Great Smoky Mountains National Park

U.S. Department of the Interior
National Park Service

Foothills Parkway Section 8D
Environmental Assessment

July 2024

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CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

The National Park Service (NPS) is evaluating the proposed construction of Section 8D of the Foothills Parkway (Parkway) in Great Smoky Mountains National Park (the park). The Section 8D corridor extends between Wears Valley Road in Wears Valley and the Gatlinburg Spur (the Spur), just south of Pigeon Forge in Sevier County, Tennessee. The Federal Highway Administration (FHWA)-Eastern Federal Lands Highway Division (EFLHD) is a cooperating agency for this project. EFLHD is enabled and entrusted to administer many different programs and types of funds to facilitate transportation improvements for federal land management agency partners, including the NPS. This document has been prepared in accordance with the revised 2020 Council on Environmental Quality (CEQ) regulations and the 2022 amendments.

PROJECT AREA AND BACKGROUND

The park and the Foothills Parkway are in the Southern Appalachian Mountains. The park straddles the border between North Carolina and Tennessee; it encompasses more than 800 square miles (approximately 522,427 acres) and is dominated by ancient mountains with elevations ranging from 850 feet to 6,643 feet at Clingmans Dome. The park is world-renowned for the diversity of its plant and animal life, beautiful scenery, and the size and integrity of the wilderness sanctuary within its boundaries (NPS 2016a). It is consistently the most-visited national park in the country, is situated within a day's drive of one-half of the population of the United States, and was visited more than 14.1 million times in 2021 (NPS 2022a).

The concept of a parkway in Tennessee near the park was conceived in the 1930s. Similar to the creation of the park itself, the NPS worked closely with Tennessee officials and park supporters to develop concepts for a scenic parkway that would provide recreational opportunities for visitors, support tourism, and improve the transportation network inside and outside the park. These efforts were emblematic of the NPS's growing commitment to regional recreation planning, particularly in the East.

The necessary legislation to establish the Parkway was introduced in Congress in 1940 and signed into law in 1944. The legislation authorized the Secretary of the Interior to accept donations of land from the State of Tennessee as an addition to the park for the construction of a scenic parkway generally paralleling and connecting with the park. In 1945, the Tennessee legislature authorized acquisition of the necessary land by donation, purchase, or condemnation. Two years later, the state legislature passed another bill that authorized the state to transfer the property to the United States prior to any construction of the Parkway by the federal government. The laws also provided for the reconstruction of a section of US 441 between Pigeon Forge and Gatlinburg, which is known as the Gatlinburg Spur. All lands comprising the 72-mile-long Parkway corridor from Interstate 40 to Chilhowee Lake (US 129), including the Spur, have been conveyed to the United States and are part of the park.

In the *Foothills Parkway Master Plan*, the designated route for the Parkway was identified as "Route 8." For planning purposes, Route 8 is divided into a series of sections referred to as Sections 8A through 8H (NPS 1968). Approximately 39 miles of the Parkway has been constructed and includes the Spur and four other sections at either end of the 72-mile corridor (Figure 1 [inset]). Construction of the Parkway began in the early 1950s with the Gatlinburg Spur. Sections 8A, 8G, and 8H, which together compose approximately 22.5 miles, were completed and opened for public use in the 1960s. The western sections (8H, 8G, 8F, and 8E) extend 33 continuous miles from Chilhowee Lake to Wears Valley and the eastern section (8A) extends 6 miles from State Route 32 to Interstate 40. Construction on the three middle sections (8B, 8C, and 8D) has not begun.

Most recently (in November 2018), 16 miles of the Parkway from Walland to Wears Valley (Sections 8E and 8F) opened to the public. Construction of these sections started in 1966, but construction paused in 1989 to address steep terrain and geological conditions along a 1.6-mile segment of Section 8E (known as the “missing link”). Construction resumed after redesigning this segment to include a series of nine bridges and completing an environmental assessment (EA). The completed sections of the Parkway provide breathtaking views and recreational driving and bicycling experiences.

The NPS and FHWA also initiated planning efforts for Sections 8D and 8B in the late 1980s and early 1990s. Following publication of a Draft Environmental Impact Statement for Section 8D in 1994 (the notice of availability was published in the *Federal Register* on January 30, 1995), the NPS paused the environmental planning and compliance process for all future Parkway sections until Section 8E was completed.

The NPS has reinitiated planning efforts for Section 8D now that Sections 8E and 8F are complete. The NPS completed an EA and issued a Finding of No Significant Impact (FONSI) for the Wears Valley Mountain Bike Trail System within the 10-mile 8D corridor in May 2022. The *Wears Valley Mountain Bike Trail System Revised EA* addresses construction of the first mile of Parkway Section 8D to provide access to the proposed mountain bike trails. The project area for this EA consists of the remaining 9 miles of the Section 8D NPS Parkway corridor from Wears Valley to the Spur, with a width ranging from 600 to 3,000 feet. For planning purposes, the corridor is subdivided into six segments, based on topography and other natural features (Figure 1).

PURPOSE AND NEED IN TAKING THE ACTION

The purpose of the proposed action is to construct Section 8D of the Parkway between Wears Valley and the Spur within the existing NPS-managed corridor to fulfill the intent of federal and state legislation authorizing construction of the Parkway. The action is needed to provide recreational opportunities, support tourism, and improve the transportation network inside and outside the park.

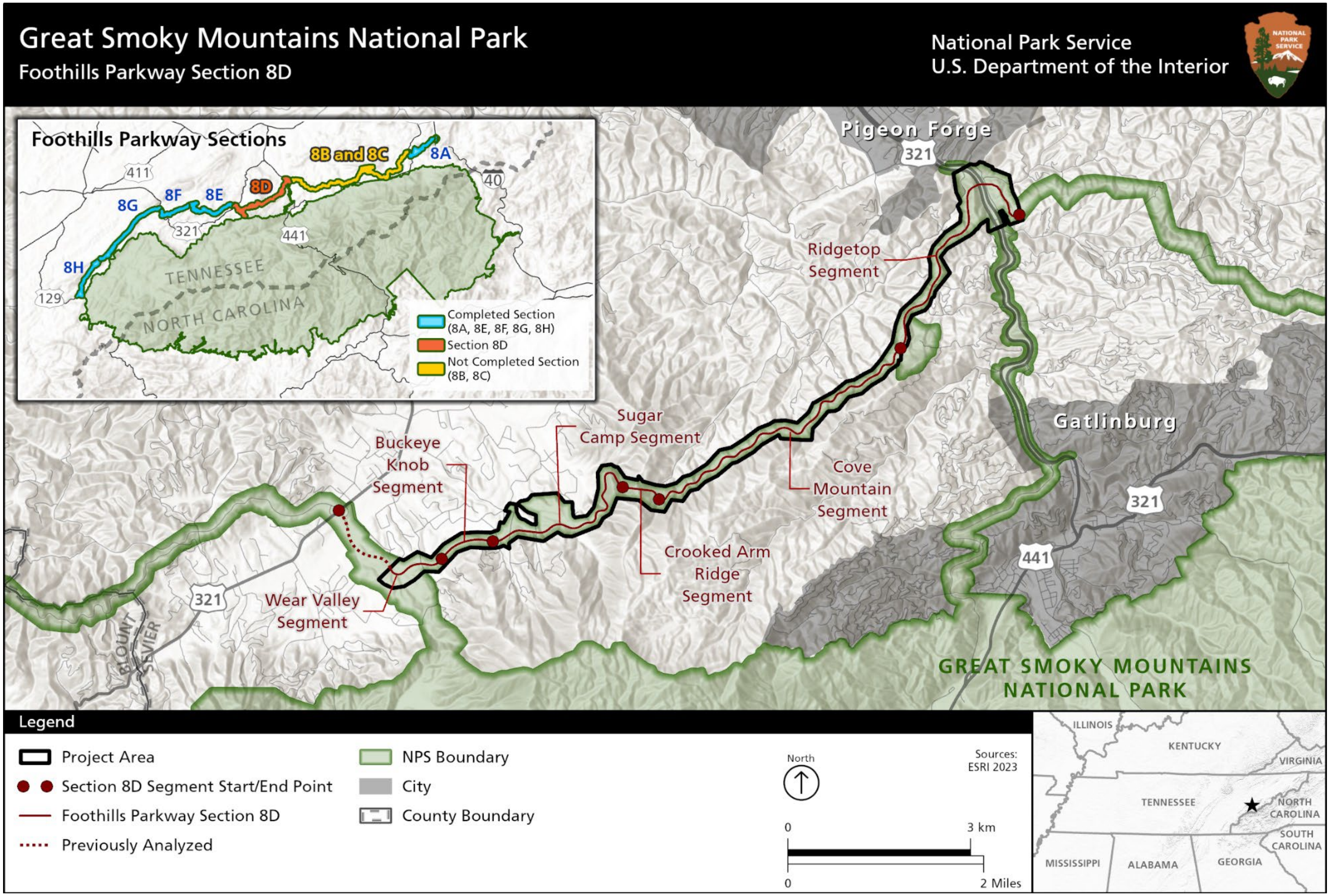


FIGURE 1. PROJECT AREA

CHAPTER 2: ALTERNATIVES

INTRODUCTION

The National Environmental Policy Act (NEPA) requires federal agencies to explore a range of reasonable alternatives aimed at addressing the purpose of and need for a proposed action. Reasonable alternatives include alternatives that are "technically and economically practical or feasible and meet the purpose and need of the proposed action" (43 Code of Federal Regulations [CFR] § 46.420(b)).

Alternatives and actions that were considered but are not technically or economically feasible, do not meet the purpose of and need for the project, create unnecessary or excessive adverse impacts on resources, or conflict with the overall management of the park or its resources were dismissed from detailed analysis. These alternatives or alternative elements and their reasons for dismissal are summarized in Appendix A. Two alternatives are discussed in this EA: the no-action alternative (alternative 1) and the proposed action (alternative 2), the NPS preferred alternative.

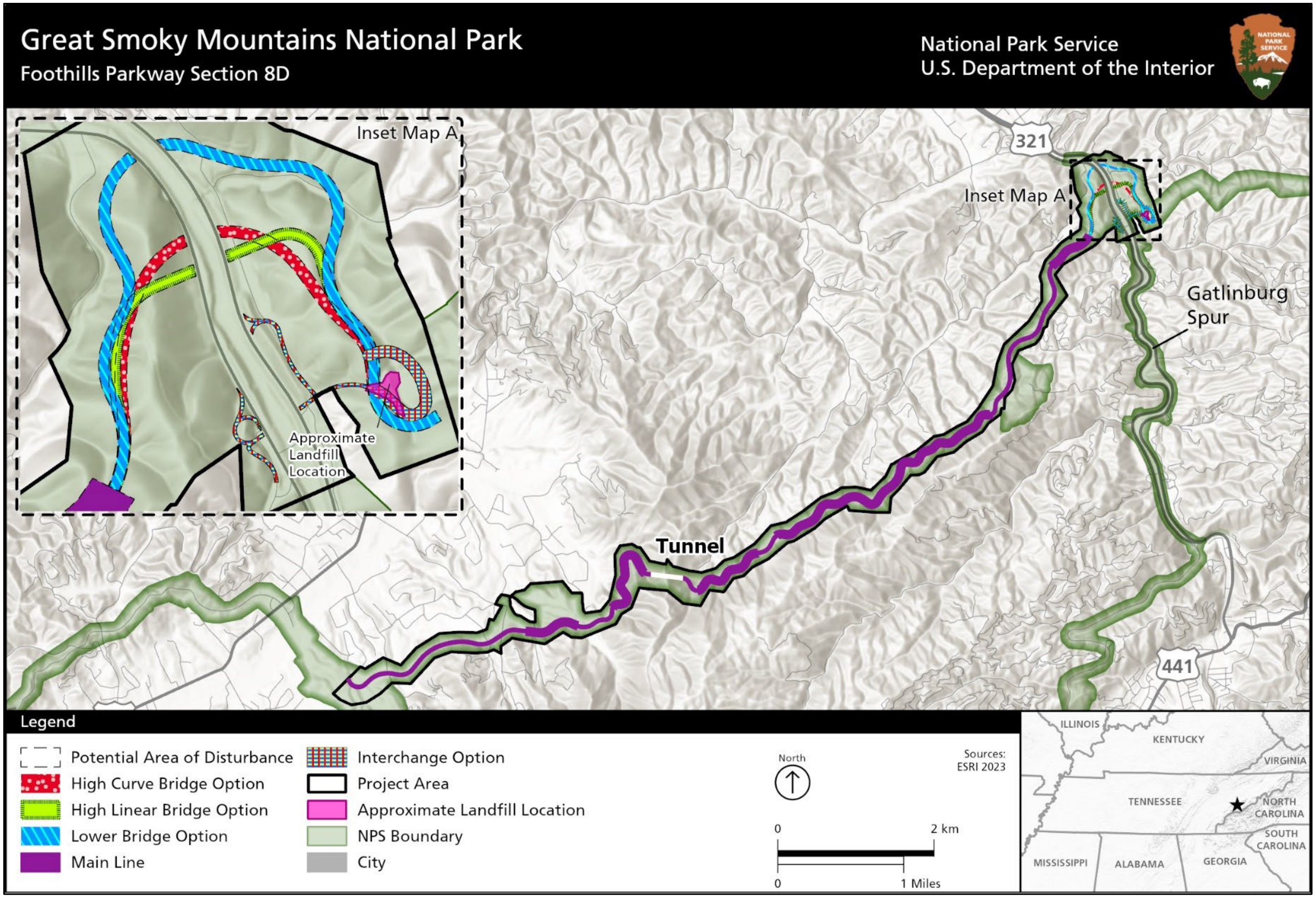
ALTERNATIVE 1: NO ACTION

Under alternative 1, the no-action alternative, the NPS would not construct Section 8D of the Parkway. The CEQ defines the no-action alternative as the alternative that represents no change from current management, and the analysis provides a baseline of continuing with the present course of actions (CEQ 1981). This alternative would not fulfill the intent of federal and state legislation authorizing construction of the Parkway. No new environmental impacts would occur from the no-action alternative. Current visitor opportunities in the project area include wildlife watching, photography, and other passive recreational activities. The project area does not contain developed visitor services such as parking, restrooms, or designated trails. Under alternative 1, the area would remain undeveloped.

ALTERNATIVE 2: PROPOSED ACTION AND NPS PREFERRED ALTERNATIVE

Under alternative 2, the NPS and FHWA-EFLHD (the agencies) would construct approximately 9 miles of Section 8D within the existing NPS-managed corridor. As discussed in chapter 1, a proposal to construct the first mile of Section 8D in the Wears Valley segment was previously analyzed in the *Wears Valley Mountain Bike Trail System Revised EA* (NPS 2022b), and a FONSI was issued in May 2022 (NPS 2022c). The first mile of Section 8D is not reanalyzed in this EA.

For this analysis, a potential area of disturbance (AOD) was developed that encompasses the area where the Parkway would be constructed along the Section 8D corridor (Figure 2). The AOD represents the maximum limits of disturbance in the project area and would be refined during final design. The AOD varies slightly, depending on the Spur bridge options described below, but generally ranges from 326 to 331 acres. To account for the maximum level of potential disturbance, the footprint of the Low Bridge Option (331 acres) was used to estimate the largest potential disturbance for alternative 2 and analyze impacts on resources in chapter 3. The AOD was developed with two different widths, which assumes the disturbance would be approximately 200 feet wide in locations without challenging topography or where bridges would likely be constructed and about 400 feet wide in locations where areas of larger cut-and-fill may be needed, or where the design may need flexibility to address topographic or environmental constraints. To better approximate the minimum limits of disturbance, the estimated cut-and-fill areas, plus 5 feet, from the conceptual design plans are used in this EA (188 acres of disturbance). The additional 5 feet would allow equipment to maneuver while building up or cutting into an embankment. This assumption also uses the footprint of the Low Bridge Option (described in chapter 3), for an accurate comparison. As a result, a range of potential impacts between 188 to 331 acres is provided in chapter 3. For planning purposes, if implemented, construction would likely occur in phases over 10 or more years after funding is identified and detailed designs and permitting are completed.



Note: The Interchange Option shown above in the legend includes the greatest potential disturbance between both Spur Interchange Access Options described under alternative 2. The Interchange Option in the legend, as indicated by the hatching, includes the potential disturbance corresponding with each of the proposed Spur Bridge Options.

FIGURE 2. POTENTIAL AREA OF DISTURBANCE ALONG SECTION 8D CORRIDOR

DESIGN AND CONSTRUCTION PROCESS

OVERVIEW

The NPS obtains funding from Congress, among other funding sources, including grants, for road construction projects in national park units and works cooperatively with FHWA-EFLHD to design and build roads in accordance with established agency procedures. Section 8D is currently in the conceptual design phase, which includes acquiring existing topographic and other mapping data; developing preliminary horizontal and vertical alignments; developing preliminary cross-sections; identifying preliminary locations for bridges, retaining walls, and pull-offs; estimating cut-and-fill needs for construction; and completing various planning studies (NPS 2021a).

The environmental compliance process for new road construction is typically completed during or after the conceptual design phase to consider environmental effects before expending fiscal resources on subsequent design phases and to incorporate any resource protection measures into the project's overall design. If alternative 2 were selected for implementation, and substantial changes were made to the project as a result of relevant data that arose during subsequent design phases, supplemental environmental compliance would be needed in accordance with NEPA and any other applicable laws or guidance prior to implementing the action.

DESIGN CONSIDERATIONS

The mountainous terrain throughout Section 8D would require a combination of cut-and-fill construction methods, retaining walls, and bridges.

The project's AOD includes disturbance associated with cut-and-fill slopes based on conceptual design information and reasonable assumptions. FHWA-EFLHD would develop specific designs for cuts and fills during subsequent design phases based on site-specific geotechnical investigations. Design objectives would aim to balance cut-and-fill while minimizing effort and the potential impacts of relocating excavated material and hauling in fill material or hauling out cut material.

A former landfill is located just east of the Spur, within the project area and partially within the AOD (Figure 2). In the vicinity of the former landfill, Section 8D would be constructed on fill. During subsequent design phases, the NPS would conduct remedial investigations and implement any corrective actions as necessary prior to construction, in accordance with federal, state, and local regulations.

The geology of the Section 8D corridor is complex, and several geological studies have been conducted (e.g., Golder 1986; FHWA 1988; Aley and Aley 1991; Miller and Niemiller 2022; GeoServices 2022, 2023). Geological conditions in the project area that warrant special design considerations include unstable slopes, pyritic material, and karst topography. These conditions are described in more detail in chapter 3.

Karst Topography

Design and construction of Section 8D segments underlain by karst would be further informed by detailed geophysical and geotechnical surveys and analysis conducted during the design and construction process. FHWA-EFLHD would manage and coordinate the design, geotechnical analysis, and construction processes based on applicable FHWA and Tennessee Department of Transportation's (TDOT) geotechnical guidelines (FHWA 2007; TDOT 2023). The agencies would develop and implement a karst management plan as part of final design.

The design and construction process for karst topography in Section 8D would aim to achieve the following goals, which are based on NPS *Management Polices 2006*:

- Maintain the inherent integrity of the karst topography's natural processes and features including its surface and subsurface drainage patterns, caves, biological resources, spring flows, and groundwater and surface water quality and quantity, which include drinking water supplies.
- Reduce geologic hazards associated with karst topography that could threaten the safety of park visitors and staff and the long-term viability of the park infrastructure.

Overall design objectives for Section 8D underlain by karst include the following:

- Minimize the roadway footprint and disturbance to the karst landscape to the extent feasible.
- Use construction techniques that minimize changes to natural karst processes.
- Where feasible, avoid disturbance to known karst features including sinkholes, losing streams (where flow is partially or completely lost to groundwater along its flow path), springs, and areas where the risk of encountering underground voids is high by establishing and maintaining vegetated buffers where no construction activity would occur.
- Avoid discharging road runoff directly to sinkholes and losing streams and design permanent stormwater management measures following karst-specific guidelines, including those found in the latest edition of the *Tennessee Permanent Stormwater Management and Design Guidance Manual's Appendix B Stormwater Design Guidelines for Karst Terrain* (TDEC & UT 2014).
- Comply with Rules of the Tennessee Department of Environment and Conservation (TDEC) Water Supply Division Chapter 0400-45-06 Underground Injection Control established to protect groundwater resources.

During the design process, the agencies would consider use of rock support deep foundation systems and/or other ground remediation programs to address karst-related constraints, particularly in Buckeye Knob (Figure 1). A ground remediation program may consist of a cement-treated base or cap and compaction grouting targeted to limit the formation of sinkholes or a rock-supported foundation system (such as micropiles, caissons, or drive H-piles) targeted to support a specific structure. Other intermediate techniques such as aggregate piers with inclusions could be used. Each of these techniques would require additional geotechnical data for design and consideration and a thorough program of ground-truthing consisting of multiple soil test borings and wireline rock coring in support of the roadway design (GeoServices 2023).

Disturbance to sinkholes would be avoided, when feasible, by establishing and maintaining vegetated buffers where no construction activity would occur. In instances where a sinkhole cannot be avoided, the feature would be crossed using bridging techniques. The most appropriate option, balancing design requirements and resource considerations, would be applied on a location-by-location basis during subsequent design phases. Bridging options include:

- Conventional Bridge Span: A conventional bridge constructed over a sinkhole area would minimize direct disturbance to the sinkhole area and changes to natural surface drainage patterns. Under conventional bridge span design, bridge foundations would be on competent bedrock that has not been altered by karst processes to the extent possible. Various ground modification methods (FHWA 2017) such as grouting would also be considered to improve the engineering properties of bedrock and soils, with a focus on methods that would not alter groundwater flow patterns or groundwater quality.
- Bridge on Grade or Land Bridge: A typical land bridge is a concrete slab bridge directly supported by a rock embankment built in and over a sinkhole. All soil, rock, and debris would be removed from weak zones within the sinkhole. The bottom of the rock embankment in such a bridge consists of large boulder-sized rock, with the rock decreasing to small cobble-sized rock as the embankment increases in height. High-strength, yet porous, geosynthetic materials are typically used in this design to increase the load-carrying capacity and create a barrier through

which a top layer of sand and other soil cannot pass. Stormwater runoff from the bridge deck would not be discharged to the sinkhole, but the rock embankment would allow for infiltration and groundwater recharge. Deep foundations secured in the underlying competent bedrock would also be considered for the land bridge concept.

- Backfill Using Riprap: This technique backfills the collapsed area with riprap. The interlocking action of the riprap backfill and the placement of the backfill on the top of the in-place bedrock can effectively bridge the solution cavity and provide a free-draining structure for groundwater and surface drainage (Moore 2006). These "inverse filters" of riprap backfill are designed to prevent overlying materials from filtering into the interstitial spaces of the clean rock backfill and solution cavity, preventing subsidence or even another collapse. TDOT commonly uses this method (Moore 2006).

Pyritic Material

Unweathered pyritic material (also known as acid-producing material) is composed of sulfide minerals and is present in the rock units at the tunnel location in Crooked Arm Ridge (Figure 1) (Golder 1986). When exposed to air and water, unweathered pyrite produces sulfates that could acidify stormwater runoff and potentially affect downstream waters (Schwartz, Palomino, and He 2018). Acid-producing material can be in the form of soil or rock.

Design and construction of Section 8D in the Crooked Arm Ridge segment would be informed by geotechnical surveys and analysis conducted during the design and construction process. This assessment would be in accordance with the established FHWA (FHWA 1990) and TDOT (TDOT 2007, 2023) guidance. In addition, fill material and pyritic bedrock exposed by construction in areas known to contain acid-producing material would be monitored during construction to locate and mitigate unweathered pyrite and prevent exposure to air and water. Resource protection measures and design solutions for identified acid-producing material would be designed as necessary in accordance with FHWA and TDOT requirements. These solutions are based on the acid-producing potential of the material and include encapsulation or sequestration in place and placement in road embankments (FHWA 1990; TDOT 2007, 2023). Figure 3 is an example of how material could be encapsulated.

If, based on the FHWA and TDOT guidelines, a material's acid-producing potential is appropriate for embankment placement and not enough embankment space is available, the material would be disposed of at a properly permitted waste site. If this waste site is created for the purposes of storing acid-producing material from the project, provisions and permitting must occur prior to the start of construction for the section of roadway (FHWA 1990; TDOT 2007, 2023).

Staging Areas

Equipment and materials staging areas have not been determined at this time. FHWA-EFLHD would identify staging areas within the AOD or in previously disturbed areas approved by the agencies. The final design plans would detail restoration requirements of the staging areas. To limit potential impacts, staging areas in the footprint of the road or in parking areas would be preferred because they would reduce the need for restoration beyond paving or gravel.

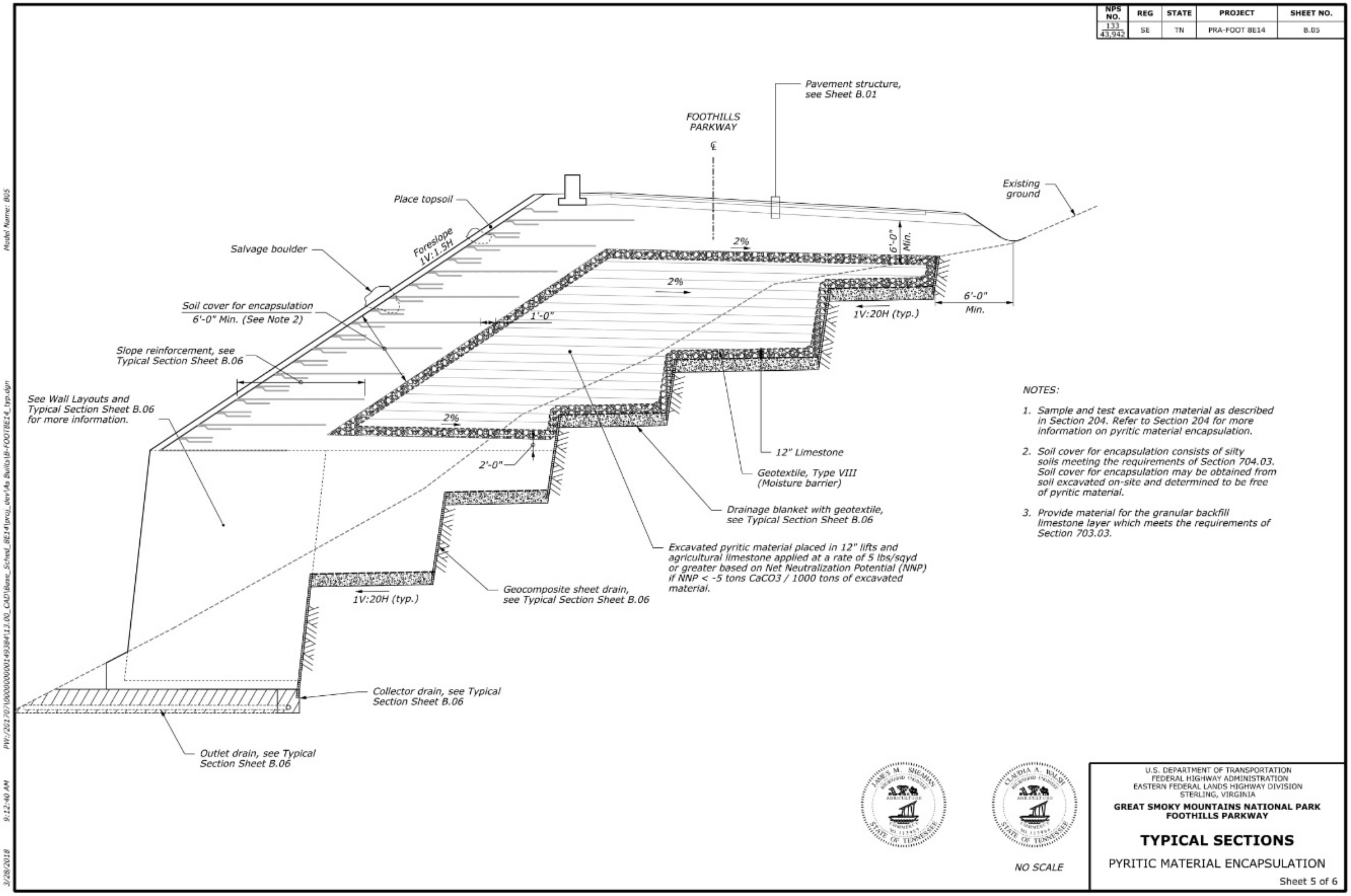


FIGURE 3. PYRITIC ENCAPSULATION TYPICAL SECTION

DESIGN ELEMENTS

ROADWAY ALIGNMENT

The alternative 2 mainline (or centerline) is shown in Figure 2. As proposed, the asphalt roadway would consist of two, 12-foot wide lanes, striped at 11 feet. Sheet flow, vegetated swales, and other site-specific stormwater best management practices (BMPs) would provide drainage. Paved shoulders approximately 3 feet wide could be used in sharper curves, as needed. Grass shoulders would be maintained along most of the roadway, with widths varying based on terrain and aesthetics. Steel-backed timber guardrails or stone veneer concrete core guard walls would be constructed where necessary. The roadway design, materials, and aesthetic considerations, such as signage, stone veneer, timber guardrails, and aluminum bridge rails would be consistent with the previously constructed sections of the Parkway and with the NPS *Park Road Standards* (NPS 1984) and *America's National Park Roads and Parkways; Drawings from the Historic American Engineering Record* guide (Davis, Croteau, and Marston 2004).

Under alternative 2, Section 8D would require vegetation removal, excavation, fill, and grading. As detailed above, the total AOD (Figure 2) would be approximately 331 acres, which assumes the largest area of possible disturbance based on the current conceptual design. The AOD represents the current "best-fit" alignment based on the topographic, hydrologic, and geologic constraints identified within the project area. The minimum limits of disturbance, represented by the cut-and-fill, plus 5 feet, for the low bridge alternative, are approximately 188 acres.

STRUCTURES AND FEATURES

Bridges and Culverts

The conceptual design, which conforms with the American Association of State Highway and Transportation Officials Load and Resistance Factor Design methodology, includes approximately 20 bridges along the mainline over existing roads, streams, and deep ravines. The typical cross section for these bridges has a total width of approximately 33 feet, which includes two 12-foot travel lanes (one in each direction), paved shoulders, and a concrete bridge guardrail (parapet). As estimated in the conceptual design, bridges would vary in length from approximately 100 feet to 1,200 feet, with three bridges approaching 1,200 feet and most others in the range of 200 to 600 feet. The bridges would vary in height, alignment, and geometry, and may require slope cuts or retaining walls based on their locations. Bridge materials and design aesthetics would be consistent with the constructed sections of the Parkway.

Moving from west to east, bridges would be built over Robeson Road, Buckeye Road, Cove Mountain Road, and the Spur; and cross three named streams: Rymel Branch, Mill Creek, and Caney Creek. Each evaluated Spur bridge option contains three bridges. Options being considered under alternative 2 for the Spur bridge and interchange are described in the "Spur Bridge Options" and "Spur Interchange Access Options" sections below. Access on and off the Parkway would occur at Wears Valley and the Spur. Access ramps at Robeson, Buckeye, and Cove Mountain Roads are not proposed. Minor realignment of these roads in the vicinity of the new bridges and within the NPS-managed corridor could be required to facilitate bridge construction. Specific realignment needs, public access during construction, and easement considerations would be addressed during subsequent design phases.

Section 8D would include 43 culverts along the mainline. Seventeen of these culverts are proposed as box culverts to accommodate flood flows and passage of aquatic biota. Box culvert locations are proposed at Machine Branch, King Hollow Branch, and Sugar Camp Branch. The remaining 26 culverts along the mainline would be traditional drainage pipes. The conceptual design also includes 5 pipe culverts associated with the Spur interchange options, of which one would only be constructed as part of the Low Bridge Option (see "Spur Bridge Options," below).

Specific designs for each stream and any wet weather conveyance crossing would be developed during subsequent design phases and include hydrologic and hydraulic studies so that structures (bridges and culverts) are sized correctly to handle floodwaters, while not inadvertently increasing flooding potential.

The Federal Emergency Management Agency (FEMA) floodplain mapping for Section 8D is limited to West Prong of the Little Pigeon River (West Prong). The remaining perennial streams in the project area are first and second order streams in relatively steep terrain, with well-defined channels and little or no floodplain development.

In general, guidelines provided for subsequent design phases would include the following:

- Bridges and structures would be designed according to the FHWA *Project Development and Design Manual* (FHWA 2024). Culverts would be designed for 25-year flood events; bridges would be designed for 50-year flood events. Culverts and bridges in the regulatory floodplain would be designed for a 100-year storm event.
- Section 8D would span large ravines and streams with bridges and maintain an undisturbed riparian buffer to the maximum extent practicable.
- All required permits for stream/wetland impacts would be obtained prior to construction.

Pull-offs, Overlooks, and Parking

Pull-offs, overlooks, and parking areas would be provided to offer opportunities for visitors to enjoy vistas, take photographs, rest, and make unplanned emergency stops. The conceptual design includes up to six potential pull-off and/or overlook locations. Alternative 2 assumes that the pull-offs, overlooks, and parking areas would be incorporated into the existing NPS corridor, immediately adjacent to the roadway, similar to other Parkway sections. Size and configuration of each pull-off and/or overlook would vary based on site conditions, safety considerations, viewing opportunities, and anticipated visitor use. The final location and design of these features would be identified during subsequent design.

Crooked Arm Ridge Tunnel

Due to topographic constraints and to minimize environmental impacts, alternative 2 includes an approximately 1,200-foot tunnel in the Crooked Arm Ridge segment of the Section 8D corridor (Figure 1). The typical cross section for the tunnel includes one 12-foot travel lane in each direction with 4-foot interior shoulders and exterior shoulders that may vary between 1.5 feet to 4 feet (Figure 4). The tunnel would include natural or mechanical ventilation, lighting, and an underground electrical line for power. A propane-fueled backup generator would also be installed at the tunnel. Drainage would be provided by trench drains uphill from the tunnel entrance and interior drainage to the edges, and would be collected with continual trench drains. Drainage for the tunnel would be consistent with other NPS-managed tunnels. Subsequent design would also address additional drainage details and evaluate the geology and potential of pyritic material in the area.

Construction methods would be defined during subsequent design phases and may include a combination of drilling, rock hammering, cut and cover, and the use of a tunnel-boring machine. Site-sensitive construction methods would be evaluated during the design phase and would favor construction techniques that produce the least potential disturbance and impacts on natural resources. If cut and cover were used, it would be limited to small areas near the portals. Up to 50,000 cubic yards of rock material would be excavated during construction of the tunnel. Because geological surveys (Golder 1986; Hatcher 1994) identified pyritic material in the Crooked Arm Ridge area, materials excavated from the tunnel would be handled in accordance with FHWA and TDOT guidelines for handling pyritic materials as discussed above. When possible, excavated material would be used as fill elsewhere in the project.

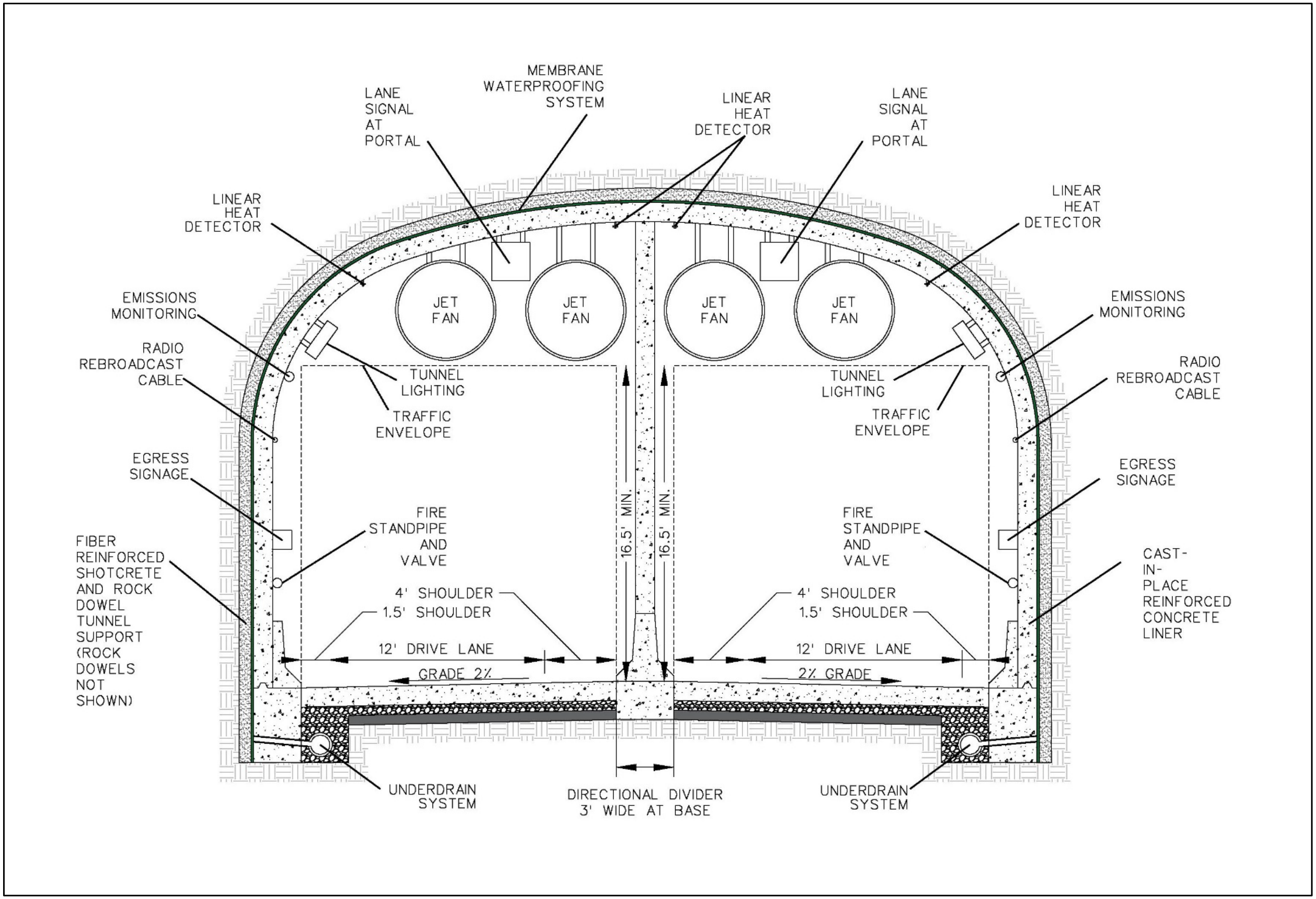


FIGURE 4. CONCEPTUAL DESIGN OF CROOKED ARM RIDGE TUNNEL

Spur Bridge Options

The NPS is considering three bridge design options where Section 8D would cross over the Spur and West Prong near Gum Stand Road and King Branch Road. All three options would connect to the Spur and local roadways using the same general interchange configuration; however, bridge height, alignment, geometry, and required slope cuts would vary for each design option. The general location of each bridge design option is shown in Figure 5, and additional information about each bridge design option is described in Table 1.

TABLE 1. SPUR BRIDGE OPTIONS

Spur Bridge Option Name	Description
Low Bridge Option	▪ Crosses the Spur and West Prong at the lowest elevation, just south of Caney Creek Road, approximately 2,900 feet north of the existing bridge between Gum Stand Road and King Branch Road. ▪ Consists of three separate bridges: (1) over an unnamed ephemeral tributary to Caney Creek, spanning up to 605 feet over a ravine with a depth of 60 feet to the deck elevation; (2) over the West Prong and the Spur, spanning up to 400 feet with a minimum height of 50 feet above the Spur roadway; and (3) over Gnatty Branch and Gnatty Branch Road, spanning up to 210 feet with a minimum vertical clearance of 16.5 feet. ▪ Requires an approximately 95-foot horizontal cut into the hillside on the eastern side of the Spur.
High-Curvilinear Bridge Option	▪ Crosses the Spur and West Prong at a higher elevation than the Low Bridge Option, with a more direct curvilinear alignment, approximately 1,800 feet north of the existing bridge between Gum Stand Road and King Branch Road. ▪ Consists of three separate bridges: (1) over an unnamed ephemeral tributary to Caney Creek, spanning up to 620 feet over a ravine with a depth of 65 feet to the deck elevation; (2) over the West Prong and the Spur, spanning up to 1,165 feet with a minimum height of 134 feet above the Spur roadway; and (3) over a gated two-track service road, spanning up to 170 feet over a low area with a depth of 26 feet to the deck elevation. ▪ Maintains a curvilinear alignment typical of the Parkway. ▪ Requires an approximately 50-foot horizontal cut on the eastern side of the Spur.
High-Linear Bridge Option	▪ Crosses the Spur and West Prong at a higher elevation than the Low Bridge Option, with a more direct linear alignment, approximately 1,600 feet north of the existing bridge between Gum Stand Road and King Branch Road. ▪ Consists of three separate bridges: (1) Bridge #3C over an unnamed ephemeral tributary to Caney Creek, spanning up to 300 feet over a ravine with a depth of 60 feet to the deck elevation; (2) Bridge #2C over the West Prong and the Spur, spanning up to 1,020 feet with a minimum height of 122 feet above the Spur roadway; and (3) Bridge #1C over a gated two-track service road, spanning up to 175 feet over a low area with a depth of 26 feet to the deck elevation. ▪ Requires an approximately 50-foot horizontal cut on the eastern side of the Spur.

