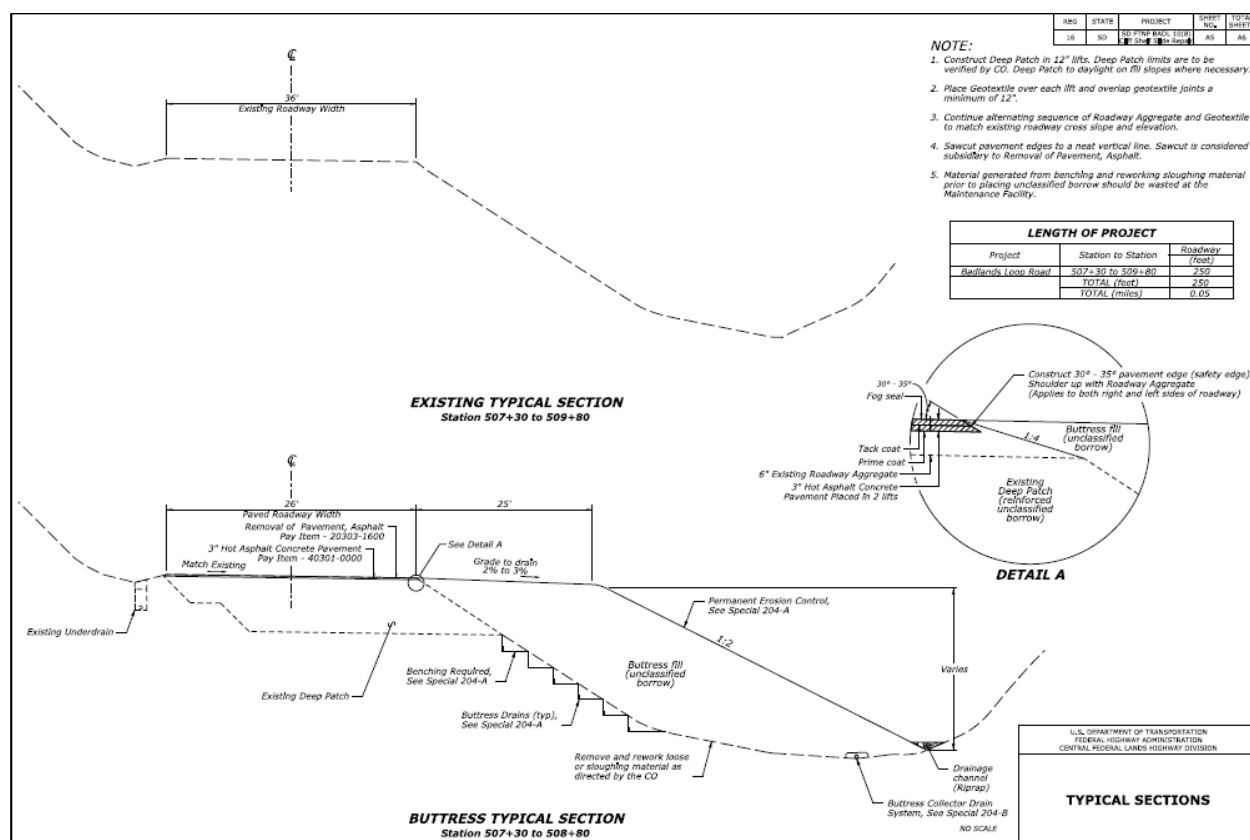


Figure 9. Drawing of Typical Buttress Section (source FHWA)

Conclusion: The preferred alternative would result in long-term impacts to the natural geologic processes of the landslide by halting its slumping movement and altering drainage at the toe of the slope, improving drainage efficiency by more effectively moving flows away from the slope.

Vegetation

Affected Environment

The project area was part of a park-wide mapping effort by Von Loh, et al. (1999) to classify the park's vegetation communities in accordance with the National Vegetation Classification System. The project area contains three vegetation classes: Western Wheatgrass Grassland Alliance; Badlands Sparse vegetation Complex; and the Three-leaved sumac/Threadleaf sedge Shrub Grassland. Each class is described below:

Western wheatgrass grassland alliance

This vegetation class is widespread throughout the park and the region, particularly on clay and silt soils. A mixture of western wheatgrass (*Pascopyrum smithi*), Blue grama (*Bouteloua gracilis*) threadleaf sedge (*Carex filifolia*), green needle grass (*Nasella viridula*) and prairie sand reed (*Calamovilfa longifolia*) characterizes the alliance.

Badlands Sparse Vegetation Complex

This geologic feature and sparse vegetation class provides the park's aesthetic focus and consists of barren to sparsely vegetated walls, cliffs, bluffs, pinnacles, mounds or haystacks, table lands, escarpments erosion fans, alkaline flats, overflows and drainages. The soils are primarily siltstone, claystone, sandstone volcanic ash and sediment. The primary vegetation includes Long-leaf sagebrush (*Artemisia longifolia*), small-flowered wild buckwheat (*Eriogonum pauciflorum*), snakeweed (*Gutierrezia sarothrae*).

Three-leaved Sumac/Threadleaf sedge Shrub Grassland.

This shrub class includes a sparse component when it grows along the upper edge of buttes and cliffs and a denser component when observed on low ridges and swales of Pierre Shale derived soils. The primary plant species include three-leaved sumac (*Rhus trilobata*) and threadleaf sedge (*Carex filifolia*).

Environmental Consequences

No Action Alternative

Direct and Indirect Impacts: Ongoing maintenance activities would be limited to previously disturbed areas along the roadway. Mitigation measures such as utilizing previously disturbed or developed areas for staging of equipment and materials and fencing off undisturbed areas would prevent damage to vegetation immediately adjacent to the roadway. Small areas of vegetation still may be impacted along the edges of the road. The deep patch construction, completed in December 2013 would minimize landslide movement and settlement from impacting the roadway for approximately 10 years. However, the deep patch would not be able to resist significant subsurface distress or prevent landslide failure. The no action alternative

would limit ongoing road maintenance activities to previously disturbed areas, limiting impacts to vegetation resources. The potential exists for slope failure under this alternative and the construction activities necessary to keep the roadway passable may result in adversely impacting the surrounding vegetation over the long-term.

