U.S. Department of the Interior
Bureau of Land Management

Environmental Assessment

Pompeys Pillar National Monument Stabilization
DOI-BLM-MT-C010-2022-0002-EA

February 2022

Pompeys Pillar National Monument
3039 US Highway 312
Pompeys Pillar, MT 59064

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1. Introduction

1.1 Summary of Proposed Project

The Pompeys Pillar National Monument is undergoing natural processes that threaten the integrity of this National Historic Landmark as well as the safety of the public who visits the location every year. The geologic makeup of the Pillar (sandstone, shale, and siltstone) lends itself to degradation through wind, moisture, and temperature changes.

Investigation into the stability of the Pillar led to its temporary closure in March of 2020 due to concerns for public safety. After contracting with a professional consulting firm, the site went through a comprehensive evaluation after which it was recommended all but the lower viewing deck of the Pillar be reopened. As part of the process a Trigger Action Response Plan (TARP) was developed which established pre-determined responses in the event of changes to the structure of the Pillar (see Appendix E). Further professional consulting has resulted in proposed measures to address the site's issues. These measures include scaling, foliage removal, drainage controls, stabilization or environmental protection for the shale and siltstone layer, buttressing at Signature Block, underpinning of Turtle Rock, and rock bolting at both Signature Block and Turtle Rock.

1.2 Purpose and Need

The purpose and need of this project is to address ongoing natural destabilization and degradation of the Pompeys Pillar National Monument and National Historic Landmark through remediation measures designed to stabilize the rock formation, prevent future degradation, manage the risk to the public, and allow for future enjoyment while maintaining the character of the site.

1.3 Decision to be Made

This document will be used to select the remediation measures that when implemented will best fulfill the purpose and need of the project while minimizing adverse impacts to other affected resources.

1.4 Land Use Plan Conformance

This project is in conformance with the *2015 Billings Field Office and Pompeys Pillar National Monument Approved Resource Management Plan.* The proposed action is in conformance with the following goals, objectives, and decisions listed in the RMP for the National Monument, Area of Critical Environmental Concern, Lewis and Clark National Historic Trail, and the Yellowstone River Corridor Special Management Area.

- **Goal REC-3:** BLM's goal is to develop and maintain appropriate recreational facilities, balancing public demand, protection of public land resources, and fiscal responsibility. (p. 3-29)
- **MD PPNM-1:** Manage Pompeys Pillar NM (51) acres to protect the historical and cultural objects for which it was designated a National Monument.

- **MD PPNM-14:** Management Zones: Front Country Zone – includes all of the National Monument lands (51 acres) and 34 acres outside of and immediately adjacent to the National Monument 2. Use this zone area to develop new facilities, including structures and roads, where they are necessary for public health and safety, are required under law, are necessary for the exercise of valid existing rights or other non-discretionary uses, prevent impacts on fragile resources, or further the purposes for which the NM was designated.
- **MD PP ACEC-9:** 4. Facilities would be designed to enhance visitor experiences. General Management Zone – (347 acres)
- **MD PPMN-5:** Visual Resource Management (VRM): Class II for the NHL (6 acres) for protection of the significant historical resource and VRM Class III for the remainder of the PPNM for consideration of potential facility development and public management concerns.
- **MD C&HR-5:** Design and maintain facilities to preserve the visual integrity of cultural resources, settings, and cultural landscapes consistent with VRM objectives established in the RMP

Yellowstone River Corridor Special Recreation Management Area, Zone 1 *(Billings Field Office RMP, Volume 2, Appendix N, page N-14)*

Best Management Practices PPMN ***(PPMN RMP, Appendix B, page B-50)***

1.5 Relationship to Statutes, Regulations, Other NEPA Documents

- Federal Land Policy and Management Act of 1976 (43 U.S.C. §§ 1701-1782, P.L. 94-579, October 21, 1976, as amended 1978, 1984, 1986, 1988, 1990-1992, 1994 and 1996)
- National Historic Preservation Act (54 U.S.C. 300101 et seq.)
- Federal Lands Recreation and Enhancement Act of 2004 (REA), P.L. 108-447 (16 U.S.C. § 6804.)
- National Historic Landmarks Program of 1983 (54 USC 302102 et seq.)
- The Pompeys Pillar Trail expansion meets directives established in the National Trails System Act of 1968 (16 USC 1241 et seq.) by providing *"for the ever-increasing outdoor recreation needs of an expanding population and in order to promote the preservation of public access to, travel within, and enjoyment and appreciation of the open-air, outdoor areas and historic resources of the Nation"*
- The proposed action also aligns with BLM Montana/Dakotas Recreation Strategy: *Connecting with Communities: "Backyard to Backcountry" 2015-2019.* Goal 2: Facilitate Greater Well-Being and Economic Benefits within Communities

This EA was prepared to thoroughly examine the potential environmental impacts of the proposed action and alterative actions in order to support informed decision-making. This EA is consistent with the purpose and goals of NEPA; the requirements of the Council on Environmental Quality's (CEQ) implementing NEPA regulations at 40 CFR Parts 1500-1508; longstanding federal judicial and regulatory interpretations; the Department of the Interior's NEPA regulations (43 CFR Part 46); and Administration priorities and polices including Secretary's Order No. 3399 requiring bureaus and offices to use "the same application or level of NEPA that would have been applied to a proposed action before the 2020 Rule went into effect."

1.6 Issues Identified for Analysis

Site specific resource concerns were identified by the BLM through the preliminary review process conducted during the internal and external scoping period. The BLM focuses its analysis on issues that are truly significant to the action in question. Issues have a cause-effect relationship with the proposed action; are within the scope of analysis; and are amenable to scientific analysis.

1.6.1 How will the remediation measures effect the historic inscriptions on the Pillar, including those on the Turtle Rock area?

1.6.2 How will the visual integrity of the site be altered by the remediation measures?

1.6.3 How will public access and experience be affected by the remediation process?

1.6.4 How will the surface disturbing activities associated with the implementation of the project and the design feature of foliage removal affect native vegetation?

1.6.5 How will the remedial measures affect the geologic integrity of the National Monument?

1.7 Issues Identified but Eliminated from Further Analysis

1.7.1 Will public safety be affected during and after the construction process?

The interest of public safety is one of the key drivers behind the project. The site would normally plan to be opened and accessible by the public during most phases of the construction process. However, there would be times when all or parts of the monument would be closed to public access for reasons such as public safety or the need to utilize places normally accessible for construction purposes. Due to the construction and design features listed in Appendix F, there is not expected to be an impact to public safety during the construction of this project.

Additionally, the Pillar is monitored by a Rock Block Monitoring System (RBMS) which consists of various monitoring devices at key points throughout the Pillar which will detect and automatically report movement in parts of the structure. There are protocols in place referred to as the Trigger Action Response Plan (TARP) that sets out predetermined courses of action if defined visual observations or monitoring thresholds are exceeded. See Appendix E for a full description of the plan. The Draft TARP and all associated RBMS pieces will remain in place both during and post construction. Once construction is complete a finalized TARP will be implemented taking into account the changes made to the Pillar. For these reasons, this issue is not carried forward for detailed analysis.

1.7.2 Will the surface disturbing activities associated with the implementation of the project cause soil erosion?

The project area is comprised of Haverson loam and Rock land soil units. These soils are loams, silt loams, very fine sandy loams, or sandy clay loams more than 20 inches deep. The secondary

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staging areas are mapped within the Rock land unit. The main construction staging area and staging area for crane to turtle rock are mapped within the Haverson loam unit. The main construction staging area and staging area for crane to turtle rock may be mowed prior to use. Secondary staging areas will not have vegetation removed prior to use; the area will be used in its current state. All staging areas, except the main construction and crane staging area, are for daily use for equipment and material. The contractors shall removal all equipment and materials at the end of each day. The contractors will protect existing ground surface in all staging areas. All potential surface disturbing activities will be required to implement the Billings Field Office Approved Resource Management Plan (ARMP), Soil Best Management Practices (BMPs) (Appendix H). With the implementation of the BiFO ARMP Soil BMP's, design features of the alternatives, and reclamation plan (Appendix I) soil erosion is not anticipated to occur. Therefore, this issue was considered but eliminated from further analyses.

1.7.3 Would construction activities on and around the Pillar affect nesting raptors?

Two species of raptors are known to nest at PPNM. An active Bald Eagle nest lies >0.6 mi to the east of the Pillar. A pair of Great Horned Owls nests on the west side of the Pillar, moving nest sites year to year but typically nesting within 0.25 mi of the Pillar. The pair may in some years nest on the west face of the Pillar itself. Both species initiate courtship and nesting in the winter, some years as early as January. Typically, nest initiation takes place in February-March with fledging typically occurring by June for Great Horned Owls and July for Bald Eagles. Harsh winter conditions can delay nest initiation by several months.

The Bald Eagle nest is screened from view of the Pillar by trees. It is unlikely that construction activities at the Pillar would affect courtship, breeding, and nesting behaviors of Bald Eagles.

Most of the proposed construction activities are planned for the eastern face of the Pillar on the opposite side from the Great Horned Owl nest sites. Activities here would likely be suitably screened by the Pillar and would have little to no effect on nesting Great Horned Owls. However, work on Turtle Rock may affect nesting owls due to its location on the north face and near the west end of the Pillar. Effects to nesting owls would be mitigated by avoiding construction activities on Turtle Rock and the west/northwest side of the Pillar from February 1 through June 30.

Considering locations of raptor nest sites relative to proposed construction activities and timing limitations to mitigate effects of proposed activities, nesting raptors have not been carried forward for further analysis

1.7.4 Would construction activities on and around the Pillar effect nesting habitats for migratory birds?

The Pillar as a landform provides diverse nesting habitats for migratory bird species. Southerly rock faces show evidence of use by swallow species as nest sites. Silver buffaloberry, chokecherry, and other shrubs may support nesting birds where they grow on the Pillar. No construction activities are planned for rock faces containing past-years' swallow nest sites. Potential nest sites for species such as Rock Wren which prefer to nest in rock crevices and cavities may be covered by stabilizing materials on a portion of the southeastern side of the Pillar under all action alternatives. Most migratory birds do not return to the same nest site annually, and rock faces at the Pillar are not unique along the Yellowstone River. Avoidance of

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construction activities from April 15 through July 15 would mitigate most effects to current year breeding and nesting migratory birds. Mowing of staging areas prior to and frequently throughout the breeding and nesting season would reduce suitable nesting habitat and reduce the likelihood of birds attempting to nest at these high use sites. Some potential nest sites in vegetation and on rock faces would be permanently removed or altered. Relative to the amount of nesting habitat available to birds along the Yellowstone River bottom and sandstone bluffs, loss of habitat at the Pillar is expected to have negligible effects to breeding and nesting migratory birds. Nesting habitats for migratory birds are therefore not carried forward for further analysis.

1.7.5 Will attempts to stabilize the Pillar inadvertently alter the characteristics for which the Pillar is listed as a National Historic Landmark (NHL)

The NHL status of Pompeys Pillar was granted in 1965 because of William Clark's 1806 signature on his return trip after reaching the Pacific Ocean with the Corps of Discovery. The presence of Clark's signature at this location is well documented, so will remain special and significant regardless of the proposed stabilization work.

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2. Alternatives

Alternatives for the Pompeys Pillar Stabilization Project were selected from a range of remedial measures developed by the engineering firm Itasca. Aside from the No Action Alternative, most remediation measures are carried forward throughout Alternatives A and B. However, some remediation measures utilize different approaches in achieving, relatively, the same outcome and constitute the differences between all of the action alternatives. A description of all remediation measures can be found in Appendix F. Alternatives were developed both in order to examine the impact of differing measures as well as provide alternatives for completing the project in the even on the ground issues arose during construction.

2.1 No Action Alternative

Under the No Action Alternative, the BLM would take no action in stabilizing Pompeys Pillar National Monument. The natural degradation would be allowed to continue to occur. Monitoring of the site utilizing previously installed instrumentation would continue. If such monitoring indicates that an issue may arise, the appropriate steps to protect public safety would be implemented. Selection of the No Action Alternative would not preclude future implementation of these, or other stabilization measures accompanied by the appropriate level of NEPA analysis. See *Table 1: Comparison of Alternatives* below for a breakdown of which remedial measures are included in each alternative.

2.2 Alternative A

Alternative A utilizes the following remedial measures to achieve protection of the Pillar:

- Scaling
- Foliage Removal
- Top of Sandstone Drainage Control
- Shale and Siltstone Stabilization
- Buttressing at Signature Block
- Rock Bolting at Signature Block 1a
- Underpinning at Turtle Rock
- Rock Bolting at Turtle Rock

Alternative A reflects the recommended remedial actions from Itasca Consulting that would enact the soundest stabilization and protection measures. After careful study, these measures are expected to be able to be applied to the Pillar notwithstanding its distinct geologic makeup. All remedial measures are described in detail in Appendix F.

2.3 Alternative B

Alternative B utilizes the following remedial measures to achieve protection of the Pillar:

- Scaling
- Foliage Removal
- Top of Sandstone Drainage Control
- Shale and Siltstone Environmental Protection
- Rock Bolting at Signature Blocks 2a, 2b, and 2c

- Rock Bolting at Signature Block 1a
- Underpinning at Turtle Rock
- Rock Bolting at Turtle Rock

Alternative B may be enacted if there are issues with the applicability of Alternative A. This measure differs from Alternative A in two ways. First, it analyzes the *Shale and Siltstone Environmental Protection* as opposed to *Shale and Siltstone Stabilization*. This is being examined in the event that during construction it is found that places of the shale and siltstone are not conducive to receive stabilization treatment, in which case environmental protection would be utilized. Next, in the event that underpinning is not feasible at the Signature Blocks 2a, 2b, and 2c, applying rock bolts in a limited capacity are a reasonable option to address some of the same concerns. All remedial measures are described in detail in Appendix F.

2.4 Alternatives Considered but not Analyzed in Detail (If Applicable)

The design of the project was provided by Itasca, a private consulting firm specializing in geotechnical project. The alternatives being considered are based upon expert opinion of what are the best methods for achieving the project's purpose and need. Alternatives that were considered were based upon differences in achieving the purpose and need in the faces of differing resource concerns and on-site factors which may necessitate altering courses of action. So, while there were no specific *alternatives* that were not considered for analysis, there were various remediation measures first considered by Itasca but eventually dismissed due to feasibility concerns. These are all outlined in Appendix I.

For the alternatives that were considered in detail, below is a table which illustrates which remedial measures were considered in each alternative.

Table 1: Comparison of Alternatives

Remedial Measure	No Action Alternative	Alternative A	Alternative B
Scaling	Excluded	Analyzed	Analyzed
Foliage Removal	Excluded	Analyzed	Analyzed
Top of Sandstone Drainage Control	Excluded	Analyzed	Analyzed
Shale and Siltstone Stabilization	Excluded	Analyzed	Excluded
Shale and Siltstone Environmental Protection	Excluded	Excluded	Analyzed
Buttressing at Signature Block	Excluded	Analyzed	Excluded
Rock Bolting at Signature Blocks 2a, 2b, and 2c	Excluded	Excluded	Analyzed
Rock Bolting at Signature Block 1a	Excluded	Analyzed	Analyzed
Underpinning at Turtle Rock	Excluded	Analyzed	Analyzed
Rock Bolting at Turtle Rock	Excluded	Analyzed	Analyzed

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3. Affected Environment and Environmental Consequences

3.1 General Setting

Pompeys Pillar National Monument lies 30 miles east of Billings, MT and less than one-mile north of I-94 and is adjacent to the Yellowstone River. The area is surrounded by agricultural development with associated housing and infrastructure including a United Grain silo facility which lies between the monument and the highway. While the setting is generally rural, its proximity to the highway and railroad further south, as well as the silo facility, take away from any true sense of solitude.

The site itself has been developed to accommodate the large number of visitors and provide them with a safe and rewarding experience. To host the large crowds that tour the area during peak season, there is a paved parking lot, interpretive center, and amphitheater. Most importantly, there is a large boardwalk wrapping around the Pillar that allows visitors to view such sites to include Clark's signature, Turtle Rock, and the surrounding landscape from the top of the Pillar. Additionally, the site contains various safety and monitoring devices to ensure the well-being of visitors and the Landmark itself.

3.2 How will the remediation measures effect the historic inscriptions of the Pillar, including those on the Turtle Rock area?

3.1.1 Affected Environment

After Clark left his name on the rock, various other travelers from fur trappers to homesteaders to soldiers and travelers on the Steamship Josephine, one of the last such boats to travers as far west as the Pillar, left their own inscriptions on the sandstone. Due to the nature of the sandstone, most, if not all, of the petroglyphs and pictographs postdate the 1700s, and even more visible elements postdate 1900. Inscriptions from solders and travelers on Josephine are primarily found on Turtle Rock.

Before Europeans reached Pompeys Pillar, generations of Native Americans made use of the rock and surrounding landscape, to leave pictographs on the rock face, only traces of which are still visible. These are found primarily on the same rock face bearing Clark's signature.

The Billings Field Office archaeologist documented PPNM extensively at the time the BLM took over management of the Monument, designated as such in 2001. John Taylor's 1990 site form created the basis for the alphanumeric numbering system used to note where rock art panels are located on the Pillar. In 2001, the Billings Field Office contracted representatives of the Art Department at Minot State University in North Dakota to provide baseline documentation of the signatures and rock art at the Monument. The project was led by Linda Olson, who expanded on Taylor's earlier numbering system to document rock art in detail. The project recorded over 2,000 separate names, dates and initials on 147 separate panels from the 11 sections of the butte, as well as a sampling of Native American petroglyphs and pictographs. Rock art and historic graffiti of varying age were documented all over the Pillar, on every accessible rock surface, although not all inscriptions contribute to the significance of the site.

3.1.2 Environmental Effects —No Action Alternative

The No Action alternative would result in continual, natural erosion at the site. No inscriptions

would be at risk by application of remediation measures. The inscriptions at the Pillar would continue their natural degradation.

3.1.3 Environmental Effects—Alternative A

The shale and siltstone stabilization component of Alternative A could result in over spraying of shotcrete/concrete onto historic inscriptions located on the sandstone above the area to be treated. A Design Feature in Appendix F specifies that measures shall be taken to prevent over spraying of these materials

The underpinning at Turtle Rock could result in the covering of significant historic inscriptions. To prevent this, a Design Feature is included in Appendix F specifying no shotcrete, concrete, resin or any other materials will be applied over the inscriptions found to the left and center left of the Turtle Rock neck/chin areas. See Figure 26 in Appendix F.