FIGURE 5. SPUR BRIDGE DESIGN OPTIONS

Spur Interchange Access Options

The NPS is considering two potential interchange access options at the Spur. To maintain the flow of traffic between the Parkway and the Spur, the three bridge design options would connect through an interchange bridge over the Spur with supporting loops and ramps. Under both interchange access options, a two-way loop on the eastern side of the Spur would connect the Parkway and the interchange. The proposed location of each interchange access option is shown in Figure 6, and additional information about each interchange access option is provided in Table 2.

TABLE 2. SPUR INTERCHANGE ACCESS OPTIONS

Spur Interchange Access Option Name	Description	Traffic Flow Description
Interchange Access Option 1	▪ Located approximately 400 feet north of the existing Gum Stand Road bridge; Gum Stand bridge would remain. ▪ Construction of the interchange bridge would require the existing access point between the Spur and Gnatty Branch Road to be shifted approximately 1,500 feet north; however, the access points for King Branch Road would remain with some modifications. ▪ Would serve as the access point for the northbound Spur exit and entrance ramps, which would require an intersection between these ramps, Gnatty Branch Road, and the road connecting to the interchange bridge.	Access to Section 8D would occur as follows: ▪ Southbound traffic would access the Parkway via an exit ramp, cross the Spur using the interchange bridge, and enter the Parkway through the two-way loop. ▪ Northbound traffic would access the Parkway via a ramp onto the new access point to Gnatty Branch Road. Access to the Spur from Section 8D would occur as follows: ▪ Northbound traffic would use the two-way loop and then connect to the Spur via an on-ramp at the new access point to King Branch Road and Gnatty Branch Road. ▪ Southbound traffic would cross the interchange bridge and enter the southbound Spur via a loop. ▪ Only traffic entering or exiting Section 8D would use the interchange. ▪ Local traffic would continue to use the existing Gum Stand Road bridge. ▪ Two existing access points to King Branch Road would remain, but King Branch Road would not connect to Gnatty Branch or the interchange.
Interchange Access Option 2	▪ Located approximately 250 feet north of the existing Gum Stand Road bridge; Gum Stand bridge would be removed. ▪ Construction of the interchange bridge would require the existing access point between the Spur and Gnatty Branch Road to be shifted approximately 1,200 feet north. The northern access point to King Branch Road would be removed, and all turning movements would occur at the existing southern access point. ▪ All traffic would use the proposed interchange access.	Access to Section 8D would occur as follows: ▪ Southbound traffic would access the Parkway via an exit ramp, cross the Spur using the interchange bridge, and enter through the two-way loop. ▪ Northbound traffic would access the Parkway via a ramp onto the new access point to Gnatty Branch Road. ▪ Traffic from the southbound Spur to Gum Stand Road would enter Gum Stand Road and access the northbound Spur, Gnatty Branch Road, and King Branch Road via a slip ramp off the interchange bridge. Access to the Spur from Section 8D would occur as follows: ▪ Access to the northbound Spur would occur via an on-ramp at the new access point for the interchange bridge. ▪ Access the southbound Spur would occur via the two-way loop, cross the interchange bridge, and enter the southbound Spur via an on-ramp.

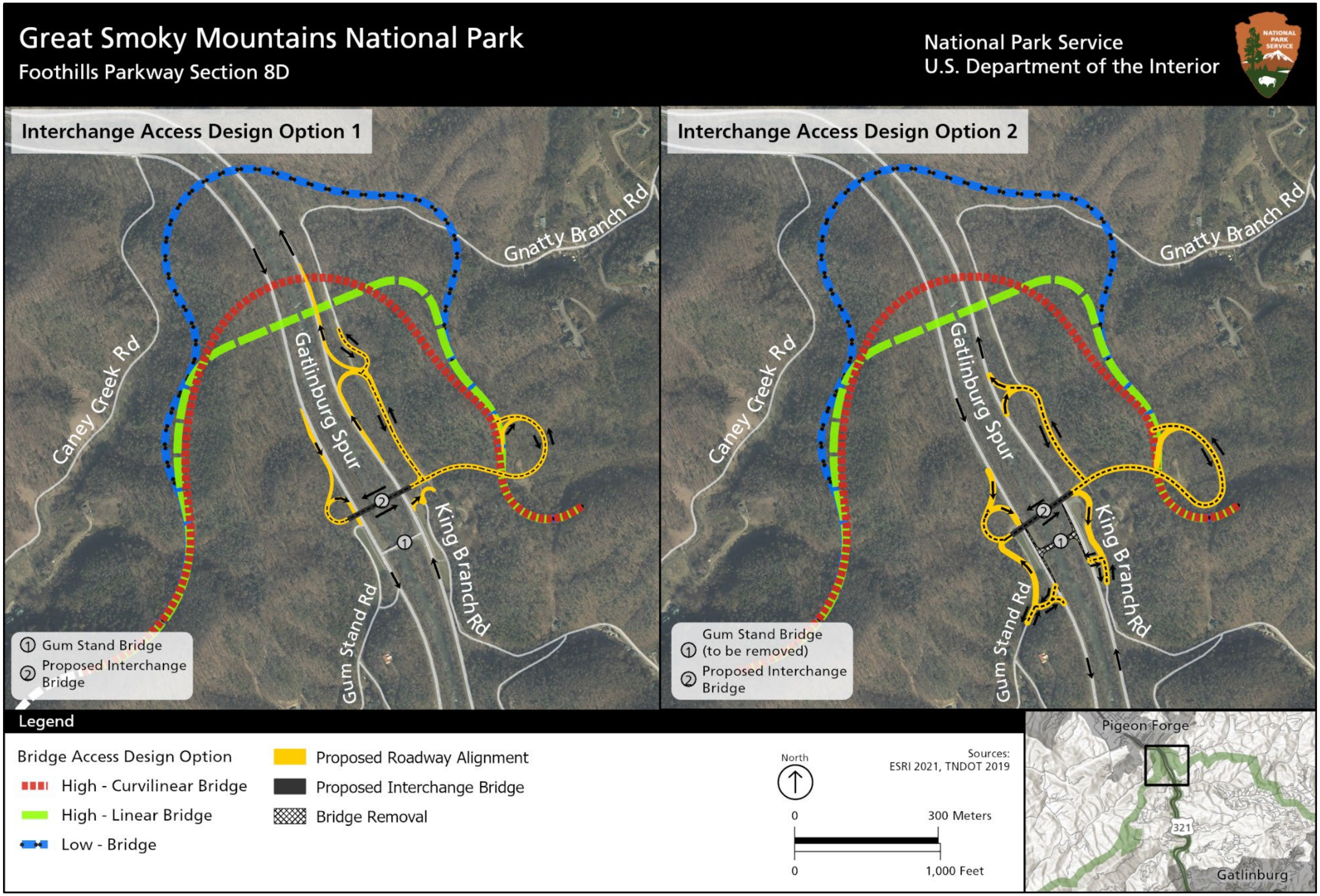


FIGURE 6. SPUR INTERCHANGE ACCESS OPTIONS

RESOURCE PROTECTION MEASURES

The NPS places a strong emphasis on avoiding, minimizing, and mitigating potentially adverse environmental impacts related to alternative 2. Therefore, the project would implement resource protection measures and BMPs, wherever feasible, to protect natural, cultural, and other resources and to maintain the quality of the visitor experience. Resource protection measures are presented in Appendix B. These protection measures are considered part of alternative 2. Resource protection measures include both BMPs as well as project-specific protections that would be implemented to avoid, minimize, and/or reduce impacts on park resources. These measures include protections for soil disturbance to reduce erosion, runoff, and silt in waterways as well as limiting vegetation removal to areas directly impacted by construction and preserving existing vegetation where possible, completing seasonal tree clearing to avoid impacts on federally listed bats and nesting birds, and implementing a monitoring and remediation period of two years following completion of construction for purposes of assessing the impact of construction on stream crossings and wetlands. Additional resource protection measures for alternative 2 may be required as a result of ongoing Endangered Species Act (ESA) section 7 consultation with the US Fish and Wildlife Service (USFWS) and ongoing National Historic Preservation Act (NHPA) section 106 consultation with the Tennessee State Historic Preservation Office (TN SHPO).

CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

Chapter 3 describes the affected environment and analyzes the potential environmental impacts of the alternatives described in chapter 2 for the resources described below. The affected environment describes existing conditions for those elements of the natural and human environment that would be affected by implementation of the alternatives considered in this EA. Impacts on these resources are then analyzed in the "Environmental Consequences" section for each alternative. The comparative analysis of impacts includes "changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives and may include effects that are later in time or farther removed in distance from the proposed action or alternatives" (40 CFR § 1508.1).

ISSUES AND IMPACT TOPICS

The NPS identified a range of issues and impact topics to evaluate in this EA. Impact topics are resources or values that are analyzed for each of the alternatives and are discussed because issues have been identified. During internal, agency, and public scoping, NPS staff identified potential issues that could result from implementation of the proposed alternatives. The NPS *NEPA Handbook* (NPS 2015a) provides specific guidance for determining whether to retain issues for detailed analysis. Issues should be retained for consideration and discussed in detail if:

- the environmental impacts associated with the issue are central to the proposal or of critical importance;
- a detailed analysis of environmental impacts related to the issue is necessary to make a reasoned choice between alternatives;
- the environmental impacts associated with the issue are a big point of contention among the public or other agencies; or
- there are potentially significant impacts to resources associated with the issue.

If none of the considerations above apply to an issue, it was dismissed from detailed analysis. Issues and impacts topics dismissed from detailed analysis, including dismissal rationale, are provided in Appendix C. Issues carried forward for detailed analysis fall under the following impact topics:

- Geologic Features and Processes
- Biological Resources
- Water Resources
- Visitor Use and Experience
- Visual Resources
- Historic Structures and Districts

ANALYSIS METHODS FOR ESTABLISHING IMPACTS

The analysis of impacts follows CEQ's 2020 implementing regulations (85 CFR 43304, July 16, 2020) and 2022 amendments (87 *Federal Register* 23453, April 20, 2022)codified at 40 CFR 1500–1508, Director's Order 12 procedures (NPS 2011), the NPS *NEPA Handbook* (NPS 2015a), and the *NPS NEPA Handbook Supplemental Guidance: Preparing Focused and Concise Environmental Assessments* (NPS 2015b). The intensity of impacts is assessed in the context of the park's purpose and significance and any resource-specific context that may be applicable. The methods used to assess impacts vary depending on the resource being considered but generally are based on a review of pertinent literature and park studies, information provided by on-site experts and other agencies, professional judgment, and park staff knowledge and insight. The analysis of potential impacts is also based on professional judgment and experience with similar roadway projects.

The environmental consequences for each resource were identified and characterized based on impact type (adverse or beneficial), area of analysis, intensity, and duration. In accordance with CEQ regulations (40 CFR 1508.1 (g)), effects or impacts are defined as follows:

(1) Effects or impacts mean changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives (direct effects), may include effects that are later in time or farther removed in distance from the proposed action or alternatives, but are still reasonably foreseeable (indirect effects), and may include effects that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions (cumulative effects).

(2) Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic (such as the effects on employment), social, or health effects, whether direct, indirect, or cumulative. Effects may also include those resulting from actions that may have both beneficial and detrimental effects, even if, on balance, the agency believes that the effect will be beneficial.

(3) A "but for" causal relationship is insufficient to make an agency responsible for a particular effect under NEPA. Effects should generally not be considered if they are remote in time, geographically remote, or the product of a lengthy causal chain. Effects do not include those effects that the agency has no ability to prevent due to its limited statutory authority or would occur regardless of the proposed action or alternatives.

TYPE OF IMPACT

The potential impacts of the proposed action are described using the following terminology:

- **Short term**: Impacts that would occur as a result of the construction activities of alternative 2. Depending on impact topic, impacts may be intermittent (days or weeks) or continuous during construction.
- **Long term**: Impacts that would continue to occur after construction is complete and may continue for years or decades.
- **Beneficial**: A favorable change in the condition or appearance of the resource, or a change that moves the resource toward a desired condition.
- **Adverse**: A change that declines, degrades, and/or moves the resource away from a desired condition or detracts from its appearance or condition.

GEOLOGIC FEATURES AND PROCESSES

AFFECTED ENVIRONMENT

BEDROCK

The Great Smoky Mountains and the foothills to the northwest were formed around 250 million years ago when metamorphic rocks were pushed upward over younger sedimentary rocks, a movement known as thrust faulting, which deformed and fractured the rock below, along, and above several major faults and many minor faults. The high-elevation spine of the Great Smoky Mountains is formed from rocks of the Great Smoky Group, including Thunderhead Sandstone and Elkmont Sandstone, which are more resistant to weathering than the rocks that occur in the foothills west of the high-elevation Smokies. At three locations in the foothills west of the high-elevation Smokies, the rocks of the Snowbird (Metcalf Phyllite and Pigeon Siltstone) and Walden Creek (Licklog, Shields, Wilhite, and Sandsuck formations) groups have eroded away, exposing "windows" into the younger sedimentary rocks that underlie the overthrust rocks. In the case of these three "windows," called the Cades, Tuckaleechee, and Wear Coves, erosion of the older, overthrust rock has revealed limestones (Jonesboro Limestone), dolomites, and shales (Blockhouse Shale). The trace of the Great Smoky thrust fault can be seen around the edges of the coves.

Descriptions of each rock time are as follows:

- Thunderhead Sandstone (Zt) formed during the Neoproterozoic Era. It consists of thick, graded beds of coarse-grained feldspathic light gray metasandstone and metaconglomerate that are interbedded with dark-gray graphitic metasiltstone and slate (Southworth et al. 2012; NPS 2016b). Thunderhead Sandstone is resistant to weathering (as compared to the other bedrock types in the project area) and it occurs along the southwestern edge of the Cove Mountain segment where meets the Crooked Arm Ridge segment (Figure 7). This formation occupies approximately 8 acres (<1%) of the project area (Southworth, Schultz, and Denenny 2005).
- Pigeon Siltstone (Zp) also formed during the Neoproterozoic Era. It is a greenish-gray, very uniform metasiltstone characterized by dark- and light-colored laminae and minor very fine-grained quartz and feldspar sand (Southworth et. al 2012; NPS 2016b). Pigeon Siltstone is more prone to weathering than Thunderhead Sandstone and commonly experiences landslides. It occurs in the Ridgetop and Cove Mountain segments, where it is the only (Ridgetop) and primary (Cove Mountain) bedrock present. This formation occupies approximately 683 acres (59%) of the project area (Southworth, Schultz, and Denenny 2005).
- Shields Formation (Zs) also formed during the Neoproterozoic Era. It is a dark-gray to greenish-gray laminated siltstone and shale (NPS 2016b). The Shields Formation is also more prone to weathering than Thunderhead Sandstone and is considered to have a medium risk for acid formation upon exposure to moisture. It occurs at the western edge of the Crooked Arm Ridge segment and continues west to the edge of the Sugar Camp Branch segment (Figure 7). This formation occupies approximately 160 acres (14%) of the project area (Southworth, Schultz, and Denenny 2005).
- Shields Formation conglomerate (Zsc) also formed during the Neoproterozoic Era. It consists of beds of a coarse conglomerate of mixed pebbles and cobbles interbedded with pebbly sandstone that grades upward into the laminated siltstone and shale of the Shields Formation (Southworth et al. 2012; NPS 2016b). The Shields Formation conglomerate is also more prone to weathering than Thunderhead Sandstone and is considered to have a medium risk for acid formation upon exposure to moisture. It occurs in the Crooked Arm Ridge segment (Figure 7), sandwiched between Pigeon Siltstone to the east and the Shields Formation to the west. This formation makes up approximately 36 acres (3%) of the project area (Southworth, Schultz, and Denenny 2005).

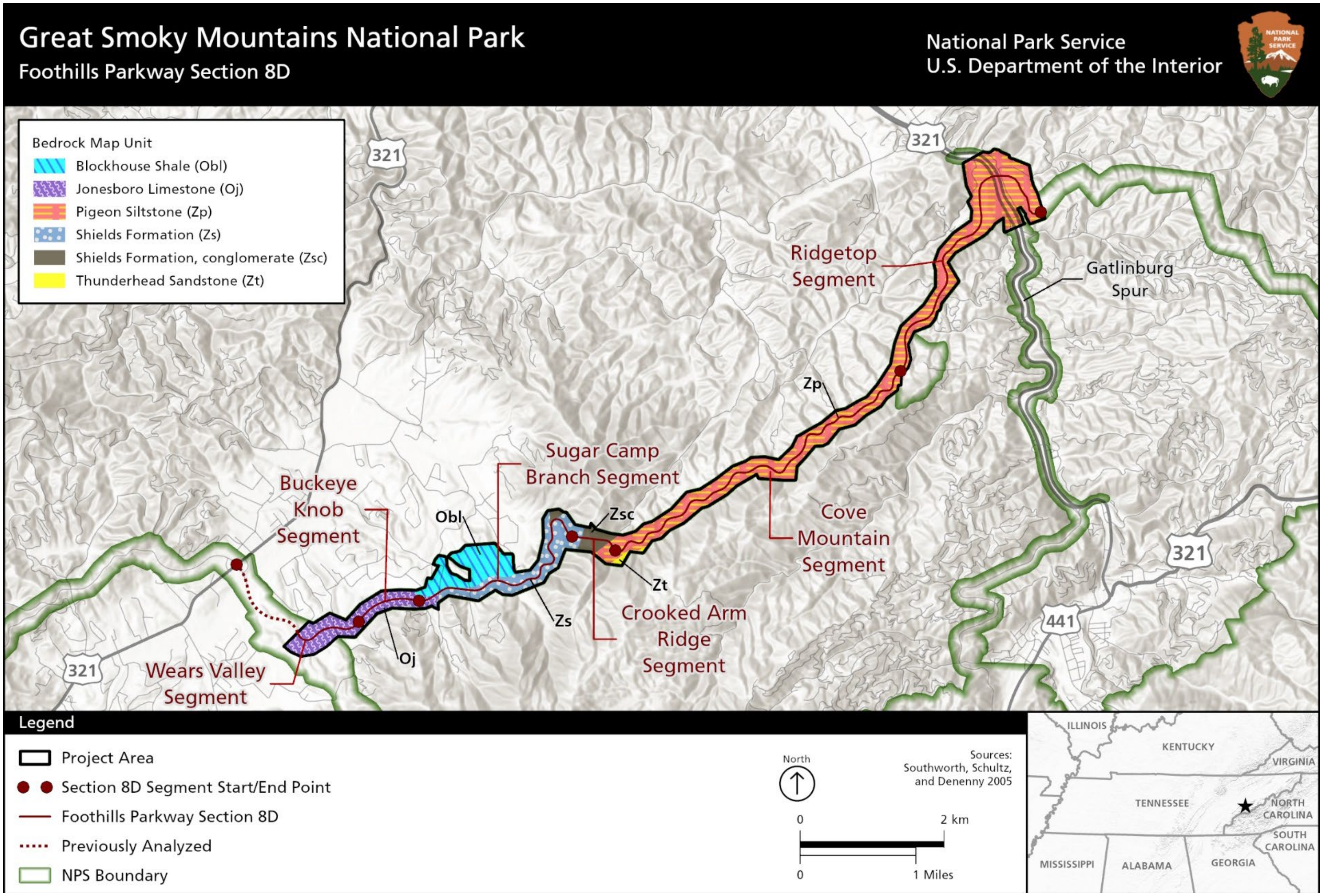
- Jonesboro Limestone (Oj) was formed during the Lower Ordovician and is considered part of the Tuckaleechee and Wear Coves. It consists of light-gray, fine-grained limestone beds that vary in thickness and are characterized by thin wavy clay and silt partings and contain some interbeds of dolomite and sandy limestone (Southworth et al. 2012; NPS 2016b). Jonesboro Limestone is prone to weathering, which can lead to the development of karst features. It appears at the western edge of the Sugar Camp Branch segment and continues west through the Buckeye Knob and Wears Valley[1] segments to the end of the project area (Figure 7). This formation makes up approximately 151 acres (13%) of the project area (Southworth, Schultz, and Denenny 2005).
- Blockhouse Shale (Obl) was also formed during the Middle Ordovocian and is considered part of the Tuckaleechee and Wear Coves. It consists of a light-gray, finely laminated, fissile calcareous shale that locally contains beds of calcerous sandstone in the lower part and beds of cobbly argillaceous limestone at the base (Southworth et al. 2012; NPS 2016b). Blockhouse Shale is also more prone to weathering than Thunderhead Sandstone, which can lead to the development of karst features. It appears around the middle of the Sugar Camp Branch segment on the northern side and continues westward until it stops near the Buckeye Knob segment (Figure 7). This formation makes up 125 acres (11%) of the project area (Southworth, Schultz, and Denenny 2005).

Subsequent erosion has formed the major features of the modern landscape, with the composition of the rocks and structural features like faults and fractured zones driving the development of stream and groundwater systems in the area.

Landslides are common in Pigeon Siltstone formations. Several landslides occurred on the southern slopes of Webb Mountain after a large rainfall on August 5, 1938 (Moneymaker 1939). Landslides also have occurred and continue to occur in Pigeon Sandstone along Interstate 40 through Pigeon River Gorge. Pigeon Siltstone (Zp) makes up nearly all of the Cove Mountain and Ridgetop segments (Figure 7). Surface features to the south and north of the corridor suggest that slumped soil in the central to eastern portion of Buckeye Knob, mapped as the Cataska-Sylco complex and the Talbott-Rock outcrop complex (Horton, San Juan, and Stoeser 2017; discussed in more detail under "Soil and Surface Materials," Figure 8) originated with a landslide (Horton, San Juan, and Stoeser 2017).

Recent investigations demonstrated the presence of multiple karst features within the Jonesboro Limestone underlying the Buckeye Knob and Wears Valley[2] segments and in the Blockhouse Shale underlying the Sugar Camp Branch segment (GeoServices 2022, 2023). These features are discussed in more detail below in the "Karst" section.

[1] A portion of the Wears Valley segment of the project area was assessed as part of the *Wears Valley Mountain Bike Trail System Revised EA* (NPS 2022b) and is not reanalyzed in this EA.
[2] A portion of the Wears Valley segment of the project area was assessed as part of the *Wears Valley Mountain Bike Trail System Revised EA* (NPS 2022b) and is not reanalyzed in this EA.



Source: Southworth et. al 2012

FIGURE 7. BEDROCK IN THE PROJECT AREA

As discussed in chapter 2, a tunnel would be constructed in the Crooked Arm Ridge segment of Section 8D under alternative 2. Of the three bedrock units in this segment, two of them, the Shields Formation and Shields Formation conglomerate, are characterized as having a medium risk for acid formation upon exposure to moisture. This acid formation is caused by the presence of sulfide minerals in the rock, which can result in the acidification of downgradient freshwater bodies if water that has been in contact with the rock is permitted to travel to downgradient locations. The risk for acid formation increases as the acid content of the formation increases. However, the Crooked Arm Ridge segment was assessed in a feasibility study conducted in 1984 and summarized in Volume 1 of the Crooked Arm Ridge Tunnel Feasibility Study. This study concluded that trace to generally small amounts of sulfide minerals were present in these formations with isolated narrow bands of concentrated sulfide mineralization that typically ranged from 0.1 to 0.2 feet in thickness (Golder 1986). The findings are discussed in more detail in the "Unweathered Pyrite" section.

SOIL AND SURFACE MATERIALS

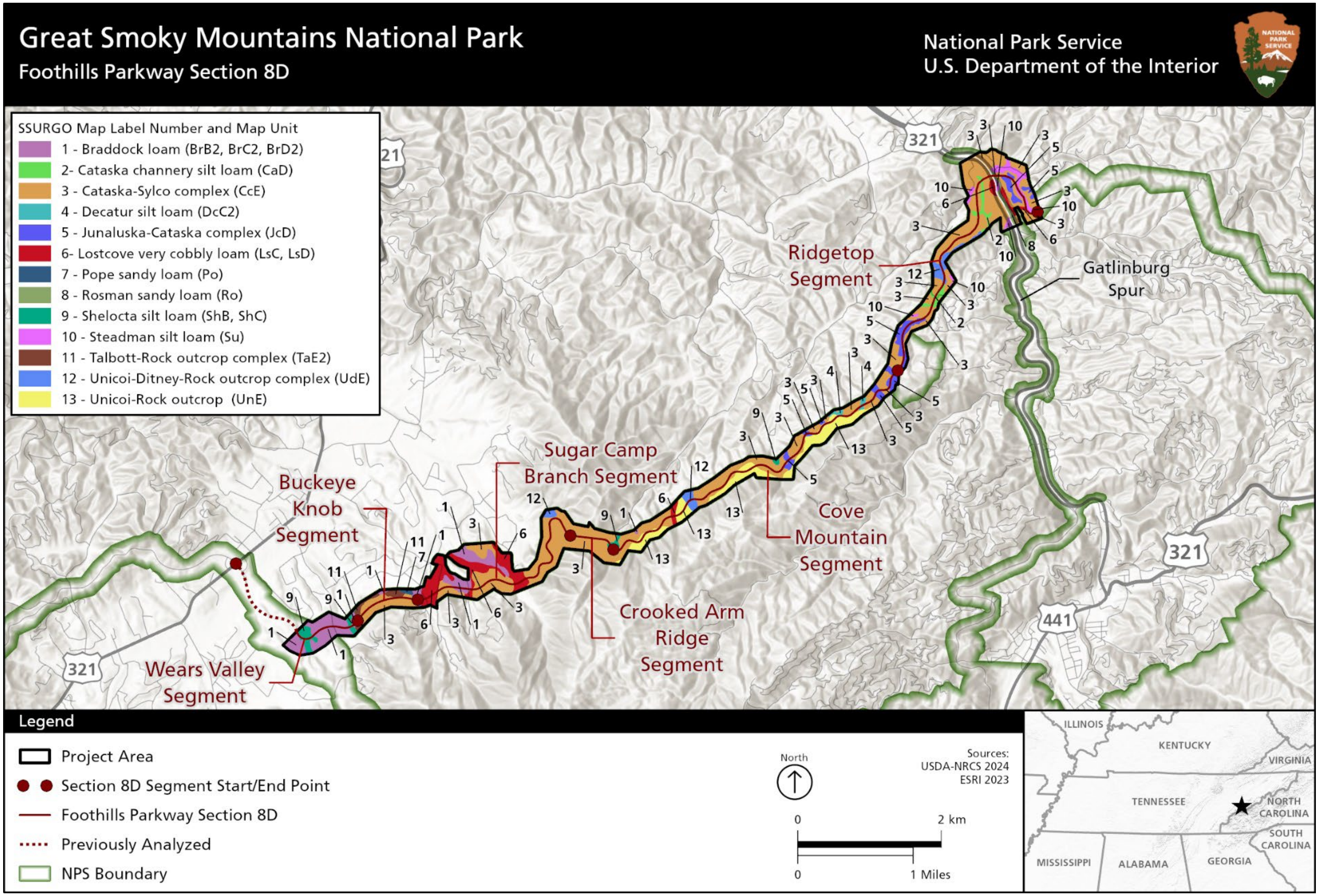
The US Department of Agriculture Natural Resources Conservation Service's Web Soil Survey indicates that the soils in the project area consist of 13 map units (USDA-NRCS 2024). A map unit is a grouping of soils by their natural landscapes and patterns. Figure 8 shows the map units within the project area, and Table 3 describes each soil type in the project area.

Approximately 55% of the project area consists of the Cataska-Sylco complex, composed of approximately 45% Cataska and similar soils, 40% Sylco and similar soils, and 15% minor components (USDA-NRCS 2024).

- Cataska series: The Cataska series consists of shallow and excessively drained soils. They formed in residuum that is affected by soil creep in the upper part in materials weathered from low-grade metasedimentary rocks such as tilted siltstone, slate, phyllite, or metasandstone. These soils are typically found on low and intermediate mountain slopes, intermountain hillslopes, and ridges. Slopes in these soils typically range from 15% to 70% but can range from 5% to 95% (USDA-NRCS 2013a).
- Sylco series: The Sylco series consists of moderately deep and somewhat excessively drained soils. They formed in residuum that is affected by soil creep in the upper part and weathered from metasedimentary rocks such as phyllite, slate, and metasandstone. These soils are typically found on mountain ridge summits and side slopes. Slopes in these soils range from 7% to 95%, but typically have slope values from 35% to 95% (USDA-NRCS 2004a).

Approximately 28% of the project area consists of the Braddock series (10%), the Unicoi-Rock outcrop complex (9%), and the Lostcove series (9%). These are summarized as follows:

- Braddock series: The Braddock series consists of very deep, well-drained and moderately permeable soils. They formed in colluvium and alluvium derived mostly from a mixture of crystalline rocks. These soils are typically found on mountain slopes and adjacent high terraces. Slopes in these soils typically range from 0 to 45% (USDA-NRCS 2022).
- Unicoi-Rock outcrop complex: The Unicoi series consists of shallow and somewhat excessively drained soils. They formed in low-grade metasedimentary rock such as arkose, metagraywacke, metasandstone, or quartzite and are typically found on mountain slopes and ridges, with rock outcrops common in most areas. Slopes in these soils typically range from 15% to 17% but can range from 8% to 95% (USDA-NRCS 2013b).
- Lostcove series: The Lostcove series consists of very deep and well-drained soils. They formed in colluvium from low-grade metasedimentary rocks low in weatherable minerals and are typically found on mountain slopes and in coves. Slopes in these soils typically range from 15% to 40% but can range from 2% to 95% (NRCS-USDA 2004b).



Source: USDA-NRCS 2024

FIGURE 8. SOILS IN THE PROJECT AREA

The remaining approximately 17% of the soils in the project area are moderately deep to very deep and are moderately drained to well-drained. They are found on mountain or upland slopes and/or ridges. The exceptions to this are the Steadman, Rosman, and Pope series, which are located in floodplain areas. These soils formed in residuum weathered from metasedimentary rocks or limestone, or in alluvium weathered from limestone, shale, igneous metamorphic or metasedimentary geology, or aged acid sandstone, siltstone, and shale.

TABLE 3. APPROXIMATE ACREAGE BY SOIL TYPE AND SLOPE RANGE IN THE PROJECT AREA

Series or Unit	Slope Range in Project Area (%)	Approximate Acres in Project Area	Percent of Project Area
Braddock loam, eroded	2 to 5	13	1%
Braddock loam, eroded	5 to 12	57	5%
Braddock loam, eroded	12 to 25	43	4%
Cataska channery silt loam	12 to 25	19	2%
Cataska-Sylco complex	25 to 80	635	55%
Decatur silt loam, eroded	5 to 12	6	1%
Junaluska-Cataska complex	12 to 25	59	5%
Lostcove very cobbly loam, extremely bouldery	5 to 12	43	4%
Lostcove very cobbly loam, extremely bouldery	12 to 25	62	5%
Pope sandy loam, occasionally flooded[1]	0 to 5	3	<1%
Rosman sandy loam, occasionally flooded[2]	0 to 2	8	1%
Shelocta silt loam	2 to 5	16	1%
Shelocta silt loam	5 to 15	9	1%
Steadman silt loam, occasionally flooded	0 to 3	32	3%
Talbott-Rock outcrop complex, eroded	25 to 60	15	1%
Unicoi-Ditney-Rock outcrop complex	30 to 80	33	3%
Unicoi-Rock outcrop complex	30 to 80	108	9%
Water	--	4	<1%

Source: USDA-NRCS 2024

Soils can be grouped into a surface material type based on how they were formed. Residual soils form in place from underlying bedrock, while colluvial soils were formed in gravity-transported materials (e.g., rocks and sediments) that moved from upslope by way of landslides, slumping, or creep and reflect currently inactive colluvial or mass-movement processes. Colluvial deposits are common on the lower slopes of this region, and many of them probably formed during periods of colder and/or wetter climate tens to hundreds of thousands of years ago; in this region, they are generally covered by forest and often are highly dissected by streams. Alluvial soils formed in water-transported alluvial deposits and may reflect both ancient or continual erosional and depositional processes. They are common as floodplains in the valleys and as bank deposits along many lower-slope streams.

Widespread deposits of colluvium-debris flows formed from the erosion of the elevated sedimentary and metasedimentary rock found on the ridges around the Tennessee Valley and Tectonic windows that overlie the Jonesboro Limestone and Blockhouse Shale. These colluvial-debris flow deposits consist of a mix of clay to boulder-sized particles exhibiting angular and sub-rounded grains, indicating low to

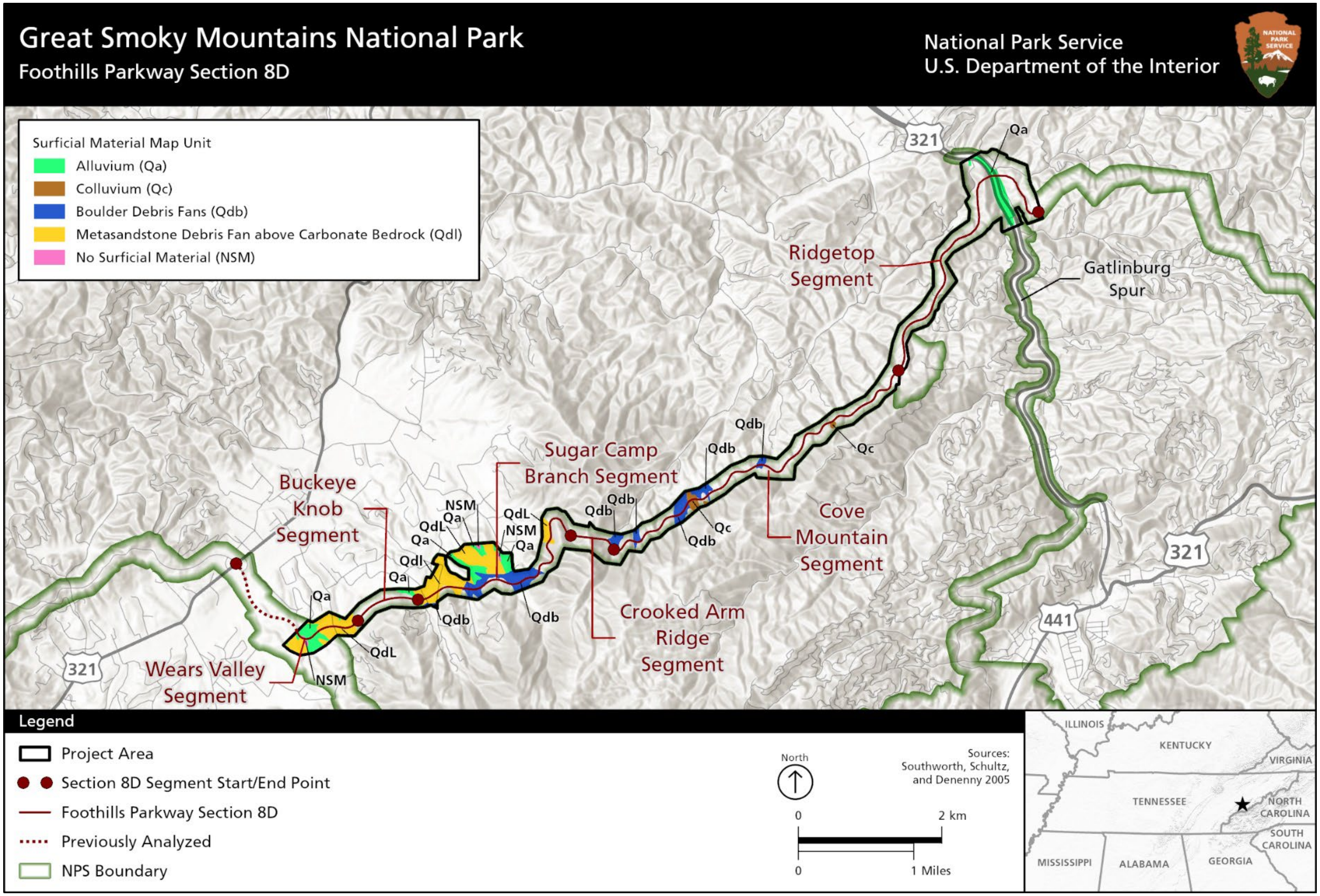
moderate transport before deposition. Within the window, there are also patches where limestone boulders outcrop. Lastly, there is a widespread quaternary alluvium blanketing the topographically lower parts of Wear Cove. This alluvium is derived from the older debris fan alluvium and was transported and emplaced during flooding events of Cove Creek (Horton, San Juan, and Stoeser 2017; GeoSciences 2022).

In the area of the Thunderhead Sandstone, surficial deposits derived from the Late-Cambrian and Cambrian Age clastic formations can be described mostly as valley fill debris flows and block fields. The valley fills are an alluvium/colluvium of angular-shaped grains of parent bedrock that were transported by water and gravity into the valley floors of the mountains (Southworth et al. 2003). The block fields are colluvium or in-place weathered surficial rock that make up the slopes and have not yet been sufficiently weathered to be transported into the valley floors (Southworth et al. 2003).

As shown on Figure 9, four predominant surficial material types are present in the project area:

- Alluvium (Qa): Project area material is of the Holocene and is composed of unconsolidated silt, sand, cobbles, and small boulders along and beneath streams, floodplains, and alluvial plains. Deposits include alluvial terraces, colluvium, and debris from adjacent slopes. This material type can overlay karst features (Southworth et al. 2012; Horton, San Juan, and Stoeser 2017; GeoSciences 2022, 2023).
- Colluvium (Qc): Project area material ranges from the Holocene and Pleistocene and is composed of angular to sub-rounded boulders and cobbles of quartz-rich rock. Deposits occur on higher slopes as collections of broken rock fragments at the base of cliffs, as fill in steep hollows, and are transitional into debris fans as they grade downslope. Deposit locations are blocky and sparsely vegetated. This material type can overlay karst features (Southworth et al. 2012; Horton, San Juan, and Stoeser 2017; GeoSciences 2022, 2023).
- Metasandstone Debris Fan above Carbonate Bedrock (Qdl): Project area material is of the Pleistocene (Qd) and consists of sub-rounded boulders, cobbles, and pebbles of metasandstone and metasiltstone in a matrix of pebbles, sand, silt, and clay that is locally stratified and overlies a base that may be modified by karst. Fan-shaped deposits are transitional downslope to fluvial terraces and alluvial plains and are vegetated by grass fields and forests with boulders visible on the surface (Southworth et al. 2012; Horton, San Juan, and Stoeser 2017).
- Boulder Debris Fans (Qdb): Project area material is of the Pleistocene and consists of sub-rounded boulders, cobbles, and pebbles of the conglomerate and sandstone bedrock of the Great Smoky Group. Fans form on lower slopes and valleys and are generally vegetated with boulders visible on the surface (Southworth et al. 2012; Horton, San Juan, and Stoeser 2017).

The fine-grained, high-silt content colluvial, alluvial, and steep residual soils and the underlying fractured and highly weathered Metcalf Phyllite and Pigeon Siltstone are generally poorly suited for stable cut slopes or fill. Because the landscape is shaped by the weaknesses in underlying bedrock, the steep slopes along which the Parkway would be built are often parallel to the dominant directions of the regional fracture system. This structure means that cutting into the hillside could allow rock to break far upslope in places where the roadway parallels and undercuts such slopes. Unstable bedrock (mapped as the Shields Formation and the Shields Formation conglomerate; Figure 7) and soils (mapped as the Cataska-Sylco complex and the Unicoi-Ditney-Rock outcrop complex; Figure 8) on steep land above Starkey Hollow, just west of the proposed tunnel entrance, are also areas where slopes may be unstable. Several areas of unstable rock are present in the central portion of the eastern edge of the Sugar Camp Branch segment. These areas include locations where rock movement has fractured rock (brittle faults), resulting in a ductile shear zone/zone of plastic deformation (Horton, San Juan, and Stoeser 2017). The rocks could fracture in directions that are different from typical directions for the area, creating more instability.



Source: Southworth et. al 2012

FIGURE 9. SURFICIAL MATERIAL DISTRIBUTION IN THE PROJECT AREA

KARST

Karst is a type of geology associated with soluble rock types like limestone, where water dissolves the bedrock and creates sinkholes, losing streams, caves, springs, and other characteristic features (GeoServices 2022, 2023). Water enters the subsurface through these features to further erode soluble rock; travels below ground, and eventually enters aquifers and/or discharges at springs, water supply wells, or streams (Aley and Aley 1991). Karst features also tend to underlie alluvial and/or colluvial soils (GeoServices 2022, 2023; USDA-NRCS 2024).