Cumulative Impacts: The combined effects of past, present and reasonably foreseeable actions on vegetation would be minimal over the long-term. The required periodic maintenance to the road would require revegetation and repair each time maintenance efforts are implemented.

The overall cumulative effects on vegetation from the no action alternative in combination with past, present and reasonably foreseeable future actions would be limited over the long-term.

Conclusion: Implementation of the no action alternative would result in long term, but limited impacts to vegetative resources because ongoing maintenance activities that would be mainly confined to previously disturbed areas. If slope and roadway failure occurs, this alternative may result in long-term changes to the surrounding vegetation of and around the increased project area.

Preferred Alternative

Direct and Indirect Impacts: Construction activities would result in a loss of vegetation and compaction of soils within the immediate deep patch and buttress installation site, as well as areas adjacent to the roadway. Impacts would be short term, localized and relatively small in size. Impacted areas would be rehabilitated and re-vegetated.

Cumulative Impacts: The combined effects of past, present and reasonably foreseeable actions on vegetation would be minimal over the short-term. The required periodic maintenance to the road would require revegetation and repair each time maintenance efforts are implemented. The overall cumulative effects on vegetation under the preferred alternative in combination with past, present and reasonably foreseeable future actions would be limited over the short-term.

Conclusion: This alternative would result in short-term impacts on vegetation during construction periods and would be mitigated by rehabilitation and re-vegetation methods after project completion. Impacts would be short term due to re-vegetation activities that would occur after construction activities are completed.

Paleontological Resources

Affected Environment

Badlands National Park is world renowned for its paleontological resources. A report that accompanied the 1929 Act creating the park described the Badlands as containing "vast beds of vertebrate remains" Dr. Hiram Prout, a St. Louis physician, described the first vertebrate fossil in 1846 (Prout 1846). Numerous important paleontological finds in the Badlands have served to

define the geologic period. Oligocene fossil remains include camels, three-toed horses, oreodonts (small sheep-like animals), antelope-like animals, rhinoceroses, false deer, rabbits, subterranean beavers, creodonts (predatory animals), land turtles, rodents and birds.

In the western part of the North Unit of Badlands Park marine fossils are found in deposits of an ancient sea that existed in the region some 67 to 75 million years ago during the Cretaceous period. Within the park, fossils found in the Pierre Shale include ammonites, nautiloids, fish, marine turtles, and mosasaurs.

Environmental Consequences

No Action Alternative

Direct and Indirect Impacts: The No Action Alternative would call for all construction activities to be confined to the existing roadway, which would not likely impact previously undisturbed bedrock. No impacts to paleontological resources are expected, however, if paleontological resources were inadvertently damaged, it would likely be a long-term impact. In addition, monitoring by a professional paleontologist would be conducted during construction activities. All borrow material would come from outside sources and therefore would minimize the potential of disturbing potential paleontological resources from non-surveyed areas within the park. However, all excavation of borrow from the Sampson Ranch will need to be monitored for fossil resources.

Cumulative Impacts: No cumulative impact to paleontological resources is expected.

Conclusion: No impact to paleontological resources is expected, however, if they were, it would likely be a long-term impact.

Preferred Alternative

Direct and Indirect Impacts: Buttress and access road construction activities have the potential to disturb paleontological resources. Although the project area is not thought to be a primary fossil locality in the park, excavation activities could lead to the disturbance or loss of resources if they exist in the project area. If this occurs, there would be a long-term adverse impact. Surveying before construction and monitoring during construction would mitigate some of the potential impact. All borrow material would come from sources outside the park and therefore would minimize the potential of disturbing potential paleontological resources from non-surveyed areas within the park. However, they will need to be surveyed and monitored by a qualified paleontologist.

Cumulative Impacts: No cumulative impact to paleontological resources is expected.

Conclusion: No impact to paleontological resources is expected, however, if they were, it would likely be a long-term impact. Monitoring and mitigation efforts would be implemented in order to lessen impacts if paleontological resources are found.

Wildlife

Affected Environment

The Cedar Pass area is located within a wildlife corridor that supports habitat for bighorn sheep. Approximately 110 bighorn sheep comprise three distinct sub-populations in the park, including the Cedar Pass sub-population, which includes approximately 15 animals (personal communication with Badlands National Park Biologist Eddie Childers). A habitat suitability model of the greater Badlands prepared in 1995 (NPS 2000), which divided the greater Badlands into five focus areas, identified 12,600 acres of bighorn sheep habitat, 12,300 acres of summer habitat, 3,760 acres of winter habitat, and 300 acres of lambing habitat within the Cedar Pass vicinity.

Park resource staff is aware of “escape” terrain for bighorn sheep located immediately adjacent to the proposed buttress project. This escape habitat provides a corridor that runs through the project area, connecting the flat terrain south of the project area with the steep slopes north of the project area, allowing access to these diverse resources.

The park currently monitors bighorn sheep populations in the project vicinity on an annual basis. Ongoing monitoring activities as well as pre and post-construction monitoring for bighorn sheep would be required under the preferred alternative.

Regarding other wildlife that could potentially be affected by the proposed project, the NPS consulted informally with the USFWS in January 2014 concerning federally listed sensitive species that may be near the project area boundaries (see appendix A). Specifically, the project team consulted the USFWS *Species by County Report* and confirmed there are two federally endangered; one proposed endangered; one proposed threatened; and one candidate species within Jackson County, which encompasses the project area. Endangered species include the whooping crane and black-footed ferret. The proposed endangered species is the northern long-eared bat. The proposed threatened species is the red knot, and the candidate species is Sprague’s pipit. Of these species, park resource staff indicates that only the black-footed ferret is known to reside within the park. The park has not recorded any observations of black-footed ferret or habitat for this species in the immediate project area. The USFWS did not return any comments during scoping for this EA.

Environmental Consequences

No Action Alternative

Direct and Indirect Impacts: The Cedar Pass sub-population of bighorn sheep use habitat in the project area during the late fall breeding and winter seasons. The continued maintenance of

the roadway would result in short term disturbance to bighorn sheep. These animals would be disturbed by noise and activities associated with repair and rehabilitation activities on the existing roadway. These impacts would be temporary, lasting only the duration of the construction period. Scheduling maintenance activities to avoid sensitive times of the year for bighorn sheep, such as the lambing season, would place additional stress on these animals during each construction period, since this alternative involves repairing the road as needed.