The proposed bolting of Turtle Rock carries risk that the bolting procedure damages the inscriptions found on the Rock. To mitigate this, drilling shall commence at a speed unlikely to created vibrations that could damage the Rock. A Design Feature specifying this requirement can be found in Appendix F. Potential Mitigation Measures should historic inscriptions be damaged includes such things as creating replica inscriptions to house in the visitor center and other forms of public education regarding any lost inscriptions.

3.1.4 Environmental Effects—Alternative B

Some of the Environmental Effects of Alternative B are the same as in Alternative A, with the substitution of shale and siltstone environmental protections rather than shale and siltstone stabilization. Both actions include the application of shotcrete, concrete, resin, sodium silicate, and other materials which could over spray onto historic inscriptions without preventative measures. Stabilization measures for Turtle Rock are the same in both alternatives.

Rock bolting of blocks 2a, 2b, and 2c would replace underpinning at the Signature Block, if it is determined to be unfeasible. Potential effects created by rock bolting includes vibration created by drilling and installation of the rock bolts, possibly disturbing historic inscriptions located on the outside of these rocks. Design Features found in Appendix F serve to prevent this kind of damage.

3.3 How will the visual integrity of the site be altered by the remediation measures?

3.3.1 Affected Environment

The Bureau of Land Management (BLM) is entrusted with the care of 264 million acres of public lands containing many outstanding scenic landscapes. By law, BLM is responsible for managing these public lands for multiple uses. But BLM is also responsible for ensuring that the scenic values of these public lands are considered before allowing uses that may have negative visual impacts. BLM accomplishes this through its Visual Resource Management (VRM) system, a system which involves inventorying scenic values and establishing management objectives for those values through the resource management planning process, and then evaluating proposed activities to determine whether they conform to the management objectives. BLM has established VRM coordinators in each state and provides training in VRM so that this system is implemented effectively and consistently throughout the Bureau. The Bureau's VRM system

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helps to ensure that the actions taken on the public lands today will benefit the landscape and adjacent communities in the future.

Visual Resources are inventoried using procedures established in the BLM Handbook H-8410-1 and are managed under the guidelines in BLM Handbook H-8431. A class is based on the physical and sociological characteristics of any given homogeneous area and serves as a management objective. Categories assigned to public lands are based on scenic quality, sensitivity level, and distance zones. Each class has an objective that prescribes the amount of change allowed in the characteristic landscape (from H-1601-1, BLM Land Use Planning Handbook). The four classes are described below:

- Class I provides for natural ecological changes with very little management activity. This class includes primitive areas, some natural areas, some wild and scenic rivers, and other similar areas where landscape modification activities should be restricted.
- Class II areas are those areas where changes in any of the basic elements (form, line, color, or texture) caused by management activity should not be evident in the characteristic landscape. The goal is to retain the existing landscape character.
- Class III includes areas where changes in the basic elements (form, line, color, or texture) caused by a management activity may be evident in the characteristic landscape. The level of change from an activity should not dominate the landscape but may attract attention of the casual observer. Changes should repeat the basic landscape elements.
- Class IV applies to areas where changes may subordinate the original composition and character; however, they should reflect what could be a natural occurrence within the characteristic landscape, if possible. The level of change to the existing landscape can be high and may dominate the view. This class provides for management activities which require modification to the existing landscape character.

Pompeys Pillar National Monument RMP/EIS established visual management objectives to minimize adverse impacts to the visual resources on the landscape, and maintain the overall integrity of VRM classes, while allowing for modifications to landscapes in those classes, consistent with the established management objectives. The six acres of the National Historic Landmark where the remedial measures are proposed to be performed are Class II in order to protect historic and cultural resources. The remaining acres of the monument come under Class III.

3.3.2 Environmental Effects—No Action Alternative

Under the No Action Alternative, the BLM would take no action in stabilizing Pompeys Pillar National Monument. The natural degradation would continue to occur. Water and wind would continue to erode away the signature rocks deepening cracks and undermining the stability of the Signature Block area and Turtle Rock.

3.3.3 Environmental Effects—Alternative A

Under Alternative A, actions would be carried out within the 6 acres of the National Historic Landmark managed as Class II. The actions described would comply with the Best Management Practices outlined in the PPMN RMP stating site design elements shall be integrated with the surrounding landscape. Elements to address include minimizing the profile of any structures and making sure they blend with the surrounding landscape.

In this case the topsoil drainage system would be designed so as not to draw the eye of the casual observer. Rocks removed by scaling could be used to conceal the drainage system. Shale and Siltstone Stabilization, underpinning at the Signature block and Turtle rock would be done by in the contractor in a manner that maintains the existing landscape character. A metal post would be utilized for underpinning at Turtle Rock. The post would be designed in a manner to match the natural forms surrounding turtle rock. The post would flare at the top and bottom eliminating potential concerns of a straight metal pipe being the solution Shotcrete shall receive color treatment during mixing, the surface shall be textured, and the surface shall be finished to appear like the shale and siltstone. The rock surfaces shall be protected against permanent damage, especially in areas the public would be able to see. The Signature Block rock bolting would be concealed with shotcrete matching the existing surface avoiding the eye of the casual observer. Detailed descriptions for all above actions can be found in Appendix F.

3.3.4 Environmental Effects—Alternative B

Actions under Alternative B would include all actions under Alterative A except *Shale and Siltstone Environmental Protection* would replace *Shale and Siltstone Stabilization*, and Rock bolting would replace underpinning at the Signature Block, if each are determined to be unfeasible. Substituting Environmental Protection and rock bolting would look the same to the casual observer upon project completion. Environmental protection would encompass the same area as the stabilization method but would not utilize shotcrete and would instead allow the existing rock to show through a thin layer of hardening material. Rock bolting would also not use shotcrete and would instead utilize hidden bolts with minimal and easily covered access points.

3.4 How will public access and experience be affected by the remediation process?

3.4.1 Affected Environment

After acquiring Pompeys Pillar National Landmark in 1991, the BLM constructed a wooden boardwalk in 1992 to provide visitors access to the sandstone butte. This walkway provides access via a walkable path from the base of the Pillar to the very top of the Pillar. The walkway also includes a few viewing platforms at Clark's signature and at the very top west side of the Pillar. The ability for visitors to access the boardwalk and Pillar is a main draw for the site and is very important to the visitors' experience in seeing the inscriptions on the sandstone and having a 360-degree view of the Yellowstone Valley landscape. Providing a safe experience and safe access to the Pillar is the top priority.

The boardwalk was temporarily closed in March 2020 until May 2021 while a comprehensive assessment was conducted to address safety concerns about the stability of the rock formation. Following this assessment, the majority of the Pillar was reopened to the public. However, the lower viewing platform at Clark's signature remains closed at this time due to ongoing safety concerns.

Pompeys Pillar National Monument receives approximately 30,000 visitors annually. A large percentage of these visitors use the boardwalk to experience the Pillar during the months of May through September.

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3.4.2 Environmental Effects—No Action Alternative

Under the No Action Alternative, access to the boardwalk may continue until it is determined that the conditions present are not safe enough to allow for public access. Techniques used to monitor the conditions could be visual inspection, data collected through the rock block monitoring system, and data analysis. The lower platform, currently closed, would remain closed indefinitely.

3.4.3 Environmental Effects—Alternative A

Under Alternative A, access to the boardwalk may continue and access could be temporarily restricted during the construction period which could be during the summer months where visitation is at the highest. The boardwalk is near some of the work areas at the signature block and turtle rock. There may be times where construction activities (scaling, top of sandstone foliage removal, drainage protection, shale and siltstone stabilization, buttressing at Signature block, underpinning at Turtle rock and rock bolting at Turtle rock) could present a safety issue with public access to the boardwalk and the boardwalk would need to be temporarily closed. Construction activities could produce additional noise from construction equipment and tools. Construction personnel would use the boardwalk to access work areas. Areas off the boardwalk, not accessible to the public, may be used by construction personnel to access the work areas. These activities may be a distraction to visitors during their visit.

Prior to construction activities, the BLM will attempt to alert potential visitors about the timeline for the project and temporary closures that are planned so we can lessen any impact to visitors' enjoyment of the Monument. A combination of press releases, social media posts, website postings, and phone messages as well as on-site information will be available.

In Alternative A, once construction activities are completed, access to the boardwalk would continue and the lower viewing platform would reopen and would ensure that public access continues at the Pillar.

3.4.4 Environmental Effects—Alternative B

Under Alternative B, like under Alternative A, access to the boardwalk may continue and access could be temporarily restricted during the construction period which could be during the summer months where visitation is at the highest. The boardwalk is near some of the work areas at the signature block and turtle rock. There may be times where construction activities (scaling, foliage removal, top of sandstone drainage control, shale and siltstone environmental protection, underpinning at Turtle rock, rock bolting at Signature block and Turtle rock) could present a safety issue with public access to the boardwalk and the boardwalk would need to be temporarily closed. Construction activities could produce additional noise from construction equipment and tools. Construction personnel would use the boardwalk to access work areas. Areas off the boardwalk, not accessible to the public, may be used by construction personnel to access the work areas. These activities may be a distraction to visitors during their visit.

Prior to construction activities, the BLM will attempt to alert potential visitors about the timeline for the project and temporary closures that are planned so we can lessen any impact to visitors' enjoyment of the Monument. A combination of press releases, social media posts, website postings, and phone messages as well as on-site information will be available.

In Alternative B, once construction activities are completed, access to the boardwalk would

continue and the lower viewing platform would reopen and would ensure that public access continues at the Pillar.

3.5 How will the surface disturbing activities associated with the implementation of the project and the design feature of foliage removal effect native vegetation?

3.5.1 Affected Environment

The project area is within the Major Land Resource Area (MLRA) (as defined by the United States Department Agriculture (USDA) Natural Resources Conservation Service (NRCS)) Sedimentary Plains, Central 58 AC. The major Ecological Site Description (ESD) is Silty (Si) RRU 11–14-inch precipitation zone (R058AC040MT) and Rock Outcrop.

The Silty ESD is grassland dominated by cool and warm season grasses, with forbs and shrubs occurring in smaller percentages. Approximately 75-80% of the annual production by weight is from grasses and sedges, 5-15% is from forbs, and 1-5% is from shrubs, half-shrubs, and cacti. Canopy cover of shrubs is typically 1-5%. Trees are not significant on this site. Dominant species include bluebunch wheatgrass (*Pseudoroegneria spicata*), green needlegrass (*Nassella viridula*), western or thickspike wheatgrass (*Pascopyrum smithii*), needleandthread (*Hesperostipa comata ssp. comata*), and short grasses such as Sandberg bluegrass (*Poa secunda*) and prairie junegrass (*Koeleria macrantha*). There are abundant forbs (purple and/or white prairie clover (*Dalea purpurea* and *Dalea candida*), prairie coneflower (*Rudbeckia fulgida*), dotted gayfeather (*Liatris puncatata*) which occur in smaller percentages. Shrubs such as Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*) and winterfat (*Krascheninnikovia lanata*) are common. There are no reasonably foreseeable future actions within this project area.

3.5.2 Environmental Effects—No Action Alternative

Under the No Action Alternative, the BLM would not authorize any action which would cause surface disturbing activities. Therefore, the native vegetation would remain in its current state and potential effects to vegetation would not occur.

3.5.3 Environmental Effects—Alternative A

Under Alternative A, the BLM would authorize actions that would potentially have a short-term effect on vegetation from the use of the staging areas. The main construction staging area and staging area for crane to turtle rock may be mowed prior to use. The secondary staging areas will not have vegetation removed prior to use; the area will be used in its current state. Disturbance may occur to vegetation within the staging areas by trampling of vegetation by workers, equipment and material storage. All staging areas, except the main construction and crane staging area, are for daily use for equipment and material. The contractors shall removal all equipment and materials at the end of each day. The contractors will protect existing ground surface in all staging areas.

The BLM would also authorize an action that would have a long-term effect on approximately 900 square feet of vegetation. The long-term effects would be from the design feature of the permeant removal of foliage within the upper signature construction area (refer to Figure 7 and Figure 8 in Section F.4). Removal would consist of a BLM approved herbicide application

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and/or physical removal of foliage (refer to Section F.4 for details).

All potential surface disturbing activities would be required to implement the Billings Field Office Approved Resource Management Plan (ARMP), Vegetation, Vegetation Rangeland, and Soils Best Management Practices (BMPs) (Appendix G.). With the implementation of the BiFO ARMP BMP's, design features of the alternative, and reclamation plan (Appendix H) effects to vegetation within the staging areas would be short-term and minimal. The design feature of foliage removal would be long-term for approximately 900 square feet of vegetation.

3.5.4 Environmental Effects—Alternative B

Under Alternative B, the BLM would authorize actions that would potentially have a short-term effect on vegetation from the use of the staging areas. The main construction staging area and staging area for crane to turtle rock may be mowed prior to use. The secondary staging areas will not have vegetation removed prior to use; the area will be used in its current state. Disturbance may occur to vegetation within the staging areas by trampling of vegetation by workers, equipment and material storage. All staging areas, except the main construction and crane staging area, are for daily use for equipment and material. The contractors shall removal all equipment and materials at the end of each day. The contractors will protect existing ground surface in all staging areas.

The BLM would also authorize an action that would have a long-term effect on approximately 900 square feet of vegetation. The long-term effects would be from the design feature of the permeant removal of foliage within the upper signature construction area (refer to Figure 7 and Figure 8 in Section F.4). Removal would consist of a BLM approved herbicide application and/or physical removal of foliage (refer to Section F.4 for details).

All potential surface disturbing activities would be required to implement the Billings Field Office Approved Resource Management Plan (ARMP), Vegetation, Vegetation Rangeland, and Soils Best Management Practices (BMPs) (Appendix G). With the implementation of the BiFO ARMP BMP's, design features of the alternative, and reclamation plan (Appendix H) effects to vegetation within the staging areas would be short-term and minimal. The design feature of foliage removal would be long-term for approximately 900 square feet of vegetation.

3.6 How will the remedial measures affect the geologic integrity of the National Monument?

3.6.1 Affected Environment

The Hell Creek (floodplain/fluvial) and the Lance (fluvial) are laterally equivalent formations. Depending on the preferences of the geographic state or the author, they are often considered the same formation and the formation names are interchangeable. Montana and North Dakota tend to favor use of the term Hell Creek, and Lance is preferred in Wyoming.

The Hell Creek Formation in the Pompeys Pillar/Billings area is composed of light-colored, fine-grained, cliff-forming massive sandstones separated by beds of darker shale and siltstone, with minor thin beds of coal. The upper and lower sandstone layers forming the Monument are friable (porous and crumbly) and separated by an easily erosible member of shales, siltstones, and thin sandstones (shortened to "siltstone" in this issue section. The basal layer of the monument is similar to the middle siltstone. The siltstone beds were subjected to faster weathering and erosion where Pompeys Pillar Creek enters the floodplain, and the Yellowstone River channel probably

avulsed at this point during a flood or ice jam event. This process left behind the erosional remnant and prominent geological feature now known as Pompeys Pillar. Temperature changes, wind, ice, water, salts, acids, biological inputs, gravity, and other factors combine to naturally weather the sandstone and siltstone layers of the pillar. The slope-forming siltstone layers are generally more susceptible to weathering and erosion, destabilizing the massive cliff-forming sandstone beds and causing rock falls and topples.

The Hell Creek Formation is locally abundant, and generally doesn't possess the mineralization or physical qualities typical of locatable building or decorative stone. It also isn't suitable for most salable mineral material uses such as road construction or maintenance, being chosen for that use only when there is nothing else available. Due to the physical properties and the National Monument designation, there are no mining claims or rock quarries on or near Pompeys Pillar. The visual, paleontological, and cultural qualities that have made Pompeys Pillar a geological landmark will be addressed in other resource sections, as will most safety questions.

3.6.2 Environmental Effects—No Action Alternative

Weathering and erosion of the siltstones and subsequent fracturing and destabilization of the massive sandstones are natural processes which will continue without the remedial measures. The Signature Blocks and Turtle Rock appear most susceptible to cracking and rock falls/slides due to the loss of support. It cannot be stated with certainty when the unstable blocks will topple from the pillar if no effort is made to restore support.

3.6.3 Environmental Effects—Alternative A

No mining operations would be affected; there are no mining claims or leasable/salable mineral operations within the project area.

If successful, the engineered interventions of the Proposed Action may slow down the weathering and erosion of the pillar and strengthen and stabilize vulnerable rock blocks. It cannot be guaranteed that any single remedial measure or combination thereof will completely stabilize the Pillar. If there is a failure during the construction or afterwards, the impacts would be similar to the No Action Alternative, just hastened.

Scaling – potentially unstable, small boulders will be manually removed from the sandstone above and adjacent to the viewing platforms. These small boulders on or near the tops of the massive sandstone tend to bounce further away, and more randomly, than the larger blocks. While removing these unstable boulders is mostly intended to improve the safety of people on the viewing platforms, the removal can enhance the stability of the pillar by decreasing the weight load on top of the Signature Blocks. The scaled rocks may be repurposed to conceal other remedial treatments, landscaping, or for other purposes designated by the BLM.

Foliage control – plants can physically and chemically weather rock, processes collectively termed biological weathering. For example, roots can create fractures, or salts/acids/decay products secreted by plants may dissolve mineral grains or the cement bonding them. Controlling foliage by removal and preventing future growth in joints above the Signature Block is expected to decrease the input of biological factors and to slow the formation of new fractures. Removing a portion of the foliage could allow water/ice to flow faster in the existing fractures – faster flowing water is more erosive. Another remedial measure, installing a top of sandstone drainage control, should divert most of the precipitation before it flows into the cracks.

Top of sandstone drainage control – precipitation drains from the top of the pillar through joints in the upper sandstone and flows out the middle siltstone layers. The siltstone layers differentially weather and erode faster than the upper sandstone, creating voids and piping beneath the Signature Block. If the water in the joints freezes, frost wedging may also increase joint dimensions. Controlling drainage on the top sandstone by diverting water away from the joints is expected to decrease the volume of water flowing into the joints and then out the middle siltstone. Sedimentary rock is naturally porous and permeable, so water diversion will not stop all water input to the existing joints. However, most of the water that does flow through the upper sandstone should be slower and therefore less abrasive to the siltstone below.