As discussed above, the bedrock and surface materials present in Section 8D are consistent with those that form or overlie a karst landscape. These include Jonesboro Limestone, a formation that is frequently "karsified" and underlies the Buckeye Knob segment, as well as alluvial and/or colluvial soils like the Cataska-Sylco complex, Lostcove very cobbly loam, and Braddock loam that make up the surface materials in the area (GeoServices 2022, 2023; Miller and Niemiller 2022; USDA-NRCS 2024.). Approximately 277 acres of the project area are underlain by a karst landscape.

Karst and other geologic features in the project area have been investigated over the last 40 years, including by Golder (1986), Aley and Aley (1991), Nolfi (2011), and Miller and Neimiller (2022). Beginning in fall 2021, GeoServices, LLC completed a series of investigations built off these previous studies to further identify and characterize karst features within the project area. Respective summaries of those investigations that are relevant to the project are included in more detail below, by karst feature. The investigations by GeoServices, LLC included desktop and field assessments. Desktop elements consisted of examining existing topographic maps and light detection and ranging (LiDAR) digital elevation model terrain analysis, while field activities included geophysical investigations (electrical resistivity imaging survey and a seismic refraction survey) and Global Positioning System (GPS) recordation of karst features (GeoServices 2022, 2023).

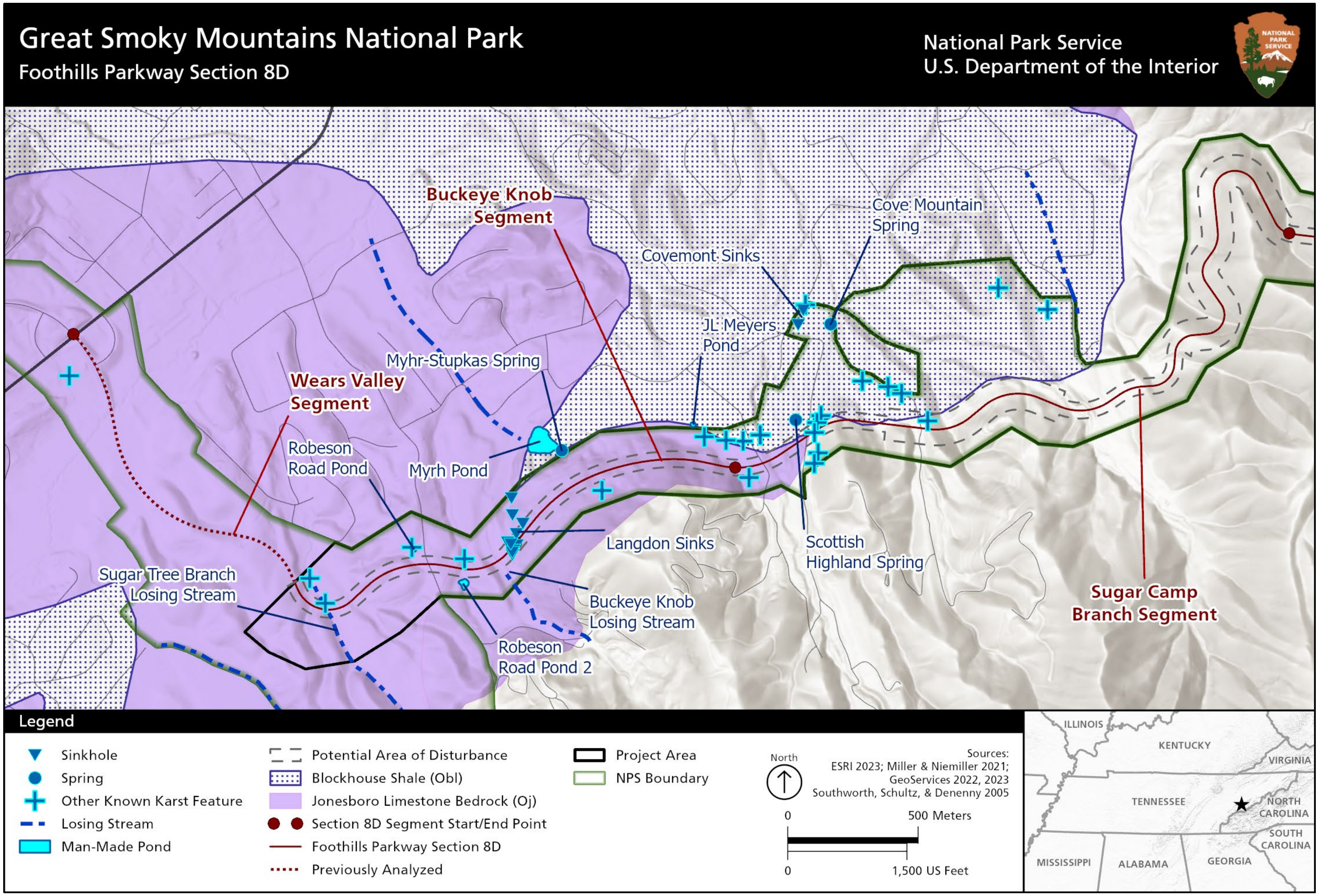
The investigations indicated the presence of an extensive karst system in the project area and confirmed the locations of multiple karst features within the Buckeye Knob, Sugar Camp Branch, and the Wears Valley segments of the project area, including the Buckeye Knob losing stream, Langdon Sinks 1 through 9 (sinkholes), JL Myers Pond, the Myhr-Stupkas Spring, Scottish Highland Spring, Covemont Sinks 2 and 3 (sinkholes), Cove Mountain Spring, and Sugar Tree Branch Losing Stream (Miller and Niemiller 2022; GeoServices 2022, 2023). Karst features are shown in Figure 10 (bedrock) and Figure 11 (soil).

Buckeye Knob Losing Stream

A losing stream is one where flow is partially or completely lost to groundwater along its flow path. The Buckeye Knob losing stream is a point along the perennial stream west of Buckeye Knob where surface water is lost to the subsurface (Miller and Niemiller 2022). The stream was observed to be flowing at the collected coordinate and dry downstream (GeoServices 2022, 2023).

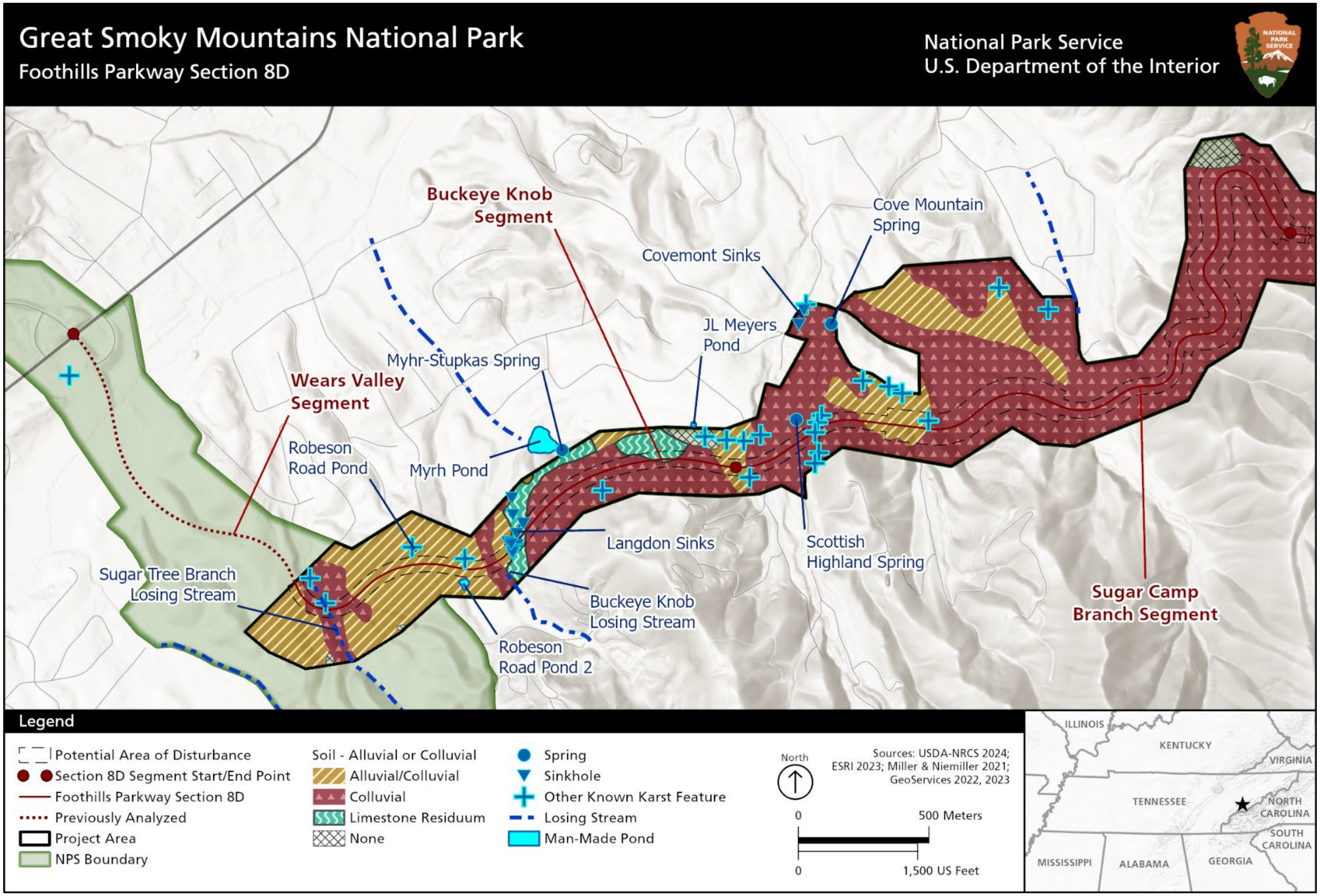
Langdon Sinks

The sinkholes on the west side of Buckeye Knob (Langdon Sinks 1–9) appear to receive little surface water other than hillside sheet flow. However, they are open, and soil entering the subsurface was observed. During times of heavy rain and wet weather, the stream to the west of Buckeye Knob could flood into the larger of the sinkholes and contribute to dissolution. This wet weather surficial flow could also contribute to recharge or discharge of the estavella, which is downgradient from the large sinkholes (GeoServices 2022, 2023). (An estavella is an opening in the ground that is generally only active in wet seasons and can act as a sink or source of water, depending on weather conditions.)



Sources: Southworth et. al 2012; GeoServices 2022, 2023

FIGURE 10. PARKWAY SECTION 8D KARST FEATURES



Source: GeoServices 2022, 2023; Miller and Niemiller 2022; USDA-NRCS 2024

FIGURE 11. PARKWAY SECTION 8D SOILS ASSOCIATED WITH KARST FEATURES

Undisclosed Cave

The undisclosed cave is a protected cave resource as determined by the Federal Cave Resource Protection Act of 1988 and is a known hibernaculum for the tricolored bat (*Perimyotis subflavus*), which is proposed as endangered under the ESA and state-listed as threatened. This feature is therefore described under the "undisclosed cave" label in this EA. This is the only known cave on NPS property within the project area (Miller and Niemiller 2022). The undisclosed cave is also discussed in more detail under "Biological Resources, Federally Listed Species."

An initial survey of the cave conducted in the 1980s by members of the East Tennessee Grotto Club on behalf of the NPS indicated a spring exiting the cave downslope of the entrance with an opening that was not passable. Soil and roots were visible in the ceiling at the highest point of the cave (Doughty 1989). The cave was described by Nolfi (2011) as 213 meters long with 15 meters of vertical extent, being mainly tight and wet, with a winding stream channel. The entrance was described as near a spring that discharges from the cave system into a pond.

The US Geological Survey (USGS) mapped the undisclosed cave in 2021 (Miller and Niemiller 2022). Formed entirely in Jonesboro Limestone, most of the undisclosed cave is located along or over an active cave stream that appears to originate from the east via a bedding plane passage, possibly from the losing stream on the west side of Buckeye Knob. The cave stream resurges as a spring in the vicinity of the cave entrance (Miller and Niemiller 2022) and feeds a 2-acre pond on adjacent private land. This spring is the source of water for the adjacent landowner's residence.

The undisclosed cave was surveyed to a length of 736 feet with all humanly enterable passages mapped to the fullest extent possible. The cave has a vertical extent of 67 feet from the highest to lowest point and a total depth from the entrance to the deepest point of 16 feet. While the undisclosed cave extends south into Buckeye Knob, it has a relatively small footprint, extending less than 200 feet from the entrance (Miller and Niemiller 2022). This extent indicates that the while 80 feet of the cave underlies the project area, it does not reach the AOD, which begins approximately 320 feet from the edge of project boundary. Subsequent geophysical investigations suggests that additional open-air voids that could not be mapped during the USGS effort may exist in the vicinity the cave (GeoServices 2023).

A cave bioinventory conducted in 2021 recorded 38 taxa, which when combined with historical observations give a total of 64 taxa identified from the cave (Miller and Niemiller 2022). Most taxa found in the cave are terrestrial, with historical records for only two aquatic species (*Caecidotea incurva* and *Cambarus bartonii*). These aquatic species were not observed during the 2021 survey.

JL Myers Pond and Losing Stream

The JL Meyers Pond and losing stream on the east side of Buckeye Knob are at the downstream terminus of a creek called Piney Spur. In 1991, Aley and Aley reported this losing stream as connected to a new depression, but the location of this losing stream was not found during the 2021 GeoServices investigations and is therefore not shown on Figure 10 or Figure 11. The new depression reported by Aley and Aley was found and is located just outside the park boundary on the southern end of the project area on the east side of Buckeye Knob. The Piney Spur Branch or Piney Spur Creek, which runs between Buckeye Knob and the homesites at JL Myers Road, is traceable from the headwaters to this sink and then untraceable on satellite imagery. The stream was not traced past the park boundary during field investigations (Aley and Aley 1991; GeoServices 2022, 2023).

Cove Mountain and Scottish Highland Springs

Two springs east of Buckeye Knob were also found during the field survey. One spring outlet was found along Cove Mountain Road, while the other was found near Scottish Highlands Road. The only spring in the project area identified in the field survey potentially used was at Cove Mountain Road. A sandstone block spring-wall was observed at the spring outlet across King Hollow Branch (GeoServices 2023).

Covemont Road Sinks

Two closed depressions along Covemont Road located during desktop review were field verified. These closed depressions appear to be covered sinks that receive little surficial water other than sheet flow from roadway runoff along Covemont Road (GeoServices 2022, 2023).

Sugar Tree Branch Losing Stream

The Sugar Tree Branch Losing Stream[3] was located during field investigation of two karst features (i.e., the closed depression at Sugar Tree Drive 1 and the closed depression/potential sinking stream at Sugar Tree Drive 2) and identified during the desktop review, (GeoServices 2022, 2023). The Sugar Tree Branch Losing Stream is a losing stream located in the Wears Valley segment of the project area and represents the longest segment of continuously losing or dry streambed in the study area (Miller and Niemiller 2022; GeoServices 2022, 2023; NPS 2022b). The stream was observed to be flowing at the collected coordinate and was dry downstream (GeoServices 2022, 2023).

Hydraulic Connectivity

Karst landscapes often have connectivity between surface and subterranean environments from the development of conduits via dissolution. Thus, in carbonate and/or karst environments, there is a direct connection between surface activities and the subsurface. The Ozark Underground Laboratory conducted a dye trace program in 1991 to "characterize hydrology of the area and determine potential impact of road construction on the groundwater resources" (Aley and Aley 1991).

Dyes were injected into two sinkholes near the proposed centerline near the west end of Section 8D (Wears Valley) and into two losing streams on the west and east sides of Buckeye Knob. Positive dye recoveries, and some possible recoveries, were found north of the injection sites at two springs near Cove Creek, but no recoveries of dye were made at Myhr-Stupkas Spring. However, while no tracer dyes were recovered from the Myhr-Stupkas Spring, hydrologic field reconnaissance indicates that the Parkway corridor would contribute recharge water to this spring (Aley and Aley 1991).

The injection locations were generally at a similar or higher surface elevation than portions of the Section 8D Wears Valley and Buckeye Knob segments. Given the isolated nature of positive dye recovery in the northern two springs previously mentioned and not in each of the springs in the area tested, it appears there is more than one underlying groundwater system related to the karst geology (Aley and Aley 1991).

UNWEATHERED PYRITE

Unweathered pyritic material (also known as acid-producing material) is composed of sulfide minerals. When exposed to air and water, unweathered pyrite produces sulfates that could acidify stormwater runoff and affect downstream waters (Schwartz, Palomino, and He 2018). Acid-producing material can be in the form of soil or rock.

The acid formation risk for bedrock in Section 8D is presented in Figure 12. The acid formation potential was determined by overlaying the project area onto a map showing the acidity of the rock formations in the area developed in 2012 by the Great Smoky Mountains Geographic Information System Lab. Section 8D does not contain any areas with a high risk of acid formation, and areas of medium risk are limited to the eastern end of the Sugar Camp Branch segment, the Crooked Arm Ridge segment, and the western end of the Cove Mountain segment.

[3] Referred to as the "Unnamed Tributary to Cove Creek" in Miller and Niemiller 2022 and NPS 2022b.

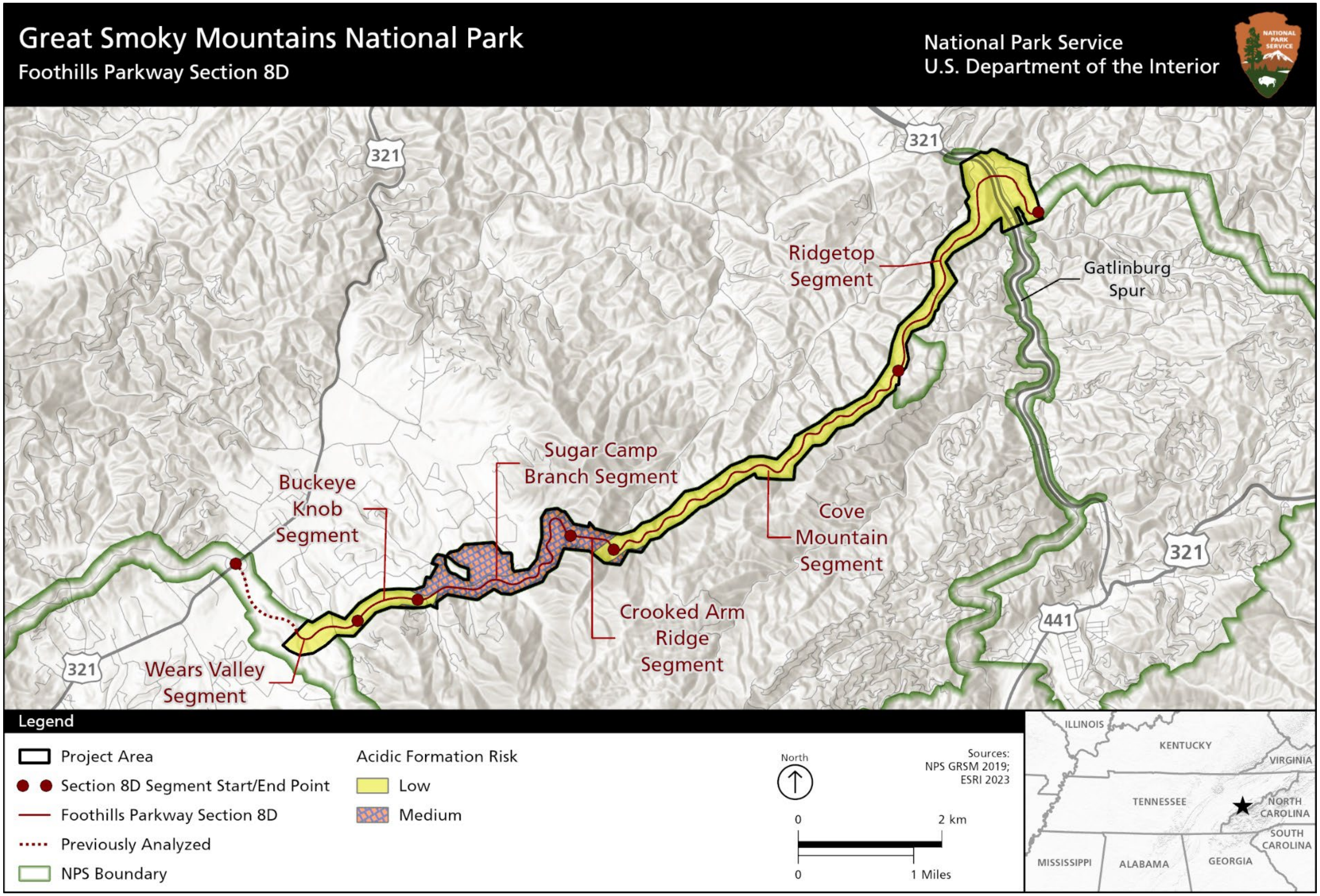


FIGURE 12. PARKWAY SECTION 8D ACID FORMATION RISK (BEDROCK)

A feasibility study conducted in 1984 and summarized in Volume 1 of the Crooked Arm Ridge Tunnel Feasibility Study found that sulfide minerals are present in the rock units in the Cove Mountain area and at the tunnel location in Crooked Arm Ridge (Golder 1986).

As part of this study, rock core samples were collected, and mineral analysis was conducted on rock from the cores. The mineral testing indicated that sulfide minerals (responsible for the acid-producing nature of unweathered pyrite) are present in the Shields Formation and Shields Formation conglomerate that make up the Crooked Arm segment. However, the study also indicated that the amount of sulfide minerals present is generally small except in a few isolated zones. Further, the rock material analyzed from the Cove Mountain area indicated the presence of only trace quantities of pyritic material (Golder 1986).

The mineral testing results generally agree with the observations made on the collected cores. The sulfides present in the rock are disseminated, pervasive, and usually present in trace amounts. Zones of concentrated sulfide mineralization—identified on the logs as pyrite bands—were rare, and where they were present, the band was typically 0.1 to 0.2 feet thick (Golder 1986).

TRENDS AND PLANNED ACTIONS

Climate change is expected to increase temperatures in Tennessee and increase precipitation intensity and variability. Both floods and droughts are expected to become more severe. Higher intensity and more frequent rainfall may lead to more soil erosion (USEPA 2016). In locations where the bedrock contains large amounts of limestone, caves and sinkholes are present in the subsurface. As erosion increases, the likelihood that caves will expand, and new sinkholes will form is also likely to increase. Warmer temperatures are expected to decrease the amount of water recharging rivers and groundwater by 2.5% to 5%, which may deplete water resources. As erosion increases and the amount of water in rivers and groundwater decreases, the concentrations of pollutants carried into waterways and groundwater is likely to increase (USEPA 2016).

Past and continued land development in the vicinity of Section 8D, in particular within Wears Valley and along the Spur, and the development of Parkway Section 8E, have altered topography and changed land cover. Residential and commercial development in Wears Valley has increased, and residential properties include primary residences, rental homes, and secondary vacation homes. The population of the census tract that includes most of Wears Valley, including the project area, has increased by approximately 20% since 2010 (US Census 2019). Section 8E was opened for public use in November 2018. Section 8E and continued land development have increased surface runoff that has increased soil erosion and the weathering of exposed bedrock, and the increased flow could erode existing karst features. Pyritic material exposed during the earlier phase (1989) construction of Section 8E temporarily halted construction until appropriate engineering and mitigation measures were implemented, after which Section 8E was successfully constructed.

Future actions planned and authorized by the NPS that could result in cumulative impacts on geological features and processes include other park transportation and recreation planning projects, which may contribute impacts to geological features. Approved in 2022, the Wears Valley Mountain Bike Trail System will include 14.1 miles of mountain bike and pedestrian trails in the westernmost segment of Section 8D. An access road of less than 1 mile will be constructed along the Section 8D corridor to access the mountain bike trail system and trailhead. The construction and operation of the Wears Valley Mountain Bike Trail System could result in slight increases in storm runoff that could contribute to further erosion and result in the weathering of exposed bedrock or the surface expression of karst features like sinkholes. Increased runoff could also result in more transport of water into the subsurface and changes to subsurface groundwater flow paths from the additional flow.

ENVIRONMENTAL CONSEQUENCES

ALTERNATIVE 1: NO ACTION

Under the no-action alternative, the NPS would not construct Section 8D of the Parkway. No direct or indirect impacts to geologic features or processes would occur from the no-action alternative. Impacts from natural processes, trends, and planned actions would continue to occur as described above.

ALTERNATIVE 2: NPS PREFERRED ALTERNATIVE

Bedrock and Soils - Slope Stability

Construction Impacts. Under alternative 2, construction of Section 8D would require excavation, land cuts, grading, and tunneling. As described in chapter 2, between 188 and 331 acres would be disturbed during the construction period. Multiple geological factors affect slope stability, including steep slopes, soil stability, and the highly weathered and fractured nature of the bedrock. As noted in the "Affected Environment" section, the soil and bedrock within the AOD are generally poorly suited for stable cut slopes or fill without specific design and resource protection measures. Table 4 displays the range of potential disturbance of each bedrock type found in the project area, as well as specific construction concerns.

TABLE 4. RANGE OF POTENTIAL ACRES OF DISTURBANCE BY ROCK TYPE

Bedrock	Design and Construction Considerations	Minimum Acres of Disturbance	Maximum Acres of Disturbance
Thunderhead Sandstone (Zt)	• Resistant to weathering (karst less likely) • Isolated instances of thick bands of pyritic material	<1	<1
Pigeon Siltstone (Zp)	• Landslide risk • Isolated instances of thick bands of pyritic material	130	218
Shields Formation (Zs)	• Medium risk for acid formation • Includes tunnel construction	34	68
Shields Formation, conglomerate (Zsc)	• Medium risk for acid formation • Includes tunnel Construction	5	8
Jonesboro Limestone (Oj)	• Prone to weathering • Known karst features	19	33
Blockhouse Shale (Obl)	• Prone to weathering • Known karst features	<1	4

Note: Minimum and maximum acres use the footprint associated with the Low Bridge Option.

Construction could also affect boulder trains, landslides, and slumps, which are inherently unstable geomorphic features. Two of these features are located along the lower slopes of Cove Mountain (the approximate middle of the Cove Mountain segment), near Caney Creek. These features are in bedrock mapped at the border of the Pigeon Siltstone and Thunderhead Sandstone, which is known to contain trace to low amounts of pyritic material, with isolated instances of thicker bands (see "Pyritic Material" below). If excavation created unstable slopes in an area containing a thicker band of pyritic material, Caney Creek could be impacted (Golder 1986; Horton, San Juan, and Stoeser 2017). The potential impacts to surface water if this material were exposed to water are discussed in the "Water Resources" section.

Excavation could impact soil stability in areas with slopes greater than 45%. Table 5 summarizes the approximate acres of the AOD by material type for soils with potential slopes greater than 45%, which would be most at risk for instability.

TABLE 5. APPROXIMATE ACRES OF DISTURBANCE BY MATERIAL TYPES IN THE AREA OF DISTURBANCE

Material	Slope Range	Minimum Acres of Disturbance	Maximum Acres of Disturbance
Talbott-Rock outcrop complex, eroded	25 to 60	<2	<3
Cataska-Sylco complex	25 to 80	111	204
Unicoi-Ditney-Rock outcrop complex	30 to 80	8	10
Unicoi-Rock outcrop complex	30 to 80	28	43

Note: Minimum and maximum acres use the footprint associated with the Low Bridge Option.

As shown in Table 5, soil with slopes greater than 45% are present in four of the soil types in the project area: the Talbott-Rock outcrop complex, the Cataska-Sylco complex, the Unicoi-Ditney-Rock outcrop complex, and the Unicoi-Rock outcrop complex (Horton, San Juan, and Stoeser 2017). Together, these soil types make up 260 acres of the 331-acre AOD and 149 acres of the 188-acre AOD, indicating the majority of the AOD includes unstable soils. As shown on Figure 8, these soil types are present throughout Section 8D, and destabilization of these soils could result in material slides or slumps.

Post-construction, partial slides or slumps along the downslope side of an at-grade paved roadway could result in the downslope side settling at a lower elevation than the upslope side. Complete slides or slumps of the supporting material could cause the road to dip sharply or result in breakage of the underlying section, Damage (cracks or breaks) and/or loss of the paved surface are possible. Post-construction material slides or slumps along the upslope side of an at-grade paved roadway could block the road. In the event the material falls onto or engulfs a vehicle, slides or slumps could cause property damage and/or injury. In the case of a bridged portion of the road, downslope slides or slumps near the bridge supports could destabilize the structure, causing instability and/or failure. An upslope slide or slump along a bridged stretch of road could have two results:

- If the bridged roadway is close enough to a “wall” of material, the slide or slump would have similar impacts to those along an at-grade roadway.
- If the bridged roadway is far enough away for the side or slump to miss the surface, the shifting material could affect the bridge supports and result in bridge instability and/or failure.

The magnitude and location of the earth movement determine the level of impact.

Material slides and slumps are expected to be avoided. Site-specific subsurface exploration and sustainable design and engineering, as detailed in Appendix B, would eliminate or control excessively large cuts and fills, prevent slope failure during and after construction, and control long-term maintenance costs. Together, these actions would reduce the potential for short or long-term adverse impacts associated with slope stability. Bridges and innovative designs in retaining walls would also eliminate the need for most large cuts and fills, preserving the existing slope structure and stability and, in some instance, enhancing them. Appropriate slope angles would vary depending on the materials encountered at each cut or fill area.

Based on the previous discussion, landslide risks and resulting impacts on slope stability would be mitigated through design and would include the stabilization of any existing unstable slopes prior to making any cuts for the roadway. Impacts on slope stability on the slumped material on Buckeye Knob would be prevented by avoiding undercutting in that area where possible. Alluvial and colluvial soils would also be disturbed; however, these soils are present in fewer than approximately 6 acres of the AOD. Slope stability in unstable areas of colluvial soils would be protected through site-specific design

engineering studies. Common design methods to address slope stability are included in Appendix B. The most appropriate method would be tailored to each location along the AOD. After construction is complete, between 124 and 265 acres of the AOD would be restored and revegetated (depending on the level of disturbance), which would improve soil stability and reduce the potential for long-term soil erosion. Similar slope stabilization and revegetation measures were successfully used during construction of Section 8E. After nearly 20 years, there have been no road washouts or concerns regarding soil erosion, indicating the slopes have remained stable post-construction.

Post-Construction Impacts. Post-construction impacts related to slope stability would be similar to pre-construction impacts—slope failure due to natural changes in conditions or everyday use of the Parkway. While potential impacts are possible, they are not anticipated due to design and resource protection measures described in Appendix B, as determined by the FHWA designers and engineers. Unstable faces would be reinforced appropriately using methods, such as concrete between blocks of rock to reduce weathering and surface scaling or a system of anchors, bolts, and dowels to tie the face together (USGS 2008). Periodic scaling/trimming would be conducted on an as-needed basis to remove material from areas prone to rock fall that may still be present. Therefore, with proper design, restoration, and ongoing maintenance activities, the risk of slope failure post-construction would be low.

Karst

Construction Impacts. The avoidance of karst areas is recognized as a highly desired approach in highway planning. In the case of Section 8D, a portion of the land acquired by Tennessee and transferred to the federal government for construction of Section 8D is characterized by karst geology, and it is unlikely that karst areas would be completely avoided. Therefore, site-specific geologic information would be required, similar to other road construction projects in karst areas. Geological formations that tend to form karst, including the Jonesboro Limestone and the Blockhouse Shale, make up 277 acres of the project area. Construction of Section 8D would convert up to approximately 7 acres of karst geology into paved surfaces and would disturb up to approximately 37 acres of vegetation that overlies karst geology.

As detailed in Appendix B, the geotechnical information and mapping gathered during the investigative phase of road design would inform route location selection and engineering options relative to karst. The use of geophysical methods such as resistivity, seismic, and ground-penetrating radar would be used to aid to characterize subsurface conditions in karst areas (Benson, Yuhr, and Kaufmann 2003).

In areas where karst is mantled or otherwise not visible, the construction of new roads with associated increases in runoff could trigger subsidence and flooding problems where previous land uses were in relative equilibrium with the karst (Moore 2006). As a result, the final design would focus on resource protection measures to avoid adversely impacting karst features. Karst protection takes multiple forms. One type focuses on maintaining the quality and quantity of water entering the feature and includes permanent measures designed to reduce impacts resulting from the project.

A second type of karst protection focuses on maintaining water flow to provide structural integrity for the overlying roadway during construction. The location of the feature and direction of water flow would determine the appropriate design and protection measure. Specific resource protection measures for karst are presented in Appendix B. These measures would be designed to maintain the quantity and quality of water entering the feature, which would avoid or minimize potential adverse impacts on karst features.

- If the location were in the proposed roadway and the water flows through the feature into the underlying karst, the feature would be capped to prevent collapse due to weathering. Existing collapses would be excavated to the bedrock drain, then the dug hole would be refilled with material graded upward from coarse rocks to finer sediments to allow natural flow through the bedrock drain without the loss of sediments that cause collapse (AGI 2001).
- If the feature located in the proposed roadway were a spring or seep, the design or protection method would maintain the flow of water from the underlying karst to the surface.

The NPS and FHWA would develop and implement a karst management plan as part of the detailed design, which would identify monitoring requirements, including the duration of monitoring (see Appendix B). Potential impacts on individual karst features are detailed below.

Dense bearing materials to support structural or heavily loaded pavement elements are unlikely to be present in Buckeye Knob, where saturated unsuitable clays and shallow karst zones are likely, and areas of free water and soft soils are present within collapsed hollows, draws, or sinkholes that may not be visible from the surface. Specific design alternatives for construction in karst environments are detailed in chapter 2, and the most appropriate method for each karst feature would be determined during subsequent design phases. In addition to design methods, site-sensitive construction methods would be evaluated during the design phase and would favor construction techniques that produce the least potential disturbance to karst geology.

Sinkholes. Physical alteration of the land can result in flooding or desiccation. It can also change the physical environment to include new sinkholes, new or cut-off water or air pathways, dried up springs, and collapsed or filled sinkholes or cave passages. Impermeable and/or unvegetated soil/rock surfaces can alter natural runoff patterns and lead to a concentration of runoff into existing sinkholes, and facilitate land collapse and the formation of a new open sinkhole or a blocked sinkhole, depending on the nature of the underlying void. The impacts of new sinkhole formation on water resources and bats are discussed under the "Water Resources, Environmental Consequences," and "Biological Resources, Environmental Consequences" sections.

In general, the western portion of Section 8D (generally Robeson Road, the Langdon Sinks, and the undisclosed cave) appears to be underlain by the highest-risk karst geology due to the presence of features generally correlated with increased sinkhole potential. These features include extensive zones underlain by carbonate and karst geologic conditions consisting of possible extensive open-air caves, shallow groundwater transport systems, and extensive potential zones for karst migration zones, which are essentially areas where sinkholes have or may form and result in the vertical movement of fine-grained clays. Because the underlying voids or caves generally expand or shrink slowly under stable conditions of surface and subsurface flow, measures to prevent changing surface water paths are necessary to prevent/mitigate the expansion of existing voids (GeoServices 2023) and would therefore serve as a primary resource protection approach. Maintaining the existing surface water paths would also prevent/mitigate creation of a new opening into the undisclosed cave. Grading and foundation design in this area would need to address the specific karst conditions present (GeoServices 2023). Site-specific design would avoid adverse impacts on karst resources.

Pooling of surface runoff in recently graded or excavated and/or unlined areas can also lead to sinkhole formation. Increased seepage into the subsurface collects in the underlying soil, eventually developing a conduit at the soil/bedrock interface below the ditch. Erosion continues until the soil over the cavity collapses, and a sinkhole is formed. The development of proper drainage systems or use of a liner in ditches or other low-lying areas in karst terrain is critical to preventing land collapse in this scenario. Appendix B details materials like sodding, asphalt, riprap, and concrete as BMPs that have historically been used to line ditches. New emphasis has been put on the use of synthetic geomembranes, which also would be considered. Use of geomembranes made of high-density polyethylene and polyvinyl chloride as ditch liners in karst areas is strongly recommended because of their flexibility, low permeability, strength against puncture, and ease of installation (Moore 2006).

Losing Streams and Spring and Seep Protection. As described in the "Affected Environment" section, a losing stream is one where flow is partially or completely lost to groundwater along its flow path. Disturbance to losing streams would be avoided, when feasible. Complete avoidance is not feasible for one losing stream; in this case, the losing stream would be bridged, maintaining a 30-foot to 60-foot riparian buffer on each side of the stream. However, two losing streams are not feasible for avoidance or bridging and would require culverts. Springs and seeps would continue to flow and require specific

treatment to reduce impacts to the road and water resources. Failure to direct the flow from under the roadway could result in instability of the fill under the roadway (INDOT 2021). Potential impacts on water resources, including losing streams, springs, and seeps, are detailed in the "Water Resources" section.

Erosion and Water Quality. Studies conducted around Buckeye Knob and Cove Creek demonstrated a direct connection between surface water and groundwater (Aley and Aley 1991; Miller and Niemiller 2022; GeoServices 2022, 2023). The quality of these waterbodies could be affected by the rapid introduction of unfiltered pollutants such as soil, gasoline, tar, exhaust particles, and hazardous waste into sinkholes. Pollutants that enter the system have long residence times because the lack of exposure to sunlight and soil microbes prevents or slows breakdown. Degradation in groundwater quality could affect downstream springs as well as fauna and associated habitat in the project area (GeoServices 2023; INDOT 2021; Moore 2006). In particular, the project area provides roosting and foraging opportunities for several species of bats, including three listed as endangered under the ESA, one species proposed for listing as endangered, and one species under review for listing. In addition, the undisclosed cave is a known hibernacula for tricolored bats. This topic is discussed under "Biological Resources, Environmental Consequences."

As described in the "Surface Water, Environmental Consequences" section, resource protection measures to maintain the quantity and quality of surface water would be part of the stormwater pollution prevention plan (SWPPP) mandated by a Tennessee Construction General Permit (Permit Number TNR100000). Impacts would also be minimized through compliance with conditions required by any section 404 permit granted for the project under the Clean Water Act (33 United States Code § 1334) and the Tennessee Water Quality Control Act (Tennessee Code § 69-3-101, et seq.).

Drainage. Karst-related drainage problems can stem from too much or too little drainage into a karst area. Impermeable and/or unvegetated soil/rock surfaces can alter natural runoff patterns, leading to a concentration of runoff into existing sinkholes, and facilitate land collapse and the formation of a new open sinkhole or of a blocked existing sinkhole. Too little drainage could result in dried springs. As a result, roadway design in a karst environment seeks to maintain existing recharge profiles to avoid altering surface to groundwater flows. Methods for maintaining this flow, and therefore avoiding potential impacts, include the proper design of lined ditches, rock pads, overflow channels, sinkhole opening improvement/protection, curbs for embankment sections, and drainage wells, as detailed in Appendix B. Groundwater contamination from drainage into karst features could be addressed by either a filtration system, retention/sediment basin, or both. If a filtration system were used to treat runoff, water sampling would be conducted to monitor system performance (Moore 2006) and detailed in a karst management plan.

Additional sinkhole improvement techniques that could be used to reduce drainage impacts on groundwater include siltation fences, trash racks, perforated and filter-cloth-wrapped stand pipes, gabion revetment, and erosion control geotextiles. The selected sinkhole improvements could be monitored to ensure that the sinkhole is not eventually plugged by silt or trash (Moore 2006).

Long-term, adverse impacts on karst resources would be avoided by implementing the site-specific design measures to avoid altering the quality and quantity of existing water flow and existing flow patterns. While some individual karst features may be modified by design options (e.g., inclusion of rock anchors or use of rip rap), those impacts would be localized and are anticipated to be minimal. As noted above, avoidance of karst features would be the preferred design option whenever feasible, further reducing the potential for long-term, adverse impacts.

Post-Construction Impacts. Post-construction impacts would be similar to construction impacts and could include the risk of sinkhole formation, expansion, and clogging if the quantity and quality of water does not continue to flow as designed. Post-construction, however, these impacts would be limited to those associated with normal use of the roadway. The implementation of proactive protection measures and

techniques to maintain pre-construction runoff patterns and conditions, such as ditch lining and filtration, the development of a system to redirect, store and treat (if necessary), and reintroduce runoff, would prevent or reduce impacts to geological and water resources. The proactive injection and storage of runoff, and protection of existing sinkholes, would prevent or reduce impacts, while the proactive protection of existing sinkholes using geomembranes or a combination of a geomembrane and fill would prevent or reduce expansion and/or clogging of existing sinkholes.

Post-construction monitoring would identify potential land subsidence that may be associated with activation of a subsurface karst feature. Monitoring may include visual inspections to monitor for changes in ground topography that could be indicators of potential land subsidence due to activation of a subsurface karst feature. Park maintenance crews would routinely evaluate Section 8D for roadside hazards, including indicators that karst settlement may be present. Areas suspected of settlement would be further evaluated by qualified geologists. The appropriate geophysical methods, such as ground-penetrating radar, electrical resistivity imaging, or seismic refraction, may be used for karst identification and to inform specific design and any resource protection measures. Additional information on post-construction monitoring is presented in Appendix B.