Cumulative Impacts: Ongoing and periodic maintenance and rehabilitation activities would result in temporary displacement of bighorn sheep due to noise and construction activities. When possible, construction activities would be restricted until completion of the lambing season. Attempts to schedule roadway maintenance would mitigate some of the impacts associated with these activities.

Conclusion: There would be short-term impacts to bighorn sheep populations from periodic construction noise and activities. When possible, construction activities would be scheduled to minimize the impact to bighorn sheep.

Preferred Alternative

Direct and Indirect Impacts: The Cedar Pass sub-population of bighorn sheep use habitat in the project area during the fall breeding and winter seasons. Buttress construction activities through the fall and early winter months would displace sheep from the project area, disrupting their distribution and use of the exit corridor within the construction zone. Additional fall breeding and winter habitat as well as a secondary corridor for movement could be used north of the project area. Upon completion of the buttress and extended deep patch repair, the NPS anticipates sheep would return and resume natural movement and use habitat within the project area. Construction of the buttress and extended deep patch repairs would result in short-term impacts to bighorn sheep due the disturbance from construction activities.

Cumulative Impacts: Stress to bighorn sheep populations from construction activities could have an adverse effect on the sheep's ability to use the project area habitat as part of their escape corridor. There are no other proposed projects that would add to the cumulative impact for bighorn sheep populations.

Conclusion: Disturbance associated with construction activities in the preferred alternative would result in short term impacts to bighorn sheep. Buttress construction activities through the fall and early winter months would displace sheep from the project area, disrupting their distribution and use of the exit corridor within the construction zone. If possible, construction activities would be scheduled to minimize the impact to bighorn sheep.

VISITOR EXPERIENCE

Affected Environment

From the years 2005 to 2013, Badlands National Park averaged 893,318 visitors per year. The Loop Road provides primary access to the park. Visitors to the park come from all regions of the United States and many foreign countries. The Loop Road is the primary means of access into the park. Visitors experience a unique area with scenic vistas of the Badlands. This landscape has been devolved by rain, winds, and frosts and the park's buttes and spires of barren soil and rock rise in stark contrast to the prairies.

Environmental Consequences

No Action Alternative

Direct and Indirect Impacts: Visitors would experience both long and short-term effects under the No Action Alternative. In the short term, park visitors would be subjected to adverse impacts caused by construction activities, lane closures, and potential road detours. Their park experience would involve the construction noise, dust, and disturbance of traveling through construction zones.

In the long-term, this alternative would not eliminate the safety concerns of the road. The road would still be subject to the movement of the Cliff Shelf Landslide, which could subject visitors to closures of the road due to catastrophic failure. Failure of the roadway would require park visitors to seek other roads to access portions of the park, thereby reducing the quality of the visitor experience because of longer travel times.

Cumulative Impacts: No cumulative impact to visitor experience is expected.

Conclusion: Impacts to visitors experience under the No Action Alternative would be both long and short term, and have adverse effects.

Preferred Alternative

Direct and Indirect Impacts: Some construction would be completed during normal visitor traffic conditions, as activities would begin well below the roadway grade. However, as construction proceeds and the buttress nears the roadway grade, lane closures would be required. A partial closure option would close a single lane for up to four weeks. Full closure of both lanes may be required for one to two weeks to complete final grading and surfacing work. Alternate routes would be available. In addition, a portion of the Cliff Shelf parking lot would be closed to the public and used to stage construction equipment. Impacts to visitor experience would be temporary and adverse due to the closures. There would also be a small adverse effect during construction as visitors would experience construction dust and noise. However, visitors would experience long term benefits due to the safety and functionality upgrades made to the roadway and Cliff Shelf slope in the preferred alternative. Seasonal timing would also be

considered for construction schedules; this would enable construction to occur during months of lower visitation, therefore mitigating some impact to visitors.

Cumulative Impacts: No cumulative impact to visitor experience is expected.

Conclusion: Impacts to visitor experience under the preferred alternative would be long and short-term, adverse effects. However, they would also experience a beneficial effect in the long-term, stemming from the continuance of a safe and functional route to enjoy the park.

PARK OPERATIONS

Affected Environment

Ongoing park operations strive to maintain the park's physical, natural, and cultural resources for the enjoyment, understanding, and appreciation of park visitors. Park staff is responsible for the day-to-day maintenance of parkway infrastructure. Park buildings, roads, and structures are maintained to provide a safe and pleasant environment for park visitors and staff. The condition of the existing road adversely affects park operations because it is in a deteriorated state and needs extensive maintenance or replacement.

Environmental Consequences

No Action Alternative

Direct and Indirect Impacts: Maintenance needs would increase as the roadway deteriorates, and would escalate substantially if the deep patch repair fails and the roadway becomes unusable. Continued roadway deterioration would result in long term cost increases, budget reallocations from other important park projects, and increased staffing to sustain a safe, passable roadway.

Cumulative Impacts: The continually rising costs of maintenance and repairs could require the allocation of project funding, staffing, or other resources, therefore impacting overall park operations. Currently, there are no other projects that would add to the cumulative impact for park operations.

Conclusion: Implementation of this alternative would result in long-term adverse impacts on park operations. The cost of the maintenance is expected to continue to rise, which would impact park operations by requiring more the parks funding and staff time each year.

Preferred Alternative:

Direct and Indirect Impacts: Construction operations would require park staff time in coordinating with FHWA and contractors. Construction activities could also delay park staff carrying out official duties, such as law enforcement activities, accessing work sites, and other

administrative functions. There would be a beneficial impact by stabilizing the road would and lessening the long term maintenance cost and time.

Cumulative Impacts: Construction activities would have a slight adverse impact by causing disruptions to park staff and day to day operations. However the beneficial impact of repairing the road and avoiding costly repairs in the future would offset the temporary impacts to park operations. There are no other proposed projects that would add to the cumulative impact for park operations.

Conclusion: Implementation of this alternative would result in short term adverse impacts on operations during the construction, but completion would be beneficial in the long-term by providing a functional roadway that does not call for frequent maintenance and staff time.