Shale & siltstone stabilization – the siltstone layers are deteriorated and weathered, threatening the stability of the Signature Blocks on top of them. Rock bolts are a common method to increase the strength of rock – when properly installed, there is a resistance to movement along the length of the bolt shaft. The proposed drainage channels and reinforced shotcrete will limit future weathering and erosion by shielding the remaining siltstone from wind, water, and temperature differentials. The drainage channels built into the shotcrete would also allow the release of water that naturally flows through permeable sedimentary rock. Strengthened siltstones, subject to much slower weathering and erosion, are expected to provide a more stable support for the Signature Blocks.

Buttressing at Signature Block – in the Signature Blocks area the middle siltstone is significantly eroded, leaving large overhangs of the massive sandstone. These sandstone blocks are unsupported and have prominent cracks along bedding planes. Under the proposed action, the overhanging blocks would have reinforced shotcrete forms constructed beneath them, in direct contact with a constructed base and the bottom of the overhanging blocks. The structure would be similar to the siltstone stabilization, but thicker. If successful, the buttressing will provide support to the currently unstable massive sandstone blocks and decrease the chances of a rockfall/slide.

Signature Block 1a Rock Bolting – rock bolts would be inserted from the top of Signature Block 1a, which is a perpendicular angle to the sandstone bedding planes most susceptible to splitting. The tension provided by the bolt shaft is intended to increase the resistance of the sandstone to further horizontal cracking. This action is required for worker safety prior to building the shale and siltstone stabilization feature and is not a stand-alone action.

Underpinning at Turtle Rock – a post would be installed, anchored to the bottom of the Turtle Head and the surface of the sandstone below. The sandstone block supporting the Turtle Head is cracked and eroding, and the Turtle Head will tumble from the Pillar if the supporting block becomes too weak. The post should provide support to the Turtle Head, which seems to be moving along joints and fractures. It may ease some of the pressure on the supporting sandstone block underneath. The Turtle Head feature is probably less suited to buttressing due to its relatively small size, and inscriptions present on the bottom.

Turtle Head Rock Bolting – rock bolts would be inserted from the top back area of the Turtle Head, which is a perpendicular angle to the sandstone bedding planes most susceptible to splitting. The tension provided by the bolt shaft is intended to increase the resistance of the sandstone to further horizontal cracking. This remedial action should arrest movement of the Turtle Head occurring at joints and fractures.

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3.6.4 Environmental Effects—Alternative B

Shale & siltstone environmental protection – sodium silicate or other treatment sprays would be applied to the surface of the siltstone layers and/or at the edges of the siltstone stabilization structure. The treatment spray fills in voids and pores, cements grains together, and acts as an impermeable barrier. This increases the hardness of the rock to which it applied, increasing its resistance to weathering or preparing a rock surface for other repairs. Treatment spray would have to be reapplied as needed, including constructing a work area for each reapplication procedure. Due to the permeability of the siltstone, water naturally moving through the rock from high to low head may degrade the coating, build up pressure under the coating, or be released at undesirable points, further degrading the pillar. The areas where treatment spray would be applied are regularly monitored for safety, cultural, and other reasons; maintenance needs are likely to be noticed in short order.

Signature Block 2a, 2b, and 2c Rock Bolting – rock bolts would be inserted from the top of Signature Blocks 2a, 2b, and 2c, which is a perpendicular angle to the sandstone bedding planes most susceptible to splitting. The tension provided by the bolt shaft is intended to increase the resistance of the sandstone to further horizontal cracking. This remedial action may be needed if buttressing these blocks is not advisable, and/or for safety.

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4. Consultation and Coordination

3.7 Summary of Consultation and Coordination

4.1.1 Tribal Consultation

Letters to the Tribes went out soliciting comments for scoping in November 2019 and November 2021. The responses to the first letters were varied. Teanna Limpy, Northern Cheyenne Tribal Historic Preservation Officer (THPO) expressed no concern with the proposed project in a letter (8/22/2019 ; in Administrative Record). John Murray, THPO for the Blackfeet Nation, called the BLM archaeologist on September 10, 2019, and left a phone message indicating will not be submitting comments on the project (memo in Administrative Record). Mike Black Wolf (Fort Belknap THPO) said he's not concerned with the project and left it to the discretion of the BIFO archaeologist to notify Mr. Black Wolf if known stone features, potential burials, petroglyphs or other significant resources might be impacted (phone call 1/24/2020; in Administrative Record).

The BIFO archaeologist escorted William Big Day, THPO for the Crow Tribe, and Veronika Spotted Bear, THPO staff, to the site July 23, 2019. Ms. Spotted Bear asked if we could stand blast Clark's signature off the Pillar. The BIFO archaeologist escorted the new Crow THPO to the site on April 14, 2021.Mr. Brien expressed no concerns regarding the proposed project.

No responses to the second letter have been received.

The following Tribes were contacted both in 2019 and 2021: The Blackfeet Nation, the Chippewa Cree, Confederated Salish and Kootenai Tribes, the Crow Tribe, Ft. Belknap Indian Community (Assiniboine, Gros Ventre), Ft. Peck Tribes (Sioux and Assiniboine), Little Shell Chippewa Tribe, the Northern Cheyenne Tribe, Eastern Shoshone Tribe, and the Northern Arapaho Nation.

4.1.2 Section 106 of the National Historic Preservation Act Consultation

*Initial l*etters were sent to the Advisory Council on Historic Properties (ACHP) and the National Historic Landmarks (NHL) Program on August 9, 2019, *to initiate consultation on the proposed project*. Ms. Astrid Liverman from the NPS's Heritage Partnerships Program (HPP) and regional coordinator of the NHL program emailed BIFO staff on August 20, 2019, expressing interest in receiving more information regarding the proposed project. Mr. Bill Marzella from the ACHP emailed with the same request.

On August 26, 2019, BIFO staff including Jennifer Macy, archaeologist, David Lefevre, Field Manager, John Reffit, PPNM Monument Manager and Lance Brady, State Office civil engineer spoke on the phone with Ms. Liverman, Justin Henderson, HPP Program Manager, Jennifer Bryant, Historian/ HABS/HAER coordinator, and Skyler Bauer, archaeologist, regarding the 2019 proposed rock stabilization and boardwalk replacement project at PPNM. , was not available for the call.

On August 27, 2019, Jennifer Macy and Dave Lefevre had a phone call with Mr. Marzella, the BLM Liaison on the ACHP.

The HPP staff attended a meeting at the Pillar on November 6, 2019, with the exception of Mr. Henderson and the addition of Tom Keohan, Historic Architect, and James Mason, the Structural, Geotechnical, Preservation, and Seismic Engineer with the NPS's Vanishing Treasures (VT) Program. Mr. Marzella was invited but was unable to attend.

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A virtual meeting was held on December 13, 2021, to update HPP, ACHP and SHPO personnel regarding the status of the stabilization project. Participants were Ms. Bush, Ms. Liverman, Mr. Henderson, Ms. Skylar Bauer (historian), Mr. John Olson (historic architect), Mr. Mason, Mr. Reffit, Mr. Lefevre, Mr. Phillip Blundell, Mr. Marzella, and Mr. Gary Smith (BLM state archaeologist).

Topics included the statuses of current Section 106 compliance, tribal consultation, determinations regarding the significance of individual inscriptions/rock art on the Pillar, and details about the current contractor responsible for the project. We discussed how the new contractor has completed research into the "makeup" of the Pillar, installation of monitoring devices, analyses completed, and proposed Remedial Measures being analyzed by the BLM specialists. The reception to the update was positive.

3.8 Summary of Public Participation

4.2.1 Public Scoping

Public scoping for the project began on November 1, 2021 and ran through November 30, 2021. Documents were posted to the project's ePlanning site during this time for the public to comment on. Additionally, the Montana/Dakotas BLM Facebook page was updated to alert the public to the opportunity to respond to scoping.

Finally, the following organizations or people were contacted for response to scoping either through email or via their organization's webpage due to either organizational interest in Pompeys Pillar National Monument or having expressed interest in the past to projects at the Pillar:

Name or Contact	**Organization**
Neal Gunnels	Director, Huntley Project Museum of Irrigated Agriculture
Sarah Cawley	Director, Lewis and Clark Trail Heritage Foundation
Brenda Maas	Visit Southeast Montana
Jeff LaRock	Lewis and Clark Interpretive Center, U.S. Forest Service
Point of Contact	Rochejhone Chapter - Lewis and Clark Trail Heritage Foundation
Point of Contact	Lewis and Clark Trail Heritage Foundation
Point of Contact	Visit Billings
Susan Barrow	President of the Board, Friends of Pompeys Pillar
Paul Eppinger	Director, Friends of Pompeys Pillar
D. J. Clark	Pheasants Forever-Yellowstone Chapter
Point of Contact	Billings Rod and Gun Club
Point of Contact	Yellowstone County Historical Society
Jessica Bush	State Archaeologist, Deputy SHPO
Barb Beck	Regional Supervisor, Montana Fish Wildlife and Parks, Region 5

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Name or Contact	Organization
Dan Wiley	Senior Leader, Integrated Resources Stewardship, LECL
Astrid Liverman	Historian, IMRO, NPS
Lauren Meyer	Intermountain Historic Preservation Services Program Manager, NPS
Ken Woody	Little Bighorn Battlefield National Monument, NPS
Justin Henderson	Heritage Partnerships Program Manager, NPS
Mark Weekley	Superintendent, Lewis and Clark NHT, NPS
Jennifer Bryant	Historian, IMRO, NPS
James Mason	Engineer, Vanishing Treasures, NPS
Linda Helm	Environmental Protection Specialist, Lewis and Clark NST
Gary Smith	Branch Chief Social and Cultural Resources, BLM Montana Dakotas State Office
Jaime Tompkins	Program Lead for National Conservation Lands/LNT/Environmental Ed & Youth, BLM Montana Dakotas State Office
Brian Smith	Program Lead, Outdoor Recreation, Tourism & Visual Resources, BLM Montana Dakotas State Office
Tom McCulloch	Assistant Director, Advisory Council on Historic Preservation
Bill Marzella	Advisory Council for Historic Preservation, BLM Liaison
Patricia Otstot	Member of the Public

During the public scoping period, the BLM received two responses. One from Mike Ruggles, Region 5 Regional Supervisor for Montana Fish, Wildlife, and Parks expressing a desire for the BLM to consider the historical signatures, visual integrity, and recreation opportunities the Pillar provides when undertaking the project. The second was from Justin Henderson, Heritage Partnership Program Manager for the National Park Service who, among other issues, wanted to ensure the BLM considered the historical signatures, the extent of the use of shotcrete rock bolts/cable bolts in the remediation measures, and actions associated with scaling operations. No comments received were in opposition to the stabilization remedial measures themselves.

4.2.2 Public Comments

The Public Comment Period will run from February 2, 2022, through February 15, 2022.

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5. List of Appendices

Appendix A—List of Preparers

Appendix B—Table of Issues and Resources Considered

Appendix C—Acronyms and Abbreviations

Appendix D—List of References

Appendix E—Geotechnical Monitoring TARP

Appendix F—Remedial Measures Analyzed in Detail

Appendix G—Applied BMPs

Appendix H—Reclamation Plan

Appendix I—Remedial Measures Not Analyzed in Detail

A. Appendix A: List of Preparers

Name	Title	Resource Area
Jenny Alexander	Outdoor Recreation Planner	Visual Resources
Phillip Blundell	Planning and Environmental Specialist	NEPA Compliance
Josh Helm	Civil Engineer	Contracting and Engineering
Jennifer Macy	Archaeologist	Cultural, paleontological, ACECs Tribal consultation
Rebecca Newton	Wildlife Biologist	Wildlife and Fisheries
Larry Padden	Natural Resource Specialist	Noxious and Invasive Plants
John Reffit	Monument Manager	Recreation Access
Stacie Thompson	Range Management Specialist	Livestock Grazing, Soils, Vegetation, BLM Sensitive Status Plants
Dorothy Van Oss	Geologist	Geology

B. Appendix B: Table of Issues and Resources Considered

Determination*	Issue	Rationale for Determination
NI	Access	The project area is within a ROW Exclusion Zone.
NI	Air Quality	Design Features during construction include dust abatement which will keep construction dust at a minimum.
NI	Areas of Critical Environmental Concern (ACEC)	The entirety of PPNM is within an ACEC. The RMP for PPNM on p.2-5 states that the primary uses for the site are for cultural and historical preservation as well as recreation. This project conforms the promotes these uses and aspects of the ACEC. See the Cultural Resources and Recreation Resources sections for further explanation.
NP	Backcountry Conservation Areas	No BCAs are in the project area.
NI	Climate	Effects to climate from equipment onsite during construction is expected to be negligible.
PI	Cultural Resources	See Section 3 for analysis on the impacts to Cultural Resources.
NI	Environmental Justice	Preservation of a National Monument is not expected to have any impact on communities protected by Environmental Justice.
NP	Farmlands (Prime or Unique)	There are no Prime or Unique Farmlands as covered under 7 CFR 657.
NP	Fire Management	No fire management activities are expected during the time of construction in the project area.
NI	Fish Habitat	Nearby aquatic habitat is not expected to be impacted by the proposed project.
NI	Floodplains	Floodplains are not expected to be impacted by the remedial measures.
NP	Forests and Rangelands	No forests or rangelands are within the project area.
NI	Human health and safety concerns	No impact is expected with implementation of project design features.
NI	Invasive, Non-native Species	No impacts from noxious or invasive weeds or non-native species are

Determination*	Issue	Rationale for Determination
		expected. BLM will continue to monitor and treat the site post construction.
NI	Lands and Realty	The project area is in a ROW Exclusion Zone and the action conforms to the areas existing use.
NP	Lands with Wilderness Characteristics	No LWC are present within the project area.
NP	Livestock Grazing Management	No livestock grazing for any purpose other than weed control is allowed in the project area.
NI	Migratory Birds and Raptors	No impact is expected with implementation of project design features.
NI	Native American Religious Concerns	Tribes have not expressed any concerns about the project impacting tribal interests. See Section 4 for a review of Tribal outreach efforts.
NI	Noise Resources	Short-term noise impacts due to construction were found to be negligible given the expected level and location.
NP	Paleontological Resources	No paleontological resources have been identified at the Pillar.
PI	Recreation Resources	See Section 3 for analysis on expected visual impacts and resulting visitor experience.
NP	Sage Grouse Habitat	There is no GRSG habitat at the monument.
NI	Socioeconomics	Impacts to socioeconomics are expected to be minor from this action.
NI	Soils	No impact is expected with implementation of project design features.
NP	Threatened, Endangered or Candidate Plant or Animal Species	No T/E or Candidate species are found within the project area.
PI	Vegetation	See section 3 for analysis on expect vegetation impacts.
PI	Visual Resources	See Section 3 for analysis on expected visual impacts and resulting visitor experience.
NI	Wastes, Hazardous or Solid	Substantial hazardous or solid wastes are not expected to be generated from enacting this project.
NI	Water	No impact is expected to water resources from the proposed action.

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Determination*	Issue	Rationale for Determination
NI	Wetlands/Riparian Zones	No wetlands or riparian zones are expected to be impacted from the remedial measures.
NP	Wild Horses and Burros	No WHB HMAs are within the project area.
NP	Wild and Scenic Rivers	No Wild and Scenic Rivers are within the project area.
NP	Wilderness and Wilderness Study Areas	No Wilderness or WSAs are within the project area.
NI	Wildlife	Wildlife impacts from the remedial measures are expected to be minimal due to the project occurring at a developed recreation site.

***** NP = not present in the area impacted by the proposed or alternative actions.

NI = present, but not affected to a degree that detailed analysis is required.

PI = present and may be impacted. Will be analyzed in affected environment and environmental effects. For consistency, the term 'effects' is used throughout the EA, but we use the term 'impacts' just in this table. (NOTE: PI does not necessarily mean effects are likely to be significant, only that there are effects to this issue, resource or use. Significance will be determined through analysis and documented in a Finding of No Significant Impact or Environmental Impact Statement.)

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C. Appendix C: Acronyms and Abbreviations

Acronym or Abbreviation	Meaning
ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council on Historic Properties
APE	Area of Potential Effect
ARPA	Archeological Resources Protection Act
BiFO	Billings Field Office
BLM	Bureau of Land Management
BMP	Best Management Practice
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DM	Departmental Manual
DR	Decision Record
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
ESD	Ecological Site Description
FLPMA	Federal Land Policy Management Act of 1976, as amended
FONSI	Finding of No Significant Impact
IB	Information Bulletin
IDT	Interdisciplinary Team
IM	Instruction Memorandum
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NHT	National Historic Trails
NPS	National Park Service
NRCS	Natural Resources Conservation Service
P.L.	Public Law

Acronym or Abbreviation	Meaning
PPNM	Pompeys Pillar National Monument
RBMS	Rock Block Monitoring System
RFFA	Reasonably Foreseeable Future Action
RMP	Resource Management Plan
ROW	Right-of-way
SHPO	State Historic Preservation Office
TARP	Trigger Action Response Plan
THPO	Tribal Historic Preservation Office
T&E	Threatened and Endangered
USC	United States Code
VRM	Visual Resource Management
VT	Vanishing Treasures Program (NPS)
WHB	Wild Horse and Burro

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D. Appendix D: List of References

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E. Appendix E: Geotechnical Monitoring TARP

The following Trigger Action Response Plan (TARP) is a DRAFT document that will be finalized by completion of the project. The TARP establishes pre-planned responses in the event of certain changes in the structure. This plan is currently being implemented, regardless of its draft status. The finalized version will take into account changes that occur through the stabilization efforts. Note that the attachments referred to at the end of the plan are not included but may be available upon request.

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Technical Memorandum

To:	Joshua Helm and Guy Stickney, Bureau of Land Management Lee Petersen, Principal Engineer, Itasca Consulting Group, Inc.
From:	Russell J. Sheets, P.E. (MT), Senior Geotechnical Engineer, Joel Swenson, Senior Geotechnical Engineer,
Subject:	Geotechnical Monitoring Trigger Action Response Plan (TARP)
Date:	March 5, 2021
Project:	Pompeys Pillar National Monument Rock Stabilization – Rock Block Monitoring System
c:	File

Barr Engineering Co. (Barr) is contracted by Itasca Consulting Group, Inc. (Itasca) to assist in design and implementation of a Rock Block Monitoring System (RBMS) at Pompeys Pillar National Monument located in Yellowstone County, Montana. A limited rock RBMS was implemented in July 2020 during Phase 1 of the project to monitor the Signature Block area and Turtle Rock area. The purpose of the initial RBMS was to provide a baseline understanding of current deformation conditions and inform efficient design of an expanded RBMS to more thoroughly monitor geohazards. The expanded RBMS recently has been installed and includes more instrumentation on the Signature Block and Turtle Rock areas as well as the Lower Rock area.