Pyritic Material

Construction Impacts. As discussed above and displayed in Table 4, the rock formations underlying the eastern edge of the Sugar Camp Branch segment, the Crooked Arm Ridge segment, and the western end of the Cove Mountain segment contain trace to medium quantities of acid-producing material (Golder 1986; Southworth et al. 2012; NPS 2016b). If exposed, this material could acidify stormwater runoff and affect downstream waters (Schwartz, Palomino, and He 2018). Resource protection measures for pyritic material are detailed in Appendix B.

Prior to excavating any potentially acid-producing rock or soil, samples would be collected and tested for acidity, alkalinity, percent pyritic sulfur, net acid/base potential, and paste pH (TDOT 2007, 2021). If acid-producing material were present, design-phase BMPs would be established to minimize exposure, including minimizing excavation where possible (avoidance), estimating the quantity that would be produced and arranging for disposal prior to construction, and diverting drainage away from excavations, where possible (TDOT 2007).

Resource protection methods and solutions for identified acid-producing material would be designed as necessary in accordance with FHWA and TDOT requirements. These solutions would be based on the acid-producing potential of the material and include full encapsulation or sequestration in place, partial encapsulation, blending, and placement in road embankments, as detailed in chapter 2 (TDOT 2007, 2021, 2023; FHWA 1990).

Potentially acid-producing material encountered during construction would be separated to the extent feasible using normal excavation procedures and, if not encapsulated, transported to a suitable disposal site, in accordance with all applicable guidelines, as detailed in Appendix B. Any questionable material identified during construction would be temporarily isolated from air and water using polyethylene sheeting until laboratory results determine its manner of disposition. Any exposed cut face on a soil slope would be covered with the polyethylene sheeting until such time that erosion control measures can be implemented (TDOT 2021).

A temporary compacted clay cap would be required to cover any incomplete encapsulation or blending area left open for more than two weeks in December, January, February, or March or for four weeks during the rest of the year. Any encapsulation area left open for more than two weeks would be graded to drain to the closest detention pond. Encapsulation areas would not have slumps, depressions, or holes that would contain water on or directly above them. A temporary detention pond (sized accordingly) would be used to collect runoff from the encapsulation area during construction (TDOT 2021).

If this material were encountered and/or encapsulated in place, water monitoring would be conducted to confirm the material has not affected downgradient surface water, with the duration of the program determined by the monitoring results and professional judgment. By implementing resource protection measures throughout the design and construction period, potential impacts from pyritic material would be avoided.

Post-Construction Impacts. Post-construction impacts related to pyritic material are not expected.

Cumulative Impacts

Impacts on geological resources and processes from cumulative actions would be the same as those described for the no-action alternative and include other park transportation and recreation planning projects. The implementation of the Wears Valley Mountain Bike Trail System could result in slight increases in stormwater runoff that could contribute to further erosion and result in the weathering of exposed bedrock or the surface expression of karst features. Increased runoff could also result in more transport of water into the subsurface and changes to subsurface groundwater flow paths from additional flow.

The construction of alternative 2 could contribute additional impacts on bedrock and soil structures, resulting in the potential for landslides and increased instability. Further, the exposure of sulfide minerals to moisture could lead to the acidification of downgradient waterbodies. However, these additional impacts are not expected because specialized design techniques and resource protection measures would be implemented to minimize/prevent these impacts to the maximum extent practicable. Therefore, alternative 2 has the potential to contribute minimal, long-term, adverse impacts on geological resources. When combined with past, present, and reasonably foreseeable projects in the project area, cumulative impacts on geological resources would be long term and adverse.

BIOLOGICAL RESOURCES

AFFECTED ENVIRONMENT

Information on vegetation and wildlife in the project area was compiled from a review of various NPS studies and reports, information on target species in the Tennessee State Wildlife Action Plan (TDEC 2015), the NPS species database (NPS 2023), and consideration of the available habitat in the vicinity of Section 8D. The analysis considers the potential for various taxa to occur within the project area or to be affected by construction activities and/or habitat loss.

VEGETATION AND SPECIAL STATUS PLANTS

The project area is approximately 93% forested (approximately 1,086 of 1,165 acres). Open field/herbaceous areas occur in the Wears Valley segment. Mixed hardwood forest is the most common vegetation, dominated by oak, hickory, and maple trees. These forests typically have a diverse understory of shrubs, wildflowers, and ferns. No old-growth or virgin forest occurs in the project area; it has been logged or burned at various times during the two centuries (NPS 1977, 2021b). Past forest disturbance also includes old road cuts (see “Trends and Planned Actions”). Young forests make up much of the project area, often with abundant tulip poplar. Individual large trees are scattered thorough most forests, which are commonly associated with past human activities (e.g., homesites).

According to the NPS (2021b) vegetation mapping inventory of the park, oak forest is the most common type of mixed hardwood vegetation in the project area, covering 53% or approximately 619 acres (Table 6). Areas mapped as low-elevation oak forest are composed of mostly chestnut oak forests with an evergreen shrub understory (mountain laurel, rhododendron, and *Vaccinium* spp.), and less commonly, with stands of mixed oak species (chestnut oak, northern red oak, scarlet oak, and white oak), sourwood, red maple, and hickory species, with a variety of deciduous shrubs and herbs in the understory. Ruderal (i.e., human-disturbed) deciduous forest is the second-most common vegetation type (28% or

approximately 328 acres). Most ruderal deciduous forest is dominated by tulip poplar or black walnut, and other hardwoods to a lesser extent. Together, these two vegetation types make up approximately 81% of the project area. The third most abundant vegetation type mapped in the project area is low-elevation pine woodland, which composes approximately 8% of the project area. These stands are dominated by yellow pines (Virginia pine, Table Mountain pine, short leaf pine, and pitch pine) on dry and often steep and/or south-facing slopes. In the western part of Section 8D, pine species include primarily Table Mountain pine and pitch pine, often with an extensive mountain laurel understory. Virginia pine is more common in the eastern part of Section 8D. This forest type ranges from nearly pure pine stands to mostly hardwood with some pine trees; hardwood trees adapted to dry sites (e.g., chestnut oak and scarlet oak) are often codominant. These three main vegetation communities are interspersed with several other vegetation types, each composing less than 5% of the project area, including: (1) managed or maintained vegetation surrounding infrastructure (cultural vegetation); (2) cultivated grasslands in the Wears Valley segment (ruderal upland); (3) Appalachian herbaceous cove forests in sheltered locations dominated by tulip poplar with yellow buckeye, sugar maple, and white ash, and a rich herb understory (low-elevation hardwood forest); (4) mixed-species deciduous forest associated with riparian zones of the West Prong and King Hollow Branch (floodplain forest); and (5) hardwood and mixed mesic hardwood-evergreen forests found along Mill Creek, likely dominated by eastern white pine (low-elevation mixed deciduous-conifer forest).

TABLE 6. APPROXIMATE ACREAGE OF VEGETATION TYPES WITHIN THE PROJECT AREA

Vegetation Type	Approximate Acres	Percent of Project Area
Cultural Vegetation	43	4%
Floodplain Forest	12	1%
Low-Elevation Hardwood Forest	21	2%
Low-Elevation Mixed Deciduous-Conifer Forest	7	<1%
Low-Elevation Oak Forest	619	53%
Low-Elevation Pine Woodland	99	8%
Ruderal Deciduous Forest[a]	328	28%
Ruderal Upland	30	3%
Water (West Prong)	6	<1%
Total	**1,165**	**100%**

Source: NPS 2021b

[a] Ruderal vegetation types occur in human-disturbed sites. The vegetation shows evidence of former and heavy human use, such as formerly cleared and/or planted sites. For forested types, succession has been allowed to occur more-or-less spontaneously because the vegetation is dominated (>80% cover) by native tree species.

No federally listed plants are expected to occur in the project area; none were found during the botanical surveys of the project area in 1991 or in 2021 by Allstar Ecology (2022). Although Section 8D is within the range of the federally threatened small whorled pogonia (*Isotria medeoloides*), it has not been documented in the park. Surveys did not find two other federally listed plants, spreading avens (*Geum radiatum*) and Virginia spiraea (*Spiraea virginiana*), reported in the park by NPS (2023) and the Natural Resource Condition Assessment (Bates et al. 2018). Allstar Ecology (2022) reported occurrences of 16 special status plant species, including 2 species listed as threatened by the State of Tennessee:

butternut (*Juglans cinerea*) and northern starflower (*Trientalis borealis*).[4] Numerous populations of American ginseng (*Panax quinquefolius*) and ramps (*Allium tricoccum*) were documented, which are both listed as Special Concern[5] in Tennessee due to commercial exploitation, not because of their rarity or lack of habitat. Allstar Ecology (2022) documented 44 occurrences of American ginseng within 13 acres of the project area and located 3 occurrences of ramps within less than an acre of the project area. In addition, 1 potential state-endangered plant species, ill-scented wakerobin (*Trillium rugelii*), was located during the 2021 survey; however, these occurrences were not confirmed because of the difficulty to discern ill-scented wakerobin from 25 other species in the *Trillium* genus. The NPS (1994) indicates this species was documented in Section 8D, and park staff have observed it in the project area. Table 7 provides the acreage of special status plants mapped by Allstar Ecology (2022) within the AOD.

Allstar Ecology (2022) mapped 252 acres containing invasive plants, which is approximately 20% of the project area. The highest concentrations of invasive plants were in the Wears Valley, Buckeye Knob, Sugar Camp Branch, and Ridgetop segments, typically near roadways and other infrastructure, old and extant homesites and other disturbed areas, and along streams and riparian areas. Concentrations of invasive plants were lower in the more remote areas of the Crooked Arm Ridge and Cove Mountain segments. The most common species were bush honeysuckles (*Lonicera* spp.), Japanese stiltgrass (M*icrostegium vimineum*), multiflora rose (*Rosa multiflora*), burning bush (*Euonymus alatus*), privet (*Ligustrum vulgare*), and autumn olive (*Elaeagnus umbellata*) (Allstar Ecology 2022).

TABLE 7. APPROXIMATE ACREAGE OF SPECIAL STATUS PLANTS WITHIN THE PROJECT AREA

Species	Global Rank	State Rank	State Status	Acreage in Project Area
Juglans cinerea (Butternut)	G3	S3	T	< 1
Trientalis borealis (Northern starflower)	G5	SNR	T	< 1
Trillium rugelii (Ill-scented wakerobin)	G4	S2	E	< 1

Sources: TDEC 2021, 2023; Allstar Ecology 2022; NatureServe 2023

Global Rank:
- G3 = Vulnerable
- G4 = Apparently Secure
- G5 = Secure

State Rank:
- S2 = Imperiled, at high risk of extirpation in Tennessee
- S3 = Uncommon, at moderate risk of extirpation in Tennessee
- S4 = Apparently secure, at a fairly low risk of extirpation in Tennessee
- SNR = Subnational conservation status not yet assessed
- Ranks that span adjacent ranks are rounded to the more imperiled rank (e.g., G1G2 is rounded to G1)

State Status:
- T = Threatened
- E = Endangered

The flora of the park includes a high diversity of bryophytes,[6] which are critical components of ecosystems. Bryophytes are sensitive to changes in environmental conditions and can be used as indicators of ecosystem health and water quality. Schwartzman and Smucker (2022) resurveyed previously recorded rare bryophytes at locations that were studied by Smith and Davison (1992) to determine changes in species presence and identify locations for listed bryophytes (TDEC 2021) along Section 8D. The survey found 195 moss, liverwort, and hornwort species with 34 taxa newly documented

[4] Special status species are those meeting one or more of the following criteria: listed as threatened and endangered under the ESA; proposed, candidate, or under review for listing under the ESA; designated as Bird of Conservation Concern; or listed as endangered, threatened, or special concern by Tennessee; and/or identified by park biologists.

[5] In Tennessee, a species or subspecies of plant is considered “Special Concern” if it is uncommon in Tennessee, or has unique or highly specific habitat requirements or scientific value and therefore requires careful monitoring of its status.

[6] Bryophytes are a group of nonvascular plants that include mosses, liverworts, and hornworts. Unlike vascular plants that have specialized tissues for water and nutrient transport, bryophytes lack true roots, stems, and leaves.

for the project area. The majority (71%) of rare or uncommon[7] taxa from the 1992 survey were also encountered in the 2021 survey. A total of 87 bryophyte species listed by the park as rare or uncommon or new to the park, including 7 designated by the State of Tennessee as Special Concern (Table 8) were identified. The survey identified 24 new records for rare bryophyte species, including the Special Concern liverwort *Lophocolea appalachiana*. Certain collection sites, such as Mill Creek, the Starkeytown Tributary, the Pilot Road Seep, Buckeye Knob, and Lower Caney Creek, were highlighted for their conservation significance, supporting diverse bryophyte species. Buckeye Knob and Lower Caney Creek support 31 and 25 species classified as rare or uncommon in the park, respectively. Buckeye Knob contains a substantial area of limestone outcrops, sinkholes, caves, and talus, which support a high diversity of calcareous-loving bryophytes. Lower Caney Creek supports limestone outcrops to a lesser degree and includes a number of diverse habitats, including dry pine ridges, calcareous slopes and outcrops, stream valleys, and floodplain habitat.

[7] The rare or uncommon status used by Schwartzman and Smucker (2022) to identify target species was determined by the abundance category in the NPS species database, in addition to the Tennessee State Status and Global and State Conservation Ranks.

TABLE 8. BRYOPHYTES IN THE PROJECT AREA DESIGNATED AS SPECIES OF SPECIAL CONCERN IN TENNESSEE

Species	Description and Habitat	Conservation Rank	Location in the Project Area
Lophocolea appalachiana	Stream-dwelling liverwort found on wet rocks in stream beds and along stream margins.	Globally imperiled (G2) and critically imperiled (S1) in Tennessee.	Upper Caney Creek, John Hollow, Mill Creek, the Pilot Road Seep, and Starkeytown Tributary.
Lejeunea blomquistii	Small liverwort associated with dry boulders and outcrops above stream ravines, requiring high humidity but usually slightly removed from stream margins.	Endemic to the Southern Appalachians, globally vulnerable (G3), and critically imperiled to imperiled (S1S2) in Tennessee.	Machine Branch, Mill Creek, and Starkeytown Tributary.
Riccardia jugata	Thalloid liverwort of Southern Appalachian distribution, typically found in seeps in moist soil or on well-decayed wood.	Considered imperiled in Tennessee (S2), needs conservation status review.	Shallow creek in Middle Caney Creek and floodplain of Gnatty Branch.
Plagiochila echinata	Found in moist ravines and spray cliffs, endemic to the Appalachians, including the Carolinas, Tennessee, Alabama, Georgia, and Kentucky.	Globally imperiled (G2) and state imperiled (S2) in Tennessee.	Mill Creek.
Cephaloziella spinicaulis	Tiny liverwort described as growing on shaded rock or cliffs and at ground level on moist forested slopes near small streams.	Considered vulnerable (G3) in eastern North America and critically imperiled (S1) rank in Tennessee.	Wet rocks and pieces of shale in small, shallow creeks (Middle Caney Creek, Rymel Branch, and Pilot Road Seep).
Pedinophyllum interruptum	Habitat: Associated with white cedars or limestone outcrops.	Conservation Status: Considered vulnerable (G3) in the United States and critically imperiled (S1) in Tennessee.	Around an undisclosed cave location, growing on boulders around the cave within and outside the park boundary.
Diplophyllum andrewsii	Habitat: Occurs on disturbed soil banks in humid locations, often with *D. apiculatum.*	Conservation Status: Vulnerable (G3) in the United States and critically imperiled (S1) in Tennessee.	Road bank by Bearwallow Hollow, soil banks on the pine ridge near the Ravine Site, and on soil above the Starkeytown Tributary.

Source: Schwartzman and Smucker (2022)

WILDLIFE, INCLUDING BIRDS OF CONSERVATION CONCERN

Most wildlife common at middle to low elevations of the park are likely found within the project area. This section focuses on wildlife in general and birds protected under the Migratory Bird Treaty Act.

Some of the large wildlife likely to occur are white-tailed deer, black bear, wild turkey, coyote, red fox, gray fox, bobcat, and European wild boar. Small mammals commonly occurring in the area include eastern gray squirrels, eastern chipmunk, striped skunk, woodchucks, opossum, long-tailed weasel, and eastern cottontail. Spotted skunk, though not common to the area, also may be present. Habitat along streams is suitable for mink and muskrat.

Common amphibians in the area are the American toad, several salamanders, and several species of frogs such as the northern cricket frog, southern leopard frog, tree frogs, upland chorus frog, green frog, and wood frog. The eastern box turtle is common in the area, and other common reptiles include the northern fence lizard, skinks, water snake, eastern garter snake, northern ring-necked snake, eastern worm snake, black rat snake, and northern copperhead.

WSP (2021) conducted diurnal and nocturnal point-count and transect bird surveys in the project area during May and June 2021. Sixty bird species were observed during 108 diurnal point-count survey events for breeding birds and transects surveys between point-counts, and 5 species were observed during 44 nocturnal survey events for nightjars. To provide relative estimates of avian diversity, each species' frequency of occurrence was calculated as the percentage of point-count surveys where it was observed. Based on frequency of occurrence, the five most common species encountered were all observed in about half of the point-count surveys. These species, in descending frequency of occurrence, included red-eyed vireo (*Vireo olivaceus*), observed in 67% of surveys; tufted titmouse (*Baeolophus bicolor*), observed in 56% of surveys; Carolina wren (*Thryothorus ludovicianus*), observed in 56% of surveys; northern cardinal (*Cardinalis cardinalis*), observed in 50% of surveys; and black-throated green warbler (*Setophaga virens*), observed in 47% of surveys. During nocturnal surveys, two species of nightjars were observed. Further detail about observations of the eastern whip-poor-will (*Antrostomus vociferus*) is provided below. One common nighthawk (*Chordeiles minor*) was reported along the transect to survey location. Additionally, two owl species were observed: one barred owl (*Strix varia*) during one survey event, and one great-horned owl (*Bubo virginianus*) during two survey events. Surveyors encountered the eastern screech owl (*Megascops asio*) prior to the start of one nocturnal survey but did not encounter one during the survey period.

No bird species listed as threatened or endangered under the ESA or by the State of Tennessee were observed. Four USFWS Birds of Conservation Concern (BCC; USFWS 2021) were documented: wood thrush (*Hylocichla mustelina*), chimney swift (*Chaetura pelagica*), eastern whip-poor-will, and yellow-billed cuckoo (*Coccyzus americanus*). The wood thrush is also listed as State Wildlife in Need of Management in Tennessee (Tenn. Comp. Rules and Regs 1660-01-32-.03). The preferred habitat and seasonality of these four species are discussed below. Two observed species, Louisiana waterthrush (*Parkesia motacilla*) and worm-eating warbler (*Helmitheros vermivorum*), were previously categorized by USFWS (2008) as BCC but are no longer listed as such in Bird Conservation Region 28 (Appalachian Mountains) (USFWS 2021). Bald eagles have been observed in the area, and there is a known nest more than 2 miles away near Gatlinburg and the West Prong; however, bald eagles mostly fish and nest near rivers and lakes, and no suitable aquatic habitat occurs within the project area.

Wood Thrush. This BCC and State Species in Need of Management was the twelfth most frequently observed species during point-count surveys, detected during 56% of surveys, at 11 of 20 point-count survey locations (WSP 2021). It is a common summer resident in the park. Wood thrush prefer well-developed, mesic deciduous and mixed forests, often with a moderate sub-canopy and shrub density, fairly open forest floor, moist soil, and decaying leaf litter layer. Wood thrush are more likely to occur in extensive forests but may nest in 2.5-acre fragments and semi-wooded residential areas and parks. Common tree species in occupied forests include American beech, sweet gum, red maple, black gum,

eastern hemlock, flowering dogwood, American hornbeam, oaks, and pines (Evans et al. 2020). Wood thrush nest from early May to mid-August in the park.

Chimney Swift. This common summer resident was documented during point-count surveys at one location where three individuals were observed flying and calling and were detected through auditory and visual observation (WSP 2021). It is a common summer resident in the park. Prior to European settlement of North America, chimney swifts nested and roosted in hollow trees in old-growth forests, but their nesting habitat was greatly increased by the construction of chimneys on buildings. As such, they are most common in urban and suburban areas. Only one pair will nest in a chimney, but nonbreeding individuals may also roost communally in tall chimneys at night. The species is present in Tennessee from late March or early April until mid-October. Their population is declining range-wide, possibly because new style chimneys are less suitable for nest sites (TWRA n.d.).

Eastern Whip-poor-will. This BCC was the most common nightjar observed during approximately 30% of nocturnal point-count surveys, at four of eight survey locations. One occurrence of the species was documented during diurnal surveys while walking early in the morning (WSP 2021). It is a fairly common summer resident in the park. Eastern whip-poor-wills prefer dry deciduous or mixed forests with little or no underbrush throughout most of their range. The openness of the forest understory is a key characteristic of preferred habitat for this species. Eastern whip-poor-wills nest from late April to mid-August in the park.

Yellow-billed Cuckoo. This BCC was documented at one location while walking a transect between point-count surveys (WSP 2021). One individual was calling and was identified by auditory observation. The yellow-billed cuckoo is a common summer resident in Tennessee, arriving in April and departing by mid-October. Yellow-billed cuckoos prefer woodland areas with clearings and dense scrubby vegetation, often along the water, where they prefer to eat caterpillars. Yellow-billed cuckoos sometimes lay eggs in nests of other cuckoos as well as in those of American robins, gray catbirds, and wood thrushes (TWRA n.d.).

Fish within streams crossed by Section 8D are discussed in the "Aquatic Ecology" section.

FEDERALLY LISTED SPECIES

The USFWS Information for Planning and Consultation (IPaC) report dated May 23, 2024, indicates eight federally listed species may occur within or be affected by activities in the project area, including four endangered species, three proposed endangered species, and one candidate species (Table 9). The little brown bat is added because it is under review for listing under the ESA.

Schroder (2021) conducted a presence/absence acoustic survey for bats, and after automated analysis and manual vetting of bat calls, determined the presence of tricolored bats and northern long-eared bats and the probable absence of gray bats, Indiana bats, and little brown bats. However, the absence of Indiana bats and little brown bats cannot be ruled out because the park contains known hibernacula. No known gray bat hibernacula or maternity roosts are present in the park, and the capture of three gray bats in 2016 was the first record of the species in the park. It is therefore assumed that the project area provides roosting and foraging habitat for all bat species described in Table 9.

The project area contains known hibernacula for tricolored bats in an undisclosed cave (Miller and Niemiller 2022). The cave is located approximately 400 feet downslope of the Section 8D project area in the Buckeye Knob segment. It is connected to upstream karst features, including extensive open-air voids and a shallow groundwater transport system. A small stream flows through the cavern, which resurges at a spring downstream of the cave, and then flows into a small adjacent pond. Winter surveys conducted since 2009 have recorded the following counts of tricolored bats in the cave: 39 in 2009, 15 in 2021, 47 in 2022, and 31 in 2023 (NPS 2024a). The decline of bats in the cave is presumably due to white-nose syndrome (WNS).

TABLE 9. FEDERALLY LISTED SPECIES POTENTIALLY IN THE PROJECT AREA

Common Name	Scientific Name	ESA Status	Occurrence in the Project Area
Gray bat	*Myotis grisescens*	Endangered	Suitable foraging and roosting habitat occurs but Schroder (2021) did not detect the species in the project area. Potential occurrence cannot be ruled out based on suitable habitat and recent park records (e.g., Bernard et al. 2020).
Indiana bat	*Myotis sodalis*	Endangered	Hibernacula occurs in Whiteoak Blowhole Cave and five other caves located 8.5 to 12 miles southwest of the project area. Potentially occurs in the project area due to the presence of suitable foraging and roosting habitat, although Schroder (2021) did not detect the species in the project area.
Northern long-eared bat	*Myotis septentrionalis*	Endangered	Hibernacula occurs in seven caves located 8.5 to 12 miles southwest of the project area. Known to occur based on acoustic detections by Schroder (2021) in the project area. Suitable foraging and roosting habitat occurs.
Tricolored bat	*Perimyotis subflavus*	Proposed Endangered	Hibernacula occurs in an undisclosed cave within the project area, and foraging and swarming habitat occurs in the project area. Acoustic surveys by Schroder (2021) determined the presence of tricolored bats.
Little brown bat	*Myotis lucifugus*	Under Review	Hibernacula occurs in eight caves located 8.5 to 12 miles southwest of the project area. Not detected by Schroder (2021), but suitable foraging and roosting habitat occurs in the project area.
Cumberland Moccasinshell	*Medionidus conradicus*	Proposed Endangered	Not found within or downstream of the project area based on their presumed absence from the West Prong watershed. It is reportedly extirpated from adjacent Hydrologic Unit Code 10 (HUC10) watersheds by USFWS (2020) modeling.
Oyster mussel	*Epioblasma capsaeformis*	Endangered	Does not occur in the Little Pigeon River (69 FR 53136). While there are historical records, the species has been locally extirpated (USFWS 2004). Inhabit rivers larger than the streams crossed by Section 8D and are not anticipated within or downstream of the project area.
Tennessee Pigtoe	*Pleuronaia barnesiana*	Proposed Endangered	Unlikely to occur in the project area based on their low probability of persistence under current conditions in the West Prong watershed by USFWS (2020) modeling.
Monarch butterfly	*Danaus plexippus*	Candidate	Possible occurrence in forest openings, meadows, and along roadsides in areas with an abundance of flowering plants, especially milkweed.

Other hibernacula occur in the park for Indiana bats, northern long-eared bats, tricolored bats, and little brown bats. The largest known Indiana bat hibernacula in the region occupies Whiteoak Blowhole Cave,

which is approximately 8.5 miles southwest of the project area. This cave is a Priority 1B hibernacula[8] and is as designated critical habitat for Indiana bats. Eight other caves, located 8.5 to 12 miles away from Section 8D and southwest of the project area, provide hibernacula to one or more of these four species. NPS winter counts of hibernating bats in these caves show that bat numbers have plummeted (see "Trends and Planned Actions" below).

The Cumberland moccasin shell, oyster mussel, and Tennessee pigtoe were dismissed from analysis because the project would have no effect on these species; they do not occur within the project area and are not likely to occur in waters downstream of the project.

STATE-LISTED WILDLIFE

The Tennessee Wildlife Resources Agency (TWRA) maintains a list of vertebrates and certain invertebrates (mollusks and crustaceans) listed under the Tennessee Nongame and Endangered or Threatened Wildlife Species Conservation Act. TDEC's rare species data viewer indicates known occurrences of 18 rare animal species within 3 USGS 24K quadrangles traversed by Section 8D: Wear Cove, Gatlinburg, and Pigeon Forge (TDEC 2023). This includes 8 species listed by Tennessee as threatened or endangered and 10 designated as State Wildlife in Need of Management. Of these, suitable habitat may occur in the project area for four state-listed species (Table 10).[9] In addition, TDEC (2023) identifies the rusty patched bumble bee, which is also federally listed. The project area is within an "uncertainty zone" for rusty patched bumble bee presence according to the USFWS (2022, 2023a), and the USFWS (2023b) map of priority grids indicates that Tennessee is historical range for the species. However, the rusty patched bumble bee was dismissed from analysis due to lack of identified suitable habitat.

TABLE 10. STATE-PROTECTED SPECIES POTENTIALLY IN THE PROJECT AREA

Common Name	Scientific	State Status	Occurrence in the Project Area
Mammals			
Tricolored bat	*Perimyotis subflavus*	Threatened	Hibernacula located in an undisclosed cave, and foraging and swarming habitat occurs.
Little brown bat	*Myotis lucifugus*	Threatened	Hibernacula located in an undisclosed cave. Not detected by Schroder (2021), but suitable foraging and roosting habitat occurs.
Reptiles			
Northern pine snake	*Pituophis melanoleucus melanoleucus*	Threatened	No known records in the project area and not documented in the park since possibly 2000 (NPS 2015c), but suitable habitat occurs in open pine woodlands.
Birds			
Swainson's warbler	*Limnothlypis swainsonii*	Endangered	Not documented during surveys but suitable habitat occurs.

Source: TDEC 2023

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8 Priority 1B hibernacula are those that have a current and/or historically observed winter populations of 10,000 or more Indiana bats, but fewer than 5,000 individuals over the past 10 years (USFWS 2019).

9 Bat species listed by the State of Tennessee as endangered or threatened are considered in the "Federally Listed Species" section.

TRENDS AND PLANNED ACTIONS

The *State of the Birds* (NABCI 2022) reports that many birds species are experiencing population declines, including in the Southern Appalachian region. Forest birds are among those declining due to region-wide habitat loss, invasive species, climate change, and pollution. Among these, the wood thrush is one of 70 "tipping point species" that has lost two-thirds of its populations in the past 50 years and is on track to lose another 50% in the next 50 years (NABCI 2022). In spite of these greater trends, bird populations are generally stable in the park (Bates et al. 2018). Clearcutting in the late-19th and early-20th centuries and acidification from atmospheric deposition of nitrogen and sulfur negatively affected bird habitat in the park; however, many species of breeding birds have recovered from these impacts to their habitat. Overall future trends are uncertain, and data are generally lacking (Bates et al. 2018).

Bat populations in the project area are trending downward. WNS, a deadly disease caused by the nonnative fungus *Pseudogymnoascus destructansis*, is the primary threat to Indiana bat, northern long-eared bat, tricolored bat, and little brown bat. Since its arrival in the park in 2012, WNS has had a dramatic impact on bat populations, similar to that seen in the Northeast of the United States (Carpenter 2017). Winter surveys of bat hibernacula at various caves in the park have documented major declines in the number of hibernating bats starting in 2014, with all four species declining by more than 90% within one or more caves in the park (NPS 2024a). Although some species within certain caves have not experienced such major declines, the overall effect on populations of these four species has been catastrophic. Gray bats do not appear to be susceptible to WNS to the same degree as other species, and no mass mortalities have been documented. Based on the few observed and confirmed reports of WNS-affected gray bats and stable population numbers, gray bats appear to be resistant to the disease despite sharing hibernacula with other highly vulnerable species (USFWS 2024a). The park has been responsive to WNS by implementing cave and area closures; developing educational materials; monitoring populations; and collaborating with researchers.

Amphibian populations have been declining in the park due to threats from infections like ranavirus and chytrid fungus (Bates et al. 2018), which are thought to be caused by nonnative species being released into the wild. Other nonnative species, including plants, threaten native wildlife. Invasive plants disrupt native ecosystems, and nonnative animals like feral hogs and nonnative trout require ongoing management. Invasive insects and diseases, such as the chestnut blight and hemlock woolly adelgid, have reduced key species like the American chestnut and hemlock in the project area (Bates et al. 2018).

Warmer temperatures and increased annual rainfall (both observed over the last 20 years in Tennessee) are expected to continue with climate change, potentially threatening aquatic ecosystems (USEPA 2016). Climate change trends in the park include extremes in precipitation, temperature, and wind, as well as earlier warming (Bates et al. 2018). Birds are experiencing shifts in migration patterns and breeding seasons. Changes in flowering times of plants and habitat loss are expected to affect pollinators like bees and monarch butterflies. Warmer temperatures and altered precipitation patterns impact bat populations, because changes in temperature and humidity can affect their hibernation cycle and food availability, with some species struggling to adapt to the new conditions. Changes in climate are projected to mitigate some impacts of WNS, although effects vary across species, and impacts may arrive too late to benefit many hibernacula (McClure et al. 2022).

Development has increase of the last several decades along the Spur and in Wears Valley. Past and continued land development on private lands in the vicinity of Section 8D and the development of Parkway Section 8E in the mid-1980s have removed vegetation and caused wildlife habitat loss and fragmented forested habitat surrounding Section 8D. However, many bridges along Section 8E allow for wildlife passage, and regrowth of forest along Section 8E has occurred. Overall, development has resulted in long-term, adverse impacts on biological resources.

ENVIRONMENTAL CONSEQUENCES

Alternative 1: No Action

Under the no-action alternative, the NPS would not construct Section 8D of the Parkway. No direct or indirect impacts on biological resources would occur from the no-action alternative. However, long-term, adverse impacts on biological resources would continue, given the trends and planned actions noted above.

Alternative 2: NPS Preferred Alternative

Vegetation and Special Status Plants

Construction Impacts. Under alternative 2, construction of Section 8D would require vegetation clearing and grading. Between 188 and 331 acres of vegetation would be disturbed under alternative 2, or between 16% and 29% of all forested acres in the project area. Approximately 95% of the vegetation cleared would be forest or woodland communities. Table 11 provides the approximate acreage of disturbance by vegetation type for both the minimum and maximum areas of disturbance. Table 11 also displays the percent of vegetation type that would be affected for both the minimum and maximum AOD and compares it to the total amount of that vegetation type in the project area. Figures 13 through 15 show the AOD overlaid on the NPS (2021b) vegetation cover.

As noted above, most of the impacted forest has been logged or burned at various times during the two centuries (NPS 1977). Forest clearing would reduce forest patch size, increase edge communities, and alter microclimates by removing the forest canopy. The NPS would minimize tree clearing by using cut, fill, and back slope grades that are the steepest permissible while maintaining safety and avoiding soil erosion.

Impacts on plants listed as threatened or endangered by the State of Tennessee are unlikely. Suitable habitat for ill-scented wakerobin (state-endangered) occurs on steep, wet, rocky slopes above Caney Creek and along Crooked Arm Ridge; however, all seven known locations are more than 150 feet from the AOD. The butternut tree (state-threatened) is unlikely to be impacted because two of three documented occurrences are located more than 200 feet away from the AOD, both along Caney Creek near the Spur and its confluence with the West Prong. One other occurrence, along Sugar Camp Branch, is located within the AOD but could be avoided because it is nearly 200 feet from the Section 8D centerline. One population of approximately 100 stems of northern starflower (state-threatened) was reported in a rich, rocky cove along Mill Creek, upstream of where the roadway would cross, but this occurrence is approximately 80 feet from the AOD and would not be disturbed during construction. The park would avoid and minimize potential impacts to special status plants by placing fencing around any known occurrences before construction. Additional resource protection measures to prevent adverse impacts on special status plants could be included as needed to avoid and minimize habitat impacts.

Construction equipment could harbor foreign soil or nonnative plant material, which could introduce or spread invasive plants. New road shoulder communities would be susceptible to the introduction and spread of invasive plants like kudzu (*Pueraria montana*), oriental bittersweet (*Celastrus orbiculatus*), wineberry (*Rubus phoenicolasius*), and bush honeysuckles (*Lonicera* spp.). Tree clearing or canopy thinning would increase the amount of light reaching the ground and could encourage the growth of invasive understory species. Any new infestations could negatively affect wildlife habitat by outcompeting native vegetation, altering habitat structure, disrupting food webs, reducing crucial resources for pollinators, contributing to habitat fragmentation, changing soil microbial communities, and increasing fire risk (Kumar and Singh 2020). The NPS would avoid the introduction and spread of invasive plants by requiring the cleaning of all earthmoving and seeding equipment prior to entering NPS lands. Once cleaned, the contractor would schedule an inspection with NPS staff to confirm sufficiency. Implementing a revegetation plan for all disturbed areas except those converted to roadway (see

"Post-Construction Impacts" below) would avoid the spread of invasive plants and restore native vegetation. The NPS would conduct post-construction invasive plant monitoring and treatment/removal in accordance with the parkwide long-term invasive plant management program (see Appendix B). The effects of these potential changes in vegetation on wildlife habitat are discussed under "Wildlife and Wildlife Habitat."

TABLE 11. APPROXIMATE ACREAGE OF IMPACTS ON VEGETATION TYPES

Vegetation Type	Project Area Total	Minimum Acres of Disturbance[b]	Maximum Acres of Disturbance
Cultural Vegetation	43	4 (8%)	5 (11%)
Floodplain Forest	12	0 (0%)	0 (0%)
Low-Elevation Hardwood Forest	21	3 (16%)	7 (32%)
Low-Elevation Mixed Deciduous-Conifer Forest	7	<1 (7%)	3 (42%)
Low-Elevation Oak Forest	619	123 (20%)	208 (34%)
Low-Elevation Pine Woodland	99	12 (12%)	14 (14%)
Ruderal Deciduous Forest[a]	328	44 (13%)	90 (28%)
Ruderal Upland and Wetland Shrub and Herbaceous*	30	3 (9%)	6 (20%)
Water	6	0 (0%)	0 (0%)

Source: NPS 2021b

[a] Ruderal vegetation types occur in human-disturbed sites. The vegetation shows evidence of former and heavy human use, such as formerly cleared and/or planted sites. For forested types, succession has been allowed to occur more-or-less spontaneously, as the vegetation is dominated (>80% cover) by native tree species.

[b] Acres are rounded to the nearest whole acre for purposes of this analysis; however, the percent of the disturbed areas is calculated based on actual acres of disturbance.

Construction of Section 8D would directly affect habitats potentially supporting rare or uncommon bryophytes. Of the seven observed taxa designated as Special Concern in Tennessee, one (*Lophocolea appalachiana*) occurs within the AOD at the Upper Caney Creek collection site, approximately 150 feet upstream of the Section 8D centerline. A bridge is proposed at this location, so impacts would be avoided. This species was also documented growing in four other locations in the project area, all outside the AOD (Schwartzman and Smucker 2022). Other occurrences of Special Concern bryophytes were at collection sites outside the AOD, including at Mill Creek, Starkeytown Tributary, Pilot Road Seep, Buckeye Knob, and Lower Caney Creek. Additional occurrences of Special Concern bryophytes are unlikely within the AOD because surveys by Smith and Davison (1992) and Schwartzman and Smucker (2022) focused on suitable habitat across the entire project area.

Other rare or uncommon bryophytes could occur in the AOD and be subject to disturbance during construction. Suitable habitats that may be affected include rock outcrops, stream ravines, cascades, wet cliffs, grottoes, large trees, seeps, and small wetlands. Bryophytes growing on exposed soil and seeps along existing road cuts in the project area are generally adapted to disturbance and might reestablish populations on areas newly disturbed by construction. Bryophytes associated with streams and wetlands may be less likely to recover following disturbance. Only one species documented within the AOD, *Campylostelium saxicola*, was collected from a single collection site, which is where *Lophocolea appalachiana* was also collected, and a bridge is proposed in this area. All other species from the collection sites intersecting the AOD were found at two or more locations within the project area.

Schwartzman and Smucker (2022) reported that 20 of the 87 bryophyte species were frequently observed (at >30% of collection sites) and nearly half (42%) were found at three or more collection sites. Therefore, although individual populations of rare or uncommon bryophytes could be impacted during construction, population-level effects are unlikely. Measures to protect aquatic ecosystems would avoid impacts on the rare bryophytes growing near stream channels, and measures to restore cut-and-fill areas and minimize effects on groundwater and stream channels would also reduce impacts on bryophytes. Suitable bryophyte habitat would be protected by constructing bridges over large ravines and streams, retaining natural streambed material within culverts, and maintaining undisturbed riparian buffers to the maximum extent practicable (see "Water Resources").

Post-Construction Impacts. Alternative 2 would convert existing vegetation into approximately 32 acres of pavement. Including maintained grass on either side of the road, up to approximately 64 acres of existing vegetation could be permanently converted to pavement and grass shoulder, which would account for approximately 5% of the project area and a small fraction of the surrounding forested landscape. The remaining area of vegetation disturbed by earthmoving activities, or a minimum of 80% of the land cleared, would be revegetated following construction activities. However, the actual road shoulder clearance would be considerably less because shoulder widths would vary based on terrain and aesthetics and would often only require 3 to 5 feet of grass, which would reduce the long-term footprint and allow for additional revegetation.

Visitor use of Section 8D would not cause consequential disturbance to vegetation at Parkway pull-offs, overlooks, and parking areas. The NPS would prevent the spread or introduction of invasive plants in accordance with the park's long-term invasive plant management program. This program has been effective at managing other sections of the Parkway. The NPS would use experience from past construction projects to ensure that no invasive plants are inadvertently introduced by the revegetation seed mixes.

The operation of Section 8D could increase access for illegal plant collection in the park but is not expected to affect special status plants. The NPS would reduce impacts of illegal plant collection by regular patrols in the park and law enforcement, in cooperation with other agencies.

Bryophytes would be vulnerable to air pollution, including pollutants emitted from vehicle exhaust: nitrogen oxides, sulfur dioxide, carbon monoxide, and volatile organic compounds (Falla et al. 2000). Ozone and other pollutants from automobile emissions could be deposited onto bryophyte surfaces and disrupt their growth and reduce their overall cover (Bignal, Ashmore, and Headley 2008; Lee, Davies, and Power 2012). However, the relatively low volumes of traffic projected for Section 8D suggests that impacts to bryophytes would be inconsequential, and air quality was dismissed from detailed analysis because Parkway operation would not measurably alter the number of vehicles operating within the airshed and would not change the level of pollutants in the airshed. Additionally, research suggests that precipitation can mitigate some pollutant deposition on bryophytes, and various structural and physiological traits of mosses influence their pollutant uptake dynamics (Varela et al. 2023). Therefore, the impacts under alternative 2 are anticipated to be minor.