SOCIOECONOMIC ENVIRONMENT

Affected Environment

Badlands National Park is located in three counties: Jackson, Pennington, and Shannon. The park is approximately 120 miles west of South Dakota's capital city Pierre, and 45 miles southeast of Rapid City. The town of Interior is located approximately 3 miles from the project area. The communities of Wall (8 miles from park boundary), Kadoka (25 miles from the park boundary) and Rapid City benefit from revenue generated by park tourism, since these population centers are located on Interstate 90 and are gateways to the park's main entrances. The other surrounding communities' economies are primarily based on agriculture.

The 2012 Census estimated the 2012 populations for Shannon and Jackson counties at 14,059 and 3,191, respectively (U.S. Census Bureau 2014). The 2008- 2012 median household income of the two counties was \$26,282 and \$43,967. Pennington County's population in 2012 was 104,347 with a median household income of \$50,253. The majority of Pennington County's population is located in Rapid City.

Based on vehicle counts at the Northeast, Interior, and Pinnacles entrances, the park averages 4,642 uses per month by non-recreational vehicles, which are assumed to be comprised mainly of local residents (NPS 2014). The NPS does not charge local residents for using the Loop Road for entry and exit.

The community of Interior relies on the Loop Road over Cedar Pass and through the Northeast entrance for high school students to commute to the school in Wall, Kadoka, and Philip. The local school in Interior only provides services for kindergarten through eighth grade students.

Environmental Consequences

No Action Alternative

Direct and Indirect Impacts: Loop Road would continue to provide primary access to and through the park and would continue to serve as the shortest route to Interstate 90 for the local communities. Ongoing maintenance activities combined with the deep patch repair would preserve this route temporarily; however continued deterioration or possible roadway failure would result in long-term impacts. Roadway closure would cause local residents to seek alternative routes to Interstate 90, which would increase trip lengths for local residents and increase maintenance costs for other local roads. This would adversely impact movement of commerce to market and students traveling to school, and could result in a small, short term increase in funding needed to maintain other roads in the region.

Cumulative Impacts: Implementation of the no action alternative combined with other past, present and reasonably foreseeable projects in the park would have long term adverse impacts on the socioeconomics of the communities surrounding the park. There would be limited increases in employment opportunities for the road construction work force.

Conclusion: Implementation of this alternative would result in long-term adverse impacts to the local and regional business and residents. Travel times and distances during the periodic construction activities would increase. Sporadic construction activities would be required in the future to maintain the road at its current state. The potential for highly adverse impacts is present if catastrophic road failure occurs.

Preferred Alternative

Direct and Indirect Impacts: Local communities would experience a long-term benefit as stabilization activities would allow the road to remain a safe and passable transportation corridor to Interstate 90. In the short-term, these communities would experience travel delays and potential roadway closures during construction. Local businesses would experience a short-term economic benefit from the construction activities as construction workers would likely spend a portion of the project funds locally.

Cumulative Impacts: No cumulative impact to socioeconomic resources is expected.

Conclusion: This alternative would result in short-term impacts to the local and regional businesses and residents by increasing travel times and distances during construction periods. Over the long-term, the preferred alternative would provide a beneficial impact by extending the life of the roadway and eliminating frequent maintenance on the roadway.

ARCHEOLOGY

Affected Environment

The park's archeology is characterized by sites that exhibit surface artifact scatters, extensive subsurface deposits, and artifact-bearing soil layers that have been buried up to five meters below the present ground surface. The Archeological Sites Management Information System (ASMIS) includes records for 344 (ASMIS 2014) sites within the park and this current site inventory represents a small fraction of the sites actually present in the park. Relatively small portions of the park have been inventoried for the presence of archeological sites (Lynott 2012). One of these sites located near the top of Cedar Pass has been determined to be eligible for listing in the National Register of Historic Places (NPS 2000), but is outside the project area and would not be affected by buttress construction activities. Section 106 of the NHPA of 1966, as amended (16 USC 470 et seq.) and its implementing regulations under 36 CFR 800 require all federal agencies to consider effects of federal actions on cultural properties eligible for or listed in the National Register. In order for an archeological site to be listed in the National Register, it must have the potential to provide information important to history or prehistory.

Although the project area has not been inventoried for archeological resources, because of its primarily steep slope-and gully terrain, the existence of intact buried archeological resources is very unlikely. A formal survey is not necessary. However, for lands immediately south of the project area, which has not been inventoried for archeological resources, should there be a need to modify or expand the project area, these lands would need to be inventoried before construction begins.

Borrow material for the buttress would be obtained from a commercial source outside of the park and the contractor would secure a borrow pit source that meets all of the requirements identified in the construction contract, including submitting written documentation satisfactory to the CO for a recommendation of either "no historic properties affected" or "no effect" according to 36 CFR 800.4(d)(1) for historic properties on or eligible for listing to the National Register of Historic Places. Provide either:

- (a) Documentation showing there are no cultural resources present, and a recommendation of either "no historic properties affected" or "no effect" according to 36 CFR 800.4(d)(1). Documents must be prepared by an individual qualified under the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation, 48 FR 44716-44740.

Documentation must be satisfactory to the State Historic Preservations Officer (SHPO) or Tribal Historic Preservations Officer (THPO) as appropriate, according to 36 CFR 800.3(c).

The CO will submit the documentation to the SHPO or THPO. Anticipate a minimum of 45 days from receipt of the documentation by the SHPO or THPO before use of the site may be approved; or

(b) Documentation showing a finding of either "no historic properties affected" or "no effect" according to 36 CFR 800.4(d)(1) has been previously obtained for the proposed activities from the State, Tribal Government or Federal Land Management Agency responsible for the land. Include attached copies of SHPO concurrence, or Memorandum of Agreement (MOA) where concurrence is not required.

Although recorded archeological sites are located outside the project area (NPS 2000) and would not be affected by proposed buttress construction activities, the Cliff Shelf Landslide is expected to continue to move in the absence of a substantial retaining structure. A National Register eligible archeological site is located in the general vicinity but well outside the proposed project area and would not be affected by replacing the temporary deep patch or construction of the buttress. If archeological resources are discovered or unanticipated effects on archeological resources are found during construction, the NPS would stop construction until a qualified archeologist could inspect the area. If the archeologist confirms the find, they would notify the SHPO, NPS Midwest Archaeological Center (MWAC), and American Indian tribes, pursuant to 36 1 CFR part 800.13. The project team would also reinitiate consultation with the SHPO and MWAC if the Area of Potential Effect (APE) changes or if new borrow areas are identified.