A Trigger Action Response Plan (TARP) is included from Barr with the RBMS. The TARP provides the engineer of record (EOR) and Bureau of Land Management (BLM) staff predetermined courses of action to be followed in the event that defined visual observations or monitoring thresholds are exceeded. A thorough explanation of the purpose and development of a TARP is presented in the Pompeys Pillar National Monument Rock Stabilization Phase 1

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report dated August 28, 2020. This technical memorandum will focus on the TARPs and their specific application and limitations to managing geohazard risks of the Signature Block, Turtle Rock, and Lower Rock areas in the event of increased movement of critical rock blocks.

1.0 General TARP Layout

The TARP developed for the Pompeys Pillar RBMS includes three key components. These are defined as:

- Ground Condition;
- Trigger Events; and
- Response Plans.

A description and explanation of each component is provided in the following sections.

1.1 Ground Condition

The left-most column of the TARP defines the ground condition in terms of both a level rank and a color code. This provides a quick, efficient means to communicate the current geohazard risk condition to site staff and key stakeholders. There are seven specific levels to describe the conditions of rock blocks based up visual observation, weather condition, and instrumentation measurements.

- Level 0: Normal Condition (White);
- Level 1: Non-Movement Condition for Review (Blue);
- Level 2: New Movement – Low Potential of Safety Impacts (Green);
- Level 3: Continual Movement – Moderate Potential of Safety Impacts (Yellow);
- Level 4: Accelerating Movement – High Potential of Safety Impacts (Orange);
- Level 5: Imminent Failure – High Risk of Safety Impacts (Red); and
- Level 6: Active or Unexpected Failure.

1.2 Trigger Events

The center columns of the TARP specify the trigger events based upon the source. Each defined trigger source requires a predefined threshold or condition that is observed or exceeded to define the Ground Condition. The TARP includes the following trigger events:

- Visual Observation;
- Weather;
- Crack Gauge;
- Tiltmeter,
- Distometer,
- LiDAR/UAV Survey; and
- AMTS, InSAR, RADAR.

The first six trigger event sources have been implement or previously used to characterize the site condition. The AMTS, InSAR, RADAR sources are included in the TARP as these methods

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could be implemented in the future if changing site conditions warrant additional monitoring approaches.

1.3 Response Plans

The right columns of the TARP define the response plan when a specific trigger event is observed and the responsible person, or party, to complete the required actions. The response plan details decisions that key stakeholders previously have agreed upon, so that when the triggers occur the responsible party is not determining the necessary course of action while a potential geohazard risk is occurring and time is critical. The response plan presented here contains the following components:

- Representative Timeline to Failure – this is intended to be a conceptual guide based on similar situations as a means to compare and assess geohazard risk. The actual timeline is established by a variety of site factors and is evaluated on a case-by-case basis.
- Action – this defines the step(s) to take, or controls to implement, when the associated trigger event occurs.
- Monitoring – the change in block condition will require increased frequency of visual inspections and RBMS data review.
- Responsible Party – the person or group with ownership to complete the Action and Monitoring associated with the Ground Condition Level.
- Criteria to Downgrade – the premise of a TARP is to ensure controls exist to appropriately respond when geohazard risk increases; however, as the risk decreases there is specified criteria to allow the hazard to be downgraded in a similar manner.
- Reporting – to ensure that all key stakeholders are aware and have ownership of geohazard risk, specific triggers require appropriate communication to those stakeholders

2.0 BLM and Itasca: Responsibilities to Complete TARP

Barr developed the TARP framework for the Signature Block, Turtle Rock, and Lower Rock areas. However, there are details of the Trigger Event and Action Plan portions to be determined by the owner (BLM) and technical advisor lead (Itasca). To facilitate the ability to efficiently and effectively complete the TARP, Barr has summarized items that require attention.

2.1 Trigger Event Thresholds

2.1.1 Weather

The primary weather-related factor is direct precipitation and infiltration. The surface run-off will enter the rock mass through existing cracks, fractures, and joints. If the water is unable to efficiently drain from the cracks then the potential for pore pressure to accumulate exists. When sufficient pore pressure develops it can affect the in-situ stress state thereby decreasing the factor of safety and increasing geohazard risk.

Additionally, the combination of water and freeze-thaw cycles can lead to block instability due to jacking or wedging of the cracks as ice forms and expands then subsequently thaws.

Weather trigger thresholds to consider for each Ground Condition:

- Storm-event rainfall over a 24 hour period,

- Accumulated rainfall over a period of days (i.e. 2 days, 5 days, 7 days),
- Freeze-thaw temperature conditions concurrent with precipitation or snow melt and run-off.

2.1.2 Monitoring & Measurement

The RBMS allows for quantitative evaluation of deformation; therefore, specific displacement and rate magnitudes can be established to define conditions that require increased attention. Currently there are crack gauges, tiltmeters, and distometers installed across the Signature Block, Turtle Rock, and Lower Rock areas. If additional monitoring systems are implemented in the future, then they can be readily incorporated into the TARP.

The trigger thresholds can be defined based upon the desired level of detail and discernment of geohazard risk for the BLM. The monitoring data evaluation for threshold exceedance for an array of sensors can be grouped, or separated, as necessary. As such, the TARP can include trigger thresholds for any combination specified below:

- Pompeys Pillar overall site;
- Group by area of interest (i.e. Signature Block area thresholds, Turtle Rock area thresholds, and Lower Rock area thresholds);
- Define by sub-block within an area group;
- Specify by instrumentation type.

There are multiple values can be evaluated to understand geohazard risk. As such, a layered series of movement thresholds should be implemented to identify changes in behavior as displacement increases. The trigger events typically include alarm thresholds based upon:

- Displacement (Total or Incremental);
- Displacement Rate/Velocity (Total, Average, or Incremental);
- Acceleration (Total, Average, or Incremental); and
- Inverse Velocity (Total, Average, or Incremental).

In general, the Ground Condition Level increases as one evaluates the above values. The initial indication of a change will be measureable displacement. As movement rate increases, then it is necessary to evaluated the velocity, then acceleration, and inverse velocity to identify changes in behavior as in all cases the displacement is constantly increasing.

2.2 Response Plan

2.2.1 Actions and Monitoring

The actions and monitoring responses have been populated with representative items for similar geohazards with increasing risk as movement accelerates. The BLM and Itasca must review these items and edit where necessary to ensure these align with risk-based conversations that have occurred over the course of the project.

2.2.2 Responsible Party and Reporting

Barr has shown the expected responsible party and reporting level based on typical approaches for similar geohazards with increasing risk as movement accelerates. These are assumptions

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based upon understanding of the project and site operation; they must be reviewed to ensure that they follow the actual site operation and management protocols. Additionally, if Pompeys Pillar and the BLM have an over-arching emergency response plan that is to be followed, then references to that plan and steps can be incorporated where applicable.

2.2.3 Criteria to Downgrade

The conditions that must be observed to define a decrease in the geohazard risk are to be agreed upon by the key stakeholders. Typical observations and monitoring trends have been included to provide guidance; however, as with the previously discussed items these must be vetted by the BLM and Itasca to ensure that it is in alignment with the evaluation of on-going risk.

3.0 Closing

Barr has developed a series of TARPs to assist the BLM and Itasca with continual evaluation and assessment of geohazard risks at Pompeys Pillar. The TARP tables focus on each specific area of interest: Signature Block area, Turtle Rock area, and Lower Rock area. They provide the typical flow and approach for assessing geohazards and appropriate levels of response to mitigate the risk to visitors and on-site staff. However, prior to implementation the TARPs must be reviewed and completed to ensure aspects of all risks identified by the BLM and Itasca have been incorporated and addressed.

Attachments:

Table 1. Trigger Action Response Plan (TARP) for Signature Block Area, Pompeys Pillar, Montana
Table 2. Trigger Action Response Plan (TARP) for Turtle Rock Area, Pompeys Pillar, Montana
Table 3. Trigger Action Response Plan (TARP) for Lower Rock Area, Pompeys Pillar, Montana

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F. Appendix F: Remedial Measures Analyzed in Detail

Appendix F discusses in detail the remedial measures that are a component of the analyzed alternatives.

The rock blocks at the Signature Area and Turtle Rock Area were numbered to facilitate coordination and will be referenced throughout Appendix F and Appendix I. See Figure 1 and Figure 2 below for their location.

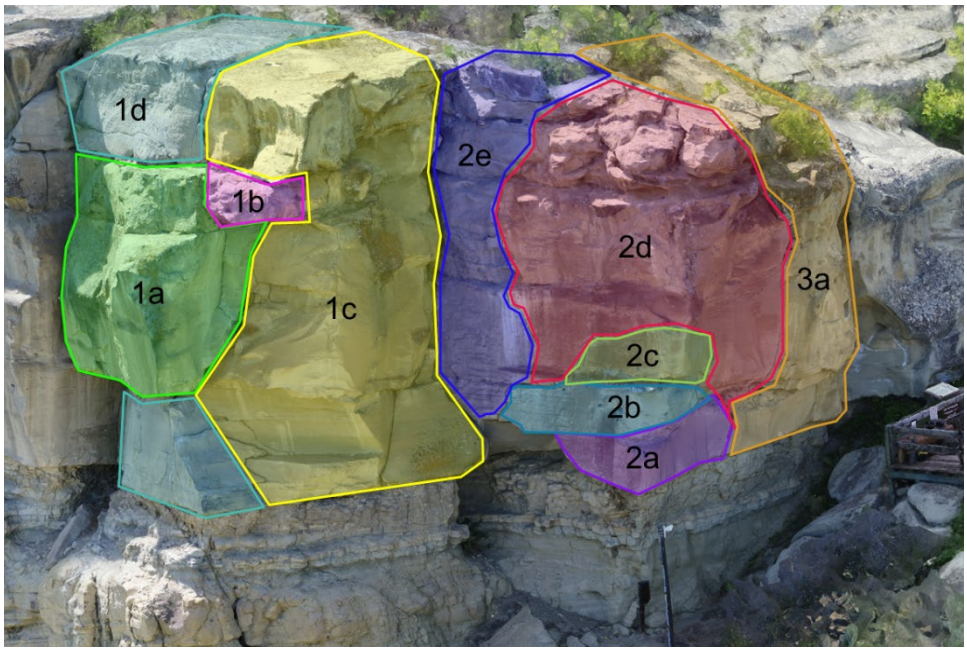

Figure 1 Block names near the Clark signature (Signature Blocks area).

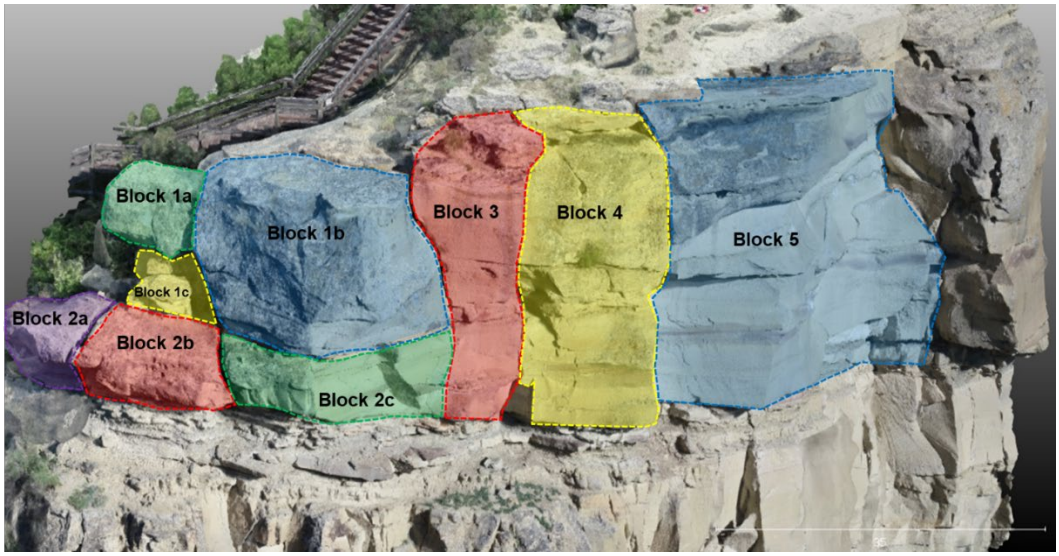

Figure 2 Turtle Rock area block numbers.

F.1. Noted Design Features

The project contains many design features which were necessary in order properly stabilize and preserve the Pillar. However, certain design features were especially noted in the analysis as those directly lessening impacts to other resources. These are listed below.

- There would be times when all or parts of the monument would be closed to public access for reasons such as public safety or the need to utilize normally publicly accessible places solely for construction purposes.
- All site design elements shall be integrated with the surrounding landscape by engaging in such measures that minimize the profile of any structures, blends in with the surrounding environment, and maintains the character of the site.
- All rock surfaces shall be protected against permanent, unintended damage during construction.
- BLM archaeologist would review and approve operations (e.g. scaling and Turtle Rock) near significant historical markings as necessary in order to ensure there are no impacts to those resources. Site monitoring would be enacted as necessary.
- Measures shall be taken to prevent over spraying of shotcrete, concrete, or other such stabilization or preservation materials in any phase of construction in order to avoid adverse impacts to historical signatures and the natural look of the remedial work.
- All drilling will include dust abatement measures and shall commence at a speed and/or force that is unlikely to create vibrations that could damage the Pillar.
- Staging areas, except the main construction and crane staging area, will be used in its current state and will not have vegetation removed prior to use.
- All staging areas, except the main construction and crane staging area, are for daily use for equipment and material. The contractors shall removal all equipment and materials from the work areas at the end of each day.
- All drainage features will be designed in such a way as to avoid erosion impacts.
- Effects to nesting owls would be mitigated by avoiding construction activities on Turtle Rock and the west/northwest side of the Pillar from February 1 through June 30.
- Effects to current year breeding and nesting migratory birds would be mitigated by avoiding construction activities from April 15 through July 15.
- Mowing of the Main Construction Staging Area prior to and frequently throughout the breeding and nesting season for migratory birds up until its use would be implemented in order to reduce suitable nesting habitat and reduce the likelihood of birds attempting to nest at these high use sites.
- All construction activities will be required to implement the Billings Field Office Approved Resource Management Plan (ARMP) Best Management Practices (BMPs) (noteworthy elements can be found in Appendix G)

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F.2. General Workspace Preparation

A workspace will be required away from the site of the remedial measures for the purpose of staging and prepping for construction. As with all construction measures, all noisy activities will take place between 8:00 a.m. and 8:00 p.m. Mowing of the area would begin on a weekly basis beginning sometime prior to April 15, as ground conditions allow. This is separate than the site-specific preparations needed that is discussed in the following sections of the appendix. The workspace would be used to store equipment needed for the project as well as a working area for the contractor for any fabrication, mixing, or other construction activity that might be best performed away from the specified remedial measure treatment locations. The entire staging area below the Pillar would be approximately 1.15 acres.

Equipment staged and utilized in this area may include but not be limited to: A large crane, job trailer, dump trucks, semi & trailer equipment for hauling, concrete trucks, concrete pump boom trucks, pump trailers, small concrete mixer, enclosed storage trailers, various pickup trucks, various trailers, rock bolt drills, water storage tanks, generators, air compressors (may be large trailer air compressors), excavation equipment (shovels to small tracked equipment), concrete/rock saw, various handheld power tools or pneumatic tools, etc. Materials staged and utilized in this area could include cement mix bags for shotcrete or other concrete materials, rebar, forms, water storage, etc.

The contractor may run electric power cords, shotcrete pump lines/hoses, water lines/hoses, air lines/hoses, etc. along the access routes, including scaffolding and walkways. Scaffolding, walkway stairs, walkways, and platforms may need to be anchored in some fashion to provide proper stability for safe use.

The contractor would till up, harrow, and flatten all disturbed areas in preparation for reseeding. The contractor would drill in seed in larger areas that a tractor and drill is reasonable to drive. Most, if not all, sloped areas would have broadcast seeding. All broadcast seed would be raked into the soil.

F.3. Scaling

F.3.1. Scaling Description

Scaling refers to the identification and manual removal of potentially unstable rocks. Note that in these remedial measure descriptions, scaling is distinguished from large rock block removal which is described in detail in Appendix I. Weathered, loose rocks were observed above and adjacent to the viewing platforms. Figure 3 and Figure 4 show two views of these areas, which are limited to locations where unstable rocks could threaten visitors on the viewing platforms. Figure 5 and Figure 6 show the area of analysis in order to account for issues that may require scaling in the interest of public safety.

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Figure 3 Likely scaling locations at the Signature Blocks area.

Figure 4 Alternate view of the likely scaling locations at the Signature Blocks area.

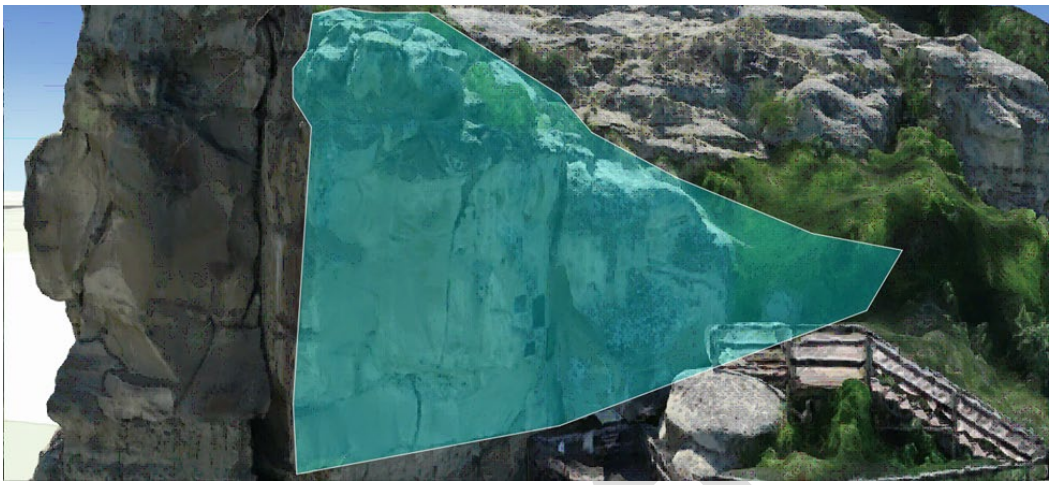

Figure 5 View of the area of analysis for scaling the Signature Blocks area.