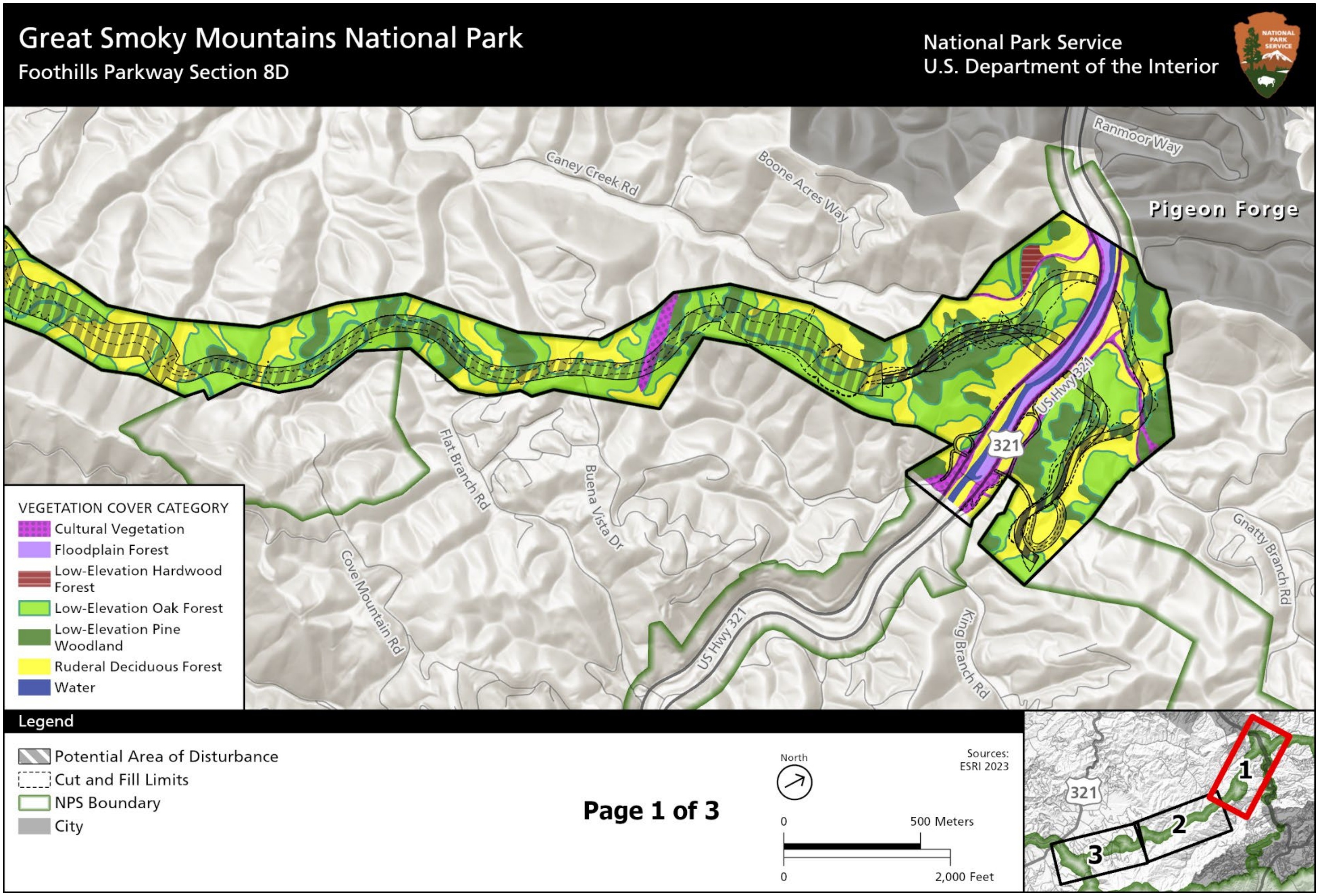

FIGURE 13. VEGETATION IN THE PROJECT AREA (FIGURE 1 OF 3)

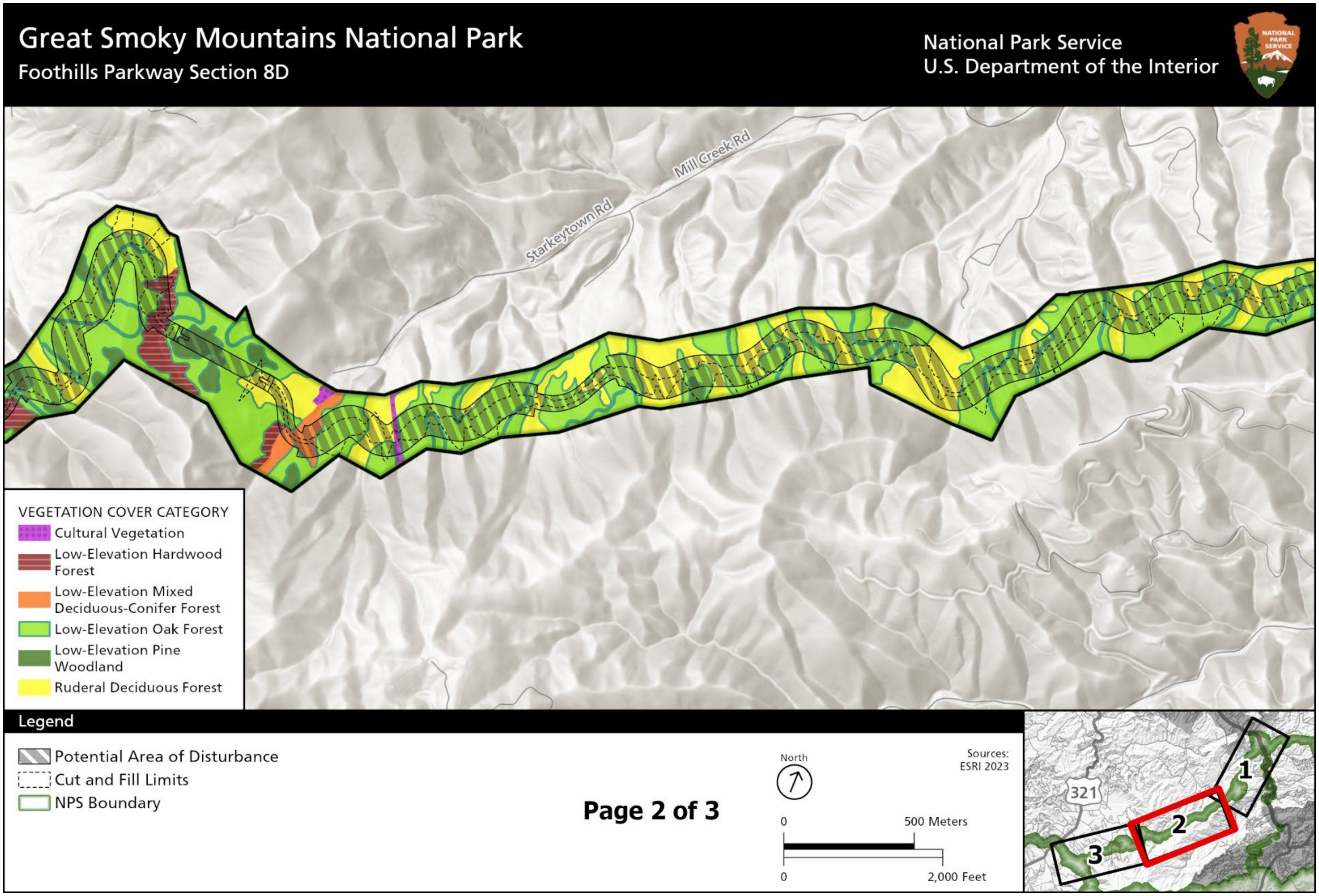

FIGURE 14. VEGETATION IN THE PROJECT AREA (FIGURE 2 OF 3)

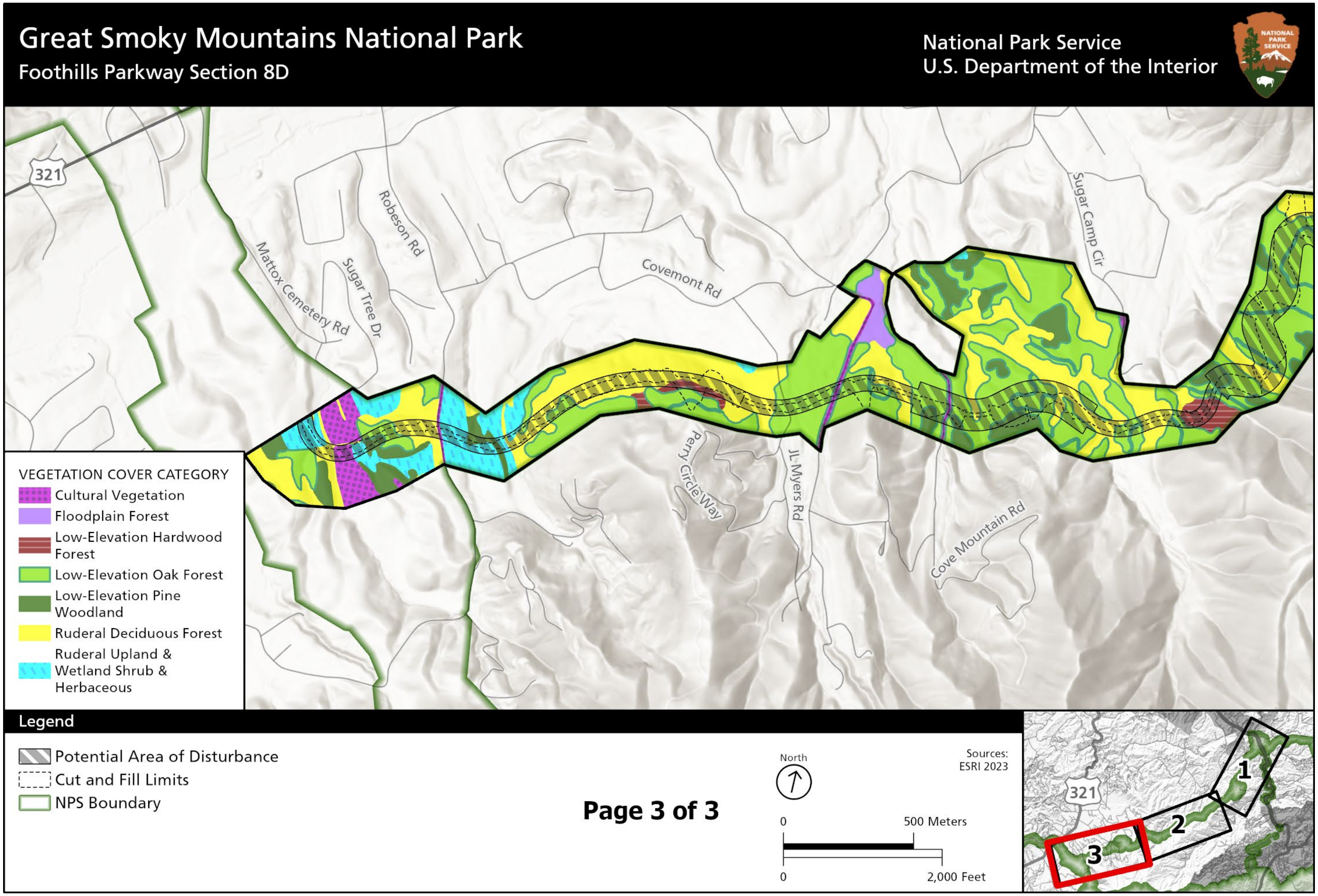

FIGURE 15. VEGETATION IN THE PROJECT AREA (FIGURE 3 OF 3)

Wildlife, Including Birds of Conservation Concern

Construction Impacts. Under alternative 2, wildlife habitat would be subject to ground disturbance within approximately 188 to 331 acres (Table 11). Permanent habitat loss for Section 8D would compose a small fraction of the surrounding forested landscape, as described above under "Vegetation and Special Status Plants." As previously discussed, a maximum of approximately 64 acres could be permanently converted to pavement and grass shoulder. Thus, at least approximately 124 to 265 acres of disturbed habitat would be restored with native vegetation following construction, depending on the level of total disturbance. It would take 10 to 15 years to revert to forested habitat and may take several decades before resembling the pre-disturbance state based on observances on previously completed sections of the Parkway. Some wildlife would avoid areas near the cleared roadway due to changes in vegetation composition and associated prey communities, causing a permanent reduction in habitat available for foraging, breeding, or resting. However, cleared area areas would be attractive to many species that nest and forage in forest openings, such as the wild turkey, white-tailed deer, groundhogs, and various rodents. This impact would diminish as forested areas mature.

Prior to construction, open fields would be mowed to avoid impacts on grassland nesting birds. The first mowing would occur before the breeding season (April 23 to August 15) to discourage birds from establishing nests. Mowing would continue at approximately four-to-seven-week intervals until construction starts.

During construction, vegetation clearing and noise from heavy equipment, and other human activities would affect wildlife. Noise and vibration could also affect wildlife in adjacent habitats. Some nighttime construction would be necessary, with limitations around sensitive receptors and resources (e.g., the undisclosed cave). Where allowed, bright lights, noise, and human activity could alter the behavior of nocturnal wildlife that may not otherwise be affected by daytime construction activities. Wildlife would experience temporary impacts from construction activities and associated noise, but mortality would be limited. Most species would avoid the construction area because of the noise, temporarily fleeing to surrounding areas, although the distance an animal would move would vary by species. This displacement may temporarily stress affected individuals and hinder their communication, but the overall impact on wildlife populations would be small given the broad distribution of these species in the surrounding forested habitats. However, smaller and less mobile animals, such as turtles, amphibians, and small mammals, could experience direct mortality from construction vehicles and equipment.

Construction of Section 8D could cause stress or direct mortality to birds that inhabit or migrate through the region via disturbance and displacement. Some nighttime construction around the Spur to avoid conflicts with existing traffic could impact migrating birds by disrupting their navigation. The bird species affected would depend on specific location and habitat characteristics but could include the BCC documented in the project area (wood thrush, eastern whip-poor-will, chimney swift, and yellow-billed cuckoo).

Overall, direct impacts that could cause bird injury or mortality are unlikely. Resource protection measures would include tree removal from November 15 through March 31, outside the nesting season, so construction is unlikely to destroy active bird nests. Noise, vibration, and human activity during construction could disturb birds foraging over the project area. Impacts could include birds avoiding the project area to reduce their exposure to the disturbance. Direct impacts on birds and bird habitat would be temporary, lasting only during construction. The fragmentation of intact forested habitat, a leading contributor to the decline in forest bird populations, could affect wood thrush (Wilcove 1985; Donovan et al. 1995; Robinson et al. 1995). Edge effects typically extend from 150 to 300 feet into the forest interior (Rosenberg et al. 2003) but have been reported extending much farther (Farwell et al. 2020). Edge effects could reduce habitat suitability for wood thrush via changes in temperature, light, and humidity, as well as increased exposure to predators and invasive species. Edge habitats created by Section 8D could also contribute to increasing populations of disturbance-tolerant predators like opossums, raccoons, domestic

cats, and parasitic birds. Wood thrush are especially vulnerable to nest parasitism by brown-headed cowbirds (Partners in Flight 2024), which could invade the area as a result of forest fragmentation. Overall, the construction of Section 8D would pose challenges to the survival of any individual wood thrush in the project area but would not adversely impact the overall population given the extensive area of surrounding forest that provides suitable unfragmented habitat. For the chimney swift, the project area does not likely provide suitable roosting or nesting because it does not contain old-growth forests. It is thus unlikely that chimney swifts would be impacted during construction, and birds foraging over the project area would not experience adverse impacts. The eastern whip-poor-will could be impacted via disturbance. However, clearing 180 to 320 acres of forested habitat could benefit whip-poor-wills by providing suitable foraging habitat. While clearing could reduce valuable cover for roosting whip-poor-wills, large areas of intact forested habitat would remain, and more than 80% of the disturbed area would be revegetated following construction activities and eventually regrow into forested habitat. Construction activities could also temporarily displace yellow-billed cuckoos and reduce its foraging habitat. However, habitat disturbance would create habitat openings and dense thickets of mid-succession forests in proximity to woodlands that are preferred by yellow-billed cuckoos.

Adverse effects on wildlife, including wood thrush and other BCC, would be minimized by efforts to keep disturbance of the forest canopy to a minimum and through immediate revegetation with native species, and post-construction management of invasive plant. Impacts to wildlife would be limited to the construction period and are not likely to cause a measurable increase in mortality or decrease the viability of wildlife populations. However, the project could adversely affect the tricolored bat (see “Federally Listed Species” and “State-Listed Species.”)

Post-Construction Impacts. Vehicles traveling on Section 8D and visitors at pull-offs could affect individual wildlife via noise or by temporarily disturbing and displacing individuals from their territories. A soundscape study report conducted for the project (WSP 2023a) found noise levels in the project area range from a daytime natural ambient sound levels of around 27 decibels (dB) L_{A50} in the more remote and mountainous locations to 50 dB L_{A50} near the eastern end of the project area by the Spur.[10] Future peak hour L_{A50} traffic noise levels on the edge of the project area would be 50 to 60 dB L_{A50} (WSP 2023a). Each 10 dB is a doubling of loudness the area; therefore, wildlife would experience a substantial increase in noise immediately adjacent to the roadway. However, roadside vegetation alongside Section 8D would minimize impacts; forests can reduce noise levels by as much as 5 dB for every 100 feet of vegetation, up to a maximum reduction of 10 dB over 200 feet (USDOT 1995). Impacts from vehicle lights would not have a major effect on wildlife because more than 80% of traffic would occur during the day based on the NPS (2024b) traffic counts on the Parkway from US 321 to Wears Valley Road. While noise levels would increase in the project area, some species would habituate to increased levels of noise and light over time and continue to live near the Parkway, while other species would leave the area. The species that remain are expected to adapt to the vehicles driving on Section 8D by changing their movements and activity patterns (although this may increase stress). The operation of Section 8D would thus impact individual animals and alter local species’ composition but is not expected to have any measurable population-level impacts.

The operation of Section 8D could kill or injure mammals, birds, reptiles, amphibians, and invertebrates via wildlife-vehicle collisions. The average annual daily traffic volume is expected to range from approximately 650 to 1,000 vehicles per day based on the observed traffic on the adjacent Parkway sections. At this relatively low volume, wildlife-vehicle collisions would be uncommon, and animals would not be repelled from crossing the roadway (FHWA 2008). Constructing 20 bridges on the mainline crossing over existing roads and several streams would also provide incidental benefits as road crossings. However, animals are expected to successfully cross the roadway at grade, and wildlife-vehicle collisions

[10] LA_{50} is the sound level exceeded 50% of the time (50th percentile) for a specified duration.

are expected to be infrequent based on comparable roadways with low traffic volumes and speed limits of 40 miles per hour or less (e.g., other sections of the Parkway and the Blue Ridge Parkway). Apart from the threatened and endangered bats discussed below, no special status species, including the state-threatened northern pine snake, are anticipated to regularly cross Section 8D. Based on this discussion, while road mortality from wildlife-vehicle collisions would adversely impact individuals, it is not expected to adversely impact wildlife populations.

Federally Listed Species

Section 8D could affect several federally listed species of bats, two bat species proposed or under review for listing, and the monarch butterfly. Potentially affected bats include: the gray bat, Indiana bat, northern long-eared, tricolored bat, and little brown bats. To address the impacts discussed below, the park would develop any additional protection measures necessary to avoid and minimize impacts to bats as part of the ongoing ESA section 7 consultation process with USFWS. These measures would address protection of tricolored bats and their habitat in and near the undisclosed cave, and may include:

- Time of year or other restrictions to avoid and minimize loud construction noise and excessive vibration that could result in the disruption or disturbance of tricolored bats in the undisclosed cave during hibernation.
- Time of year or other restrictions to avoid and minimize nighttime work that could result in the disruption or disturbance of tricolored bats during fall swarming and spring staging in the vicinity of the undisclosed cave.
- Restrictions to avoid and minimize activities that alter the entrance(s) or internal environment (e.g., adverse alterations to airflow, microclimate, and hydrology) of the undisclosed cave at any time of year.
- Implementation of management practices that would improve tricolored bat summer roosting habitat in the park.

Vegetation Clearing. Section 8D would require clearing approximately 331 acres (maximum, within the AOD), with forests and woodlands making up about 320 acres of this area (Table 11). The minimum area of forest clearing would be approximately 180 acres based on cut-and-fill from the conceptual design. Despite the removal of suitable roosting trees, ample, suitable alternative large-diameter trees and snags would be available in the area. Section 8D would fragment forested stands, reducing foraging habitat and potentially creating barriers to movement. However, this impact is considered insignificant relative to the available forest habitat as detailed below.

The project area includes areas used by tricolored bats during the fall “swarming” period when they mate and acquire additional fat reserves prior to hibernation, and during late hibernation and spring emergence when bats may exit the cave and roost in surrounding trees. Approximately 0.5 miles of the 9-mile roadway falls within a 430-meter buffer around the undisclosed cave, which corresponds to the maximum distance from caves that Tate (2020) observed tricolored bats roosting during late hibernation (428 meters) and the 0.25-mile buffer that USFWS (2024b) recommends for avoiding tree removal regardless of season. Within the 430-meter buffer, constructing Section 8D would require clearing between approximately 9 to 12 acres of forest (Figure 15). This area composes 10% to 13% of the total forested habitat within the 430-meter buffer (90.4 acres). Additionally, 5.4 miles of Section 8D (60%) would be within a 3-mile buffer of the cave, which corresponds to the distance used by USFWS (2024b) to determine where tricolored bats may occur surrounding winter hibernacula. Similarly, within the 3-mile buffer, constructing Section 8D would require clearing approximately 77 to 150 acres of forest, which composes only 0.5% to 1.1% of the total forested habitat within the 3-mile buffer (13,649 acres). To minimize impacts on roosting bats, the park would limit tree removal, avoid large-diameter trees, and perform tree removal during winter when bats are hibernating, from November 15 to March 31.

Additionally, the park would minimize the number of potential roost trees removed by clearing as few trees as possible and protecting retained trees using fencing. A post-construction revegetation plan would be implemented, allowing between 124 to 265 acres of the AOD to be restored with native vegetation following construction, depending on the amount of disturbance. During operation, hazard trees would be removed between November 15 and March 31 and with consideration for bat activity. Surveys of trees with bat roost characteristics would be performed before removal to avoid harming bats. These measures would limit impacts on bats during vegetation clearing for construction and operation of Section 8D and would effectively avoid adverse impacts to the gray bat, Indiana bat, northern long-eared bat, and little brown bat. However, tree clearing could adversely impact tricolored bats preparing for or emerging from hibernation. Through consultation with USFWS, the park would implement any additional protective measures.

Effects to Hibernacula. There would be no impacts to hibernacula for gray bat, Indiana bat, northern long-eared bat, or little brown bat. Construction near karst features could affect the undisclosed cave that tricolored bats are known to use. Excavation, grading, and other construction activities could compromise the stability of karst features like sinkholes, or alter water flow patterns, potentially polluting groundwater via surface runoff and degrading water quality in the cave. Tree removal and ground disturbance could temporarily affect surface and groundwater hydrology and indirectly alter the cave microclimate (humidity, temperature, and airflow) and suitability for tricolored bats. Also, the increase in paved areas in Section 8D could accelerate water drainage into karst systems, potentially causing sinkhole collapse and the formation of new ones.

The park would implement a karst management plan as part of the final design to maintain the integrity of the karst topography's natural processes and mitigate the associated hazards and impacts to bats. The plan would include measures to avoid and minimize changes to surface and subsurface drainage patterns into the undisclosed cave, and avoid impacts to groundwater and surface water quality and quantity. It would also include specific details and requirements for monitoring and site inspections. Further detail on what would be included in the karst management plan is provided in Appendix B. Through consultation with USFWS, the park seeks to ensure that constructing Section 8D in areas with karst topography does not affect the suitability of bat hibernacula in the undisclosed cave.

Construction noise and/or vibration could be detectable within the undisclosed cave opening located approximately 300 feet downslope from the AOD. The loudest construction activities, including boring and pile driving could disturb tricolored bats during hibernation. While unlikely, these loud noises could occur near the undisclosed cave. The boring to construct the Crooked Arm Ridge Tunnel would occur approximately 1.8 miles away from the undisclosed cave. Despite the park's proposed conservation measures, a relatively small number of tricolored bats that hibernate in the undisclosed cave could experience minor, adverse impacts due to unavoidable construction noise and vibration. During operation, vehicle noise would be audible at the cave entrance. The existing soundscape in this area has daytime existing ambient (L_{A50}) sound levels of 27 to 35 dB. The predicted L_{A50} sound level contours for future traffic noise levels in the vicinity of the undisclosed cave would be approximately 30 to 33 dB L_{A50}. Although these levels exceed the daytime natural ambient sound level of 27 dB (WSP 2023a), this level of noise would not likely impact tricolored bats within and around the undisclosed cave.

Construction Noise, Vibration, and Visual Disturbance. During construction, human activity and noise from heavy equipment, tunnel boring, and pile driving would affect bats, both within the AOD and adjacent habitats. Bats could be temporarily displaced but would find extensive suitable habitat available outside the affected area. If construction occurs during evening and nighttime hours, construction lights could also disrupt bat foraging. However, the park would limit construction activities to daylight hours whenever possible; where nighttime construction is necessary, the park would require the shielding of light sources to avoid light spillover, limit fugitive light from portable sources, and direct temporary construction lighting away from suitable bat habitat during the active season (April 1 through November 14). The NPS would further avoid impacts on tricolored bats by not performing work at night within

0.25 miles of the undisclosed cave during spring staging and fall swarming periods (from February 15 to May 15, and from August 15 to November 15). Overall, while noise, vibration, and visual disturbance may temporarily disturb bats and alter their behavior, adverse effects would be avoided or minimized via implementation of the NPS's proposed conservation measures. Overall impacts to federally listed bats from these stressors are unlikely, and any temporary effects on bats would be considered discountable.

If Interchange Option 2, which includes removal of the Gum Stand Road bridge, were selected, the NPS would perform surveys for bat presence at the bridge in accordance with USFWS survey guidelines (USFWS latest version) prior to removal of the bridge. If surveys indicate that the bridge is occupied by special status bats, NPS would reinitiate consultation with USFWS, and bridge demolition would occur during winter (November 16 to March 31) to avoid disturbing bats during their active season (April 1 to November 15).

Post-Construction Impacts and Vehicle Collisions. Noise and visual disturbances associated with vehicles and visitor use of Section 8D could affect bats over the long term. Studies have shown that bats tend to avoid areas with high levels of noise and visual disturbance, such as transportation corridors, but other studies have found that bats may tolerate substantial levels of noise and visual disturbance and have not documented noticeable shifts in behavioral patterns or roosting site selection (USFWS 2008). Studies have also found that bats appear to become habituated to ongoing noise and visual disturbances, suggesting that impacts decrease over time following construction of a new project (USFWS 2002). Available park data suggest that Indiana and northern long-eared bats typically do not roost within 100 feet of roads. If noise and visual disturbances cause bats to avoid the roadway by 100 feet, the amount of suitable forested habitat for roosting bats would be reduced by a maximum of approximately 220 acres along Section 8D. Overall, noise or visual disturbance from the operation of Section 8D is initially anticipated to result in behavioral responses to these stressors, but bats are expected to continue using surrounding habitats. Additionally, under alternative 2, the opening of the undisclosed cave would be gated to prevent entry by park visitors, reducing the potential for disturbances to hibernating bats, while allowing active bats and other wildlife to pass.

Vehicular collisions with bats on Section 8D could cause injury or mortality to various bat species, particularly between March and November when bats are active. However, a study of Indiana bats suggests that bats avoid roadways because they perceive vehicles as a threat (Zurcher et al. 2010). Despite the risk of bat-vehicle collisions (Russell et al. 2009; Fensome and Mathews 2016), this stressor is not likely to affect federally listed bats because traffic volumes would be low (650 to 1,000 vehicles per day), speed limits would be 25 to 40 miles per hour, and most traffic would occur during the day when bats are inactive.

Indirect Interactions. Constructing Section 8D would have temporary physical and chemical disturbances on the aquatic ecosystem, primarily due to increased turbidity and sedimentation from erosion in construction areas (see "Water Resources"). These changes may temporarily affect flying insects with aquatic larvae within the affected streams, which could indirectly affect bat foraging. Resource protection measures include soil erosion and sediment control practices, stormwater BMPs, and protective buffers to minimize impacts. The project area may expose pyritic rock and soils, potentially leading to acidification of streams, but design and protection measures is planned to prevent this. Also, numerous unaffected areas with abundant insect prey would remain available in the project vicinity, and no lasting indirect effects on bats are expected.

Monarch Butterfly. Alternative 2 is not likely to adversely affect the monarch butterfly. Neither an abundance of milkweed (host plant) nor nectar-producing flowers occur within the project area. Botanical surveys found two species of milkweed: *Asclepias quadrifolia* and *Asclepias tuberosa*; however, populations were small and uncommon. Milkweed that may occur in areas subject to disturbance would be protected, where practicable. Also, a revegetation plan would include a diversity of native plants,

including milkweed, and provide habitat for monarch butterflies. These beneficial effects to the monarch butterfly would offset any potential adverse effects, and the overall impact would be insignificant.

State-Listed Species

Construction Impacts. Under alternative 2, the state-endangered Swainson's warbler could be affected by a reduced availability of forested rhododendron thickets within ravine habitats in the Sugar Camp Branch, Crooked Arm Ridge, Cove Mountain, and Ridgetop segments. However, neither this species nor other threatened or endangered birds were observed in the project area during point-count surveys (WSP 2021). Constructing 20 bridges on the mainline crossing over existing roads, streams, and deep ravines, including over Rymel Branch, Mill Creek, and Caney Creek, would avoid impacts on suitable rhododendron habitat in many locations. Culverts would also be installed in locations where suitable habitat may occur, such as Sugar Camp Branch. Culverts would have a maximum permanent impact of 1,000 square feet per crossing and a total of approximately 0.58 acres of permanent instream impacts.

The northern pine snake is unlikely to occur due to its presumed absence from the park since 2000 (NPS 2015c). If the species were to occur in the project area, it would likely be limited to approximately 15 acres of low-elevation pine woodland habitat in the AOD (Table 11). Clearing forested vegetation in this area would increase the dry, relatively open habitat preferred by the species. Thus, the potential for the northern pine snake to be impacted during construction is low, and tree clearing would likely enhance its habitat.

Post-Construction Impacts. Impacts to the Swainson's warbler and pine snake would be similar to those discussed above for "Wildlife, Including Birds of Conservation Concern." Vehicle collisions would be a low risk to both species. Operating Section 8D is also not expected to have fragmentation effects due to projected traffic volumes and speed limits of 40 miles per hour or less.

Cumulative Impacts

Impacts on biological resources from cumulative actions would be the same as those described for the no-action alternative and contribute adverse impacts on biological resources in the project area from permanent habitat destruction and fragmentation and associated human disturbance. When the incremental impacts from alternative 2 are combined with the impacts from past, present, and reasonably foreseeable actions, the overall cumulative impact on wildlife would be adverse, with the incremental impacts of alternative 2 contributing minor impacts, largely due to impacts to the tricolored bat.

WATER RESOURCES

AFFECTED ENVIRONMENT

The surface hydrology of the project area is described in a draft combined Statement of Findings for floodplains and wetlands (Appendix D). Surface water and groundwater systems in this area are tightly linked, with one recharging the other, depending on the location in the landscape. Residents of valleys downslope from the project area use springs and shallow and deep groundwater wells for domestic water supply. Terrestrial and aquatic ecological communities are adapted to and depend on the existing hydrologic regime.

STREAMS

The project area for Section 8D includes 48 streams mapped by the USGS (2023) National Hydrography Dataset. Based on a field delineation in 2021, streams in the project area make up approximately 9.9 miles of perennial reaches, 0.9 miles of intermittent reaches, and 0.8 miles of ephemeral reaches. The West Prong is the largest stream, located at the eastern end of the project area where Section 8D would intersect the Spur. The West Prong flows north between the northbound and southbound lanes of the Spur. TDEC classifies the West Prong and all surface waters in the park as Exceptional Tennessee Waters. An existing bridge over the West Prong in the project area connects the Spur between Gum Stand Road and King

Branch Road. Upstream of the project area, the West Prong flows through Gatlinburg; downstream, it flows through Pigeon Forge and then merges with the main stem of the Little Pigeon River in Sevierville.

In addition to the West Prong, seven other streams in the project area are named, from west to east: Machine Branch, King Hollow Branch, Sugar Camp Branch, Rymel Branch, Mill Creek, Caney Creek, and Gnatty Branch. The proposed bridges at the Section 8D interchange with the Spur would intersect with two additional named streams in addition to the West Prong: Caney Creek and Gnatty Branch. The project area, from Wears Valley to Crooked Arm Ridge, drains directly into Cove Creek or into its many tributaries that include Machine Branch, Sugar Camp Branch, and Rymel Branch. The headwaters of these tributaries are on the slopes of Cove Mountain and Crooked Arm Ridge. Flow in the upper reaches of other tributaries crossing Section 8D is flashy, and culverts installed under the existing "pioneer road" built in the early 1990s for drilling to test the underlying geology of Section 8D were undersized, and most have been washed out or bypassed (NPS 1994). From the east side of the Crooked Arm Ridge segment to Grindstone Ridge in the Cove Mountain segment, the area is drained by Mill Creek and its tributaries. Caney Creek drains the area east of Grindstone Ridge to the Spur and the West Prong (Cove Mountain and Ridgetop segments).

WETLANDS

The project area includes approximately 1.27 acres of 17 delineated palustrine wetlands (Table 12). In accordance with the Federal Geographic Data Committee Wetlands Classification Standard, all delineated streams discussed in the previous section are classified as riverine wetlands (FGDC 2013).

TABLE 12. WETLANDS WITHIN THE PROJECT AREA

Wetland ID	Cowardin Classification	Code	Acres
AB-C-W	Palustrine, Scrub-Shrub	PSS	0.03
AJ-AD-W	Palustrine, Forested	PFO	0.62
AJ-AH-W	Palustrine, Scrub-Shrub	PSS	0.11
AJ-AL-W	Palustrine, Scrub-Shrub	PSS	0.01
AJ-AN-W	Palustrine, Emergent	PEM	0.01
AJ-AO-W	Palustrine, Emergent	PEM	0.03
AJ-B-W	Palustrine, Emergent	PEM	0.12
AJ-E-W	Palustrine, Emergent	PEM	0.01
AJ-J	Palustrine, Emergent	PEM	0.13
AJ-N-W	Palustrine, Emergent	PEM	< 0.01
AJ-R-W	Palustrine, Forested	PFO	0.11
AJ-S-W	Palustrine, Scrub-Shrub	PSS	0.01
AJ-T-W	Palustrine, Scrub-Shrub	PSS	0.01
AJ-X-W	Palustrine, Forested	PFO	0.03
JBAQ	Palustrine, Forested	PFO	< 0.01
MD-E-W	Palustrine, Forested	PFO	0.03
MD-K-W	Palustrine, Forested	PFO	0.01
		Total	**1.27**

Fourteen of these wetlands are located along the mainline of Section 8D, totaling 1.19 acres, and three wetlands are located in the vicinity of the bridge options connecting 8D to the Spur, totaling 0.052 acres. Several wetlands areas are found along the small streams that Section 8D would cross, but the streams typically do not have adjacent wetlands because of their high gradient and rocky character.

GROUNDWATER

Surface waters in the project area are fed by groundwater, which often surfaces at seeps and springs. There are two different groundwater systems in the project area. West of the Crooked Arm Ridge segment, groundwater characteristics are determined predominantly by the karst system that has developed in the carbonate bedrock underlying Wears Valley. East of the Crooked Arm Ridge segment, in the Mill Creek and Caney Creek valleys, an important shallow groundwater system is associated with the alluvial and colluvial surficial deposits and a deep groundwater system dependent on fracture zones in the fine-grained, impermeable phyllite and siltstone bedrock. Groundwater from the karst system in the western portion of the project area provides most drinking water in Wears Valley. Domestic water in the Mill and Caney Creek valleys is drawn from a combination of springs/shallow aquifers and deeper wells.

The karst topography found in portions of the project area indicates the dissolution of soluble rocks by surface water, creating a landscape with sinkholes and caves. There is a more direct connection between surface water and groundwater in the portion of the project area with karst topography than in other locations. A dye trace study conducted by Aley and Aley (1991) confirmed some connection between study injection sites around Buckeye Knob and two springs near Cove Creek. Geophysical surveys indicate the potential for open-air voids with surface water infiltration into the Wears Valley karst system (GeoServices 2022, 2023). Any change in the groundwater connection to surface water inflows, or changes in stormwater runoff due to surface hydrology changes, could affect groundwater. Thin soils and active sinkholes in the area increase the risk of surface runoff directly entering the groundwater supply without being purified by percolating through soils. Multiple springs are associated with karst features in the Buckeye Knob and Sugar Camp Branch segments, as detailed in the "Geological Features and Processes" section (e.g., Myrh-Stupkas Spring, Cove Mountain Spring, and Scottish Highland Springs), as well as sinkholes and losing streams (Figure 10). When the dye trace results are considered alongside the presence of sinkholes and a nearby losing stream, the results demonstrate a direct connection between the groundwater system in the limestone units and the surface (Aley and Aley 1991). Exploration of the Langdon Sinks and the undisclosed cave indicate open-air voids (possible cave features) and surface water infiltration into the karst system. Water quality sampling in the streams in Wears Valley indicates past contamination from upstream human activities (see "Water Resources, Trends and Planned Actions").

WATER QUALITY

Water in the project area is generally clean and contains few contaminants. As required by section 303(d) of the Clean Water Act, the state identifies surface waters every two years that do not meet designated uses or are expected to exceed water quality standards and need additional pollution controls. The West Prong (stream segments TN06010107010_2000 and TN06010107010_3000) is included on the TDEC (2022) 303(d) list for phosphorus, *Escherichia coli (E. coli)*, and temperature. Cove Creek downstream of Wears Valley is included on the 2022 303(d) list for *E. coli*, due to shoreline grazing and residential septic systems (TDEC 2022).

During prior planning efforts for Section 8D, pre-construction water quality monitoring documented baseline conditions, which are likely similar today due to the lack of extensive development in the upstream watersheds. Turbidity was low, even during higher flows. Dissolved oxygen values showed no indication of severe oxygen depletion at any of the stations sampled. Nitrate concentrations were typical of healthy forest ecosystems. In summary, monitoring data indicated that water quality conditions for aquatic biota in streams were good, although the low alkalinity of some systems (except Cove Creek) suggested a high risk of stream acidification and heavy metal availability to the food chain. The project

area could include soils and bedrock with unweathered pyrite, including in locations around the proposed Crooked Arm Ridge Tunnel. However, none of the streams measured in the project area had a pH approaching the low values of other streams in the park known to be influenced by pyritic zones. The bedrock and soils of the upper Mill Creek and Caney Creek watersheds contain small concentrations of pyrite (Golder 1986). The lowest pH measured in these streams was about 6, and the lowest alkalinity was about 20 micro-equivalents per liter, suggesting that the water may have a limited ability to buffer against changes in pH. Water samples taken at Gnatty Branch and a Rymel Branch tributary had higher sulfate concentrations than expected relative to atmospheric deposition and similar sized streams, although field surveys showed no evidence of sulfidic materials in the vicinity of Gnatty Branch.[11] The groundwater chemistry of the sites monitored generally paralleled the surface water chemistry, reflecting the weatherability of the bedrock as well as local land use.

FLOODPLAINS

Section 8D intersects floodplains of the West Prong where it would connect to the Spur via one of three bridge options. Floodplains in this area are classified as Zone A, where FEMA (2009) has mapped flood hazard areas with a 1% annual chance of flooding (i.e., located within the 100-year floodplain). The US Army Corps of Engineers' *Flood Preparedness Study* also mapped the 100-year and 500-year floodplains along the West Prong and associated base flood elevations, based on hydrologic and hydraulic models (USACE 2020). No other mapped floodplains are associated with any streams in the project area. However, there may be other locations considered to be flood-prone where Section 8D would cross over perennial or ephemeral streams or ephemeral channels (i.e., wet weather conveyances). The floodplains in the project area are described further in a draft combined Statement of Findings for floodplains and wetlands (Appendix D).

AQUATIC ECOLOGY

During prior planning efforts for constructing Section 8D, the NPS surveyed fishes and benthic macroinvertebrates in potentially affected streams. Headwater streams within the project area were relatively undisturbed except for some residential development on Buckeye Knob, with high proportions of pollution-sensitive mayfly, stonefly, and caddisfly taxa. In wider, lower elevation streams in the project area, there was an increase in total benthic invertebrate taxa and a decrease in pollution-sensitive taxa, likely due to increasing water temperatures. The headwater sites near the proposed road were too small or isolated to support fish, but all downstream streams contained fish communities. Mill Creek had a healthy reproducing population of rainbow trout near the proposed Parkway. No threatened or endangered fish species were found, but small numbers of Tennessee dace, a species listed by TWRA (2023) as In Need of Management, were collected in Mill Creek and Cove Creek below the project area. Fish were rare or absent in the sampled stream reaches nearest to Section 8D, probably as a result of low or intermittent stream flows or natural barriers to upstream movement. Caney Creek, Machine Branch, and Cove Creek were similar in that their fish communities were dominated by common minnows: blacknose dace, creek chubs, central stonerollers, and saffron shiners. A bioinventory of the undisclosed cave (Miller and Niemiller 2022) was focused on aquatic fauna, given its location near the project area, but found no aquatic species.