Environmental Consequences

No Action Alternative

Direct and Indirect Impacts: The deep patch construction, completed in December 2013 would minimize landslide movement and settlement from impacting the roadway for approximately 10 years. However, the deep patch would not be able to resist significant subsurface distress or prevent landslide failure. The no action alternative would limit ongoing road maintenance activities to previously disturbed areas, limiting impacts to potential archeological resources. The potential exists for slope failure under this alternative and the construction activities necessary to keep the roadway passable may result in altering the topography, which could expose potential archeological resources. If slope and roadway failure is substantial, permanent alteration to topography may be necessary, which could have long term impacts to potential archeological resources.

Cumulative Impacts: Deep patch construction and ongoing maintenance activities have permanently altered geological resources, which have the potential to inadvertently affect archeological resources. Implementation of the no action alternative in combination with the other projects discussed in this section would result in long-term adverse cumulative impacts archeological resources are inadvertently discovered.

Conclusion: Implementation of the no action alternative would result in long term, but limited impacts to archeological resources because ongoing maintenance activities would be mainly confined to previously disturbed areas that have no known archeological resources. If slope and roadway failure occurs, this alternative may result in long-term changes to the geological resources of the area and would have greater impacts to potential archeological resources.

Preferred Alternative

Direct and Indirect Impacts: There would be no effects to archeological resources within the project area. Because the buttress would be constructed from the toe of the slope upward toward the roadway grade, berm pressure would be added quickly for slide stabilization. This construction method would reduce the tendency for site erosion to which the slide is contributing, and would minimize impacts to potential archeological resources.

Archeological sites may exist south of the project area, although this area has not been surveyed. The project team would reinitiate consultation with the South Dakota SHPO if the Area of Potential Effect (APE) changes, if new borrow areas are identified, or if there is an inadvertent archeological discovery.

Cumulative Impacts: Recorded archeological sites are located outside the project area and would not be affected by buttress construction activities. However, lands immediately south of the project area have not been inventoried for archeological resources and archeological resources may exist should there be a need to modify or expand the project area.

Conclusion: No cumulative impacts to archeological resources would occur from buttress construction activities.

CONSULTATION AND COORDINATION

Internal Scoping

Scoping is an early and open process to determine the extent of environmental issues and alternatives to be addressed. Scoping was initiated by an interdisciplinary team of professionals from BADL, FHWA, and DSC staff. Public scoping began with an announcement released January, 2014 describing the preferred alternative and soliciting comments or concerns with the proposal to install a buttress to stabilize the Cliff Shelf Landslide. Scoping issues or impact topics that were considered, but not evaluated further, are discussed in “Impact Topics Dismissed from Further Consideration.”

Public Scoping

Agency Consultation

The NHPA (16 USC 470 et seq.): NEPA; NPS Organic Act; NPS Management Policies 2006; DO-12: Conservation Planning, Environmental Impact Analysis, and Decision-making (2001); and DO-28: Cultural Resources Management Guideline require the consideration of impacts on cultural resources, either listed in or eligible to be listed in the National Register. In accordance with Section 106 of the NHPA, the South Dakota Office of the State Historic Preservation Officer (SHPO) was notified of the proposed project by letter. Consultation with the SHPO concurred that the preferred alternative will have “no adverse effect” on historic properties (South Dakota Office of the State Historic Preservation Officer, Paige Olson, Review and Compliance Coordinator, Pierre, SD, letter to Eric Brunnemann, National Park Service, Interior, SD, October 24 , 2013).

In accordance with the Endangered Species Act, the NPS contacted the USFWS by letter on January 22, 2014 to solicit input on threatened and endangered species concerns for the proposed project. NPS sent additional follow-up email correspondence on February 2, 2014, as well as additional telephone correspondence February 25, 2014. NPS has not received any further correspondence from USFWS.

American Indian Consultation

American Indian tribes were contacted to determine if any ethnographic resources were in the project area and if a tribe wanted to be involved in the environmental compliance process. The NPS will continue to consult with American Indian tribes throughout the planning and implementation of the proposed project as required under CFR 36.800.2. American Indian Tribes would have an opportunity to review and comment on this EA.

NPS has received the following correspondence from the following tribes:

The Flandreau Santee Sioux Tribe of South Dakota sent a letter to the park on 1/9/2014 indicating the tribe has no interest in the geographic extent of the project area.

The Cheyenne and Arapaho Tribes sent a letter to the park on 2/18/2014 indicating they would like to be involved with the proposed project.

Environmental Assessment Review and List of Recipients

This EA will be released for a 30-day public comment period. To inform the public of the availability of the EA, the NPS will publish and distribute a postcard or press release to the parks' general mailing list (450 individuals and organizations); affiliated tribes; and federal, state, and local agencies, and members of the public on the park's mailing list, as well as place an ad in the local newspaper. The park will provide a press release to the area media:

- Colorado State University Library

Copies of the EA would be provided to interested individuals, upon request. Copies of the document will also be available for review at the Badlands National Park Visitor Center and on the Internet at <http://parkplanning.nps.gov/BADL>.

During the public comment period, the public is encouraged to submit their comments to the NPS address provided on the cover page at the beginning of this document. Following the close of the comment period, all public comments will be reviewed and analyzed prior to the release of a decision document. The NPS will issue responses to substantive comments received during the public comment period and would make appropriate changes to this EA, as needed.

List of Preparers and Contributors

National Park Service, Badlands National Park

Eddie Childers, Wildlife Biologist

Megan Cherry, Museum Technician

Rachel Benton, Paleontologist

Wolf Schwarz, Facility Manager

Ellen Starck, Physical Science Technician

Pam Griswold, Pinnacles District Ranger

National Park Service, Denver Service Center

Tracy Cudworth, Project Manager

Richard Boston, NEPA Specialist

Steve DeGrush, Natural Resource Specialist

Dustin Hill, Transportation Compliance Assistant

Federal Highway Administration

Justin Henwood, Project Manager

Brooke Rosener, Survey and Mapping Specialist

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2014 Threatened, Endangered, and Candidate Species of South Dakota.
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2014 State and County Quick Facts. Available at:
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2013 Cliff Shelf Landslide Geotechnical Design Report. Report # SD-PX-BADL-13-01.