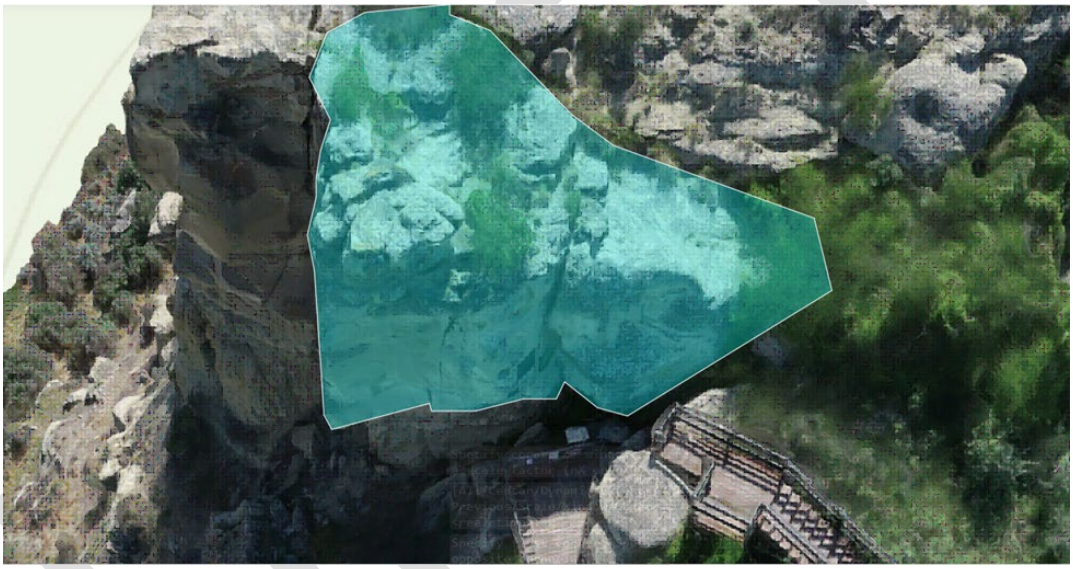

Figure 6 Alternate view of the area of analysis for scaling the Signature Blocks area

F.3.2. Scaling Process

To preserve any archeological features present, the scaling process would include the following steps:

- Close-up inspection of the area by BLM staff to identify the archeological features has been completed; locations to be scaled bear no historic inscriptions or other markings of cultural significance,
- Sounding the rock surfaces with scaling bars to identify loose or drummy rocks (by the contractor observed by a competent engineer),
- Preparation of a visual scaling plan, identifying rocks to be scaled,

- Approval of the scaling plan by the BLM, and
- Initiate rock scaling in the presence of a BiFO archaeologist utilizing safety protocols.

The contractor performing the scaling would be required to conduct such operations within a set of parameters as established by BLM. These requirements would ensure that construction operations would both maintain public safety and not create any further impacts or disturbance beyond what is intended from the scaling operations.

The contractor would remove only the rocks identified on the construction drawings. These rocks would be removed with an amount of effort no more than the maximum specified in the construction specifications.

The equipment for the scaling may be a scaling bar, crowbar, chisel and hammer, or similar devices. Pneumatic equipment or powered equipment may be used if the effort applied would meet the specifications. Vibration limits would be considered in the design of this project and the writeup of the construction specification.

The intention is to remove both the rocks that pose safety concerns to the public as well as those that pose safety concerns to the construction workers. The contractor would review all areas for rock scaling for these considerations. If rocks that are loosely held, or not firmly attached based on a specified effort, those rocks must be removed in order to properly perform the construction underneath in a safe manner. The construction specifications would make consideration on how to determine the process for removing rocks that pose safety concerns to the construction underneath. This process may vary from a specified removal effort alone. BLM archaeologists would review and approve the scaling operations as necessary in order to ensure there are no impact to significant historical resources. Site monitoring would be enacted as necessary.

No rocks removed would be released in an uncontrolled manner. The rocks would be lifted and lowered using a crane or similar equipment. This process may vary based on the situation and size of the rock removed, but in all cases the removed rock would be lowered in a controlled manner.

Some or all of the scaled rock would stay with the Pillar in some location designated by the BLM. Some of the rock may be used to help conceal the remedial measure treatments (such as the Top of the Sandstone Drainage).

F.4. Foliage Removal

F.4.1. Foliage Removal Description

To reduce the weathering effects, the foliage on the top of the Signature Blocks area will be removed. Figure 7 and Figure 8 illustrates the approximate area within which the foliage will be removed. In all, an area of approximately 900 square feet would have its vegetation permanently removed from the top of Signature Block. This will be done by first killing the foliage with an herbicide and/or by physical removal methods. This area would be monitored in the future to kill and remove any new growth.

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Figure 7 Foliage removal area at the Signature Block.

Figure 8 Full area of analysis for foliage removal.

F.4.2. Foliage Removal Process

The BLM would spray and kill all of the woody vegetation, or deep-rooted vegetation, with approved BLM herbicides as identified on the construction plans. The vegetation would be removed and may be stockpiled in place on top of the Signature Blocks by the BLM. During construction, the contractor would then remove the excess debris left over from the BLM removal. The contractor would also conduct additional vegetation removal to ensure the extent of

removal is reached and all vegetation is removed in areas to receive specified remedial measure treatments.

Vegetation removals would be large woody plants (or plants with deep invasive roots) everywhere indicated on the construction drawings. Total vegetation removal (including grasses) would only be in areas with large joint crack protection treatments (or other design features), all other areas would still have grasses to remain.

F.5. Top of Sandstone Drainage Control

F.5.1. Top of Sandstone Drainage Control Description

The rain runoff at the top of the Signature Block area contributes to the weathering. The weathering has two principal impacts:

- The rock at the top of the Signature Blocks weathers faster as a result of the poor drainage. The evidence of this is most evident at the top of Signature Block 2.
- Water that enters the major joints highlighted in Figure 9. These joints are affected by the presence of water. The water also courses down 9the joints, causing accelerated weathering and erosion of the siltstone. Figure 10 illustrates the voids in the siltstone created by this weathering and erosion.

Figure 9 Major joints exposed on top of the Signature Blocks.

To control this drainage, diversion structures and trenches may be constructed to direct water away from the top of Signature Blocks. Figure 11 illustrates the existing contours atop the Signature Blocks. The blue ellipse in Figure 11 illustrates the approximate limits of the drainage control, and the red line illustrates a possible location of a diversion structure to route the water away from the top of the blocks. The diverted water may also be captured in a pipe toward the upper part of Figure 11. Details of possible curb, trench, piping/guttering, and pipe discharge are shown in Figure 12 with the total area of consideration for drainage control measures are shown in Figure 13.

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Figure 10 Siltstone weathering and erosion areas.

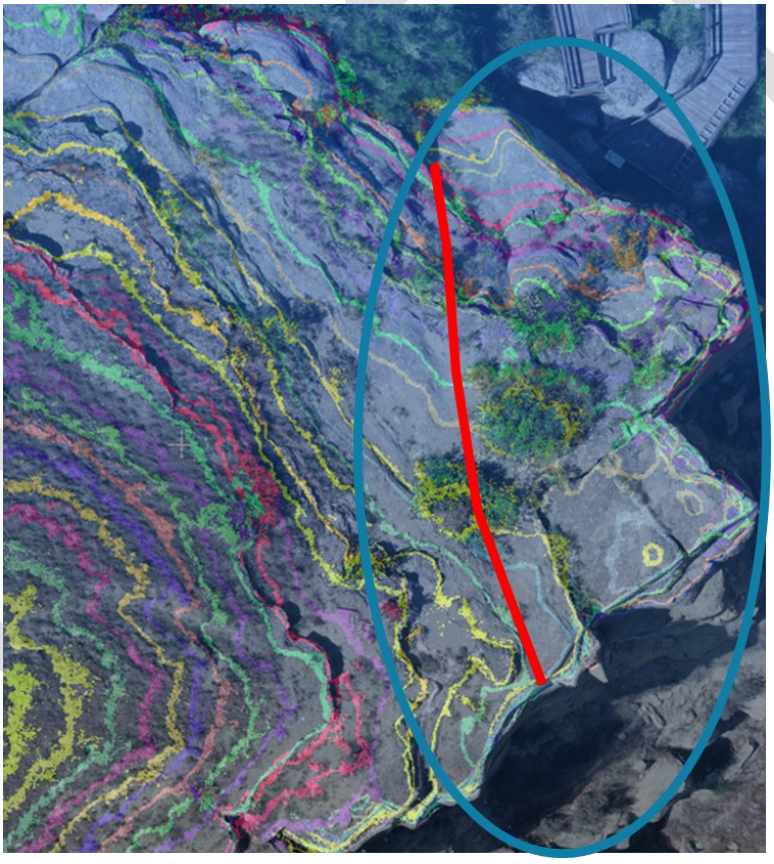

Figure 11 Approximate drainage control area atop the Signature Blocks with highlighted elevation contours.

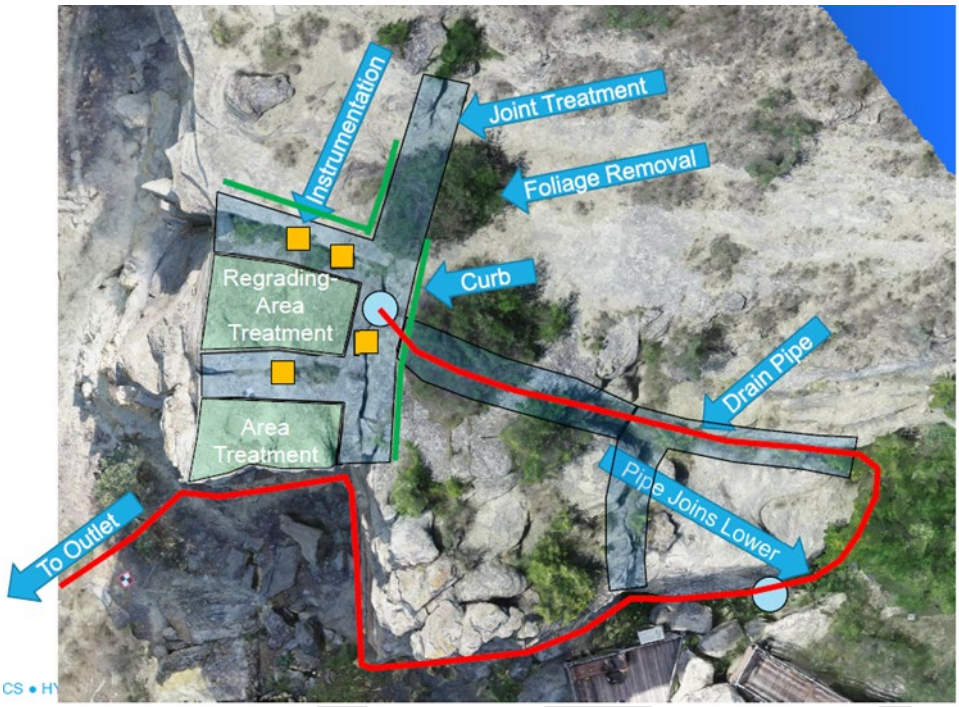

Figure 12 ***Possible configuration of drainage control atop the Signature Blocks to include curbing, regrading, and drainpipe.***

Figure 13 ***Full area of analysis for drainage control measures atop the Signature Blocks.***

F.5.2. Top of Sandstone Drainage Control Process

The contractor would cover the large joint cracks that make up the large blocks at the Signature

Blocks (Blocks 1-3). The covering would divert most of the surface water into a drainage system and prevent erosion issues that has destabilized the large rock blocks. See *Shale and Siltstone Stabilization – Drainage System* for details on the drainage pipe system in this area.

The contractor would protect rock shelf ledges from damage during construction. All rock surfaces would be protected to prevent permanent damage to rock surfaces, especially in areas easily viewed by the public. The contractor would not splatter concrete material on rock surfaces. In order to help prevent this, the contractor would cover the surrounding areas (visqueen plastic, tarps, etc.) and/or build a barrier wall/surface to catch any additional splatter.

The contractor would remove materials from the top of the rock blocks by crane, by hand, or by other similar nondestructive means. The contractor would remove leftover debris from the foliage removal and any additional foliage that would interfere with the drainage control installation as indicated on the construction drawings.

The contractor would use a rotary disk saw (similar to a concrete saw) and mechanical chisel to cut a 6”-10” deep groove into the top of the sandstone for placement of a concrete curb and gutter. The width of the curb and gutter would be detailed in the construction drawings (the width may be 18”-24” based on typical road construction). The contractor would install anchors/rock bolts into the sandstone for the concrete curb and gutter and then build forms for the curb and gutter. The contractor would mix the concrete, either below in the staging area or on top of the sandstone rock, depending on quantity of concrete needed. The concrete may be placed by wheelbarrow from the mixer on top of the sandstone, a boom pump truck from below in the staging area, or crane lifted concrete bucket, depending on quantity of concrete needed. The contractor would finish the placed concrete and remove the forms.

The contractor would install a High-Density Polyethylene (HDPE) sheet covering the large joint cracks. The size of the HDPE would only cover the large joint crack and uniform surface concrete on both sides. The HDPE would be secured down by anchors, bolts, or screws on the upslope side of the crack.

The contractor would install a membrane material (polymer sheet material or other nonporous material). The sheet would cover most of the top of Block 1 and cover other locations as indicated on the construction drawings. The contractor would add a sand layer underneath the membrane material to be used to create a sloped membrane surface towards the drain. The contractor would secure the edges of the membrane material with anchors, bolts, screws, or staples. The contractor would place natural looking ballast material on top of the membrane to 1) hide the membrane and make it blend into the surroundings, and 2) hold the membrane in place during high wind. The ballast material could be crushed local sandstone that blends into the surroundings or other material that may help to conceal the membrane. Rock crushing may be done on-site or off-site using a rock crushing machine.

F.6. Shale and Siltstone Stabilization

F.6.1. Shale and Siltstone Stabilization Description

The stability analyses during preliminary design showed that siltstone deterioration under the sandstone blocks at the Signature Block was a critical threat to block stability. Currently, the siltstone surface is weathered and broken, and in many places may be excavated with hand tools. Figure 14 illustrates the approximate location and extent of a siltstone stabilization concept. The

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termination location at each end of the treatment is expected to be as shown in Figure 16 and Figure 17. The shaded area is rock bolt and reinforced structure, constructed by:

- Digging out loose material at base under blocks 2-4,
- Scaling and preparing the siltstone over an area approximately 90 ft long x 9 ft high,
- Installing preventative measures to ensure shotcrete overspray will not impact historic inscriptions above the layer being treated.
- These measures shall be approved by the BIFO archaeologist to ensure no cultural or historic markings would be impacted.
- Placing 7 ft anchors, 4 ft on center,
- Placing 250 ft of drainage channels,
- Placing reinforced shotcrete into the voids identified in Figure 10,
- Placing reinforced shotcrete 8-inches thick across the stabilization zone highlighted in Figure 14, and
- Texturing and coloring the shotcrete surface to simulate siltstone.

Refer to Figure 15 or conceptual elevation and section drawings of the treatment. Note that while the term "shotcrete" is being used for simplicity, the intent is to utilize shotcrete, cast in place concrete, or some other binding substance and method that both stabilizes the structure and blends into the natural environment. This treatment will reinforce the siltstone via the rock bolts and areal coverage of the shotcrete, plus the shotcrete will protect the siltstone from humidity, water, and temperature changes.

Figure 14 Approximate location and extent of siltstone stabilization.

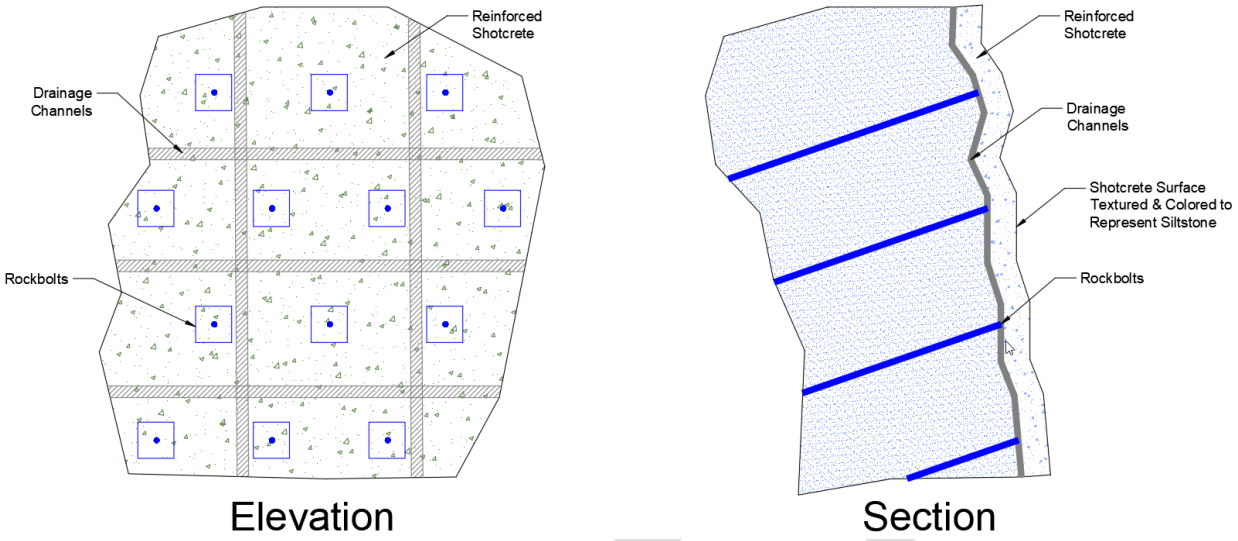

Figure 15 Siltstone stabilization elevation and cross section.