[11] The Rymel Branch tributary drains the southwest side of the Crooked Arm Ridge segment, including the area of the west portal of the proposed tunnel. The stream chemistry appears to have been influenced by pyrite associated with Thunderhead Sandstone, but high sulfate values appear to be caused mostly by drainage from areas outside the project area.

TRENDS AND PLANNED ACTIONS

Past and continued land development in the vicinity of Section 8D, in particular within Wears Valley and along the Spur, and the development of the 1.65-mile “missing link” section of Parkway Section 8E have altered topography and changed land cover over the past few decades. This increase in imperious surface across the region has likely increased surface runoff, altered stream hydrology, and reduced groundwater recharge. Construction activities in the watersheds above Section 8D, such as the subdivision on Buckeye Knob, have caused past siltation of some surface waters. Otherwise, the contributing watersheds are relatively undeveloped. The only relatively recent development in the project area was construction of the “pioneer road” in the early 1990s for drilling to test the underlying geology of Section 8D. A LiDAR-generated shaded relief map clearly shows various old road cuts, some of which are the pioneer road, but others may have existed before the land was transferred to the NPS. Culverts installed at drainageways under the pioneer road were undersized by at least a factor of two, and most have been washed out or bypassed. Some erosion has occurred in the vicinity of this road cut, and associated sedimentation of streams has occurred. No efforts have been made to maintain the pioneer road, and it is currently overgrown. Other than the public roads that cross the project area, no designated park roads or trails exist in the project area to provide public or administrative access.

Although the project area is located within forested watersheds with limited human development, there is evidence of human impacts on water quality and aquatic ecology in some locations. Water quality sampling in the streams in Wears Valley by Aley and Aley (1991) documented groundwater supplies in the area were subject to contamination (fecal coliform and optical brighteners found in laundry detergent), presumably from subsurface sewage disposal and land use activities. Aley and Aley (1991) stated that “[their] results indicates that, even though the population is relatively sparse, some contamination of groundwater by sewage exists within the study area.” Also, the lack of aquatic fauna found in the undisclosed cave may possibly indicate a prior mortality event caused by human activity in the recharge area for the cave, though no evidence of such an event appears obvious in the cave (Miller and Niemiller 2022). Downstream of the project area, most land is in open fields or pastures, and grazing livestock have direct access to streams in many places. The loss of riparian buffer zones because of these activities on private lands have resulted in long-term, adverse impacts on water resources within and surrounding the project area. There is additional concern over karst aquifer contamination from sources such as septic systems and other pollutants. Groundwater downstream of the project area is increasingly used for domestic water supplies. According to Bates et al. (2018), much of the development in the project vicinity is occurring in areas lacking municipal sewer systems or water supplies, and there are concerns about increasing development because numerous groundwater wells are being developed in the karst (limestone) aquifer adjacent to the park. The continuation of increased well drilling may lower groundwater levels and alter groundwater transport.

Human activities have caused the West Prong to be listed as impaired where it flows through the project area, as required by section 303(d) of the Clean Water Act. The main sources of water quality degradation would continue to be from nonpoint sources associated with existing residential septic systems, sanitary sewer overflows, and stormwater runoff (TDEC 2022). As an impaired waterway not meeting its designated uses, it is anticipated that TDEC and the US Environmental Protection Agency will continue to enforce pollution controls as required by the Clean Water Act. Other future projects with the potential to affect water quality in the West Prong include the proposed Gatlinburg Wastewater Treatment Plant upgrade and expansion. The plant is currently operating at/near capacity. Increasing the capacity of the plant from 3.0 million gallons per day to 4.5 million gallons per day would add to the amount of treated wastewater effluent discharged to the West Prong. Upgrading the plant would improve the quality of effluent discharged to the West Prong, resulting in long-term change in pollutant loadings or water quality in the West Prong. Also, the Gatlinburg Spur Improvements and Wears Valley Mountain Bike Trail System projects would increase the amount of impervious surface, increase stormwater runoff, and remove riparian vegetation, which would contribute minimal, long-term, adverse impacts to the West

Prong and Cove Creek. Design of stormwater drainage and other resource protection measures would minimize impacts.

Climate change is impacting water resources in the region as rising temperatures and increased precipitation variability are contributing to more severe droughts and floods (NPS 2024c,d). Specifically for the park, annual precipitation is anticipated to be highly variable, indicating years can be considerably drier or wetter than experienced historically. Very dry intervals and warming can lead to drought conditions that affect river levels, water availability, and ecosystem health. Very wet years and overall increases in annual precipitation can lead to flooding that may impact water quality, infrastructure, transportation routes (NPS 2024d). Aquatic organisms are also at risk, as increased temperatures and changes in water flow can reduce dissolved oxygen levels. Summer droughts may amplify these effects, while periods of extreme rainfall can increase the impacts of pollution on streams (USEPA 2016). These changes affect streams and wetlands by altering flow patterns, which impacts the habitats of various aquatic and semi-aquatic species. Groundwater recharge decreases with warming temperatures from higher rates of evaporation and less consistent rainfall. Although rainfall during spring is likely to increase during the next 40 to 50 years, the total amount of water running off into rivers or recharging groundwater each year in Tennessee is likely to decline 2.5% to 5% (USEPA 2016). Furthermore, the changing frequency and intensity of floods affect floodplain values and increase risk, and increased sedimentation and pollutants that may result from more intense rainfall events affect water quality (USEPA 2016).

ENVIRONMENTAL CONSEQUENCES

ALTERNATIVE 1: NO ACTION

Under the no-action alternative, Section 8D would not be constructed, and there would be no change to the project area. Therefore, no direct or indirect impacts on water resources, including streams and wetlands, groundwater, water quality, floodplains, and aquatic ecology, would occur as a result of the no-action alternative. However, long-term, adverse impacts on water resources would continue, given the trends and planned actions noted above.

ALTERNATIVE 2: NPS PREFERRED ALTERNATIVE

Streams and Wetlands

Construction Impacts. Impacts on wetlands and streams would be the same under both the minimum and maximum disturbance assumptions. As a result, impacts on wetlands are not provided as a range. Four palustrine wetlands are located within the AOD for the mainline, but both temporary and permanent impacts could be avoided because these wetlands are either located more than 50 feet from the Section 8D centerline or would be spanned by a bridge. One palustrine wetland (AB-C-W) is located within the proposed ramp areas for both interchange options at the Spur (Figure 16 through Figure 20). Impacts to this wetland would be unavoidable because some cut-and-fill is likely required in this area, and the entire 0.024-acre wetland would be permanently impacted. Both proposed bridges over the West Prong would require one 30 foot x 30 foot support pier to be placed within the channel of the West Prong, permanently disturbing approximately 0.04 acres (1,650 to 1,800 square feet) of the river bed. Demolishing the existing bridge at Gum Stand Road, if Interchange Option 2 were selected, would include removing two 30 foot x 10 foot bridge piers from the river channel. Removing these piers would result in a gain of 600 square feet of open water and benthic habitat. Thus, the net permanent impact to the riverine wetlands of the West Prong would be 0.02 to 0.03 acres (1,050 to 1,200 square feet). An additional 0.27 acres of riverine wetlands would be permanently impacted by culvert installation. Because there would be a permanent loss of wetlands, compensatory mitigation would be required in compliance with Executive Order 11990 and Director's Order #77-1: *Wetland Protection*. The specific acres, location, and additional mitigation requirements are detailed in the draft combined Statement of Findings, which would be finalized with more details provided during future design efforts (see Appendix D).

Installing two bridge piers within the West Prong channel, potentially removing the Gum Stand Road bridge piers, and installing approximately 48 culverts within small streams could temporarily alter streamflow and cause localized sediment disturbance and turbidity. Impacts from any in-water work or ground disturbance in the vicinity would be minimized by adherence to the conditions of any Clean Water Act section 404 and 401 permits. Although impacts could occur for several days during construction, an appropriately sized clear-span bridge or culvert would maintain stream flows over the long term. Potential impacts would be reduced by preserving an undisturbed riparian buffer to the maximum extent practicable. The NPS would monitor the impact of construction activities on stream crossings and wetlands for a period of two years following construction. This monitoring would identify any construction-related impacts to streams and wetlands that require restoration, repair, or other mitigation. At a minimum, monitoring would be conducted immediately after construction is completed and at least once each spring and fall for two years following the completion of construction, and after any significant flood event. If the monitoring indicates that a stream crossing was not properly constructed/restored, the NPS would implement measures to correct the problem. Mitigation for impacts from instream work would be addressed by following NPS Procedural Manual 77-1: Wetland Protection (NPS 2016c) and adhering to protection measures specified by Clean Water Act 404 and 401 permits.

Overall, while alternative 2 would mitigate permanently lost wetlands, there would be a long-term, adverse impact on wetlands within the project area. Of the 1.27 acres of palustrine wetlands within the project area, approximately 0.024 acres would be permanently lost. Additionally, approximately 0.3 acres of riverine wetlands would also be affected. The NPS would employ a 5:1 mitigation ratio to compensate for the loss of riverine wetland function and would provide mitigation via planting native woody vegetation on approximately 1.59 acres of nearby riverine wetland buffers (riparian areas). The proposed mitigation would be provided through the Cades Cove Stream Restoration Project (see Appendix D).

The NPS would plant forested buffers on both sides of the stream channels at the proposed mitigation sites. The streams within the mitigation sites are stable but lack fully forested buffers. The proposed mitigation sites are currently in poor condition and functionally impaired due to past agricultural practices. Channelization, realignment, and riparian clearing have created discontinuity in aquatic and terrestrial habitats. Features such as meandering planforms, appropriate channel geometries, diverse riffle substrates, large woody debris, overhanging vegetation, stable and self-maintaining pool habitats, and native, vegetated riparian corridors are present immediately upstream of the project area. Accordingly, the Cades Cove Stream Restoration Project provides an opportunity to restore these features on the project streams and provide both geomorphic continuity and habitat connectivity that has not been present since before settlement and modification of the cove bottoms.

Post-Construction Impacts. Following construction, operation of Section 8D would not affect streams and wetlands, apart from minor water quality concerns discussed below.

Groundwater

Construction Impacts. Groundwater could be temporarily impacted during construction due to slightly increased stormwater and sediment yield associated with unstable soils during vegetation removal and ground disturbance. The creation of cut slopes could alter or reduce the lateral flow of shallow groundwater flow and soil water storage within colluvial and alluvial soils. This, in turn, could affect recharge of the aquifer and downslope springs and streams. Adverse impacts to groundwater would be minimized by BMPs to avoid or reduce pollution by controlling it at its source. Additionally, as described under the "Geologic Features and Processes" section, design would ensure the same quality and quantity of water would continue to flow through the project area. Stormwater management would be an integral part of project design and construction, and all required permits would be obtained prior to construction. Impacts associated with stormwater would be mitigated by implementing a SWPPP and complying with a Tennessee Construction General Permit (Permit Number TNR100000). The SWPPP would identify the construction activities that could cause pollutants in the stormwater and describe the measures or practices

to control these pollutants. The SWPPP would also specify stormwater BMPs and include measures required by TDEC (2012, or latest edition). Using a series of BMPs, the stormwater system would be designed to manage runoff before it becomes concentrated; the system would be designed to direct stormwater through the stream buffer zone as shallow sheet flow to avoid adding pollutants that would degrade surface waters. Implementing the SWPPP would effectively mitigate most stormwater impacts by minimizing soil erosion and preserving vegetation, thereby minimizing the overall impact of ground disturbance and vegetation clearing. Together, these measures would minimize adverse impacts on groundwater to the extent that they would be minor and temporary.

Potential impacts to groundwater are an important consideration in areas with karst topography. The area near Buckeye Knob, located in the western portion of Section 8D near Wears Valley, contains active sinkholes, losing streams, and other surficial expression of karst activity (GeoServices 2022, 2023). The direct connection between surface water and groundwater in this area, and in locations in the Sugar Camp Branch segment, could facilitate the introduction of sediment, turbidity, and bacteria into the groundwater from surface runoff generated by construction activities. Installing culverts could affect riverine wetlands by changing their hydrology, which could change surface flows and potentially alter subsurface groundwater that feeds into springs and downslope wetlands. Culvert installation includes several losing stream reaches and potential for downstream groundwater turbidity and sedimentation. Grading and vegetation removal during construction would alter surface water flow, which could cause karst features to gain or lose incoming surface water or cause new or expanded sinkholes to form. The design of roadside ditches and other conveyances would ensure proper filtration of surface runoff to protect karst features along roadways, requiring various design techniques such as excavation and aggregate caps, plugging, high/low mobility grouting, void-bridging, drainage control, and specialized bridge pier construction. These methods aim to prevent contamination and structural damage by sealing or reinforcing weak zones and managing water flow effectively. Furthermore, as detailed in "Geologic Features and Processes" section, disturbance to sinkholes would be avoided, when feasible, by establishing and maintaining vegetated buffers where no construction activity would occur or using various bridging techniques such as conventional bridges on stable bedrock, land bridges supported by rock embankments, and backfilling with riprap. These methods would minimize changes to natural drainage patterns and protect groundwater by enhancing the structural integrity of karst features and allowing for continued groundwater recharge.

To avoid potential downstream impacts on groundwater supplies within karst topography, impacts would be avoided by implementing a karst management plan. For example, if there were a need to remediate a sinkhole during construction, the plan would include conceptual design information for temporary stabilization. Direct disturbance of soil or vegetation would be avoided within a buffer surrounding identified karst-like features, where possible. The NPS would perform monitoring to identify potential land subsidence that may be associated with activation of a subsurface karst feature. Specific protection measures to address groundwater issues within karst topography would be reactive because treatments would require specific design. The NPS would also notify the public immediately of any groundwater contamination, in cooperation with the Sevier County Health Department and TDEC. Further information about potential impacts related to the karst features is detailed in the "Geologic Features and Processes" section, and the "Water Quality" section below covers impacts to groundwater quality. Additionally, groundwater collected by and discharged from the tunnel drainage system after construction could affect water resources (e.g., if any acidic groundwater derives from pyritic rock). As discussed above, under "Water Quality," potential impacts from acid-producing materials would be addressed by proper disposal or encapsulation.

While residents downslope of Section 8D who obtain drinking water from shallow wells and springs could be adversely impacted by flow reduction, the design methods used to protect karst resources would ensure the same quality and quantity of waterflow through the project area. Adverse effects on shallow subsurface flow would be minimized by limiting vegetation removal to areas directly impacted by

roadway construction, preserving existing vegetation where possible, and limiting soil and vegetation removal for cut-and-fill slopes and grading wherever possible. Changes to existing topography would be minimized.

Post-Construction Impacts. Following construction, between 124 and 265 acres would be restored with native vegetation to stabilize the soil and water flow pattern, depending on the level of disturbance. After three to five years, erosion and sediment losses would subside to baseline values (Fielding et al. 2022; Shah et al. 2022). The remaining 32 acres of new impervious surfaces and 32 acres of permanently maintained grass road shoulder (maximum) could alter stormwater runoff, volumes, including changes to the timing and quantity and quality of runoff. However, due to the resource protection measures to protect karst resources in the AOD, stormwater would be designed to match existing conditions, reducing or eliminating this potential adverse impact.

In areas with karst terrain in the Buckeye Knob and the Sugar Camp Branch segments, post-construction changes in surface topography and vegetation could change the amount of surface runoff directly entering the groundwater supply without undergoing filtration by percolating through layers of soil. In addition, changes in the surface runoff from the Parkway could influence the lateral flow of shallow subsurface water via addition or removal of runoff, particularly to the lower slopes of Buckeye Knob, where this lateral flow could alter discharge at springs. The NPS would develop a detailed design and construct Section 8D, to the maximum extent technically feasible, to ensure that downstream waters are not negatively impacted by changes in runoff temperature, volumes, durations, or rates resulting from the project. The roadway design would promote drainage as diffuse overland sheet flow over native vegetation cover, rather than as channelized runoff (Maestri and Lord 1987). Adverse impacts would be avoided by implementing post-construction monitoring as part of a karst management plan and water quality monitoring, discussed below. Park maintenance crews would routinely evaluate the road corridor for indicators of land subsidence that may be associated with activation of a subsurface karst feature. Vegetated buffers between stream channels and the Parkway would further limit overall impacts on downstream waters.

Water Quality

Construction Impacts. Ground disturbance and vegetation clearing of between approximately 188 to 331 acres during construction of Section 8D could affect surface waters by temporarily increasing stormwater runoff volume during rain events and causing localized landslides, soil erosion and sediment transport, which in turn, could increase turbidity, sediment loading, and nutrient loading in downslope waters and streams, some of which are classified as impaired streams. Site runoff could lead to sedimentation and changes in storm flow and base flow discharges with the potential for adverse effects on downslope riparian habitats and water supplies. Residential wells and springs in karst areas could experience elevated turbidity. The NPS would avoid and minimize impacts by implementing a karst management plan, SWPPP and limiting the number of large cuts and fills. Bridges and retaining walls would be used where appropriate. During the design process, detailed methods would be developed either to avoid or stabilize areas prone to landslide. Site-specific survey work, ecological design, and engineering studies would be conducted during design to determine specific locations and drainage requirements.

Construction carries the risk of spilled or leaked contaminants (e.g., petroleum products, oils, and other hazardous substances from equipment) that could enter surfaces waters, resulting in short- or long-term impacts on water quality. Impacts from a spill would be potentially greater in proximity to karst features. Impacts would be minimized by requiring secondary containment and overfill protection for all tanks during equipment/vehicle refueling. The NPS would also require the contractor to develop and adhere to a spill prevention control and countermeasures plan during construction. Bulk fuel storage (over 50 gallons) would not be allowed on-site, and fuel trucks would not be parked for extended periods on NPS lands. For quantities less than 100 gallons, all containers would be US Department of Transportation-approved, and any containers between 10 and 50 gallons would need to be double-walled and set in a waterproof

containment system (such as a large tub or a fuel pit). For hazardous spills, the contractor would be required to have no less than two 55-gallon spill cleanup kits at each active work site. All spills of size would need to be reported the NPS immediately. All spills over 10 gallons would need to be reported to the NPS and TDEC. This plan, combined with the measures discussed above, would reduce impacts to surface water and groundwater. Effective design and resource protection measures would also be implemented to avoid impacts from concrete washouts. As discussed above, the NPS would implement measures to effectively reduce potential adverse impacts from ground disturbance and vegetation clearing, meeting the requirement of the Construction General Permit that any new or increased discharges to Exceptional Tennessee Waters not degrade water quality.

Construction could disturb soils and bedrock with unweathered pyrite that, if exposed to air and water during construction, could turn into sulfuric acid and acidify nearby streams (Schwartz, Palomino, and He 2018), including Mill and Caney Creeks. Pyritic rock and soils could also be exposed during construction. Tunnel construction would involve extensive excavation in an area known to have pyritic materials. The potential exposure of these materials and resulting acidification of surface runoff could adversely impact water quality and aquatic biota if not properly managed (Schwartz, Palomino, and He 2018). During detailed design, the NPS would conduct a subsurface investigation to develop a project-specific design to address any pyritic materials identified at that time. During construction, a professional geologist would monitor materials excavated from the tunnel or from other areas to assess the extent and concentration of pyrite to determine the potential for acid generation. Core drilling and techniques such as induced-polarization resistivity testing may be used to identify pyritic soils (TDOT 2007). Pyritic soils would be checked carefully, and appropriate steps would be taken to encapsulate them (see Byerly 1990), in accordance with the TDOT (2021) or FHWA (1990) special provisions. Options to manage pyritic material would include: avoiding excavation and exposure of the rock/soil, if possible; applying agricultural lime or other stabilizers (blending) to neutralize acidity and inhibit oxidation; encapsulating it with nonreactive materials such as clay, soil, or other inert materials to prevent contact with air and water; or hauling the material off-site and encapsulating it in a certified disposal site. Potential impacts and associated impacts from pyritic material are addressed in further detail in the “Geologic Features and Processes” section, under “Pyritic Material.” With proper treatment and/or disposal, the amount of acidophilic bacteria would be limited, sulfides would be removed, and alkalinity of any exposed acid-producing material would be increased. Potential impacts of acid runoff would further be avoided or minimized by stormwater BMPs specified in an SWPPP and site restoration measures specified in a project-specific revegetation plan. Also, the NPS would perform monitoring after construction if acidic drainage/runoff is observed and consider additional resource protection measures based on project area characteristics. Additional information on construction monitoring is presented in Appendix B.

Prior monitoring to assess impacts of Parkway construction on first-order streams along the 1.65-mile “missing link” section suggest that impacts on water quality of streams would be minimal. The missing link section is not in karst topography, but is adjacent to karst resources. Chewning (2011) and Privette (2017) monitored water quality data over seven years and reported that Parkway construction did not have any off-site impacts at monitoring stations located on downstream private land, and that any fluctuations in water quality were due in part to the characteristics of the watersheds and other land disturbances. The NPS would implement a similar water quality monitoring effort at a representative sample of surface water and groundwater sites within and downstream of Section 8D. Monitoring would be conducted prior to, during, and after construction and would include surface water and selected drinking water sources (springs and wells). The NPS would use this monitoring to confirm that that roadway contaminants and pyritic soils do not leach into downstream surface waters or into the groundwater system, as was successfully demonstrated during the recent construction of the “missing link” portion of Section 8E. Overall, it is anticipated that any impacts to water quality would be minor and temporary. Implementation of measures discussed above would prevent long-term adverse impacts on water quality.

Post-Construction Impacts. Following construction, surface water would be temporarily impacted by the slight increase in stormwater runoff and sediment yield associated with clearing of between approximately 188 to 331 acres. At least 80%, or up to approximately 124 to 265 acres (depending on level of disturbance), would be restored with native vegetation, and it would take approximately three to five years before changes in flow return to baseline values (Fielding et al. 2022; Shah et al. 2022). The remaining impervious surfaces and maintained grass road shoulder would not cause a noticeable increase in stormwater runoff, including changes to the timing and quantity and quality of runoff. Buffers between stream channels and the Parkway would limit overall impacts on downstream waters. The NPS would design Section 8D to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the area with regard to the temperature, rate, volume, and duration of flow. The NPS would also design permanent stormwater management measures, including those provided by TDEC and UT (2014) to minimize the amount of stormwater generated from Section 8D.

Floodplains

Construction Impacts. As part the construction of Section 8D, the NPS proposes to build two bridges to span the floodplain of the West Prong, both of which would require two piers placed in the 100-year floodplain. Similar to the wetlands discuss, the potential impacts on floodplains do not vary between the two assumptions for areas of disturbance. The piers would result in a permanent impact of approximately 0.08 acres; however, if Interchange Option 2 were selected, the existing bridge at Gum Stand Road would be removed and the demolition of its two piers would reduce the overall floodplain impacts to approximately 0.06 acres. This is the only portion of the project area where the regulatory floodplain has been defined. By spanning over the floodplain, except for 0.06 acres of permanent fill, the proposed action would minimize the disruption to the floodplain and help maintain natural floodplain values, including wildlife habitat and vegetation. Measures to mitigate floodplain risk include coordinating with local emergency management for real-time flood alerts, developing updated flood response plans, and ensuring that structures comply with National Flood Insurance Program standards. Bridge designs would account for 100-year flood events, and property protection would adhere to FHWA standards. Additionally, fuel and hazardous materials storage would be stored above the floodplain. These measures would limit floodplain impacts to the degree that overall risks would be minor despite a small permanent alteration to floodplain values. Alternative 2 would neither alter flood elevations nor permanently affect floodplain functions and would have negligible effects on floodplain values. These impacts and mitigation are detailed in a draft combined Statement of Findings for floodplains and wetlands, which confirms that the project is consistent with Executive Orders 11988 and 13690, and Director's Order #77-2: *Floodplain Management* (NPS 2002; see Appendix D).

Aquatic Ecology

Construction Impacts. The AOD contains approximately 0.24 acres of delineated palustrine wetlands and 14,300 feet of riverine wetlands. The minimum acreage within the cut-and-fill from the conceptual design is approximately 0.04 acres of palustrine wetland and 5,450 feet of riverine wetlands. Instream work in the West Prong to construct two new bridges at the Spur, and potentially removing the Gum Stand Road bridge, would temporarily modify the existing stream channel and result in short-term, direct impacts to benthic (stream bottom) communities in the West Prong. Channel disturbance in the West Prong would also result in localized changes to turbidity levels in the water column. In-water construction would be scheduled during low-flow periods to minimize the impact on water flow and aquatic life by reducing the amount of sediment disturbed during construction. Cofferdams would also be used around pier footings to create a dry work area within the river. Soil materials excavated for footings in or near the water would be removed and relocated to prevent the material from being washed back into the West Prong. These measures, together with other protective measures and standard BMPs would ensure that temporary impacts to riverine biota would be inconsequential. In addition, installing 48 culverts at stream crossings would remove or alter benthic and streambank habitats. Physical and chemical alterations to the streambed associated with construction could cause temporary changes to the fish and benthic

invertebrate communities. However, the high-energy nature of the affected first and second order streams in relatively steep terrain makes it unlikely that there would be any lasting impacts to aquatic biota from sedimentation. Seventeen of the proposed culverts would be box culverts to accommodate flood flows and passage of aquatic biota, while other pipe culverts would have natural bed material placed inside to reduce the loss of benthic stream habitat. As described under "Streams and Wetlands," impacts would be greatly minimized by adherence to the conditions of any Clean Water Act section 401 and 404 permits. Disturbance to stream beds and banks would be limited to no more than necessary, and compensatory mitigation to offset the following permanent losses of benthic habitat: 0.04 acres in the West Prong for bridge pier construction, 0.27 acres of riverine wetlands for culvert installation, and 0.024 acres of permanent impacts to one palustrine wetland for interchange access ramp construction is proposed. This analysis assumes all impacts would be permanent; however, wetland impacts would be avoided to the extent possible through the design process. As a result, permanent impacts may be reduced to temporary or no impacts during final design.

Ground disturbance during construction in the vicinity of streams and wetlands could impact aquatic organisms via increased turbidity and sedimentation. Turbidity could interfere with the activities of sight-feeding organisms or clog the gills of aquatic animals and affect their respiration. Sedimentation could affect aquatic organisms by reducing habitat availability and diversity and smothering fish eggs and bottom-dwelling organisms (Loar et al. 1980). Increased sedimentation could also affect aquatic species richness and density (Wiederholm 1984). However, stormwater BMPs like silt fences, infiltration systems, inlet protection, and sediment traps would be used to control erosion and sedimentation near streams and wetlands and protect aquatic biota (Maestri and Lord 1987). These BMPs and other pollution prevention measures would be included in a SWPPP that would largely mitigate potential adverse impacts from stormwater runoff. Preserving an undisturbed riparian buffer to the maximum extent practicable would limit the overall impacts on downstream waters by trapping sediments, nutrients, and pollutants from stormwater runoff to prevent them from entering streams and wetlands.

Additionally, oil spills and heavy metal and sulfuric acid runoff from exposed pyritic bedrock could adversely impact aquatic ecosystems, potentially leading to fish and salamander kills. However, a spill prevention control and countermeasures plan would minimize the risk of oil spills. Impacts would be further minimized by requiring secondary containment and overfill protection for all tanks during equipment/vehicle refueling. For acid-producing material, the NPS would conduct a subsurface investigation during final design and develop a project-specific design to address any pyritic materials identified. As detailed above in the "Water Quality" section, proper treatment of this material, plus other stormwater management controls, would avoid adverse effects.

Construction of Section 8D could expose sulfide minerals from pyritic material and produce sulfates that could acidify stormwater runoff and potentially affect downstream waters, as discussed above. Because of the low alkalinity of some streams crossed by Section 8D, including Mill Creek and Caney Creek, the risk of stream acidification and heavy metal contamination of the food chain is high. Runoff of heavy metals and sulfuric acid leached from exposed bedrock is a longer-term, nonpoint source problem that could continue long after the completion of construction, leading to fish and salamander kills. As discussed under "Surface Water," the NPS would implement effective resource protection measures solutions, including fill encapsulation or hauling off-site where necessary, and any long-term impact would be manageable.

In summary, physical and chemical alterations of streams and wetlands impacted during construction could cause temporary changes to the populations of fish, amphibians, and other biota that rely on clean water for survival. However, protection measures during instream work, erosion and sediment controls, and pollution prevention practices would protect aquatic biota and avoid or minimize adverse impacts to aquatic habitat. Also, permanent impacts would be offset by compensatory mitigation. The NPS would implement a monitoring program, immediately after construction and for two years post-construction, to evaluate impacts on streams and wetlands and water quality, as discussed above. This monitoring would

identify the nature and extent of construction impacts, and the NPS would implement restoration actions to stabilize problem areas and implement BMPs to address any observed impacts on water aquatic ecology.

Post-Construction Impacts. Following construction, aquatic ecology would be temporarily impacted due to slightly increased sediment yields associated with vegetation clearing and other ground disturbance. After restoration, the new impervious surfaces and permanently maintained grass road shoulder would not cause a noticeable increase in stormwater runoff, including changes to the timing and quantity and quality of runoff. Buffers between stream channels and the Parkway would limit overall impacts on downstream waters, and proper stormwater management would mitigate impacts. During operation of Section 8D, increases in impervious surface would increase stormwater runoff, which could contain roadway contaminates, compared to existing conditions. Groundwater collected by and discharged from the tunnel drainage system after construction could affect water resources. A hydrodynamic separator or similar treatment would be determined during final design if additional investigations reveal this to be a concern.

Overall, the construction and operation of Section 8D would result in short-term, adverse impacts on aquatic ecology from localized sedimentation during construction. In the long term, the operation of Section 8D would cause adverse impacts on aquatic ecology in the area. The project design would include area-specific stormwater drainage plans and stormwater BMPs to minimize potential water quality impacts during construction and impacts from new impervious surfaces and associated permanent changes to stormwater drainage patterns.

Cumulative Impacts

Impacts on water resources from cumulative actions would be the same as those described for the no-action alternative and contribute adverse impacts on water resources in the project area due to changes in topography, land cover, and associated construction disturbance. When the incremental impacts from alternative 2 are combined with the impacts from past, present, and reasonably foreseeable actions, the overall cumulative impact on water resources would be adverse, with the incremental impacts of alternative 2 contributing minor impacts during construction due to increased runoff and potential sedimentation of surface waters and wetlands, the potential transport of water into the subsurface, and changes to groundwater flow.

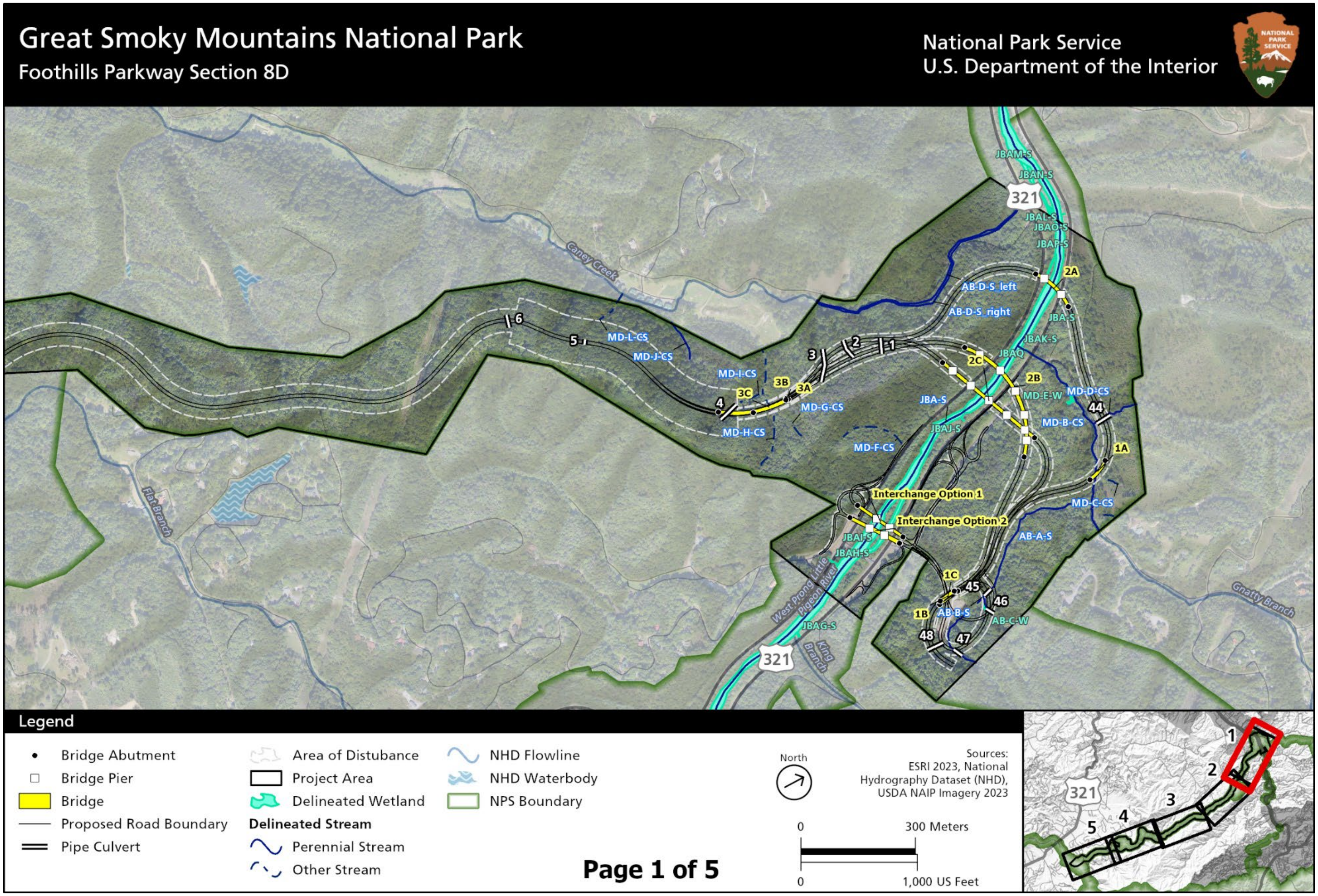

FIGURE 16. WETLANDS AND WATERBODIES IN THE PROJECT VICINITY (FIGURE 1 OF 5)

Figure 17. Wetlands and Waterbodies in the Project Vicinity (Figure 2 of 5)

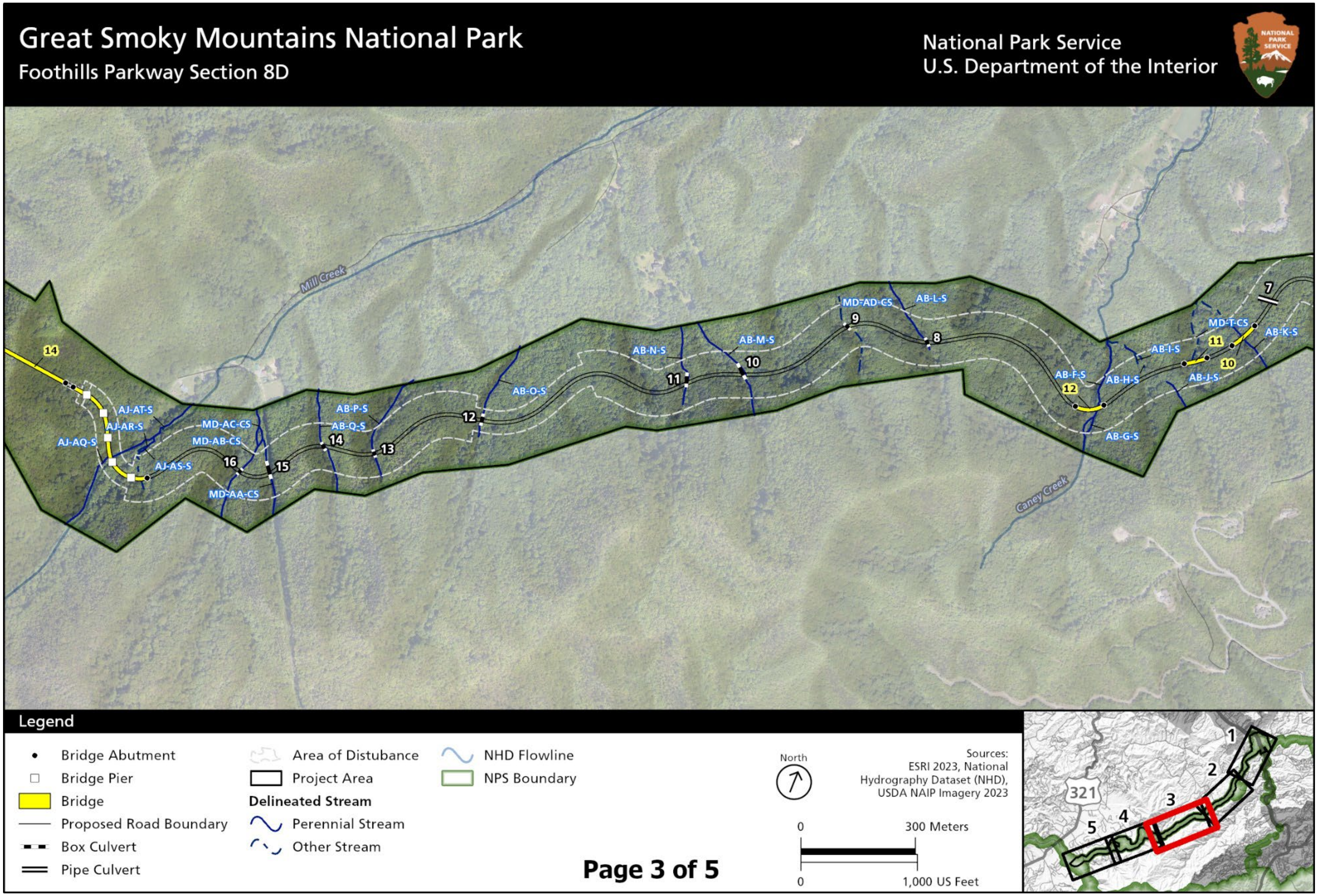

FIGURE 18. WETLANDS AND WATERBODIES IN THE PROJECT VICINITY (FIGURE 3 OF 5)

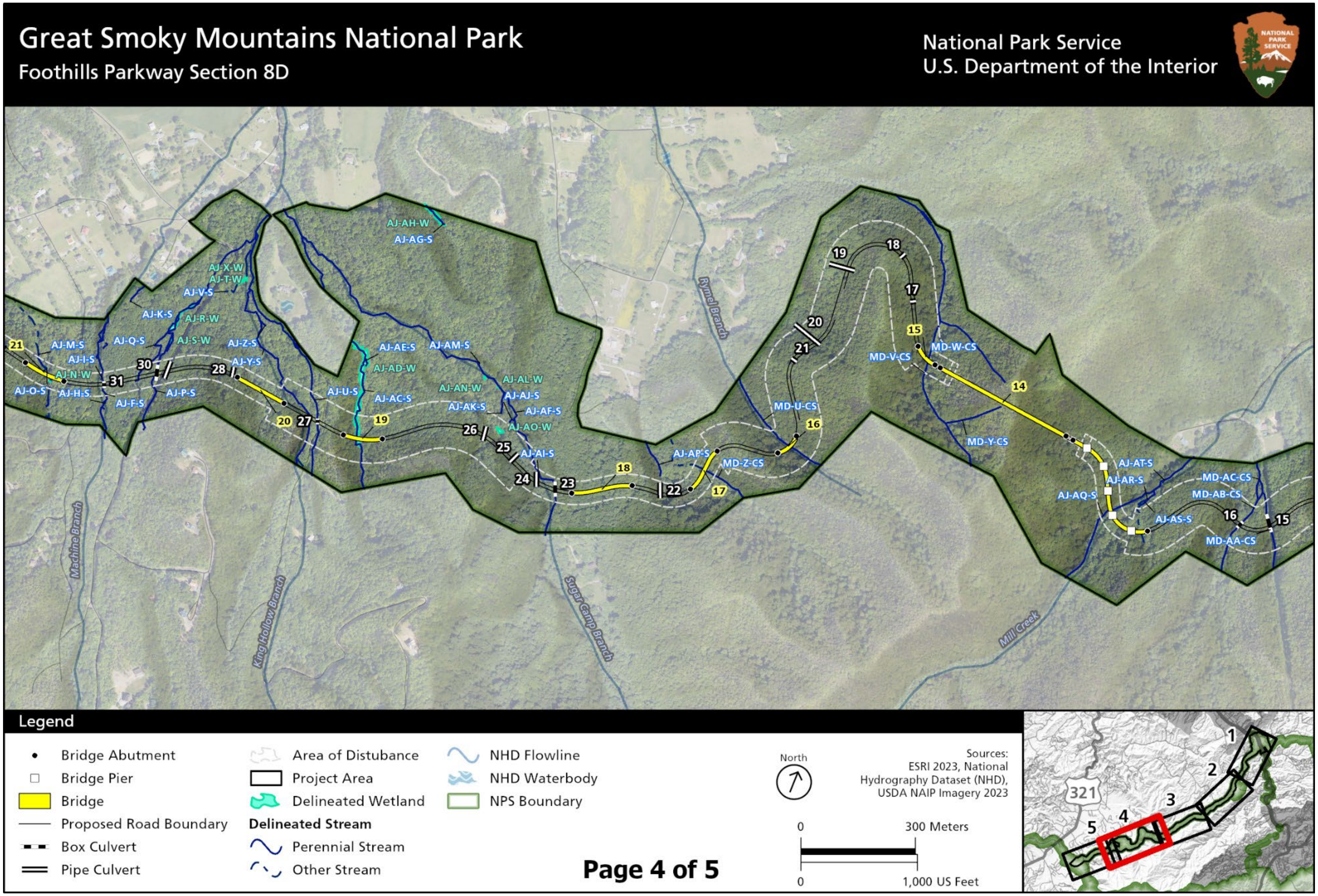

FIGURE 19. WETLANDS AND WATERBODIES IN THE PROJECT VICINITY (FIGURE 4 OF 5)

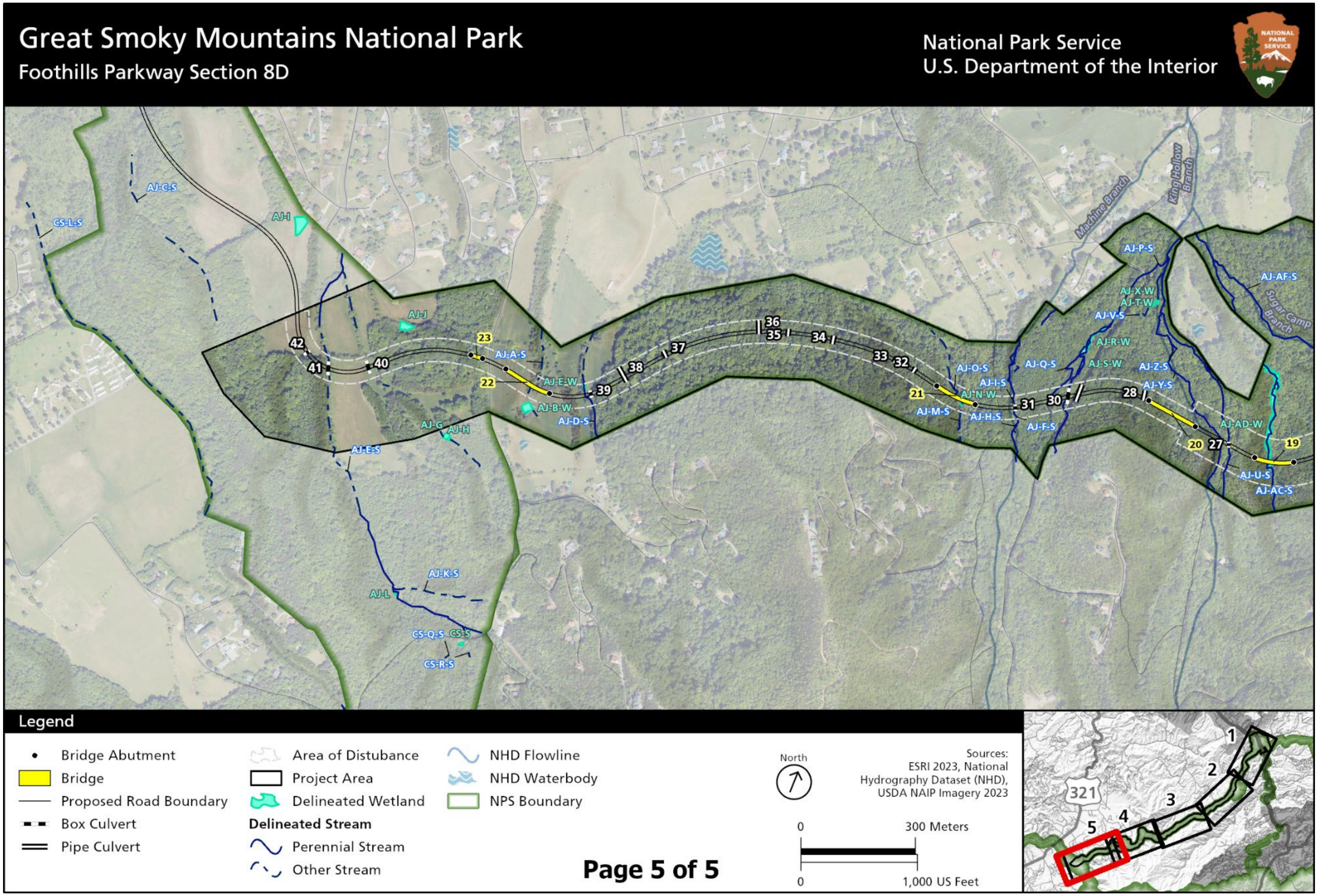

FIGURE 20. WETLANDS AND WATERBODIES IN THE PROJECT VICINITY (FIGURE 5 OF 5)

VISITOR USE AND EXPERIENCE

AFFECTED ENVIRONMENT

VISITOR AMENITIES AND TRAVEL

Visitors do not currently have vehicular access to the Section 8D project area; therefore, approximately 70% of visitors enter the park via the Spur through the downtown Gatlinburg entrance or the Gatlinburg Bypass entrance. The Section 8D project area also does not currently contain any developed visitor services such as parking, restrooms, or designated trails. However, some visitors currently use the undeveloped project area corridor for hiking, wildlife viewing, and photography.