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2000 Environmental Assessment: Stabilization of Loop Road over Cedar Pass.

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APPENDIX A: Scoping Announcement and Agency Comments



United States Department of the Interior
NATIONAL PARK SERVICE
Denver Service Center – Planning Division
12795 W. Alameda Parkway
Lakewood, CO 80228



January 22, 2014

Field Supervisor
U.S. Fish and Wildlife Service
South Dakota Ecological Services Field Office
420 S. Garfield Avenue, Suite 400
Pierre, SD 57501-5408

**RE: Scoping Notice – Preparation of Environmental Assessment to Repair Cliff Shelf
Landslide with a Buttress**

The National Park Service (NPS) is preparing an Environmental Assessment (EA) to analyze the impacts of constructing a rock and gravel buttress to protect roadway users by stabilizing the Cliff Shelf landslide along the Badlands Loop Road (South Dakota Highway 240). The project area is located four miles southwest of the park's northeast entrance station and just west of the Cliff Shelf Trail parking lot in the Cedar Pass area. The EA will analyze the environmental effects of two alternatives for stabilizing the landslide, which include the no-action alternative and the preferred buttress installation.

In the no-action alternative, the NPS would continue regular roadway and embankment maintenance, which would add to a history of temporary mitigation measures to prevent or repair slope damage and reestablish safe roadway access through the park. The preferred alternative would construct a buttress with sufficient mass to resist continued landslide movements. The buttress would have a maximum width of 25 feet and consist of unclassified borrow. The foreslope would have a maximum ratio of 1:2 (vertical to horizontal) with various heights along the approximately 200-foot length of the project area. The buttress would also have an internal drainage system to collect and dissipate subsurface water. Engineers expect the buttress' performance lifespan would approach 50 years with periodic maintenance required along the roadway surface. The preferred alternative is similar to the buttress constructed to stabilize the adjacent Cedar Pass landslide, which has performed well over the last 10 years.

Compared to the no-action alternative, the buttress installation would include localized impacts to geological resources and soils; paleontological resources; vegetation; and wildlife, including bighorn sheep habitat.

The NPS consulted the United States Fish and Wildlife Service (USFWS) *Species by County Report* on 12/2/2013 and confirmed there are two federally endangered; one proposed endangered; one proposed threatened; and one candidate species within Jackson County, which encompasses the project area. Endangered species include the whooping crane and black-footed ferret. The proposed endangered species is the northern long-eared bat. The proposed threatened species is the red knot, and the candidate species is Sprague's pipit. Consultation with park staff indicates that the black-footed ferret is known to reside within the park, but has not been

documented within the project area. Biological surveys may be completed prior to construction for any actions carried forward under the preferred alternative.

Although the development of the EA is in its preliminary stages, we believe the eventual implementation of the preferred alternative will not have any effect on federally listed species or their designated habitat. Therefore, we would like to request any information your office may have regarding the presence of federally listed threatened or endangered species, species proposed for listing, and existing or proposed critical habitat, which may be near the project area boundaries.

In compliance with Section 7 consultation and NPS policy, as soon as the EA is complete, we will send a copy to you for your review and comment. **We would appreciate any preliminary input you have by February 20, 2014.** Comments can be sent to:

Steve DeGrush
Denver Service Center - Planning Division
ATTN: EA Comments for BADL Cliff Shelf Landslide Buttress
12795 W. Alameda Parkway
Lakewood, CO 80228

If you have questions about the project or would like more information, please contact Steve DeGrush, Natural Resource Specialist, NPS Denver Service Center, at 303-969-2724 or by email at steve_b_degrush@nps.gov.

Sincerely,

Steve DeGrush
Natural Resource Specialist

APPENDIX B: Detour Plan

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
16	SD	SD FTTP RAD. 1008 JPL Shell Side Repair	T7	T9

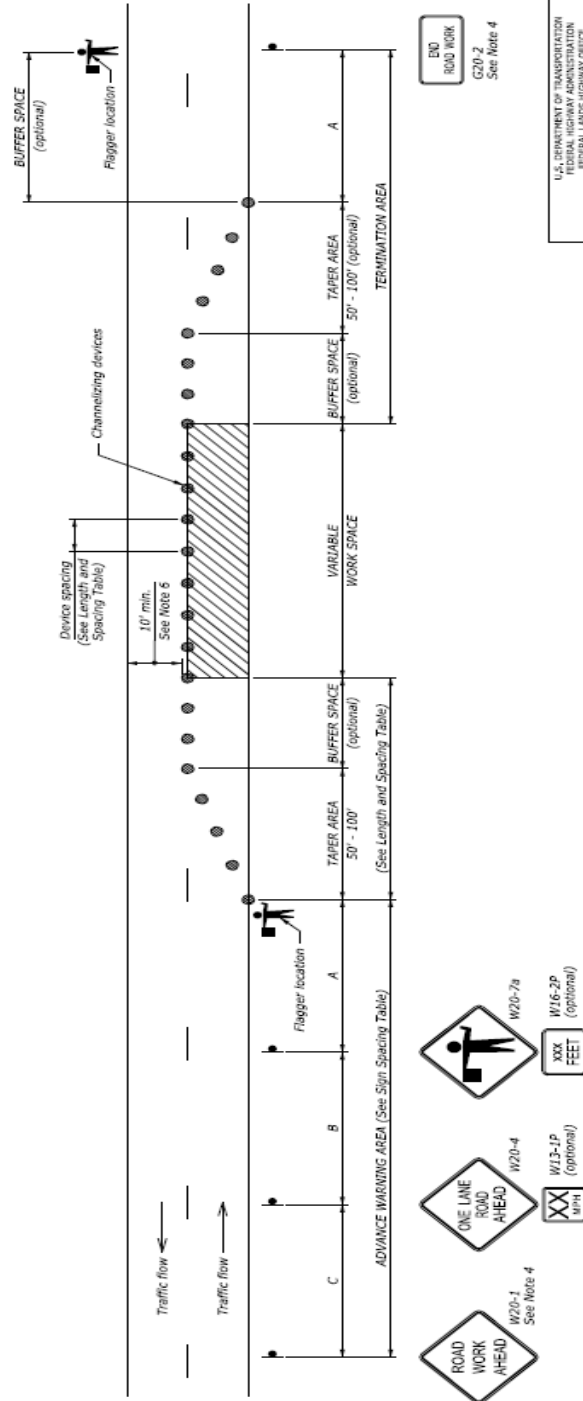
NOTE:

1. Signs are shown for one direction of travel only. Place devices similar to those depicted for the opposite direction of travel.
2. Final location and spacing of signs and devices may be changed to fit field conditions as approved by the CD.
3. For pilot car operation, mount the PILOT CAR FOLLOW ME (G20-4) sign at a conspicuous location on the rear of vehicle. Prominently display the name of the contractor on the pilot car.
4. If closure is completely within the project limits, eliminate the "ROAD WORK AHEAD" (W20-1) and "END ROAD WORK" (G20-2) signs.
5. For night time flagging operation, provide floodlighting at flagger stations.
6. For project specific minimum width, refer to the Special Contract Requirements, Section 156.
7. Do not allow equipment, materials, or vehicles to be parked or stored in the buffer space.

ROAD TYPE	DISTANCE BETWEEN SIGNS IN FEET		
	A	B	C
Urban and Rural 30 MPH and less	100	100	100
Urban and Rural 35 MPH to 50 MPH	350	350	350
Rural greater than 50 MPH	500	500	500
Expressway / Freeway	1000	1500	2640

LENGTH AND SPACING TABLE					
APPROACH SPEED*	BUFFER SPACE LENGTH	CHANNELIZING DEVICE			WORK SPACE
		TAPER	BUFFER SPACE	SPACING IN FEET	
20	115	20	40	40	
	155	20	50	50	
	200	20	60	60	
	250	20	70	70	
	305	20	80	80	
35	405	20	80	80	
	465	20	90	90	
	505	20	100	100	
	545	20	110	110	
	585	20	120	120	
40	645	20	130	130	
	705	20	140	140	
	765	20	150	150	
	825	20	160	160	
	885	20	170	170	
45	945	20	180	180	
	1005	20	190	190	
	1065	20	200	200	
	1125	20	210	210	
	1185	20	220	220	
50	1245	20	230	230	
	1305	20	240	240	
	1365	20	250	250	
	1425	20	260	260	
	1485	20	270	270	
55	1545	20	280	280	
	1605	20	290	290	
	1665	20	300	300	
	1725	20	310	310	
	1785	20	320	320	
60	1845	20	330	330	
	1905	20	340	340	
	1965	20	350	350	
	2025	20	360	360	
	2085	20	370	370	
65	2145	20	380	380	
	2205	20	390	390	
	2265	20	400	400	
	2325	20	410	410	
	2385	20	420	420	
70	2445	20	430	430	
	2505	20	440	440	
	2565	20	450	450	
	2625	20	460	460	
	2685	20	470	470	
75	2745	20	480	480	
	2805	20	490	490	
	2865	20	500	500	
	2925	20	510	510	
	2985	20	520	520	
80	3045	20	530	530	
	3105	20	540	540	
	3165	20	550	550	
	3225	20	560	560	
	3285	20	570	570	
85	3345	20	580	580	
	3405	20	590	590	
	3465	20	600	600	
	3525	20	610	610	
	3585	20	620	620	
90	3645	20	630	630	
	3705	20	640	640	
	3765	20	650	650	
	3825	20	660	660	
	3885	20	670	670	
95	3945	20	680	680	
	4005	20	690	690	
	4065	20	700	700	
	4125	20	710	710	
	4185	20	720	720	
100	4245	20	730	730	
	4305	20	740	740	
	4365	20	750	750	
	4425	20	760	760	
	4485	20	770	770	

* Approach speed based on the regulatory posted speed, not the advisory speed.



NO SCALE

**U.S. CUSTOMARY STANDARD
TEMPORARY TRAFFIC CONTROL
SINGLE LANE CLOSURE LAYOUT
(WITH FLAGGERS)**

REVISION	DATE	635-6
DRAWN: 9/2010		
NPS PROJ MCA 28-0937 DRAWING NO. 137-124283		

APPENDIX C: Best Management Practices (BMPs)

Resource Area / BMPs
<p>General Considerations</p> <p>Impact areas and buffer zones would be flagged prior to construction to ensure that resource damage (as determined by the project footprint and buffer zone surrounding construction areas) would not be exceeded during construction.</p> <p>A staging area for the construction office (a trailer), construction equipment, and material storage would be located in the Cliff Shelf parking area near the project site. The staging area would be returned to pre-construction conditions or better once construction has been completed. Standards and methods for acceptable post-construction conditions would be developed in consultation with the park's vegetation program manager.</p> <p>Before construction, the contractor(s) for individual projects would work with park staff to develop a construction traffic management plan. The plan would include information on construction phases and duration, traffic scheduling, proposed haul routes, staging area management, visitor safety, detour routes, and pedestrian and bicyclist movements on adjacent routes. The NPS would limit the transport of debris, construction equipment, and materials to periods of off-peak traffic whenever possible.</p> <p>Trash and other solid waste associated with construction operations that cannot be recycled, would be disposed of in trash bins and disposed of weekly, or sooner if warranted, outside of the park.</p> <p>All tools, equipment, barricades, signs, surplus materials, and rubbish would be removed from the project work limits upon project completion. Any asphalt surfaces damaged during construction of the project would be repaired to original conditions. All demolition debris would be removed from the project site. This material would be disposed of outside the park at an approved location.</p> <p>All equipment on projects would be maintained in a clean and well-functioning state to avoid or minimize contamination from mechanical fluids. All equipment would be checked daily.</p> <p>A hazardous spill plan would be in place, stating what actions would be taken in the case of a spill, notification measures, and preventive measures to be implemented, such as the placement of refueling facilities, storage, and handling of hazardous materials.</p>
<p>Air Quality</p> <p>Fugitive dust generated by construction would be controlled by spraying water on the construction site and surrounding area, if needed. This may be necessary to prevent the coating of vegetation with dust, which can interrupt photosynthetic mechanisms and increase stress on plants.</p> <p>To reduce entrainment of fine particles from hauling material, sufficient freeboard would be</p>