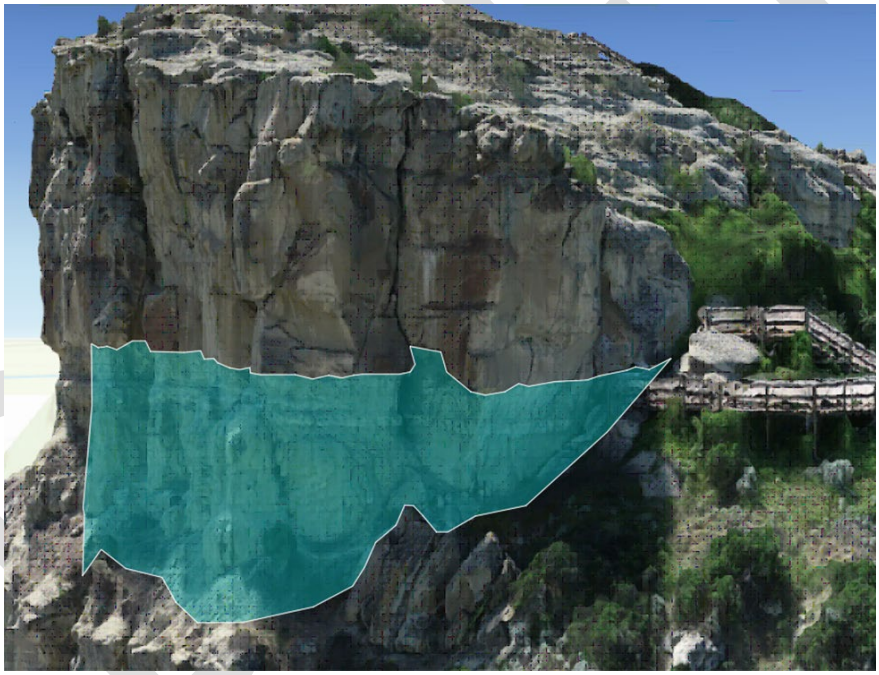

Figure 16 Full area of analysis for shale and siltstone stabilization.

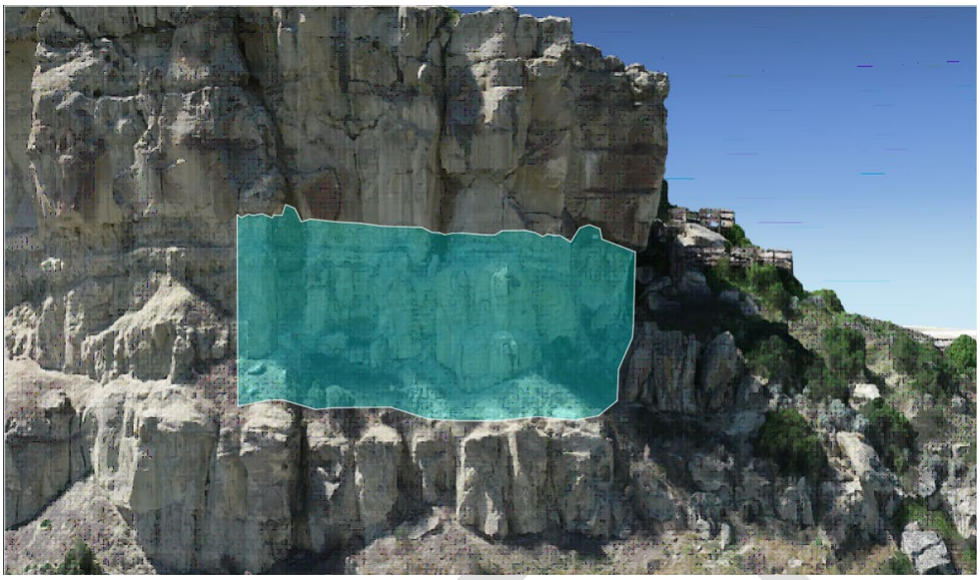

Figure 17 Alternate view of the full area of analysis for shale and siltstone stabilization.

The visible shotcrete surface will be textured and colored to represent the siltstone layers. The shotcrete will have integral color so that any future chip outs would expose a matching color. As an example, Figure 18 shows the light rail station at Minneapolis-St. Paul International Airport, where the concrete wall panels were textured with form liners and then colored. Figure 19 shows another example of concrete texturing and coloring from the Minnesota Zoo.

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Figure 18 Example of concrete sculpting and coloring (left real rock, right concrete that has been colored to match then intentionally smoothed).

Figure 19 Example of concrete texturing and coloring at Minnesota Zoo.

F.6.2. Shale and Siltstone Stabilization Process

The contractor would prepare the shale and siltstone area immediately below the treatment areas

by first flattening out the soil immediately below the treatment area and build a platform and scaffolding (as necessary) on this flattened soil area. Then, the contractor would also build an access route from the staging area below to the shale and siltstone area, this may include stair type scaffolding/walkways as well as simple designated walking paths on the ground.

The contractor would build an access route to the top of the sandstone rock blocks using rubber matting (or other material), ladders, scaffolding, and walkways/stairs. The rock surfaces would be protected against permanent damage, especially in areas the public would be able to see. Much like with the process for the *Top of Sandstone Drainage Controls*, the contractor would have to cover the surrounding areas (visqueen plastic, tarps, etc.) and/or build a barrier wall/surface to catch any additional splatter.

The contractor would shape, remove material, and prepare the surface of the shale and siltstone. The surface of the shale and siltstone likely has loose material that should not be left in place behind the stabilization shotcrete and concrete. The contractor shall install any preventative measures necessary to ensure applied materials do not overspray onto any historic inscriptions above the layer being treated. The contractor may spray the shale and siltstone with sodium silica to strengthen the shale and siltstone in order to protect the material during installation of the shale and siltstone stabilization shotcrete and concrete.

Here, as with all other uses of sodium silica spray (e.g., *Shale and Siltstone Environmental Protection* and the seam repair for *Underpinning at Turtle Rock*), it would be applied to areas scheduled for repair/patching. As a result, it will likely be applied to areas of both siltstone/shale as well as sandstone. Rock containing higher levels of fines (typically shales) will not absorb the sodium silicate at the same rate as the sandstone. As a result, the contractor will end up applying less sodium on high content shale layers. The sodium silicate has not been found to alter the colors. It may slightly alter the sheen of the rock but with a bit time and weathering would be unnoticeable.

The sodium silicates will strengthen softer sandstone and siltstone layers and may slightly increase its resistance to weathering. The sodium silicate causes a slight to modest increase in hardness. It may increase the hardness of a soft, highly weatherable stone layer to something more comparable to the adjacent, harder stone layers. The value of the sodium silicate is to provide a short- to mid-term increase in surface hardness to allow repair materials to be applied.

The contractor would install rock bolts into the shale and siltstone. The contractor would place mesh welded wire and rebar onto the surface of the shale and siltstone. The contractor would place a drainage system behind and within the shotcrete/concrete surface.

The contractor would fill gaps/holes in the shale and siltstone created by erosion where the large blocks meet, at the base of the sandstone. These holes would be filled with a lighter concrete (or similar material). This lighter concrete would act as good fill material and provide a nonporous material, while applying a lesser load (weight) for the treatment area. A drain would be placed in the gaps/hole so that any additional water not captured on the top of the rocks drainage or flowing through the rock would be collected into the drainage system. The drain will connect into the drainage pipe system with the outlet below the Pillar near or in the construction staging area.

The contractor would either form the shale and siltstone surface to receive concrete or spray shotcrete to the surface. In both cases, it is likely to have a separate concrete footing under this

shotcrete/concrete surface. The footing would likely be placed separately from the shotcrete/concrete surface.

The contractor would build forms for the concrete. The contractor would mix the concrete in the staging area. The concrete would be placed by a boom pump truck from below in the staging area. The contractor would finish the placed concrete and remove the forms. The contractor would then place any additional rebar and mesh welded wire on the surface of the concrete. The contractor would then place shotcrete to the surface of the concrete. This shotcrete would receive color treatment during mixing, the surface would be textured, and the surface would be finished to appear like the shale and siltstone.

The contractor would place shotcrete to the surface of the shale and siltstone. This shotcrete would receive color treatment during mixing, the surface would be textured, and the surface would be finished to appear like the shale and siltstone.

The contractor would install the shotcrete/concrete from bottom to top of the exposed shale and siltstone, including below current soil ground level. The contractor would have to cover the surrounding areas (visqueen plastic, tarps, etc.) and/or build a barrier wall/surface to catch any additional splatter.

The drainage system would connect the *Top of Sandstone Drainage Control* with the *Shale and Siltstone Stabilization* remedial measures. It would have pipe trenched into the surface from the top of the rock drainage to the shale and siltstone stabilization, then, down to an outlet location in or near the staging area. In all locations the drainage system pipe would be concealed, either by 1) covering with existing soil or 2) tucked into a rock crack, then covered with a shotcrete finish similar to the finish of the Shale and Siltstone Stabilization. The outlet location would be a permanent outlet and would be properly designed to control the flow of anticipated rainwater in a means to not cause erosion issues below. The construction drawings would show a detail of the specific look to the outlet. The outlet could be premanufacture (precast concrete, corrugated metal pipe outlets, etc.) and set using the crane or smaller equipment on-site. The drainage pipe system would have cleanouts concealed by rock, shotcrete, etc. The cleanouts would blend with the natural area.

At the end of the construction process, the contractor would replace the soil to close to original conditions against the Shale and Siltstone Stabilization shotcrete. The soil would be properly compacted. Vibration limits would be considered in the design of this project and the writeup of the construction specification. If compaction vibration is not acceptable, the soil may need to be treated with cement or other stabilization chemicals in order to properly stabilize the soil. Sandstone rocks would be placed back in a natural looking layout as currently is the case.

F.7. Shale and Siltstone Environmental Protection

F.7.1. Shale and Siltstone Environmental Protection Description

This remedial measure would protect the siltstone from humidity and temperature changes and protect from water, thus slowing the weathering process. This measure would not provide structural stabilization. The extent would be approximately the same as the siltstone stabilization as described in Section F.6 and illustrated in Figure 20.

Siltstone environmental protection would be pursued only if siltstone stabilization were found to be unsuitable, based on technical, archeological, or aesthetic considerations. The possible

materials would likely be spray-on materials that provide the necessary environmental protection while blending into the natural environment.

Figure 20 Extent of environmental protection of the siltstone.

F.7.2. Shale and Siltstone Environmental Protection Process

The shale and siltstone environmental protection would consist of the contractor spraying sodium silica (or similar treatment spray) onto the surface of the shale and siltstone (See Section F.6.2 for a description of the spray). The contractor would install any preventative measures necessary to ensure applied materials do not overspray onto any historic inscriptions above the layer being treated. The preventative measures shall be approved by the BIFO archaeologist to ensure no historic inscriptions or other cultural features would be impacted. Some removal and preparation may still be needed to ensure that the surface is solid and able to withstand years of erosion and weathering effects. This treatment would also use a working area immediately below the shale and siltstone; however, the nature of the shale and siltstone environmental protection treatment would be less workspace intrusive for application than the shale and siltstone stabilization.

F.8. Buttressing at Signature Block

F.8.1. Buttressing at Signature Block Description

The corner of Block 2 at the Signature Blocks area (see Figure 1**Error! Reference source not found.**) has a substantial overhang, as shown in Figure 21. The lack of supporting siltstone has contributed to rock breakage and bedding plane opening, as shown in Figure 22. The breakage and opening have created potentially unstable rock blocks 2a, 2b, and 2c (see Figure 1).

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Figure 21 Two views of the Signature Block 2 overhang.

Figure 22 Signature Block 2 rock breakage.

To stabilize the corner of Block 2, buttressing is proposed. This remedial measure is like the siltstone stabilization described in Section F.6, consisting of shotcrete or concrete with rock bolts and drainage. This treatment, shown in Figure 23, requires greater thickness, foundation considerations, and positive contact with the underside of the Block 2 overhang. The buttressing will transition smoothly to the siltstone stabilization applied to the adjacent siltstone exposure and will have the same texture and coloring. The contractor shall install any preventative measures necessary to ensure applied materials do not overspray onto any historic inscriptions above the layer being treated. The preventative measures shall be approved by the BIFO archaeologist to ensure no historic inscriptions would be inadvertently impacted. The shotcrete

will have integral color so that any future chip outs would expose a matching color. Figure 24 shows a horizontal section through the Block 2 buttressing. The buttressing will be founded on the micropyles.

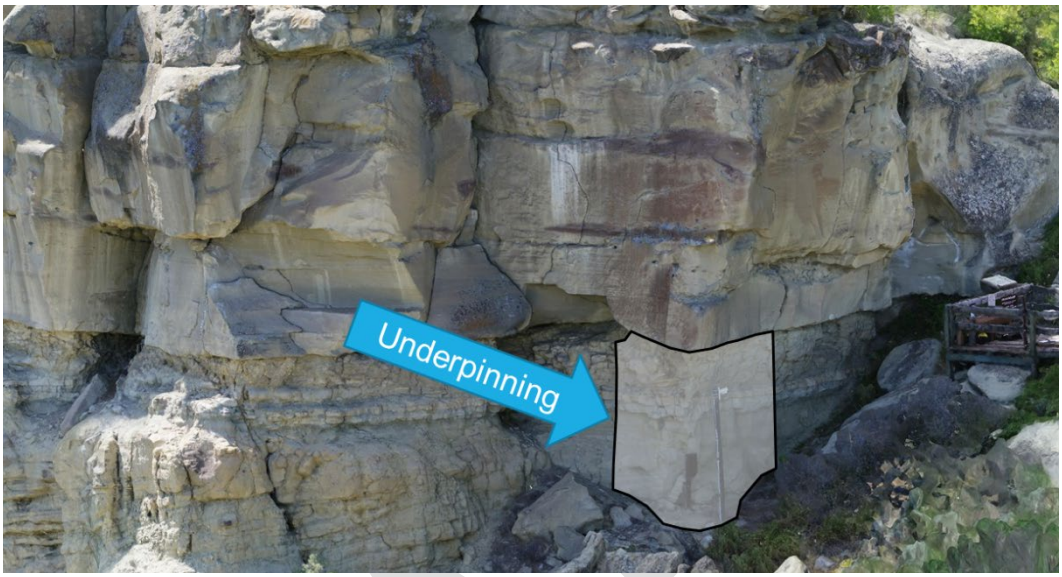

Figure 23 Block 2 underpinning.

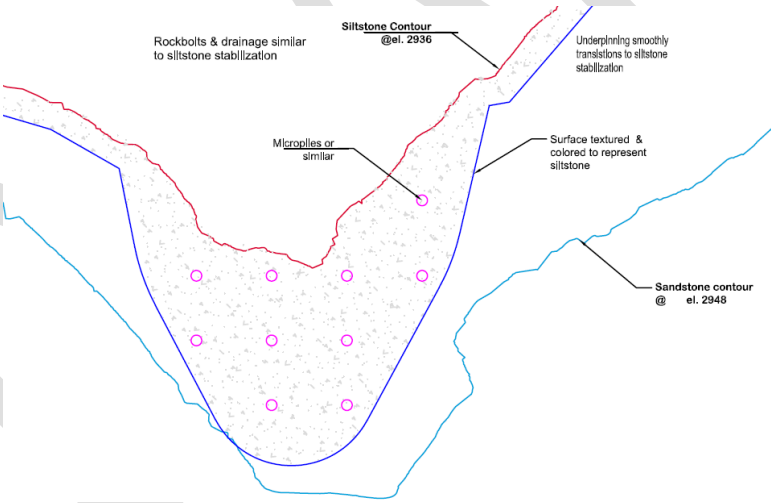

Figure 24 Horizontal section of Block 2 underpinning.

F.8.2. Buttressing at Signature Block Process

The contractor would first need to prepare the shale and siltstone area immediately below the treatment area at Signature block. The contractor would flatten out the soil immediately below the treatment area and would then excavate to the next layer of sandstone below the existing soil (~2-10'). Next, the contractor would build a foundation on the sandstone layer below. The foundation could be either a concrete footing or base load bearing plates anchored to the sandstone. There would be installed load bearing plates above on the sandstone. The load

bearing plates would be anchored into the sandstone above and below. The contractor may need to shore the existing rock with temporary jack shore posts, however, there would eventually be installed permanent load bearing posts for the underpinning.

The contractor would place rebar for a concrete foundation located under the entire buttressing area. The concrete may be cast against the earth or forms built. The contractor would place rebar for the fill between the foundation and the existing sandstone above and then fill with shotcrete or concrete. The contractor may need to use formwork in order to fill with concrete for the underpinning.

The contractor would then place any additional rebar and mesh welded wire on the surface of the concrete. The contractor would then place shotcrete to the surface of the concrete. This shotcrete would receive color treatment during mixing, the surface would be textured, and the surface would be finished to appear like the shale and siltstone. The shotcrete surface treatment would be integrated into the rest of the shale and siltstone stabilization.

F.9. Rock Bolting at Signature Blocks 2a, 2b, and 2c

F.9.1. Rock Bolting at Signature Blocks 2a, 2b, and 2c Description

Blocks 2a, 2b, and 2c rock bolting would be an alternative to the buttressing described in Section F.8. Figure 25 illustrates this concept. Several rock bolts would be placed down from the underside of the overhang, into the sandstone above. The figure shows three rock bolts, but the required number may be more or less, depending upon the conditions and the design. The rock bolt head plates and nuts would be recessed into to the top of the head. After placement, the recess would be grouted with cementitious material, then textured and colored to match the rock.

This alternative means of stabilizing Blocks 2a, 2b, and 2c would be pursued only in the event that buttressing was found to be inadvisable.

Figure 25 Signature Block 2a, 2b, and 2c rock bolting.

F.9.2. Rock Bolting at Signature Blocks 2a, 2b, and 2c Process

This area may be reached by some sort of rock coring/drilling equipment, such as a small tracked equipment, large telescoping boom drill equipment, or similar. The contractor would use a

handheld rock drill to core through the sandstone, siltstone, and shale. Efforts shall be made to drill at a speed to generate the smallest amount of vibration as possible, to prevent rocks bearing historic inscriptions from being shaken loose during the process. The holes would be cleaned out, then the rock bolts installed by placing the rock bolt and grout into the hole. The rock bolt would not extend to the surface of the hole so that the rock bolt would be covered by textured and colored grout/shotcrete to conceal the rock bolts. Vibration limits would be considered in the design of this project and the writeup of the construction specification.

F.10. Rock Bolting at Signature Block 1a

F.10.1. Rock Bolting at Signature Block 1a Description

Due to concerns of engaging in the remediation measures to the shale and siltstone layer, rock bolts are being proposed to stabilize Block 1a at Signature Block. The required number may vary depending upon the conditions and the design. The rock bolt head plates and nuts would be recessed into to the top of the head. After placement, the recess would be grouted with cementitious material, then textured and colored to match the rock. Additionally, the placement of this measure coincides with the Top of Sandstone Drainage Control measure which could cover all or a portion of the head plate locations.