To analyze vehicular access and circulation near Section 8D, the Foothills Parkway Section 8D Traffic Study, completed in 2022, evaluated traffic operations for a number of scenarios, including the no-action alternative, the proposed action with Spur interchange access option 1, and the proposed action with Spur interchange access option 2 (WSP 2022). The traffic study evaluated the level of service (LOS) at 13 intersections and analyzed vehicle queue lengths for the approaches of each intersection. LOS is a measure used to relate the quality of traffic service using a scale ranging from A to F. LOS A is considered free flow, where traffic flows at or above the posted speed limit, while LOS F is considered heavily congested where traffic demand exceeds the capacity of the roadway. The traffic study analyzed traffic conditions during two peak visitation periods, July and October, which represent two worst-case traffic conditions.

A safe road network ensures that vehicles have adequate sight distances at corners, intersections, and parking areas; minimizes the possibility for conflicts among motorized vehicles, pedestrians, and bicyclists; and allows for vehicles to easily stay within their travel lanes. As demonstrated by the existing LOS conditions provided in the Foothills Parkway Section 8D Traffic Study, several intersections are operating at unstable conditions that are either approaching or above capacity (or LOS E or F) (WSP 2022). Five intersections near the Spur interchange operate at a LOS E or F during July weekdays and Saturday peak hours, as well as during October weekdays and Saturday peak hours.

TRENDS AND PLANNED ACTIONS

The park is consistently the most-visited national park in the country. Visitation and development in the park have noticeably increased over the past decade, and traffic and visitation are anticipated to continue to increase in future years. Based on the reported data of recreational visitors, nearly 14.1 million people visited the park in 2021, the most on record (NPS 2024e). This represents a continuation of growth in recent years, with record visitation occurring in 2018 and 2019. Additional data from monthly traffic counts indicate that roadways within the park also have experienced increases in use. On the Parkway, 292,268 vehicles traveled a segment of the roadway west of US 321 and west of Walland in 2021, up from 93,961 vehicles on this same segment in 2013. Near the western terminus of the Section 8D project area, an estimated 281,000 to 321,000 vehicles traveled Parkway in 2021, down slightly from an estimated 321,000 to 336,000 in 2019. Near the eastern terminus of the Section 8D project area, on the Spur, an estimated 10.8 million vehicles traveled the roadway in 2021, compared with a range of 10.4 million to 11.7 million vehicles in previous years. Near Metcalf Bottoms, 284,493 vehicles traveled on Wear Cove Gap Road in 2021, up from 125,719 vehicles in 2013 (WSP 2022).

The Foothills Parkway Section 8D Traffic Study (WSP 2022) predicts a 1.5% annual growth rate in traffic flows along existing portions of the Parkway, Gum Stand Road, Gnatty Branch Road, and King Branch Road by 2045. However, changes in traffic patterns are not anticipated to noticeably improve the LOS in several intersection locations during peak periods.

Climate change is also expected to affect visitation patterns. As the climate continues to warm, resulting in warmer weather in all seasons, visitation to the park is anticipated to increase. Over the years, impacts

on visitor experience in the park have included traffic congestion, diminished aesthetics, and fewer opportunities to experience solitude. As visitation continues to increase, visitors may have a diminished experience and fewer opportunities to enjoy the park's scenic beauty, diversity of natural resources, and rich human history. Where, when, and how many people visit parks is likely to change with continued warming (NPS 2024f). To combat these changes, visitors may avoid traveling in the project area during extremely warm months. The high-visitation season for travelers may also extend across additional weeks to months as weather patterns change.

Present and reasonably foreseeable actions include the construction and implementation of the Wears Valley Mountain Bike Trail System and the Gatlinburg Spur improvements. The mountain bike trail system would provide a new recreational opportunity not currently available in the park and may help distribute visitation and reduce congestion in the park. The Gatlinburg Spur improvements would improve visitor experience by reducing congestion and improving visitor safety. In general, these projects would result in long-term, beneficial impacts on visitor use and experience by providing a broader range of recreational opportunities.

ENVIRONMENTAL CONSEQUENCES

ALTERNATIVE 1: NO ACTION

Under alternative 1, the NPS would not construct Section 8D of the Parkway and would not fulfill the 1944 US Congressional intent to create the Parkway. Therefore, visitor use and experience would remain unchanged along the existing Parkway, and visitors would continue to follow existing traffic patterns to access the existing portions of the Parkway via the Spur, US 321/441, and Wears Valley Road/East Wears Valley Road. Vehicular access to the project area would be non-existent because Section 8D of the Parkway would not be constructed, thus prohibiting direct connections from Wears Valley to the Spur and the western sections of the Parkway. Visitors would continue to have access to nearly 22.5 miles of Sections 8A, 8G, and 8H, as well as other roads in the park. Additionally, under alternative 1, existing and planned projects by others in the region, including TDOT, would continue as planned. Section 8D would not be modeled as part of the overall regional transportation network.

Alternative 1 evaluates the project area under future year 2045 traffic operation conditions without Section 8D. Alternative 1 traffic volumes within the proposed project area include the existing peak hour traffic volumes, the additional traffic from planned developments, and the addition of traffic due to background growth. Under alternative 1, nine of the existing project area intersections would operate with LOS E or F. The remaining intersections would operate with LOS D or better. Six of the study intersections would have at least one lane group with 95th percentile queues that would exceed the available storage, resulting in congested conditions and adverse impacts on visitor use and experience. According to the Foothills Parkway Section 8D Traffic Study (WSP 2022), traffic volumes would continue to be at or above capacity at several intersections during peak seasonal times and would operate at a LOS E or F, as listed in Table 13.

Because no change to traffic flow or roadway capacity would occur under alternative 1, the high volume of vehicles within the transportation network would continue to experience traffic delays, as shown in Table 13, particularly during times of peak seasonal use.

No construction equipment or tools would be used under this alternative, creating no visual or auditory impacts for visitors to experience. Alternative 1 would not result in long-term, adverse impacts on visitor use and experience along the Parkway above what is already occurring, as described under trends and planned actions.

TABLE 13. 2045 NO-ACTION OPERATIONS ANALYSIS SUMMARY

Intersection Name and Control Type	2045 No-Action Alternative Conditions	
	LOS	Delay
3. Wears Valley Road and Line Springs Road (TWSC)	F	747.7
5. US 321 and 441/Wears Valley Road/E Wears Valley Road (Signalized)	F	543.2
7. Wears Valley Road and US 321 Ramp to Foothills Parkway Ramp (West) (TWSC)	E	36.6
8. Wears Valley Road and US 321 Ramp to Foothills Parkway Ramp (East) (TWSC)	F	75.8
10. Southbound Spur/Foothills Parkway Spur Connector (YIELD)[a]	N/A	N/A
12. Southbound Spur (US 321/441) and Gum Stand Road On-Ramp (YIELD)[a]	F	236.0
13. Southbound Spur and Gatlinburg Spur Cutover at Little Pigeon River Bridge (TWSC)	F	410.0
18. Northbound Spur and King Branch Road/Gnatty Branch Road (TWSC)	F	1,927.0
19. Northbound Spur and Gatlinburg Spur Cutover at Little Pigeon River Bridge (TWSC)	F	1,996.0
20. Northbound Spur and King Branch Road On-Ramp (TWSC)	F	2,823.9

Note: This analysis is for the July/October Weekday/Weekend Peak
TWSC = two-way STOP-controlled unsignalized intersection (TWSC intersections do not have an overall LOS. Worst movement LOS/delay shown).
AWSC = all-way STOP-controlled unsignalized intersection
Delay is measured in seconds per vehicle.

[a] This intersection was analyzed using Highway Capacity Manual (HCM) 2000 results because of HCM 6th Edition limitations.

ALTERNATIVE 2: NPS PREFERRED ALTERNATIVE

Visitor Amenities and Travel

Construction Impacts. Under alternative 2, visitor use and experience would remain unchanged along Section 8D of the Parkway during construction. Visitors and drivers do not currently have access, nor would they be granted access to this section of roadway during the construction period. Construction of Section 8D would be largely confined within the AOD and the immediate vicinity of the Spur to minimize impacts on resources. As such, interchange access option 1 and/or option 2 would be constructed off the existing alignment to minimize adverse effects to visitor experience from traffic disruptions along the Spur during construction. Construction activities for either interchange access option would temporarily disrupt visitors' experience of the roadway and its views. While a construction start date for Section 8D has not been established and Congress has not appropriated funding to build the project, for planning purposes, construction likely would be implemented in a series of phases over a period of 10 or more years after funding is identified, and design and permitting are completed.

Post-Construction Impacts. Once completed, the proposed interchange improvements would result in long-term benefits to visitor use and experience by providing a direct connection to Section 8D of the Parkway in addition to scenic views of the park. However, changes in traffic patterns would not noticeably improve the LOS in several intersection locations during peak periods based on the results of the Foothills Parkway Section 8D Traffic Study (WSP 2022). In this study, LOS was measured based on modeled traffic flow (average speed), anticipated queue lengths, and number of stops.

As shown in Table 14, while the construction of Section 8D would not eliminate existing congestion during peak periods, it would not increase congestion. With Spur interchange access option 1, 10 of the study intersections would operate at LOS E or F. The remaining study intersections are expected to operate at LOS D or better under this alternative under worst-case conditions. Seven of the study

intersections would have at least one lane group with 95th percentile queues that would exceed the available storage under the proposed action with Spur interchange access option 1. With Spur interchange access option 2, eight of the study intersections would operate at LOS E or F. The remaining study intersections are expected to operate at LOS D or better under this alternative. Seven of the study intersections would have at least one lane group with 95th percentile queues that would exceed the available storage under the proposed action with Spur interchange access option 2. Therefore, the 2045 traffic forecasts indicate that the proposed interchange improvements and forecasted traffic levels in the project area would not decrease the delay or affect the corresponding LOS, and delays may increase slightly based on regional growth.

TABLE 14. 2045 ALTERNATIVE 2 OPERATIONS ANALYSIS SUMMARY

Intersection Name and Control Type	2045 Conditions for Interchange Option 1		2045 Conditions for Interchange Option 2	
	LOS	Delay	LOS	Delay
3. Wears Valley Road and Line Springs Road (TWSC)	F	791.4	F	791.4
5. US 321 and 441/Wears Valley Road/E Wears Valley Road (Signalized)	F	543.2	F	543.2
7. Wears Valley Road and US 321 Ramp to Foothills Parkway Ramp (West) (TWSC)	E	43.1	E	43.1
8. Wears Valley Road and US 321 Ramp to Foothills Parkway Ramp (East) (TWSC)	F	102.6	F	102.6
10. Southbound Spur/Foothills Parkway Spur Connector (YIELD)[a]	F	938.5	F	673.1
12. Southbound Spur (US 321/441) and Gum Stand Road On-Ramp (YIELD)[a]	F	312.3	N/A	N/A
13. Southbound Spur and Gatlinburg Spur Cutover at Little Pigeon River Bridge (TWSC)	F	595.4	N/A	N/A
18. Northbound Spur and King Branch Road/Gnatty Branch Road (TWSC)	B	10.3	N/A	N/A
19. Northbound Spur and Gatlinburg Spur Cutover at Little Pigeon River Bridge (TWSC)	F	2,423.3	N/A	N/A
20. Northbound Spur and King Branch Road On-Ramp (TWSC)	F	2,823.9	F	1,890.5

Note: LOS and delay are represented as peak travel times during July and October in the park, including during weekday and weekend time periods.
TWSC = two-way STOP-controlled unsignalized intersection (TWSC intersections do not have an overall LOS. Worst movement LOS/delay shown).
AWSC = all-way STOP-controlled unsignalized intersection
Delay is measured in seconds per vehicle.
[a] This intersection was analyzed using HCM 2000 results because of HCM 6th Edition limitations.

Once construction was complete, the project area would open to visitors and include pull-offs and parking areas located throughout Section 8D to offer opportunities for visitors and drivers to see the vistas, cultural resources, and natural features, as well as to make unplanned emergency stops. Visitors would be able to enjoy the entirety of the approximately 10-mile portion of Section 8D and would no longer be required to travel north via the Spur, US 321/US 441, and Wears Valley Road to connect to the existing portions of Sections 8E, 8G, and 8H of the Parkway. Visitor use and experience would improve by providing an additional visitor access point to the park and enhancing overall connectivity to the constructed portion of the Parkway. Pull-off areas would provide visitors with increased and safer

opportunities to view the landscape and rest. Accessibility would be improved, including parking for persons with disabilities, and emergency access would be improved because pull-off areas would allow vehicles to pull-over for emergency response personnel.

Construction of Section 8D, as well as the construction of one of the Spur bridge options, would remain as permanent features on the landscape, potentially adversely affecting visitor use and experience by detracting from the visual quality and character of the project area as a result of tree removal, construction of the proposed bridges, increases in paved surfaces, construction of retaining walls, and tunneling at the Crooked Arm Ridge segment (see "Visual Resources"). Although no measurements were taken in the Crooked Arm Ridge segment, topography suggests that under certain weather conditions, motorists could suddenly encounter heavy crosswinds upon leaving the proposed tunnel, particularly at the west end. Convergence of ridges could cause convergence of near-surface air moving from Wears Valley up the canyon toward the western exit of the tunnel, leading to increased wind speeds. This situation could be especially dangerous for large recreational vehicles or cars pulling trailers and would be mitigated by incorporating needed closures due to high wind, commensurate with current park policy.

Noise and emissions from construction equipment may also cause short-term disruptions to visitors at recreational or natural areas. Alternative 2 is anticipated to have short-term, adverse impacts on visitor use and experience of the visual conditions. Following construction, views and vistas along Section 8D of the Parkway would be restored, where possible, and vegetation removal is anticipated to return within 5 to 10 years, as seen along other sections of the Parkway during construction periods; however, some areas may require a longer time.

Cumulative Impacts

Past, present, and reasonably foreseeable actions that would impact visitor use and experience include increased park visitation, additional recreational opportunities, population growth, and associated traffic congestion in adjacent communities, especially due to regional growth. Construction activities would result in short-term, adverse impacts on visitors due to noise levels from tree removal and construction equipment. However, alternative 2 is anticipated to benefit visitor use and experience in the long term by diverting existing visitors of the Parkway from nearby roadway systems to Section 8D, which would allow for fewer disruptions to the visitor experience. Additional present and reasonably foreseeable projects in the park would also result in long-term, beneficial impacts on visitor use and experience by providing a broader range of recreational opportunities in connection with Section 8D. When combined with the effects of past, present, and reasonably foreseeable actions, the incremental changes of alternative 2 would contribute additional beneficial impacts on the overall visitor experience and use effects from other ongoing and future projects. The contribution of beneficial impacts from alternative 2 would be noticeable because they would introduce a new visitor use to a currently undeveloped area; however, this use would be consistent with proposed development and visitor improvements in the vicinity.

VISUAL RESOURCES

Information on visual resources was compiled from a review of various NPS studies and reports regarding visual resources in the vicinity of Section 8D. Section 8D would introduce new visual elements to the existing visual environment and result in varying levels of visual alteration/impact when viewed from locations outside the project area.

AFFECTED ENVIRONMENT

The project is located in eastern Tennessee in the Smoky Mountains, which are part of the Appalachian chain and are characterized by undulating mountains and foothills covered by hardwood forests. Scenic resources within the Great Smokies include 350 miles of scenic roadways that showcase the ruggedness,

magnitude, height, and scenic grandeur of the Smoky Mountains. The park's foundation document considers scenic quality a fundamental component of park resources (NPS 2016a).

The visual resources in adjacent sections of the Parkway are similar to those proposed for Section 8D. The most distinct visual resources of the region are mountains, hills, forests, rivers, and ponds. This topography and vegetation inherently limit visibility in most locations throughout the project area. The NPS manages the entire Section 8D corridor, which is generally undeveloped and forested. Current land uses surrounding the project area include rural residential, municipal buildings, retail/commercial areas, and roadways, including the Spur, and various categories of local roads (WSP 2023b).

The project area for Section 8D is located between 1,400 feet to 2,200 feet in elevation and generally lies mid-way on slope faces. Views of Wears Valley, rural landscapes, scenic Hatcher Mountain, Bench Mountain, Grindstone Ridge, and distant views of Conner Heights would characterize available views from the project. A corridor view of the Pigeon River Valley could be seen at the Spur. Conversely, views of the roadway would be available to viewers in these same areas.

Once built, the project would be visible on the landscape to neighbors and travelers. According to *Guidelines for the Visual Impact Assessment of Highway Projects* (FHWA 2015), neighbors are defined as viewers who occupy land adjacent to or visible to the proposed project, such as residents in the area, while travelers are viewers who would use the proposed transportation project, and generally consist of tourists, others visiting the park, and local commuters.

A visibility analysis was completed in 2023 to identify the locations within the study area (a 3-mile corridor surrounding the project footprint) where the proposed Section 8D roadway could be seen from ground-level vantage points (WSP 2023b).

Trends and Planned Actions

The predicted increase in annual visitation may lead to an eventual change in park aesthetics due to overuse, trampled vegetation, and soil compaction. Such changes could reduce forested areas, add paved surfaces, and otherwise alter the natural landscape. Climate change has led to warming of nearly all national park units across the country, which also impacts aesthetics of the park through potential vegetation loss, greater risk of wildfires, and impacts from a higher frequency of severe storms and flooding events. Though the physical landscape of Section 8D would change from its natural landscape to a Parkway through implementation of this project, the visual character of Section 8D would remain consistent with the congressional mandate and with adjacent sections of the Parkway as a winding roadway traversing through the forested landscape. As discussed in the "Cumulative Impacts" section, past, present, and reasonably foreseeable actions may alter the visual character of the landscape surrounding Section 8D. While these projects would alter the existing visual character, they would not alter the overall Parkway setting.

ENVIRONMENTAL CONSEQUENCES

Alternative 1: No Action

Under the no-action alternative, Section 8D would not be constructed, and the project area would remain mostly forested vegetation. There would be no change to the existing visual character of the project area. However, long-term, adverse impacts on visual resources would continue, given the trends and planned actions noted above.

Alternative 2: NPS Preferred Alternative

Section 8D would introduce new visual elements to the existing visual environment and result in varying levels of visual alteration/impact when viewed from locations within and outside the project area.

Sensitivity to changes in the visual environment depend on viewer type and the duration of the views. The prominence and extent or degree of visual impacts, or visual changes, would vary for viewers within the vicinity of Section 8D, particularly as the distance from visual elements increases and the number of trees, vegetation, and land cover between the viewer and the project begin to screen new visual elements.

Visual Character

Construction Impacts. Alternative 2 would alter the existing visual character of the project area, which is currently undeveloped and forested. Elements of the proposed action that could affect the visual character include tree removal; construction of a new roadway, bridges, a tunnel, and retaining walls; and increases in paved surfaces. In accordance with NPS parkway design standards, bridges, retaining walls, and road cuts and fill would be designed and constructed to reduce their visual impact as much as possible, and large cut-and-fill areas would be reduced by using bridges in areas of challenging topography.

The 2023 Visual Impact Analysis (WSP 2023b) indicates that Section 8D construction would be most visible in the vicinity of Wears Valley, where the road would be located in the valley before climbing in altitude through mountainous terrain toward the Spur. In this area, primary viewers would be neighbors from the residential areas looking toward Section 8D. In recent years, residential development (including both permanent and vacation homes) and commercial development in Wears Valley has also altered the landscape, and this new development is particularly noticeable during leaf-off conditions. While the Parkway would be visible if constructed, in other times of the year (during leaf-on conditions), existing vegetation would screen viewers from seeing portions of the roadway in most locations. Views across the valley toward Section 8D would generally remain similar to existing natural materials, rural forms, and textures (i.e., fields, trees, rural buildings, roadways, and signage) in the foreground view; however, the project would introduce new elements to the middle-ground views. Elements that would be visible from residential and commercially developed areas would likely include vegetation removal and cut-and-fill slopes.

Post-Construction Impacts. Following construction, temporarily disturbed areas would be revegetated, and native plant species would be selected that are adapted to specific existing conditions. Special attention would be paid to establishing planting patterns that reflect natural vegetation patterns. In areas of cut-and-fill, revegetation with native species would help to stabilize the slopes, control erosion, and minimize temporary adverse visual impacts from the scars. While the cut-and-fill features would diminish in visibility as native vegetation returns to the slopes, it may take between 5 and 10 years once construction is complete for vegetation to fully reestablish.

Changes in the visual environment would be noticeable in those areas directly adjacent to the project, particularly until the revegetation of exposed cut-and-fill slopes has grown enough to visually soften contrasting slopes. Because the Parkway would be in the middle-ground distance zone from most residences and development, the visual changes would tend to be less distinctive (i.e., it would be difficult to discern individual components) than if viewed from closer locations. The visibility and potential visual impacts are expected to diminish as the project is viewed from greater distances. Lines, forms, colors, and textures associated with Section 8D, such as roadways, bridges, and retaining walls, are not expected to be visible or discernible to viewers and would not contrast with other human-made elements throughout the valley. Furthermore, resource protection measures, as defined in Appendix B, such as the revegetation of cut slopes, are expected to help blend the cut slopes into the surrounding visual context. Overall, impacts to neighbors living in nearby residential areas from the change in view are expected to be low and would be reduced over time as vegetation is established on cut-and-fill slopes.

Park Views from Section 8D

Construction Impacts. During construction, access to Section 8D would be limited to construction crews and essential workers, so park views from the project site into the park would be limited.

Post-Construction Impacts. While the purpose of the Parkway is to allow visitors vistas into the park, which would occur at designated pull-off areas along the roadway, the terrain would only allow limited views from Section 8D, other than from locations along the Spur. Because the Parkway follows the crest line at Flat Branch for more than 1,200 feet, it offers an extended view into the park for "windshield sightseers" in this location. Although Section 8D is short, it offers expansive multi-ridge mountain vistas to visitors.

The primary view would be to the southeast, an expanse of up to 120 degrees across several middle-ground and background ridges to a far-distance view of the Mount LeConte range. The secondary view to the opposite side of the project area would be a northwest vista to the rolling ridges of Grindstone Ridge. With extensive yet appropriate clearing of vegetation in the near foreground, both primary and secondary views in the Flat Branch segment could be noticeable. However, the natural curvature of the ridgeline at Flat Branch would orient the focus of vehicle sightseers toward the Mount LeConte side of the Parkway. This would be true for both northeast-and southwest-bound travelers.

Views of Section 8D from the Park and Surrounding Areas

Construction Impacts. During construction, the project would initially require grading; cut-and-fill slopes; vegetation clearing and subsequent revegetation; installation of temporary erosion and sediment control practices; and construction of roadways, bridges, retaining walls, overlooks, and other ancillary structures. It would include temporary staging areas and long-term use and storage of heavy equipment on-site during the construction period. Throughout construction, the staging of equipment and materials would occur along the project corridor, generally within the existing project area or on nearby vacant parcels, as permitted. Residences directly adjacent to the project area may have direct views of the site. The presence of existing trees and vegetation would likely screen visual impacts associated with construction activities, and vegetation recovery plans would help to revegetate exposed soils.

Construction equipment and activities would be noticeable throughout the active construction period and is likely to include tree cutting equipment, dump trucks, cranes, excavators, loaders, lifts, backhoes, bulldozers, compactors, mixers, and pump trucks. Barricades, cones, flagging and flaggers, flashing lights, warning signs, and other lane closures, as well as additional items are also expected for vehicle management. This equipment is often brightly colored to promote visibility and safety. Other sources of visual changes during construction would include staging areas, material storage, trailers, fencing, vehicular detours, construction signing, flashing safety lights, and work lighting. Lights may be used to safely illuminate the workspaces, which could cause spillover light onto adjacent parcels. These activities may be visible to neighbors and travelers throughout the study area during the construction period. Visual detractions from construction activities would be removed upon completion of project construction. As such, visual impacts associated with construction would be temporary.

Post-Construction Impacts. During the development of the 2023 *Visual Analysis Study*, the NPS analyzed the potential for visual impacts on visitors inside the park, including at locations such as the Little Greenbrier Trail and Cove Mountain Fire Tower. The visual analysis confirmed that Section 8D would not be visible to visitors inside the park because of topography and existing vegetation. Topography and dense vegetation would likely block most views toward the Flat Branch area of Section 8D from the park, but a far-distance view may be available from some locations (e.g., hiking trails or overnight camper cabins on Mount LeConte). Views from these areas may be slightly more open during the winter when deciduous trees drop their leaves, but at such great distances, views would be at least 4 miles from the project and would likely include the town of Gatlinburg, with its roadways, buildings, and other human-made visual elements, thus, Section 8D would not be a distinct difference in the character of the landscape. Furthermore, areas within the park boundary that could have views of Section 8D include mountain tops and ridge tops. Recreational viewers are typically sensitive to changes in visual conditions because they have expectations of natural visual elements; however, the distance to the Section 8D

corridor and existing human-made elements would reduce the visual impact of the roadway and the potential for adverse impacts.

Most views of the Parkway from the Gatlinburg Spur would be screened by topography, land cover, and existing vegetation; however, Section 8D requires construction of a new bridge over the Spur and the West Prong. At these locations, the bridge would be elevated above the highway and visible to both neighboring and traveling viewers. Associated improvements including ramps, connection roads, graded slopes, and cuts and fills would also change the existing visual environment.

Topography and vegetation would continue to block most views of the project to and from residential areas near the Spur; however, some residential viewers likely would be exposed to concrete, asphalt, vegetation removal, slope cuts, and other project elements. These items would contrast with existing views of trees and vegetated slopes, and changes likely would be adverse. Generally, travelers, who consist of viewers who would use the proposed transportation project, are typically not sensitive to changes in the visual environment (FHWA 2015); however, due to the scenic nature of the valley and the large number of tourists, the sensitivity of travelers is considered higher than typical for this project. The bridge over the highway and river would expose travelers to the new visual elements mentioned above, which would contrast with the existing visual environment for these viewers. Therefore, changes in the visual environment would have adverse impacts on traveling viewers.

The various bridge options would have varying degrees of impact to viewers. The Low Bridge Option would be visible for a shorter period than the High-Curvilinear Bridge Option or the High-Linear Bridge Option, but because its height would be lower, it would be closer to vehicles driving on the Spur. Construction of a bridge that would pass over the Spur at a low height would require a 95-foot horizontal cut into the hillside on the eastern side of the Spur. Additionally, road cut would be visible to people driving along Caney Creek Road. The High-Curvilinear Bridge Option would minimize scarring in the vicinity of the Spur, maintain a curvilinear alignment similar to the rest of the Parkway design, and require a less extensive horizontal cut (50 feet) on the eastern side of the Spur compared to the Low Bridge Option. In addition, the road cut for the High-Curvilinear Bridge would not be visible to park visitors driving along the Spur. The High-Linear Bridge Option would also require a less extensive horizontal cut (50 feet) on the eastern side of the Spur compared to the Low Bridge Option. This bridge option would feature a linear alignment that would differ from the curvilinear alignment of the Section 8D mainline roadway geometry.

Visualizations from the northbound Spur are provided in Figure 21through Figure 23. Because of topography, the Low Bridge Option would be located approximately 0.25 miles north of the two high bridge options, but existing conditions, viewer sensitivities, and visual impacts would be similar. Both high bridge options would be noticeably higher in elevation than the Low Bridge Option. The higher bridge options would be more prominent to traveling viewers and would require longer bridges to span the width of the valley at a higher elevation. The longer span would also require more visible structures, such as the bridge deck, piers, and footers, but vegetation and the narrow field of vision would limit the exposed structures.

The longer and higher bridge options would likely introduce more visual impacts than a similar bridge at a lower elevation; however, the higher bridge options would require less cut-and-fill construction in the scenic Pigeon River Valley. Therefore, overall visual impacts associated with all three bridge options are considered similar, with localized, long-term, adverse impacts to travelers along the Spur. Regardless of which bridge option is selected, the design materials and positioning of the bridge would aim to minimize visual impacts. However, its visual prominence still would be noticeable to travelers along the roadway.

Note: Simulations are intended to show massing and visual impacts. Final bridge design, column location, and aesthetic treatments would be developed during final design.

FIGURE 21. EXISTING CONDITIONS AND PHOTOGRAPHIC SIMULATION – LOW BRIDGE OPTION

Note: Simulations are intended to show massing and visual impacts. Final bridge design, column location, and aesthetic treatments would be developed during final design.

FIGURE 22. EXISTING CONDITIONS AND PHOTOGRAPHIC SIMULATION – HIGH-CURVILINEAR BRIDGE OPTION

Note: Simulations are intended to show massing and visual impacts. Final bridge design, column location, and aesthetic treatments would be developed during final design.

FIGURE 23. EXISTING CONDITIONS AND PHOTOGRAPHIC SIMULATION – HIGH-LINEAR BRIDGE OPTION

Cumulative Impacts

Past, present, and reasonably foreseeable future actions have and continue to contribute to the cumulative impacts on visual resources. Past projects completed in the surrounding areas include nearby Parkway project sections, while future actions could include bridge and roadway maintenance of the Parkway and the Gatlinburg Spur improvements. All past, present, and future projects were carried forward to provide for a better user experience and ability to travel safely throughout the park. When the incremental temporary construction impacts from alternative 2 are combined with the impacts from past, present, and reasonably foreseeable actions, the overall cumulative impact on visual resources would result in short-term, adverse impacts. Long-term, adverse impacts on visual resources are anticipated; however, these impacts would be minimized by the project's commitment to maintaining a consistent visual character throughout the entire Parkway corridor.

HISTORIC STRUCTURES AND DISTRICTS

AFFECTED ENVIRONMENT

HISTORIC STRUCTURES

No historic structures or other aboveground historic resources have been identified in the direct area of potential effects (APE); however, visual impacts on potentially eligible or unevaluated properties could occur. Current TN SHPO data show 22 previously identified historic-era resources within the visual portion of the APE, referred to as the indirect APE. Following the TN SHPO's recommendation, NPS staff field verified the current status of the previously identified resources in May 2024 (Table 15**)**. Upon review, 15 of the 22 previously identified resources had been evaluated in the 1992 Thompson report, and all 15 were recommended as not individually eligible for National Register of Historic Places (National Register) listing. Four of these 15 resources are no longer extant as of May 2024, and 7 currently have an undetermined status as extant due to a lack of visibility from public property (the remaining 4 were verified as still standing). Of the seven historic resources not included in the Thompson report, four are no longer extant (SV-209, 1046, 1171B, 1172), while three are still extant (SV-204, SV-1028, and SV-1171); these three resources are being treated as National Register-eligible for the current undertaking in the absence of a formal determination of eligibility.

GATLINBURG SPUR HISTORIC DISTRICT

During previous consultation for the Gatlinburg Spur Improvements Project (Project No.: SHPO0001128), the NPS and the TN SHPO agreed that the Gatlinburg Spur is eligible for listing in the National Register as a historic district. The NPS will conduct a formal Determination of Eligibility for the Spur and an inventory of contributing features per stipulations in the Memorandum of Agreement for the Spur Improvements Project. The NPS consultation letter dated April 3, 2023, includes a summary of relevant design history for the Spur, which is incorporated by reference. Contributing features of National Register-eligible road systems often include bridges, culverts, tunnels, retaining walls, and pull-offs, all of which are present along the Spur (photo documentation of the current conditions of the Spur was completed previously and accepted by the TN SHPO in January 2024). As part of the Section 8D project, the NPS identified built Spur features within the direct APE that could be altered by the project. The following resources located within the APE are contributing features to the Gatlinburg Spur Historic District:

- The four-lane roadway alignment consisting of two southbound and two northbound lanes on either side of the West Prong.
- Gum Stand Road Bridge (constructed in 1960).
- Three culverts and associated stone headwalls.

TABLE 15. PREVIOUSLY IDENTIFIED HISTORIC RESOURCES IN THE PROJECT AREA

TN SHPO ID	Resource Name	May 2024 Field Result	Individual National Register Eligibility Status for Current Assessment of Effects
SV-132	West Lawson House	Not extant	Not eligible (Thompson 1992, now demolished)
SV-133	West Lawson Barn	Not extant	Not eligible (Thompson 1992, now demolished)
SV-212	Mack Myers House	Undetermined, not visible from public property	Not eligible (Thompson 1992)
SV-210	Lewis Myers House (ca. 1946)	Undetermined (possibly extant), not fully visible from public property	Not eligible (Thompson 1992)
SV-211	Lewis Myers House (ca. 1920)	Undetermined, not visible from public property	Not eligible (Thompson 1992)
SV-223	Walter Huskey Barn (ca. 1920)	Not extant	Not eligible (Thompson 1992, now demolished)
SV-202	Walter Huskey Barn (ca. 1920)	Not extant	Not eligible (Thompson 1992, now demolished)
SV-201	Walter Huskey House (Pyramid)	Undetermined (probably not extant based on aerial photos), not fully visible from the road	Not eligible (Thompson 1992)
SV-203	J.C. Monicier House (ca. 1940 flagstone)	Undetermined, not visible from public property	Not eligible (Thompson 1992)
SV-224	J.W. Huskey House (1928-1929)	Undetermined, probably not extant (non-historic house in approximate same location)	Not eligible (Thompson 1992)
SV-225	Estes McCarter Barn	Undetermined, not visible from public property	Not eligible (Thompson 1992)
SV-226	George Loveday House Ruins	Chimney and foundation extant	Not eligible (Thompson 1992)
SV-227	Freeman Starkey House	Extant	Not eligible (Thompson 1992)
SV-228	Freeman Starkey Barn	Extant	Not eligible (Thompson 1992)
SV-229	Andrew Starkey House	Extant	Not eligible (Thompson 1992)
SV-209	Jim Cooper House	Not extant	Not eligible
SV-204	Henry Huskey House (ca. 1950)	Extant	Assumed National Register-eligible for the current undertaking
SV-1046	Cardwell House	Not extant	Not eligible
SV-1028	James Cardwell House	Extant	Assumed National Register-eligible for the current undertaking
SV-1171	Jerry King Farm	Extant	Assumed National Register-eligible for the current undertaking
SV-1171B	Jerry King Farm-Barn	Not extant	Not eligible
SV-1172	George Laymon Farm	Not extant (demolished ca. 2022)	Not eligible

Note: Resources without dates of construction reflect the absence of a date in the TN SHPO data.

TRENDS AND PLANNED ACTIONS

The NPS's Cultural Resources Climate Change Strategy establishes goals to preserve and maintain cultural resources as the climate continues to warm. Rising temperatures expedite crystallization of efflorescent salts from increased evaporation rates, which can lead to higher rates of structural cracking and deterioration of the existing masonry bridges in the project area and other historic structures in the National Register-eligible Gatlinburg Spur (NPS 2016d). Moisture absorption in brick and porous stone structures from the potential increase of intense rainfall events may lead to frost damage, mold growth, and stress from the salt crystallization (NPS 2016d). Surface cracking, flaking, and sugaring (i.e., surface disintegration) of these structures and spalling (i.e., peeling away) of stone could also occur as a result of worsening freeze/thaw cycles. If wildfires or other catastrophic weather events related to climate change become more frequent in the park because of warming temperatures or human-caused activity, cracking and other physical damage may occur and potentially further degrade historic cultural resources in the project area.