Resource Area / BMPs
maintained, and loose material loads (aggregate, soils, etc.) would be covered with tarps.
<p>Water Quality</p> <p>Erosion would be minimized to the extent possible, by using BMP's that would provide locations for stormwater runoff to percolate through soils. Existing roads and paved surfaces would be used as much as possible for construction activities and for keeping heavy equipment off undesignated paths and trails.</p> <p>Standard erosion control measures—such as silt fences, sand bags, or equivalent control methods—would be used to minimize any potential sediment delivery to ephemeral streams.</p>
<p>Soundscapes</p> <p>To reduce noise and emissions, construction equipment would not be permitted to idle for longer than 15 minutes.</p> <p>Contractors would be required to properly maintain construction equipment (e.g., mufflers) to minimize noise from equipment use.</p>
<p>Night Sky</p> <p>If needed, construction activities may occur during night hours for a minimal amount of time.</p> <p>Lighting would only be provided where necessary for the mobility or safety of visitors and staff.</p> <p>Fully shielded fixtures with asymmetrical light throws would be used to minimize the number of bollards for lighting. These fixtures would concentrate lighting on the horizontal surface to direct light only where needed. It is assumed that where illumination is necessary there would be no horizontal light spread beyond paved surfaces.</p>
<p>Geological Resources</p> <p>Before clearing and grading, the ground in the area to be cleared would be clearly marked to minimize the amount of cleared area.</p> <p>Only those areas necessary for construction would be cleared and grubbed.</p> <p>Because disturbed soils are susceptible to erosion until revegetation takes place, standard erosion control measures such as silt fences, straw wattles and / or sand bags would be used to minimize any potential soil erosion.</p> <p>The amount of disturbed earth area would be minimized, and the duration of soil exposure to rainfall limited.</p>
<p>Vegetation</p> <p>Social trails created by construction activities would be obliterated and revegetated, as appropriate, upon the completion of the project in each individual area to reduce further resource damage.</p> <p>Weed control methods would be implemented to minimize the introduction of noxious weeds</p>

Resource Area / BMPs

including power-washing of all earth-moving equipment and project-related vehicles brought into the park. The location selected for vehicle washing would be approved by a supervisory biologist.

The staging area location for construction equipment would be park approved, and the need to treat for nonnative vegetation would be considered.

Nonnative species encroachment and distribution would be monitored for two to three years after construction by qualified park staff.

Revegetation efforts would be initiated as soon as possible following construction to minimize the competition of native species with nonnative species.

Vehicle parking would be limited to existing roads or at the project staging area.

Any fill, rock, or additional topsoil needed would be obtained from a park-approved source. Topsoil from the project area would be used whenever feasible.

Wildlife

Construction activities would be restricted to daylight hours, from dawn to dusk.

Visitor Use and Experience

The park would develop and implement a visitor protection plan for park review and approval that would:

- Provide procedures for managing the staging area to restrict public access and maintain site safety.
- Ensure that visitors are safely and efficiently routed around construction areas.
- Outline measures to protect the safety of visitors by providing established and maintained walkways across the site, as well as barrier fencing along trails and paths.

To the extent practicable, work would be scheduled to avoid construction activity and construction-related delays during peak visitation times. No holiday or nighttime work would be allowed. Unless otherwise approved by the park, operation of heavy construction equipment would be restricted to dawn to dusk, year-round. Weekend work (Friday through Sunday) would not be allowed unless authorized by park staff overseeing the construction.

As allowed by time and funding, information about this transportation project and other foreseeable future projects would be shared with the public through park publications and other appropriate means during construction periods. This could take the form of an informational brochure or flyer distributed at the gate and sent to those with reservations at park facilities, postings on the park's website, press releases, and other methods. The purpose would be to minimize the potential for negative impacts to visitor experience during project implementation and other planned projects during the same construction season.

Resource Area / BMPs
<p>NPS employees, residents, and concessioners would be notified about project implementation and road delays or road closures, as appropriate.</p> <p>The contractor would provide a weekly construction schedule with daily updates to the NPS field supervisor to assist the park in managing visitation and park operations during construction.</p> <p>If required, flaggers, signs, or other new technology, as appropriate, would be used to manage traffic around work areas.</p> <p>Continued vehicular and pedestrian access to visitor facilities would be provided during construction. Temporary pedestrian pathways would be provided as needed between key visitor destinations and then removed and restored to natural conditions upon project completion.</p> <p>To reduce noise impacts on visitors, construction sites would be temporarily off-limits to visitors.</p>
<p>Socioeconomic Environment</p> <p>To coordinate with gateway communities in relation to project implementation, the NPS would develop and maintain a constructive dialogue and outreach effort with public and private organizations and businesses, including state and local tourism and travel offices and establish positive and effective working relationships with park concessioners and others in the tourism industry to ensure a high quality of service to park visitors.</p>
<p>Archeological Resources</p> <p>If previously unknown archeological resources were discovered during the project, a park archeologist would be contacted immediately. All work in the immediate vicinity of the discovery would be halted until the resources could be identified and documented and an appropriate mitigation strategy developed, if necessary, in consultation with the SHPO and the affiliated tribes. If the site would be adversely affected, a treatment plan would be prepared as needed. Treatment plans would fully evaluate avoidance, project redesign, and data recovery alternatives.</p> <p>All construction workers would be informed of appropriate site etiquette and the penalties of illegally collecting artifacts or of intentionally damaging any archeological or historic property. Workers would also be informed of correct procedures if previously unknown resources were uncovered during construction activities.</p> <p>The staging area for construction equipment and materials storage would be located where there is no potential for archeological resource disturbance. If the site selected for this activity changed during later design phases for any alternative, additional archeological surveys would be conducted to ensure that the staging area is clear of archeological resources.</p>
<p>Ethnographic Resources</p> <p>If Native American human remains, funerary objects, sacred objects, or objects of cultural</p>

Resource Area / BMPs

patrimony are uncovered during construction, all work would cease immediately, and the tribes would be contacted per regulations regarding inadvertent discoveries covered by the Native American Graves Protection and Repatriation Act.



As the nation's principal conservation agency, the Department of the Interior has the responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historic places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. Administration.

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