F.10.2. Rock Bolting at Signature Block 1a Process

Much like with the rock bolting process for Signature Blocks 2a, 2b, and 2c, the contractor would use a handheld rock drill to core through the sandstone, siltstone, and shale. Efforts shall be made to drill at a speed to generate the smallest amount of vibration as possible, to prevent rocks bearing historic inscriptions from being shaken loose during the process. The holes would be cleaned out, then the rock bolts installed by placing the rock bolt and grout into the hole. The rock bolt would not extend to the surface of the hole so that the rock bolt would be covered by textured and colored grout/shotcrete to conceal the rock bolts. Vibration limits would be considered in the design of this project and the writeup of the construction specification.

F.11. Underpinning at Turtle Rock

F.11.1. Underpinning at Turtle Rock Description

Observations from the crane basket during a site visit showed that the rock supporting the forward part of the turtle head at Turtle Rock is relatively small, affected by bedding planes and cracking, and shows signs of eroding. The supporting rock is outlined in Figure 26, and the bedding planes, cracks, and joints are highlighted in Figure 27. Advanced imagery through *3DEC* showed that the turtle head is unstable if the rock outlined in Figure 26 is gone.

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Figure 26 Two views of the rock supporting the Turtle Rock head.

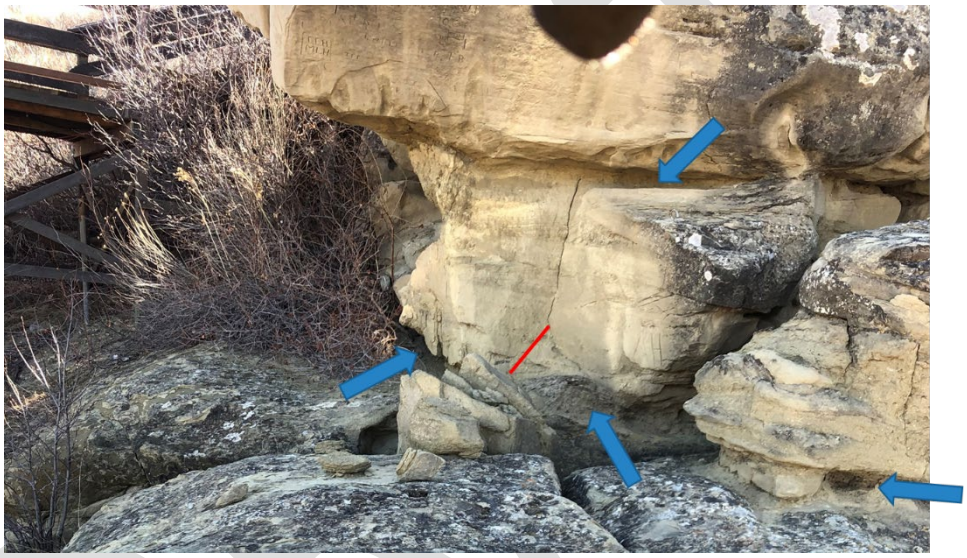

Figure 27 Rock conditions under the Turtle Rock head.

Figure 28 shows the approximate location and outward extent of the proposed underpinning for the Turtle Rock head. The location and extent of possible measures on the existing rock surface being considered for analysis purposes is shown in Figure 29. The underpinning will be anchored to the rock below and placed in such a manner to support the turtle head from additional movement. The underpinning post will be comprised of a textured metal with the intent to blend into adjacent sandstone.

To aid in the underpinning measure, additional sealant protection will be applied to the thin seam of shale and siltstone to aid in its preservation and ensure that the "head" of Rock has a stable foundation. The application will consist of a sodium silicate material.

There are inscriptions on the rock on the underside of the Turtle Rock head (see for example the left image in Figure 26) and for this reason a larger area than is likely needed is being examined.

No concrete, shotcrete, resin (e.g. sodium silicate spray), or any other materials shall be placed across significant historic inscriptions found on the left of center of the turtle rock neck and chin area.

Figure 28 Rendering of the of the proposed underpinning stabilizing the Turtle Rock head.

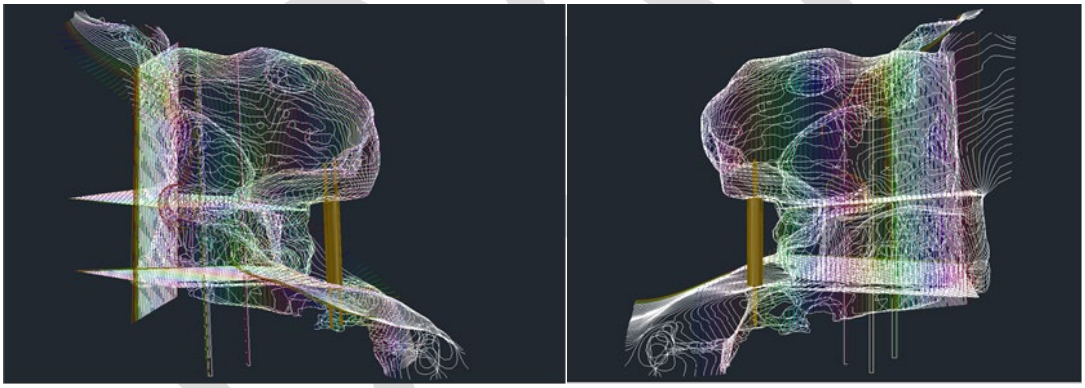

Figure 29 Location of the underpinning

Figure 30 Full area of analysis of possible underpinning at Turtle Rock head.

F.11.2. Underpinning at Turtle Rock Process

In order to first access Turtle Rock, the contractor would need to remove the side panels from the existing boardwalk and build stairs/walkways from the existing boardwalk to Turtle Rock. These stairs/walkways would be gated and restricted from public use. The contractor would build an access route using rubber matting (or other material), ladders, scaffolding, and walkways/stairs. The rock surfaces would be protected against permanent damage. The construction drawings would show details or locations of the temporary access. The staging and construction area around Turtle Rock would be approximately 356 square feet; vegetation within this area would be removed which would amount to approximately 158 square feet. Overall, the contractor would use the public boardwalk on a limited basis. The Turtle Rock area would be the biggest use of the boardwalk for the contractor.

The Underpinning at Turtle Rock would be used in conjunction with rock bolting as each offers a piece of the Turtle Rock stabilization effort. For underpinning, the contractor would prepare the shale and siltstone area immediately below the treatment area including flattening out the soil immediately below the treatment area. The contractor would then excavate to the next layer of sandstone below the existing soil (~2-10'). The contractor would build a foundation on the sandstone layer below. The foundation could be either a concrete footing or base load bearing plates anchored to the sandstone. The contractor would also install load bearing plates above on the sandstone. There may need to shore the existing rock with temporary jack shore posts. The contractor would install permanent load bearing post for the underpinning. The underpinning post will be composed of textured metal with the intent to blend into adjacent sandstone.

The contractor would stabilize shale seams under the Turtle Head. The shale seams would be cleaned out to removed loose material. The remaining rock surfaces will be treated with sodium silicate spray (See Section F.6.2 for a description of the spray). Then reinforcing (type to be determined) will be placed, and mortar hand packed into the seams. Finally the surface will be colored and textured to match adjacent rock.

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F.12. Rock Bolting at Turtle Rock

F.12.1. Rock Bolting at Turtle Rock Description

An alternative to the Turtle Rock head underpinning described in Section F.11 would be rock bolting. Figure 31 illustrates this concept. Several rock bolts would be placed down through the Turtle Rock head, into the sandstone below and possibly into the mixed siltstone and sandstone below. The figure shows three rock bolts, but the required number may be more or less, depending upon the conditions and the design. As annotated on the left image, the rock bolt head plates and nuts would be recessed into the top of the head. After placement, the recess would be grouted with cementitious material, then textured and colored to match the rock.

Figure 31 Turtle Rock head rock bolting.

Another design consideration is the necessary anchorage forces. Typically, greater rock bolt force requirements would require greater anchorage lengths. Depending upon the stability and anchorage capacity of the sandstone immediately underlying the head, the rock bolts may need to extend down into the mixed siltstone and sandstone below (see the note on the right image in Figure 31).

F.12.2. Rock Bolting at Turtle Rock Process

The contractor would install about three rock bolts on the top backside of the Turtle Head as indicated on the construction drawings. The contractor would use a handheld rock drill to core through the sandstone, siltstone, and shale. Like with *Signature Block Rock bolting*, the holes would be cleaned out, then the rock bolts installed by placing the rock bolt and grout into the hole. The rock bolt would not extend to the surface of the hole so that the rock bolt would be covered by textured and colored grout/shotcrete to conceal the rock bolts. Vibration limits would be considered in the design of this project and the writeup of the construction specification.

G. Appendix G: Applied BMPs

G.1. Soil

- Surface disturbance on sustained slopes over 25%, would require reclamation and mitigation planning that demonstrates how site productivity will be restored.
- Surface runoff will be adequately controlled using mitigations such as: water bars, fiber mats, contour felling, and vegetative filters.
- Off-site areas will be protected from accelerated erosion, such as rilling, gullying, piping, and mass wasting.
- Surface-disturbing activities will not be conducted during extended wet periods.
- Construction will not be allowed when soils are frozen.
- Construction activities will be restricted during wet or muddy conditions and will be designed following BMPs to control erosion and sedimentation.
- Surface disturbing activities are to be avoided in areas of active mass movements (landslides and slumps) (MT-11-2)
- Erosion control and sited restoration measures will be initiated within one year of completion of a project. Disturbed areas will be re-contoured to provide proper drainage.
- Interim reclamation for long-term projects would be considered at the project level plan and could include seeding with BLM-approved seed mixtures.
- All surface disturbances are to be reseeded/re-vegetated with native plant species common to the site's natural plant community. Site specific planning may warrant the use, on a case-by-case basis, of introduced species where difficult site stabilization or wildlife concerns prevail.
- Require a temporary protection surface treatment such as mulch, matting and netting for the reclamation of all mechanically disturbed areas (this excludes wildland fire).
- Speed restrictions for areas susceptible to wind erosion i.e., 25 mph, limited travel
- Use of saline dust inhibitors
- Areas with steep topography will be developed in accordance with the BLM Gold Book (United States
- Department of the Interior and United States Department of Agriculture 2007) requirements. Lease roads and constructed facilities will be located in accordance with the approved APD. In areas of construction, topsoil will be stockpiled separately from other material, and be reused in reclamation of the disturbed areas. Unused portions of the producing well site will have topsoil spread over it and will be reseeded
- Construction activities will be restricted during wet or muddy conditions and will be designed following BMPs to control erosion and sedimentation. If porous subsurface materials are encountered during pit construction, all onsite fluid pits will be lined. During road and utility ROW construction, surface soils will be stockpiled adjacent to the

cuts and fills.

- Stream crossings will be designed to minimize impacts and not impede stream flow. Erosion control measures will be maintained and continued until adequate vegetation cover (as defined by BLM on a case-by-case basis) is reestablished. Vegetation will be removed only when necessary. Water bars will be constructed on slopes of 3:1 or steeper.
- Erosion control and site restoration measures will be initiated as soon as a particular area is no longer needed for exploration, production, staging, or access. Disturbed areas will be recontoured to provide proper drainage.
- The road ditches would be flat bottomed and "V" ditches not allowed. Place water turn outs where appropriate to lessen the water impacts upon the ditches.
- Topsoil piles may be required to be seeded following the BLM seeding policy.
- Displaced farmland, whether in crop production or not, will be reclaimed to original soil productivity through adoption of standard reclamation procedures.
- Require the use of specialized low-surface impact equipment (e.g., balloon-tired vehicles) or helicopters, as determined by the BLM Authorized Officer, for activities in off-road areas where it is deemed necessary to protect fragile soils and other resources.
- During periods of adverse soil moisture conditions caused by climatic factors such as thawing, heavy rains, snow, flooding, or drought, suspend activities on existing roads that could create excessive surface rutting. When adverse conditions exist, the operator/permittee would contact the BLM Authorized Officer for an evaluation and decision based on soil types, soil moisture, slope, vegetation, and cover.
- When preparing the site for reclamation, include contour furrowing, terracing, reduction of steep cut and fill slopes, and the installation of water bars, as determined appropriate for site-specific conditions.
- Restoration requirements include reshaping, re-contouring, and/or resurfacing with topsoil, installation of water bars, and seeding on the contour. Removal of structures such as culverts, concrete pads, cattle guards, and signs would usually be required. Fertilization and/or fencing of the disturbance may be required. Additional erosion control measures (e.g., fiber matting and barriers) to discourage road travel may be required.

G.2. Vegetation

- Where seeding is required, use appropriate seed mixture and seeding techniques approved by the BLM Authorized Officer.
- Keep removal and disturbance of vegetation to a minimum through construction site management (e.g., using previously disturbed areas and existing easements, limiting equipment/materials storage and staging sites, etc.).
- Generally, conduct reclamation with native seeds that are representative of the indigenous species present in the adjacent habitat. Document rationale for potential seeding with selected nonnative species. Possible exceptions would include use of nonnative species

for a temporary cover crop to outcompete weeds. In all cases, ensure seed mixtures are approved by the BLM Authorized Officer prior to planting.

- Certify that all interim and final seed mixes, hay, straw, and hay/straw products are free of plant species listed on the Montana noxious weed list.
- An area is considered to be satisfactorily reclaimed when all disturbed areas have been recontoured to blend with the natural topography, erosion has been stabilized, and an acceptable vegetative cover has been established. Use established guidelines to determine if revegetation has been successful.

G.3. Vegetation Rangeland

- The perennial plant cover of the reclaimed area would equal or exceed perennial cover of selected comparison areas normally, adjacent habitat. If the adjacent habitat is severely disturbed, an ecological site description may be used as a cover standard. Selected cover can be determined using a method as described in Sampling Vegetation Attributes, Interagency Technical Reference, 1996, BLM/RS/ST-96/002+1730. The reclamation plan for the area project would identify the site-specific release criteria and associated statistical methods in the reclamation plan or permit.
- Surface disturbing exploration operations would be subject to site specific stipulations found in Appendix C.
- Disturbed areas resulting from any construction will be seeded in accordance with the BLM seeding policy (USDI BLM, 1999c) or surface owner‘s requirements. Depending on surface ownership, seeding is usually required during the fall or spring.
- Should the reseeding of sagebrush be required, different seeding times and techniques will be required.
- To the extent practicable, vegetation will be preserved and protected from construction operations and equipment except where clearing operations are required to conduct oil and gas operations, such as for roads, well pads, pipelines, power lines, utility lines, and structures. Clearing of vegetation will be restricted to the minimum area needed for construction and equipment.
- Cuts and fills for new roads will be sloped to minimize erosion and to facilitate re-vegetation. Riparian zones will be protected by federal lease stipulations and permit mitigation measures. The BLM seeding policy will be followed for all reclamation and reseeding activities.
- During reclamation activities, early succession plants will be used for re-vegetation to provide a fast-growing cover crop to minimize and compete against noxious weeds.
- Operator reclamation plans will be developed in consultation with the surface owner. Reclaimed areas reseeded with native species will require a certified weed-free seed mix. The seed mix used on private surface will be developed in consultation with the surface owner. Successful revegetation will usually require at least two growing seasons to ensure a self-sustaining stand of seeded species.

- Where seeding is required, use appropriate seed mixture and seeding techniques approved by the BLM Authorized Officer.
- Generally, conduct reclamation with native seeds that are representative of the indigenous species present in the adjacent habitat. Document rationale for potential seeding with selected nonnative species. Possible exceptions would include use of nonnative species for a temporary cover crop to outcompete weeds. In all cases, ensure seed mixes are approved by the BLM Authorized Officer prior to planting.
- Certify that all interim and final seed mixes, hay, straw, and hay/straw products are free of plant species listed on the Montana noxious weed list.
- Displaced farmland, whether in crop production or not, will be reclaimed to original soil productivity through adoption of standard reclamation procedures.

H. Appendix H: Reclamation Plan

SECTION 32 92 00 – TURF AND GRASSES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Restoration of construction area by installation of topsoil, topsoil/compost mixture, seed, sod, soil amendments, mulch, and erosion control.

B. Related Sections:
   1. Section 01 33 00 - Submittal Procedures

1.2 REFERENCES

A. Montana Department of Transportation "Standard and Supplemental Specifications for Road and Bridge Construction", latest edition (MDT Spec.):
   1. 610 – Roadside Re-vegetation

B. Montana Department of Transportation Erosion and Sediment Control Best Management Practices Manual.

1.3 SUBMITTALS

A. Provide the following submittals consistent with Section 01 33 00 at or prior to the preconstruction meeting:
   1. Seed:
      a. Provide source and invoice for seed to be used for this Project.
      b. Producer's certificate of compliance – Written documentation verifying compliance of mixture of seed furnished. Include percentage of various seed species, year of production, germination rate, seed bag tags, and weed seed content. Submit to the Contracting Officer at least 5 days prior to delivery.
      c. Species within native seed mixes species shall have their origin documented by the Montana State Seed Lab (MSSL) to certify that the product is a local ecotype plant.
      d. Provide Contracting Officer with seed bag tags used for identification purposes.
   2. Topsoil per MnDOT Spec 3877.3.
      a. The Contractor shall split and test a sample from prospective source with the Owner prior to the preconstruction meeting.
      b. The Contractor's QC sample and Owner's QA sample shall meet the requirements of MDT Spec. 713.05. If the requirements are not met the Contractor must provide material from another source.

1.4 PERFORMANCE REQUIREMENTS

A. The Establishment Period for plants shall begin for immediately after installation, with the approval of the Contracting Officer, and continue until the date that the Contracting Officer performs a final inspection:
   1. The establishment period for seeded areas is 45 days.
   2. The germination period for seed is 14 days.

1.5 SEQUENCING AND SCHEDULING

A. Provide submittals prior to preconstruction meeting.

B. Notify the Contracting Officer 30 days prior to placement of topsoil and/or compost to allow for inspection, sampling, and testing if necessary.

C. Notify the Contracting Officer at least 3 days in advance of hauling topsoil borrow on Site so the Contracting Officer may review grades prior to placement.

PART 2 - PRODUCTS

2.1 SEED: Conform to MDT Spec. 713.08.

A. TOPSOIL: The contractor shall seed all disturbed areas with the seed mixtures listed below. There shall be no primary or secondary noxious weed seed in the seed mixture. Seed shall be tested and the viability testing of seed shall be done in accordance with State law(s) and within six months prior to purchase. Commercial seed shall be either certified or registered seed. The seed mixture container shall be tagged in accordance with State law(s) and available for inspection by the authorized officer.

B. All disturbed areas of less than 15% shall be drill seeded after October (before ground freezes) or prior to May 15 (after ground thaws) at 6″ drill row spacing at a depth of ¼″ to ½″ with the BLM approved seed mix (shown below).

C. Where drilling is not possible (slopes greater than 15%), seed shall be broadcast and the area shall be raked or chained to cover the seed. When broadcasting the seed, the pounds per acre noted below are to be doubled.

D. If seed mix needs to be alternated due to availability, changes need to be preapproved by BLM.

<u>Seed mix to be used at sites that are under 15% slope</u>

Bluebunch wheatgrass	Pseudoroegneria spicata	5 lbs/acre
Western wheatgrass	Pascopyrum smithii	4 lbs/acre
Needleandthread grass	Hesperostipa comata	2 lbs/acre
Prairie Junegrass	Koeleria macrantha	1 lbs/acre

Sandbergs bluegrass	Poa secunda	1 lbs/acre
Milkvetch spp	Astragalus spp	1 lbs/acre
Purple prairie Clover	Dalea purpurea	1 lbs/acre

Seed mix to be used at sites that are over 15% slope

Bluebunch wheatgrass	Pseudoroegneria spicata	7 lbs/acre
Needlandthread grass	Hesperostipa comata	4 lbs/acre
Indian ricegrass	Oryzopsis hymenoides	4 lbs/acre

2.2 Conform to MDT Spec. 713.05.

2.3 FERTILZER: Conform to MDT Spec. 713.09.

A. Provide plant fertilizer that is commercial grade and uniform in composition and conforms to applicable state and federal regulations.

B. Slow release fertilizer. A minimum of 70 percent of the nitrogen component shall be a slow-release water insoluble nitrogen.

C. Fertilizer shall contain a minimum percentage by weight 10-10-10 (NKP).

2.4 MULCH: Conform to MDT Spec. 7136.10.

2.5 ROLLED EROSION CONTROL products; Conform to MDT Spec. 713.12.

A. Long term blanket, unless identified otherwise in the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review restoration areas with the Contracting Officer. Determine locations for seed. Schedule for restoration of areas may be revised to fit field conditions:
   1. No compensation will be allowed for areas considered to be needlessly restored if restoration activities are performed without the authorization of the Contracting Officer.

B. Finish grades are to be inspected and approved by the Contracting Officer prior to start of restoration.

3.2 DELIVERY AND STORAGE

A. Delivery:
   1. Notify the Contracting Officer of the delivery schedule in advance so the plant material may be inspected upon arrival at the Site. Remove unacceptable plant material from the Site immediately.
   2. Deliver fertilizer and lime to the Site in the original, unopened containers bearing the manufacturer's guaranteed chemical analysis, name, trade name or trademark, and in conformance to state and federal law. In lieu of containers, fertilizer and lime may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.
   3. During delivery, protect seed from contamination.

B. Storage:
   1. Keep seed, lime, and fertilizer in dry storage away from contaminants.

3.3 TOPSOIL

A. Conform to MDT Spec. 610.03.1, and as modified below.

B. Subgrade to be inspected and approved by Contracting Officer prior to placement of topsoil. Shape subgrade to the approximate contour of the finished surface. All construction debris shall be removed from the area prior to the placement of topsoil.

C. Shape topsoil to the approximate contour of the finish surface, with a minimum compacted depth of 6-inches.

3.4 SEEDBED SURFACE

A. Conform to MDT Spec. 610.03.2.C.

B. Fertilizers and Conditioners: Conform to MDT Spec. 610.03.2.E, and as modified below.
   1. Apply fertilizer at a rate of 400 lbs. per acre (9.2 lbs./1,000 sq. ft.).
   2. Where soil pH is lower than 5.5, apply lime at 3 tons per acre (140 lbs./1,000 sq. ft.).

3.5 SOWING SEED

A. Seeding Preparation and Application: Conform to MDT Spec. 610.03.2.D for the mixes specified.

B. Seed shall be applied with a drill seeder, unless otherwise approved by the Owner.

3.6 ROLLED EROSIOIN PREVENTION PRODUTS

A. Erosion control blanket shall be installed immediately following seeding in accordance with MDT Spec. 610.03.4, and as modified below.

B. Raking or harrowing of soil/seed shall be done before installation of erosion control blanket.

C. Install blanket parallel to the direction of flow in all cases.

D. If permanent seeding is not available at the time of blanket installation, this material will have to be removed, re-seeded, and installed again as a permanent erosion control measure. If permanent seeding is available at the time of initial installation, a 1-time proper installation is acceptable.

3.7 CLEANUP

A. Immediately following the topsoil, and seed placement, clean all hard surfaces impacted these operations:
   1. Respond within 24 hours of a request by the Contracting Officer, with the necessary equipment to perform the cleanup operations.

3.8 MAINTENANCE

1. Restored areas that have been satisfactorily completed and are disturbed by additional construction activity required by the timing and sequencing of the Work shall be restored over to the same requirements of the original work.
2. Water the seeded areas to ensure establishment:
   a. Compensation will be made for all watering activity during the initial 45-day maintenance period for seed, per Bid Item for Application of Water for Turf Establishment.
   b. At the end of the 45-day maintenance period, Contracting Officer will make an inspection of all restored areas. Contracting Officer may direct Contractor to continue watering of any area if deemed necessary. Frequency of watering shall be as directed and modified by the Contracting Officer. Duration of watering shall continue at the directed frequency until Contractor is directed by Contracting Officer to cease.
3. Weed control shall be the responsibility of the contractor during the initial 45-day establishment period. Weed control may include spot spraying and mowing to control weed growth.
4. Seeded areas that do not show seed germination 14 days after installation shall be replaced at the proper season by the Contractor at his/her expense and watering will be required every day at a minimum.
5. Seeded areas that do not show definite growth and establishment 45 days after installation shall be replaced and established at the proper season by the Contractor at his/her expense.

3.9 INSPECTION AND ACCEPTANCE

A. Seeding and turf work will be inspected for acceptance in parts agreeable to the Contracting Officer, provided Work offered for inspection is complete, including maintenance for the portion in question.

B. Seeded areas will be inspected for germination and growth 14 days after placement. Any restored areas that do not show definite germination and growth, as determined by the Contracting Officer, shall be replaced and re-established by the Contractor at his/her expense.

C. At the conclusion of the establishment period(s), a final inspection of planting(s) will be made to determine the conditions of areas specified for landscaping.

D. When inspected landscape work does not comply with requirements, replace rejected Work and continue specified maintenance until re-inspected by Contracting Officer and found to be acceptable. Remove rejected materials from the Site.

E. Seed evaluation at the conclusion of the establishment period related to acceptance, shall be based on at least 1 species per square foot with 70 percent of seeding per square foot being of the permanent seed species within the applied mix.

END OF SECTION 32 92 00

I. Appendix I: Remedial Measures Not Analyzed in Detail

Appendix I discusses the actions that were initially considered as solutions to the issues at Pompeys Pillar National Monument but were eventually dropped due to feasibility concerns or need.

I.1. Large Block Removal

Large block removal refers to the process of pre-emptively removing larger pieces of the monument that may eventually become unstable. As opposed to scaling which utilizes only manual removal, options for undertaking large block removal would involve the use of heavy equipment, drilling, and/or explosives. This type of remediation was found to create too great of a risk of harm to both the monument itself and the workers undertaking the action.

I.2. Rockfall Controls (Signature and Lower Rock Areas)

Previously, the BLM has installed barriers to control visitor access and protect visitors from potential rockfall. During a project review in July 2020, possibly moving and extending the barrier is being considered. Figure 1 shows the southeast end of the barrier adjacent to the Signature Block area, prior to being extended, and Figure 2 shows the northwest end.

Figure 1 Southeast end of the barrier, prior to being extended.

Figure 2 Northwest end of the barrier.

The contractor determined that the current rockfall limits are sufficient for continued use. The Rock Block Monitoring System (RBMS) will provide data and notifications in a manner that if significant changes occur, further review will be conducted. No significant changes are anticipated at this time. An extended barrier had been considered on the north side. The approximate location and extent are illustrated in Figure 3. The most at-risk blocks in this area are instrumented with tiltmeters and will continue to be monitored.

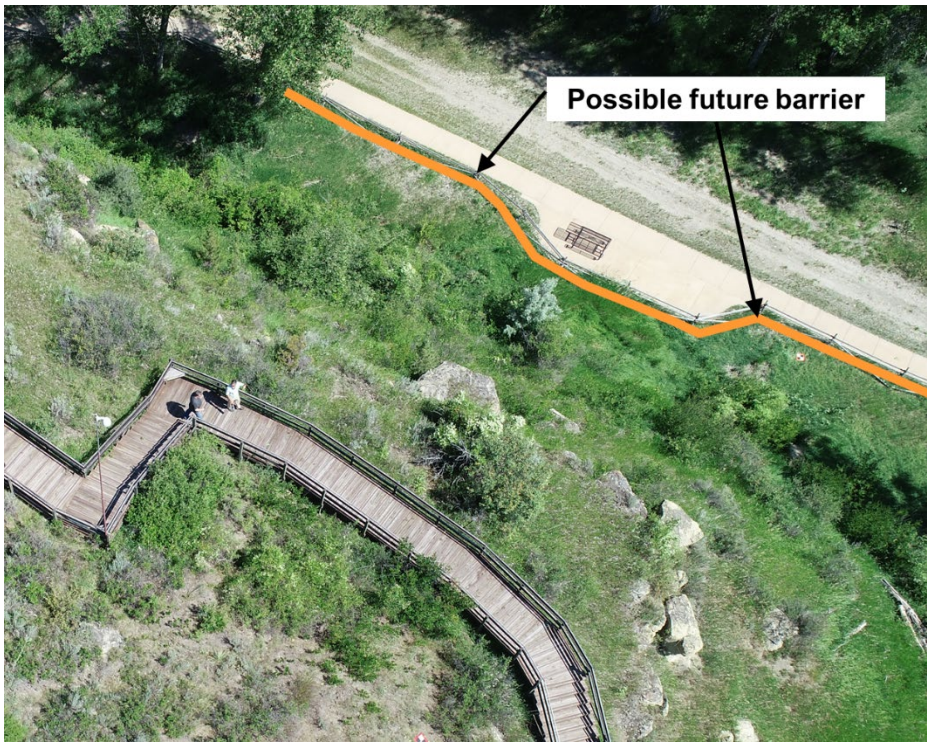

Figure 3 Possible future rockfall control downslope of the Lower Rock area.

I.3. Signature Blocks Area Joint Treatments

The joint treatments remedial measure that would inject a cement or polyurethane grout into the major joints to strengthen the joints and glue the rock blocks together. Four major joints could be treated, as shown in Figure 4:

- The joint south of Block 1,
- The joint west of Block 1, between Block 1 and 2,
- The crack exposed on the east face of Block 2, which divides Block 2 into two parts, and
- The joint between Block 2 and Block 3.

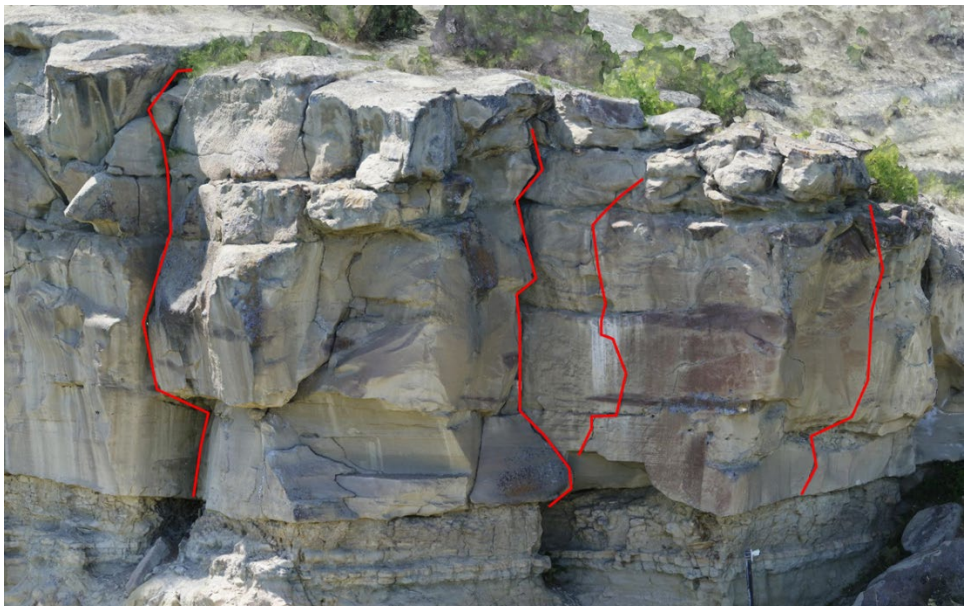

Figure 4 Proposed treated joints.

The suitability of joint treatments for this project depends on a trade-off between the potential balanced against aesthetics, risks, and effectiveness. Joint grouting has proved effective in hard rocks, and in conditions where the rock mass is confined. Neither is the case for the Signature Blocks at Pompeys Pillar. The sandstone is porous and friable, so while a grout may penetrate the sandstone a fraction of an inch, the adjacent sandstone will remain weak and friable. Hence, the effectiveness of this remedial measure is questionable.

Grouting these joints has the following risks:

- Grout pressure jacking open the joints, leading to instability. This risk would be overcome by multiple grout placement stages, limiting amount of grout placed/area of joint treated to accept values. This would affect costs.
- Sealing and grout leakage. The joint exposures would be sealed to prevent grout leakage. However, grout leakage via interconnected joints and bedding planes would remain an issue and could lead to unacceptable aesthetics.
- Grout placement. The two bullet points above mean that many grout ports and sealing would be required, leading to additional aesthetics issue.

Balancing the limited effectiveness and the potential risks, this remedial measure is not recommended.

I.4. Water Diversion in Joints

This measure was intended to control most of the surface water entering the major joints. However, some snow (and subsequent melt water) and rainfall would fall immediately adjacent to the major joints and may enter the joints. Water entry into the joints could be increased by the foliage removal described in Section F.4. Figure 5 illustrates siltstone weathering and erosion caused in part by water in the major joints.

Figure 5 provides a perspective and plan view of the originally proposed locations of joint water diversion measures, and Figure 6 illustrates sealing concepts.

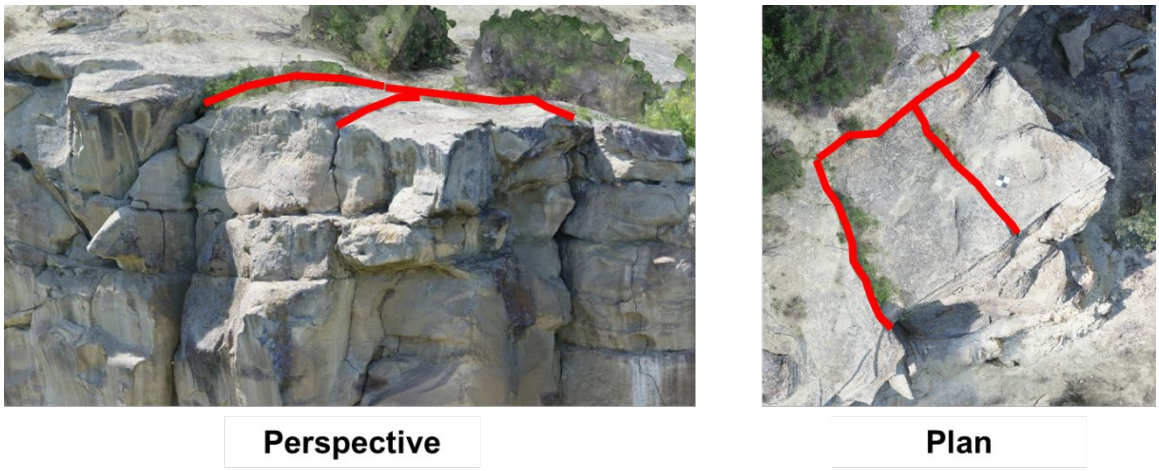

Figure 5 Locations of joint water diversion measures.

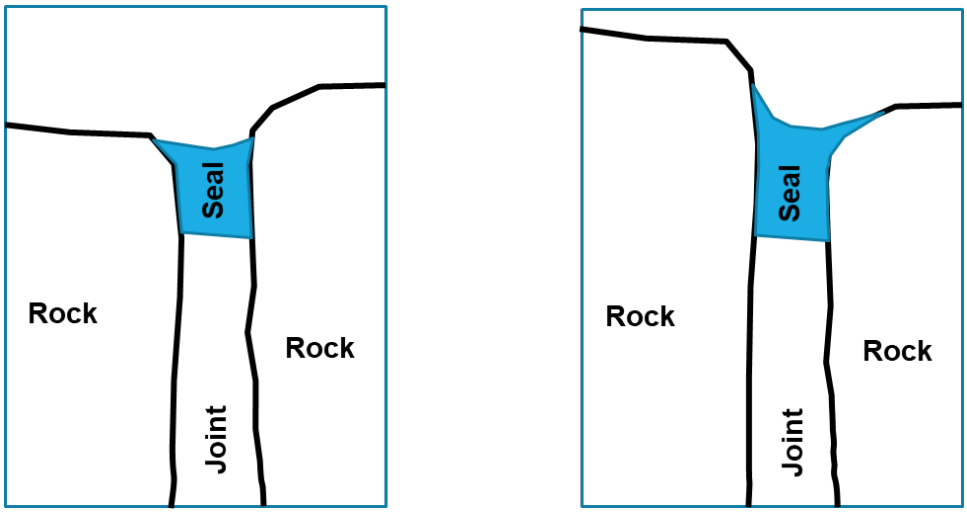

Figure 6 Sealing concepts for joint water diversion.

Sealing the joints would require four interrelated engineering developments that are difficult to achieve given the geologic makeup of the monument and would make this a measure unlikely to be implemented.

- Material selection—The joint sealing material must have a long service life, be resistant to erosion and UV rays, acceptable expansion and contraction characteristics.
- Drainage and water control—The seals must drain to an acceptable location, where the water flow is controlled and routed to an acceptable location.
- Sealing—The seals must bond with the rock (or some other connection or termination.
- Service life and maintenance—An acceptably long service life with an acceptable amount of maintenance is important.