Past, present, and reasonably foreseeable actions may alter the visual character of the landscape surrounding Section 8D. While these projects would alter the existing visual character, they would not alter the setting of historic resources in the visual APE that would diminish their historic integrity to the level of an adverse effect. The overall setting of the APE has been altered by rapidly increasing new residential and commercial development over the past 30 years, changing the setting enough that other actions related to the construction and use of this segment of the Parkway would have minimal impact on an already altered setting.

ENVIRONMENTAL CONSEQUENCES

The criteria of adverse effect from section 106 of the NHPA were applied (36 CFR § 800.5) were applied to the three historic properties within the APE. An adverse effect to a historic property is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify it for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. The TN SHPO reviewed the Assessment of Effects (AOE) report as part of its NHPA section 106 consultation effort for the project. The consultation process is detailed in chapter 4.

ALTERNATIVE 1: NO ACTION

Under the no-action alternative, the NPS would not construct Section 8D of the Parkway. No impacts to historic resources would occur from the no-action alternative; however, adverse impacts on historic structures and districts could occur, given the trends and planned actions noted above.

ALTERNATIVE 2: NPS PREFERRED ALTERNATIVE

Historic Structures

Three historic-period structures within the indirect APE that are included in the TN SHPO files as previously identified are being treated as National Register-eligible for the purposes of the current undertaking (Henry Huskey House, James Cardwell House, and Jerry King Farm).

Construction Impacts. The Parkway would be consistent with the NPS *Park Road Standards* and with the constructed sections of the Parkway (NPS 1984). The proposed Section 8D bridge and interchange are part of the original plan for the construction of Parkway. Roadway materials and aesthetic considerations would be consistent with the constructed sections of the Parkway. The inclusion of stormwater management features (e.g., grass ditches and vegetated swales) would have no adverse effect on the historic character of the Spur, the primary feature of the eligible Gatlinburg Spur Historic District.

Exotic plant species would be removed during construction, and cut slopes would be rounded out to enhance revegetation with indigenous species. Although construction would alter the Spur's woodland

setting (a character-defining feature of the Spur roadway), the impact would be localized and short term. Revegetation would restore the woodland setting, and the clearcutting of trees for construction would have no adverse effect on the historic character of the Spur because revegetation would mitigate the construction impacts.

There would be no direct construction impacts on the three previously identified historic resources within the APE; therefore, no adverse effect during construction are anticipated. Additionally, the standard design parameters established by the NPS would ensure Section 8D would be consistent with the previously constructed sections of the Parkway. As a result, indirect effects on the other previously identified historic resources within the indirect APE would not rise to the level of an adverse effect per NHPA during construction.

Post-Construction Impacts. Section 8D through Wears Valley would be visible from the historic resources within the indirect APE. Because of NPS design parameters intended to minimize the intrusiveness of Section 8D, indirect effects on historic resources within the indirect APE would not rise to the level of an adverse effect per NHPA, especially because the existing Wears Valley Road already bisects the area and is part of the visual character of the Valley. The Parkway design would be consistent with previously built sections of the Parkway, and resource protection measures would be in place to restore the vegetation as closely as possible to the corridor's current appearance. The new roadway drainage features, such as swales and ditches, would be grassed or otherwise vegetated, maintaining the existing appearance of the project area. Section 8D would not adversely alter the setting of any of the historic resources within the indirect APE.

Gatlinburg Spur Historic District

Spur Bridge Options

The NPS is considering three bridge design options where Section 8D would cross over the Spur and West Prong near Gum Stand Road and King Branch Road. All three options would connect to the Spur and local roadways using the same general interchange configuration; however, bridge height, alignment, geometry, and required slope cuts would vary for each design option. The lengths of the three bridges for the Low Bridge Option would range from approximately 210 feet to 605 feet, while the length of the three bridges evaluated for the High-Curvilinear Option would range from approximately 170 feet to 1,165 feet. The length of the three bridges for the High-Linear Bridge Option would range from approximately 180 feet to 1,020 feet. Visual simulations of each bridge option are included as Figure 21 through Figure 23. The replacement of the Gum Stand Road Bridge would remove a contributing element to the Spur, which would constitute an adverse effect. The remaining stone-faced culverts along the Spur are considered contributing elements to the Spur Historic District. The remaining 11 culverts would be altered by extending the inlet or outlet pipes and relocating the affected inlet or outlet structures or stone headwalls. In cases where stone masonry headwalls would be relocated, the headwall would be dismantled, and the stones would be numbered and stored for construction of the relocated headwall. New stone that matches the color and texture of the existing stone would be used if the integrity of existing stone is compromised or if additional stone is required based on design/structural considerations. As such, alteration of the 11 stone headwalls would have no adverse effect on the Spur.

<u>Low Bridge Option</u>. This bridge design option would minimize the distance from which the overpass would be visible to people driving on the Spur (northbound and southbound) and the length of time during which drivers would see it. The Low Bridge Option would be visible for a shorter driving period than the High-Curvilinear Bridge Option or the High-Linear Bridge Option; however, because its height would be lower, it would be visible to vehicles driving on the Spur as they approach the structure and pass beneath it. Furthermore, construction of the Low Bridge Option would require a 95-foot horizontal cut into the hillside on the eastern side of the Spur, which would be visible to motorists on the Spur and on Caney Creek Road.

The scale of the Low Bridge Option would be consistent with the human scale of the scenic Parkway, consistent with other bridges on the Spur, and less obtrusive on the landscape than the other bridge options. Although visible cuts, the retaining walls, and the bridge itself would be an intrusion on the historic Spur's setting, these features would not adversely affect the other contributing features of the potentially eligible Gatlinburg Spur Historic District. The Spur would retain its historic use as a scenic byway, while the integrity of its location, design, setting, materials, workmanship, feeling, and association with the Mission 66 era would remain intact. The location of the Spur would not change, and the design, setting, materials, workmanship, feeling, and association of the Spur would remain consistent with existing conditions along its length, which as a whole, would not be adversely altered by the construction of the bridge.

<u>High-Curvilinear Bridge Option</u>. This option would require a less extensive horizontal cut (50 feet) on the eastern side of the Spur compared to the Low Bridge Option; the cut would not be visible to park visitors driving along the Spur. However, the High-Curvilinear Bridge Option would be more prominent to traveling viewers and would be longer to cross the width of the valley at a higher elevation. The longer span would also require a more substantial and visible structure (i.e., the bridge deck, piers, and footers), but vegetation and the narrow field of vision would limit the exposed structures. The High-Curvilinear Bridge Option would likely introduce more visual impacts than a similar bridge at a lower elevation; however, the higher bridge option would require less cut-and-fill construction in the scenic Pigeon River Valley (NPS 2022b).

The scale of the High-Curvilinear Option would not be consistent with the human scale of the scenic Parkway and would be more visually obtrusive on the landscape than the Low Bridge Option. However, although the visible cuts, retaining walls, and construction of the bridge itself would intrude on the historic Spur's setting, they would not adversely affect the potentially eligible Gatlinburg Spur Historic District. The Spur would retain its historic use as a scenic byway, while the integrity of its location, design, setting, materials, workmanship, feeling, and association with the Mission 66 era would remain intact. The location of the Spur would not change, and the design, setting, materials, workmanship, feeling, and association of the Spur would remain consistent with existing conditions along its length, which as a whole, would not be adversely altered by the construction of the bridge.

<u>High-Linear Bridge Option</u>. Like the High-Curvilinear Option, the scale of the High-Linear Option would not be consistent with the existing bridges on the Spur and would be more visually obtrusive on the landscape than the Low Bridge Option. Although the visible cuts, retaining walls, and construction of the bridge itself would intrude on the historic Spur's setting, they would not adversely affect the contributing features of the potentially eligible Gatlinburg Spur Historic District. The Spur would retain its historic use as a scenic byway, while the integrity of its location, design, setting, materials, workmanship, feeling, and association with the Mission 66 era would remain intact. The location of the Spur would not change, and the design, setting, materials, workmanship, feeling, and association of the Spur would remain consistent with existing conditions along its length, which would not be adversely altered as a whole by the construction of the bridge.

<u>Preferred Bridge Option Identification</u>. To allow for design flexibility, the NPS does not identify a preferred bridge option in this EA. Should alternative 2 be selected for implementation, consultation with the TN SHPO would be ongoing, pending the identification of the preferred bridge option for review and concurrence. See chapter 4 "Consultation and Coordination" for more details regarding section 106 consultation.

Spur Interchange Access Options

The NPS is considering two interchange access options at the Spur to minimize project-related impacts. To maintain the flow of traffic between the Parkway and the Spur, the three bridge design options would connect through an interchange bridge over the Spur with supporting loops and ramps. Under both

interchange access options, a two-way loop on the eastern side of the Spur would connect the Parkway and the interchange.

Interchange Access Option 1. The construction of a new interchange bridge under interchange access option 1 would not negatively affect the overall historic character of the Spur or undermine its eligibility for listing in the National Register. The proposed Section 8D bridge and interchange are part of the original plan for the construction of Parkway, and roadway materials and aesthetic considerations would be consistent with the constructed sections of the Parkway. The modifications to the existing access points between the Spur and Gnatty Branch Road and King Branch Road would not negatively affect the historic character of the Spur. While construction of new access ramps would introduce a new visual element to the historic roadway, the ramps would be designed to be compatible with the Spur's Mission 66-era design aesthetics. As a result, their addition would not undermine the eligibility of the potential National Register district. Although these proposed alterations would affect the Spur's design integrity in a concentrated location, the Gatlinburg Spur Historic District would still retain its integrity in terms of location, setting, materials, workmanship, feeling, and association with the Mission 66 era. The location of the Spur would not change, and the design, setting, materials, workmanship, feeling, and association of the Spur would remain consistent with existing conditions along its length, which would not be adversely altered overall by the construction.

Interchange Access Option 2. The construction of a new interchange bridge under interchange access option 2 would not negatively affect the overall historic character of the Spur or undermine its eligibility for listing in the National Register. The proposed Section 8D bridge and interchange are part of the original construction plan for Parkway, and roadway materials and aesthetic considerations would be consistent with the constructed sections of the Parkway. The construction of a new interchange bridge would not have an adverse effect on the historic character of the Spur. Additionally, the modification to the existing access point between the Spur and Gnatty Branch Road and the removal of the access point between the Spur and King Branch Road would not have an adverse effect on the historic character of the Spur. Although these proposed alterations would affect the Spur's design integrity in a concentrated location, the larger Gatlinburg Spur Historic District would retain its integrity in terms of location, setting, materials, workmanship, feeling, and association with the Mission 66 era. The location of the Spur would not change, and the design, setting, materials, workmanship, feeling, and association of the Spur would remain consistent with existing conditions along its length, which would not be adversely altered by the construction of the bridge. Option 2 includes the removal of the existing Gum Stand Road Bridge, which would be an adverse effect on this contributing element. The NPS will continue consultation with the TN SHPO if this is the preferred option.

Preferred Interchange Option Identification. To allow for design flexibility, the NPS does not identify a preferred interchange option in this EA. Should alternative 2 be selected for implementation, consultation with the TN SHPO would be ongoing, pending the identification of the preferred interchange option for review and concurrence. See chapter 4 "Consultation and Coordination" for more details regarding section 106 consultation.

CUMULATIVE IMPACTS

As discussed above in the "Trends and Planned Actions" section, past and continued land development in the vicinity of Section 8D, in Wears Valley, and along the Spur, and the development of Parkway Section 8E have altered the general character of the built environment in the vicinity of the eligible Gatlinburg Spur Historic District. However, the general changes to the built environment would not cumulatively result in adverse effects to the eligible district. Although construction associated with alternative 2 would adversely impact the Spur's woodland setting, which is a character-defining feature of the Spur roadway, the impact would be localized and short term. Pending concurrence with the TN SHPO, revegetation would restore the woodland setting, and the clearcutting of trees for the purpose of construction would have no adverse effect on the historic character of the Gatlinburg Spur Historic District.

CHAPTER 4: CONSULTATION AND COORDINATION

A detailed description of the civic engagement and the agency consultation conducted during the development of the EA is provided below.

PUBLIC PARTICIPATION AND SCOPING

THE CIVIC ENGAGEMENT AND SCOPING PROCESS

Public involvement is an essential component of the NEPA planning process. The NPS issued a press release to local, regional, and national media outlets on September 30, 2021, announcing the start of the civic engagement period for Section 8D, including the preliminary alternatives and potential impacts. The NPS also sent the press release and electronic newsletter to interested individuals and organizations notifying them of the opportunity to comment, and activated the NPS Planning, Environment & Public Comment (PEPC) website (https://parkplanning.nps.gov/Section8D) for the public to submit comments. In addition to the press release and newsletter, the NPS hosted a virtual public meeting on October 14, 2021. The meeting included an overview of the project and a question-and-answer session. Sixty-four attendees were present during the public meeting, and 285 correspondences were received during the public comment period.

The formal NEPA process and 30-day public scoping period was initiated on October 19, 2023. The park issued a press release announcing the public scoping period, and a newsletter was released to park stakeholders, partners, and adjacent property owners. The newsletter provided information about the project background, purpose and need for taking action, an overview of the preliminary alternatives, resource considerations, the current project schedule, and information on how to comment. The park encouraged the public to submit comments through the NPS's PEPC website at: https://parkplanning.nps.gov/Section8D. Ninety-five correspondences were received during the public comment period.

PUBLIC COMMENT

The EA and draft combined Statement of Findings are available on the NPS PEPC website: https://parkplanning.nps.gov/Section8D for formal public and agency review and comment for 30 days. Interested individuals, agencies, and organizations were notified of its availability.

AGENCY AND TRIBAL CONSULTATION

The NPS initiated consultation with relevant agencies during the preparation of this EA, as discussed in more detail below.

SECTION 7 OF THE ENDANGERED SPECIES ACT

In accordance with section 7 of the ESA, the NPS prepared a Biological Assessment and initiated formal consultation with USFWS. Based on the biological analysis of potential impacts from constructing Section 8D, the NPS requested concurrence from USFWS that all potential effects from the preferred alternative to federally listed, proposed, and candidate species would be insignificant or discountable, and the project *may affect but is not likely to adversely affect* the gray bat, Indiana bat, northern long-eared bat, and monarch butterfly. However, the project could adversely affect the tricolored bat, and the NPS will obtain a biological opinion from USFWS as an outcome of section 7 consultation. The Cumberland moccasin shell, oyster mussel, and Tennessee pigtoe were dismissed from analysis because the project would have no effect on these species due to their absence from the project area or downstream waterways. Consultation efforts with USFWS are ongoing, and the park will complete the section 7 consultation process prior to finalizing the NPS decision document for this EA. The conclusion of the section 7 consultation process will be provided in the decision document.

SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT AND TRIBAL CONSULTATION

In accordance with section 106 of the NHPA, the park is consulting with the TN SHPO. The NPS initiated consultation with the TN SHPO on October 21, 2021, and provided a Phase 1 archeological survey for review and concurrence. On November 19, 2021, the TN SHPO provided comments on the report. Comments were focused on minor clarifications and administrative requirements. On March 8, 2022, the park provided the revised Phase 1 archeological survey for review and concurrence, with a follow up and request for a meeting on January 31, 2024. On February 5, 2024, the TN SHPO concurred with the findings in the report.

The NPS met with the TN SHPO on March 5, 2023, to discuss the Section 8D project and its potential impacts, particularly regarding Wears Valley's historical landscape, and to identify potential project impacts. On March 29, 2024, the NPS presented its findings for review and concurrence, recommending that Wears Valley is ineligible for National Register listing. The TN SHPO concurred with the findings on the Determination of Eligibility on April 18, 2024. However, the TN SHPO noted that there may be properties within Wears Valley that may be individually eligible for listing, thus three unevaluated properties were retained for analysis.

The NPS sent a letter to TN SHPO on July 11, 2024, presenting its finding in the AOE report for review and concurrence. The TN SHPO concurred with the findings in the AOE report on July 12, 2024, noting that none of the bridge options would result in an adverse effect. Of the two interchange options, TN SHPO concurred that Interchange Access Option 1 would not adversely affect the National Register-eligible Gatlinburg Spur Historic District and that Interchange Option 2 would adversely affect it.

A final determination of effect is pending completion of the section 106 process, including identification of the preferred interchange and bridge design options, consideration of any public comments on this EA, and ongoing consultation with the TN SHPO and traditionally associated Native American Tribes. The park will complete the section 106 consultation process prior to finalizing the NPS decision document for this EA.

In accordance with section 106 of the NHPA, the park initiated consultation with six Native American Tribes on March 4, 2024, providing a description of the proposed action, background information, and project maps. These Tribes included: Cherokee Nation, Eastern Band of Cherokee Indians, Eastern Shawnee Tribe of Oklahoma, United Keetoowah Band of Cherokee Indians in Oklahoma, Muscogee Creek Nation, and Poarch Band of Creek Indians. No responses were received. The park will continue to coordinate with these Tribes during the design phase, as section 106 consultation advances. Coordination with these Tribes will occur when design updates are provided to the TN SHPO.

ACRONYMS AND ABBREVIATIONS

AOD	area of disturbance
AOE	Assessment of Effects
APE	area of potential effects
AWSC	all-way STOP-controlled unsignalized intersection
BCC	Birds of Conservation Concern
BMP	best management practice
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
dB	decibels
EA	environmental assessment
E. coli	*Escherichia coli*
EFLHD	Eastern Federal Lands Highway Division
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
GPS	Global Positioning System
HCM	Highway Capacity Manual
IPaC	Information for Planning and Consultation
LiDAR	light detection and ranging
LOS	level of service
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
park	Great Smoky Mountains National Park
Parkway	Foothills Parkway
PEPC	NPS Planning, Environment, and Public Comment
Section 8D	Section 8D of the Foothills Parkway
Spur	Gatlinburg Spur
SWPPP	stormwater pollution prevention plan
TDEC	Tennessee Department of Environment and Conservation
TDOT	Tennessee Department of Transportation

TN SHPO	Tennessee State Historic Preservation Office
TWRA	Tennessee Wildlife Resources Agency
TWSC	two-way STOP-controlled unsignalized intersection
USFWS	United States Fish and Wildlife Service
USGS	US Geological Survey
West Prong	West Prong of the Little Pigeon River
WNS	white-nose syndrome

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Great Smoky Mountains National Park

U.S. Department of the Interior
National Park Service

Foothills Parkway Section 8D Environmental Assessment Appendices

July 2024

Appendix A – Alternatives Considered But Dismissed

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ALTERNATIVES CONSIDERED BUT DISMISSED

As explained in chapter 2 of the environmental assessment, due to the geographic and topographic constraints of the Foothills Parkway corridor, no other detailed roadway alignments were considered for Section 8D. The following alternatives were considered but dismissed from further analysis because they were not considered reasonable alternatives (e.g., they did not meet purpose and need or were determined not to be technically or economically feasible).

Construction outside the existing corridor – Constructing portions of Foothills Parkway Section 8D outside the existing National Park Service (NPS)-managed corridor to avoid potentially sensitive areas such as karst or unstable slopes was dismissed from analysis because it does not meet the purpose and need. As described in the "Project Area and Background" section in chapter 1, all lands comprising the Foothills Parkway corridor were acquired by Tennessee and conveyed to the United States government. Federal and state legislation authorize construction within the existing corridor. Accordingly, the purpose of the proposed action is to construct Section 8D of the Foothills Parkway within the existing NPS-managed corridor.

Construction of recreational amenities – Public comments received during civic engagement (October 2021) and public scoping (October 2023) requested that the NPS consider constructing recreational amenities such as hiking, biking, and equestrian trails within the 8D corridor, either in conjunction with the road or in lieu of the road. Although federal and state legislation do not preclude other recreational amenities in the corridor, the legislative mandate is to construct a scenic parkway within the NPS-managed corridor. Therefore, constructing recreational amenities in lieu of the road does not meet the purpose and need or address legislative mandates. The NPS has completed the environmental compliance process for mountain bike trails in the Wears Valley segment of Section 8D and may consider other recreational amenities in the future. However, the current planning process for Section 8D is focused on road construction.

Appendix B – Resource Protection Measures and Best Management Practices

RESOURCE PROTECTION MEASURES AND BEST MANAGEMENT PRACTICES

Topic	Measure	Authority	Responsible Party
Design and Construction (General)	Use bridges and retaining walls where appropriate to minimize the number of large cuts and fills. Conduct site-specific survey work and engineering studies during final design to determine specific locations of bridges and retaining walls.	National Park Service (NPS) *Management Policies 2006*, Sections 4.1.1 and 9.1.1	NPS/Federal Highway Administration (FHWA)
Design and Construction (General)	Develop detailed methods during final design to avoid areas where the potential for landslides has been identified or to construct in a manner that would ultimately stabilize these areas.	NPS *Management Policies 2006*, Sections 4.8.1.3 and 9.1.1.5	NPS/FHWA
Design and Construction (Wildlife)	Conduct tree and vegetation clearing between November 15 and March 31 to avoid impacts on federally listed bats and nesting birds. Avoid removal of large-diameter trees whenever possible to minimize impacts on bat habitat.	Endangered Species Act (ESA) and Migratory Bird Treaty Act	NPS/FHWA
Design and Construction (Vegetation)	Limit vegetation removal to areas directly impacted by roadway construction and preserve existing vegetation where possible. Avoid and minimize impacts on retained trees adjacent to the area of disturbance (AOD) by using management practices such as tree protection fencing, root pruning, and preventing compaction of soil over root systems. Avoid damage to and properly prune damaged limbs on retained trees using standard arboricultural practices.	NPS *Management Policies 2006*, Section 4.4.2.1	NPS/FHWA
Design, Construction, and Operation (Wildlife)	Develop additional protection measures to avoid and minimize impacts to bats as part of the ongoing ESA section 7 consultation process with the US Fish and Wildlife Service (USFWS). These measures would address protection of tricolored bats and their habitat in and near the undisclosed cave and may include: • Time of year or other restrictions to avoid and minimize loud construction noise and excessive vibration that could result in the disruption or disturbance of tricolored bats in the undisclosed cave during hibernation.	ESA; NPS *Management Policies 2006*, Section 4.4.2.3	NPS/FHWA

Topic	Measure	Authority	Responsible Party
	• Time of year or other restrictions to avoid and minimize nighttime work that could result in the disruption or disturbance of tricolored bats during fall swarming and spring staging in the vicinity of the undisclosed cave. • Restrictions to avoid and minimize activities resulting in alteration of the undisclosed cave entrance(s) or internal environments (e.g., adverse alterations to airflow, microclimate, and hydrology) at any time of year. • Implementation of management practices that would improve tricolored bat summer roosting habitat in the park.		
Design and Construction (Wildlife)	If Interchange Option 2, which includes removal of the Gum Stand Road Crossover Bridge, were selected, perform surveys for bat presence at the bridge in accordance with USFWS survey guidelines (USFWS latest version) prior to removal of the bridge. If surveys indicate that the bridge is occupied by special status bats, the NPS would reinitiate consultation with USFWS, and bridge demolition would occur during winter (November 16 through March 31) to avoid disturbing bats during their active season (April 1 through November 15).	ESA; NPS *Management Policies 2006*, Section 4.4.2.3	NPS/FHWA
Design and Construction (Wildlife)	Limit construction activities to daylight hours whenever possible. Where nighttime construction is necessary: • Direct temporary construction lighting away from suitable bat habitat during the active season (April 1 through November 14). • Shield light sources to avoid light spillover. • Limit fugitive light from portable sources.	ESA; NPS *Management Policies 2006*, Section 4.4.2.3	FHWA
Operation (Wildlife)	Remove hazard trees only in consideration of bat protection requirements. Limit tree removal between November 15 and March 31. If removal of a tree with bat roost characteristics is needed between April 1 and November 14, have a qualified individual observe for bats for 30 minutes before and after sunset. Remove the tree the following morning if bats were not observed. If bats were observed, re-survey the tree and do not cut until the survey confirms that bats are no longer roosting in the tree. In cases where imminent harm to life and property exists, complete hazard tree removal in consultation with the USFWS.	ESA; NPS *Management Policies 2006*, Section 4.4.2.4	NPS

Topic	Measure	Authority	Responsible Party
Design and Construction (Wildlife)	Mow open field areas within the AOD prior to construction to avoid impacts on grassland nesting birds. Complete the first mowing before the breeding season (April 23 to August 15) to discourage birds from establishing nests; continue mowing at approximately four-to-seven-week intervals until construction starts.	Migratory Bird Treaty Act; NPS *Management Policies 2006*, Section 4.4.2.1	NPS/FHWA
Design, Construction, and Operation (Vegetation)	Develop and implement a revegetation plan for all areas temporarily disturbed during construction to include at a minimum: (1) locations of revegetation sites;, (2) soil preparation needs such as aerification and decompaction; (3) locations and details for any needed topsoil storage; (4) use native plant species to blend with the existing natural environment and promote the visual character of the park; (5) use natural patterns in planting plans to create congruous vegetative patterns; (6) time of year that the seeding would occur and the methodology of the seeding; (7) any needed measures to control invasive vegetation including but not limited to those measures described below; (8) post-construction monitoring of revegetation success; and (9) post-construction control of invasive plants.	NPS *Management Policies 2006*, Sections 4.4.2.5 and 9.1.3.2	NPS/FHWA
Design and Construction (Vegetation)	Implement the following measures to stop further spread of invasive plants into and out of the project area: • Clean all earthmoving and seeding equipment prior to entering NPS lands. Once cleaned, the contractor would schedule inspection with NPS staff to confirm sufficiency. • Use only topsoil, rock, sand, gravel, or other natural materials from park-approved sources.	Federal Noxious Weed Act; NPS *Management Policies 2006*, Section 4.4.4	NPS/FHWA
Design, Construction, and Operation (Vegetation)	Conduct invasive plant monitoring and treatment/removal in accordance with the parkwide long-term invasive plant management program. After the initial post-construction monitoring and control period, integrate invasive plant management with the parkwide invasive plant management program based on observed conditions and management priorities.	Federal Noxious Weed Act; NPS *Management Policies 2006*, Section 4.4.4	NPS
Design and Construction (Vegetation)	Install fencing prior to construction to protect special status plants growing near the AOD.	ESA; NPS *Management Policies 2006*, Section 4.4.1.5	NPS

Topic	Measure	Authority	Responsible Party
Design and Construction (Vegetation and Water Resources)	Preserve an undisturbed riparian buffer to the maximum extent practicable.	NPS *Management Policies 2006*, Section 4.6.6	NPS/FHWA
Design and Construction (Water Resources, Karst, Vegetation)	Implement sediment and erosion control measures consistent with the permitting requirements and recommendations contained in the Tennessee Department of Environmental and Conservation's (TDEC) Tennessee Erosion and Sediment Control Handbook (TDEC 2012, or latest edition), including revegetation, to minimize erosion and visual scars. File a Notice of Intent with TDEC to obtain coverage under the Tennessee Construction General Permit (Permit Number TNR100000). Develop a site-specific stormwater pollution prevention plan in accordance with Part 5 of the General Permit that would: • Specify erosion control materials that are weed-free, pest-free, and do not pose an entanglement risk to wildlife. Use natural fiber logs or fascines and natural fiber blankets that are certified as weed-free. Prohibit specific materials in the park, including (1) imported hay bales, straw bales, wood chips, or mulch; and (2) all forms of plastic/synthetic mesh netting, including those that are labeled as biodegradable or photodegradable. • Include provisions for removal of temporary erosion and sediment control measures after vegetation is established and the site is stable.	TN Code 69-3-101 et seq.; NPS *Management Policies 2006*, Section 4.6.6	NPS/FHWA
Design, Construction, and Operation (Water Resources)	Develop and implement a water quality monitoring program similar to previous Parkway monitoring (e.g., Privette 2017). Conduct monitoring at a representative sample of surface water and groundwater sites within and downstream of Section 8D. Conduct monitoring prior to, during, and after construction and include surface water and selected drinking water sources (springs and wells).	NPS *Management Policies 2006*, Section 4.6.3	NPS/FHWA
Design and Construction (Water Resources)	Adhere to the conditions of any Clean Water Act section 404 and 401 permits to minimize potential impacts on streams and wetlands during any in-water work or ground disturbance in the vicinity of aquatic resources.	Clean Water Act; NPS Director's Order #77-1	FHWA

Topic	Measure	Authority	Responsible Party
Design and Construction (Water Resources)	Provide compensatory mitigation to offset wetland impacts by planting native woody vegetation with a 5:1 mitigation ratio to restore natural wetland functions and ensure permanent site protection of riverine wetland buffers in the Cades Cove Stream Restoration Project.	NPS Director's Order #77-1	NPS/FHWA
Operation (Water Resources)	Implement a monitoring and remediation period of two years following completion of construction for purposes of assessing the impact of construction activities on stream crossings and wetlands. Use the monitoring and remediation phase to identify any construction-related impacts to streams and wetlands that require restoration, repair, or other mitigation. At minimum, conduct such monitoring immediately after construction is completed and at least once each spring and fall for two years following the completion of construction, and after any significant flood event. If the monitoring indicates that the stream crossing was not properly constructed/restored, undertake measures to correct the problem.	NPS Director's Order #77-1	NPS
Design and Construction (Cultural Resources)	Establish 100-foot protective buffers around archeological sites that are potentially eligible for listing in the National Register of Historic Places (National Register) and install fencing to prevent entry during construction.	National Historic Preservation Act (NHPA)	NPS
Design and Construction (Cultural Resources)	If construction activities inadvertently discover a previously unidentified archeological site, component, and/or human remains, cease all construction work in the immediate area, secure the area, and notify the Superintendent and the Park Archeologist immediately. Any willful destruction of the archeological site, component, and/or human remains can result in the prosecution of individuals under the Archeological Resource Protection Act of 1979 and other statutes that protect the park's cultural resources. Cease all construction work in any area that contains a previously unidentified archeological site, component, and/or human remains until it can be evaluated by the NPS to determine whether it meets eligibility criteria of the National Register. If the archeological site and/or component are considered eligible to the National Register, the NPS will develop a plan, in consultation with the State Historic Preservation Office (SHPO)/Tribal Historic Preservation Office (THPO), to protect it or undertake a program of data recovery to mitigate the loss of important archeological data. The discovery of human remains, funerary objects, and objects of cultural patrimony will be treated in accordance with the Native American Graves and Repatriation Act (NAGPRA) (25 United States Code 3001). These terms are	NHPA; Native American Graves Protection and Repatriation Act	NPS

Topic	Measure	Authority	Responsible Party
	defined in NAGPRA. If human remains, funerary objects, or objects of cultural patrimony are discovered, cease all construction work in the immediate area, secure the area, and notify the Superintendent and the Park Archeologist immediately. The NPS will initiate consultation with the appropriate SHPO/THPOs and other interested Native American groups to determine the disposition of the human remains, funerary objects, and/or objects of cultural patrimony.		
Design and Construction	Designate concrete washout pits to contain all concrete and wash water waste; ensuring pits are located at least 60 feet away from streams, wetlands, water bodies, sinkholes, drainage ditches, and storm drains, and designed for easy cleanup and removal after construction completion. Line washout pits with an impermeable membrane.	NPS *Management Policies 2006*, Section 4.6.6	NPS/FHWA
Design, Construction, and Operation (Water Resources)	Locate and handle acid-producing material via proper monitoring, testing, and disposition of the material, in accordance with the Tennessee Department of Transportation (TDOT) *Guidelines for Acid Producing Rock Investigation, Testing, Monitoring and Mitigation* (TDOT 2007) and FHWA *Guidelines for Handling Excavated Acid-producing Materials* (Byerly 1990), which generally would consist of: • Screen the project area for pyritic materials using the available geographic information system (GIS) data, geologic literature and maps, and institutional knowledge. • Conduct a visual and geographic assessment of the project area to locate areas of acid-producing material using established TDOT criteria. • Require excavation monitoring and testing by a certified geologist, or qualified individual, to identify any pyrite or pyritic-appearing material, including but not limited to all excavation associated with the tunnel. • Develop a sampling plan based on the visual and geographic assessment and conduct pre-construction sampling and testing to identify the existence, extent, and volume of potential acid-producing material. • Use a professional geologist to periodically oversee construction to examine borehole cuttings and disturbed material for mineralogical content; fizz rating (an assessment of the acid-generating potential of the rock sample); sulfur odor, particularly during fizz testing; or paste pH. The geologist should be on call to resolve issues that may arise.	NPS *Management Policies 2006*, Section 4.8.1.2	NPS/FHWA

Topic	Measure	Authority	Responsible Party

	• Mitigate acid-producing materials based on type: excavated or cut slope.
	  ○ Excavated material can be blended, partially encapsulated, fully encapsulated, or disposed of at a properly permitted waste disposal area.
	  ○ Cut slopes can be altered to allow the placement of non-acidic material followed by the application of soil/plant growth medium (if required) followed by hydroseeding and hydromulching consistent with standard erosion control best management practices (BMPs). Geotechnical measures such as anchored fall drapes may be required for friable cut slope materials.
	• Perform post-construction water monitoring if acidic drainage/runoff is observed and consider additional mitigations based on project area characteristics.		

Design and Construction (Wildlife)	Require the contractor to remove food trash daily, use a bear-proof dumpsters, and incorporate BearWise® practices into construction activities.	NPS *Management Policies 2006*, Sections 9.1.6.1 and 9.1.1.2	NPS/FHWA
Design, Construction, and Operation (Karst, Water Resources)	Implement the following measures to avoid and minimize impacts on karst natural processes and features: • Conduct additional detailed geophysical and geotechnical surveys to further characterize natural karst processes and features in the project area. Use survey data to inform the design process and support development of options to avoid and minimize impacts. • Where feasible, avoid direct disturbance of soil and vegetation within a buffer surrounding identified karst features during the design and construction process. The avoidance buffer size would be consistent with those established for water resources (i.e., 60 feet around Exceptional Tennessee Waters) and based on the best professional judgment of technical specialists knowledgeable about the specific karst feature and local karst features. • If no practicable alternatives exist to avoid identified karst features, use the survey data to support design of specific options and mitigation measures to minimize impacts on the identified features.	NPS *Management Policies 2006*, Section 4.8.1.2	NPS/FHWA

Topic	Measure	Authority	Responsible Party
	• Avoid and minimize discharge of sediment and other potential pollutants to sinkholes and losing streams using BMPs that are consistent with the Tennessee Erosion and Sediment Control Handbook (TDEC 2012, or latest edition). • Comply with Rules of the TDEC Water Supply Division Chapter 0400-45-06 Underground Injection Control established to protect groundwater resources. • Avoid and minimize long-term changes to natural karst drainage patterns and associated surface water and groundwater quality by designing and constructing permanent stormwater BMPs that are consistent with the *Tennessee Permanent Stormwater Management and Design Guidance* Manual's Appendix B Stormwater Design Guidelines for Karst Terrain (TDEC and UT 2014, or latest editions) and other applicable karst-specific guidelines. o Minimize ponding, widely distribute infiltration, and treat runoff using runoff reduction methods. o Maintain, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow. • Adhere to state and federal regulations regarding the storage and handling of fuels and lubricating oils during construction. Do not allow bulk fuel storage (over 50 gallons) on site and do not park fuel trucks for extended periods on NPS lands. For quantities less than 100 gallons, all containers would be US Department of Transportation-approved and any containers between 10 and 50 gallons would need to be double-walled and set in a waterproof containment system (such as a large tub or a fuel pit). • Require secondary containment and overfill protection for refueling of all tanks.		

Topic	Measure	Authority	Responsible Party
Design and Construction (Karst, Water Resources)	• Avoid disturbance to sinkholes, when feasible, by establishing and maintaining vegetated buffers where no construction activity would occur. In instances where a sinkhole cannot be avoided, use bridging techniques to cross the feature. Base the method selected on the characteristics and conditions of the sinkhole that needed to be crossed. Bridging options include: o Conventional Bridge Span: A conventional bridge constructed over a sinkhole area to minimize direct disturbance to the sinkhole area and changes to natural surface drainage patterns. o Bridge on Grade or Land Bridge: A typical land bridge is a concrete slab bridge directly supported by a rock embankment built in and over a sinkhole. o Backfill using Riprap: This technique backfills the collapsed area with riprap. The interlocking action of the riprap backfill and the placement of the backfill on the top of the in-place bedrock can effectively bridge the solution cavity and provide a free draining structure for groundwater and surface drainage (Moore 2006). • Maintain positive site drainage to collect and transport surface water away from structural areas and karst features that would otherwise not receive such surface water during construction and for the life of the structure. • Install rock pads beneath embankments using clean riprap limestone to bridge depressions and sinkholes.	NPS *Management Policies 2006*, Section 4.8.1.2, Tennessee Permanent Stormwater Management and Design Guidance Manual's Appendix B Stormwater Design Guidelines for Karst Terrain	NPS/FHWA
Design, Construction, and Operation (Karst and Water Resources)	Develop and implement a karst management plan as part of the final design package, including, but not limited to: • Provisions for conducting periodic inspections of surface features, mitigation measures applied, and construction activities in karst areas to proactively identify potential concerns during construction and the need to revise or update any procedures established during the design phase. Inspections would be conducted by qualified professionals with experience working in karst (e.g., geologists, geotechnical engineers, and hydrogeologists). This would include review of data from the water quality monitoring program described above. • Thresholds to identify when corrective actions need to be considered.	NPS *Management Policies 2006*, Section 4.8.1.2	NPS/FHWA

Topic	Measure	Authority	Responsible Party
	• Communication protocols for escalating potential issues and obtaining approval for corrective actions, including any required regulatory approvals. • Conceptual design information for temporary stabilization of inadvertently discovered karst features and new karst features that could form during or after construction, including ground subsidence, formation of new sinkholes, or enlargement/collapse of existing sinkholes. • Post-construction monitoring to survey for potential land subsidence that may be associated with activation of a subsurface karst feature.		
Design and Construction (Karst and Water Resources)	Consider the use of rock support deep foundation systems and/or other ground remediation programs, particularly in Buckeye Knob. A ground remediation program may consist of a cement-treated base or cap and compaction grouting targeted to limit the formation of sinkholes or a rock-supported foundation system (such as micropiles, caissons, or drive H-piles) targeted to support a specific structure. Use other intermediate techniques such as aggregate piers with inclusions, as required. Each of these techniques would require additional geotechnical data for design and consideration and a thorough program of ground truthing consisting of multiple soil test borings and wireline rock coring in support of the roadway design (GeoServices 2023).	NPS *Management Policies 2006*, Section 4.8.1	NPS/FHWA
Design, Construction, and Operation (Unstable Slopes)	Conduct additional surveys to identify areas of slope instability and implement measures designed based on the location-specific characteristics, including those found in Unstable Slope Management Program for Federal Land Management Agencies (FHWA 2019). Common methods are listed below. • Create benched slopes to catch material that might travel from above, reduce the velocity of surface runoff, increase infiltration, and provide immediate erosion control for bare soil where vegetative cover is not yet established (Idaho DOT 2011). • Strengthen and/or stabilize the slope using load anchoring, load transfer, or reinforcement techniques and/or drainage techniques as appropriate (FHWA 1999; Highland and Bobrowsky 2008). • Reduce the weight of material to decrease the possibility of stream/river undercutting or construction loading (Highland and Bobrowsky 2008).	NPS *Management Policies 2006*, Sections 4.8.1.3 and 9.1.1.5	NPS/FHWA

Topic	Measure	Authority	Responsible Party
	• Use methods such as catchment zones or retaining walls, as appropriate, to protect the roadway from falling rock (Highland and Bobrowsky 2008). Reference the guidance provided in the FHWA's Context Sensitive Rock Slope Design Solutions (FHWA 2011 or latest edition) to help determine the appropriate method. • Excavate areas prone to rock fall. Create benches to intercept rock fall, and conduct scaling/trimming to remove loose, unstable, or overhanging blocks of rock that may fall (Highland and Bobrowsky 2008). • Reinforce potential rockfall areas. Apply concrete to provide surface reinforcement between blocks of rock and to reduce weathering and surface scaling, or use rock anchors, bolts, and dowels to reinforce and tie together an unstable rock face (Highland and Bobrowsky 2008).		
Design and Construction (General)	• Limit soil and vegetation removal for cut/fill slopes and grading wherever possible. Avoid or minimize changes to the existing topography by simulating the visual character of the native landscapes. • Design contours to resemble natural terrain. • Design the height and extent of cut/fill slopes to minimize the "high-wall" visual effects.	NPS *Management Policies 2006*, Sections 4.4.2.4 and 9.1.3.1	FHWA
Design and Construction (General)	Apply aesthetic design treatments to all visible bridges, walls, and other structures: • Use forms, materials, and finishes such as stone masonry that are sensitive to local visual characteristics and existing Parkway design style to match current Parkway appearance and design. • Use low-sheen and non-reflective surface materials on structures to reduce glare.	NPS *Management Policies 2006*, Section 9.1.1.2	FHWA
Design and Construction (General)	Locate laydown areas for storage of construction machinery and materials in areas that would have the least effect on vegetation and sensitive viewpoints and avoid ecologically sensitive areas. • Use existing hard/paved areas for project staging where practical. • Consider using opaque fencing in laydown and staging areas to reduce visual impacts to sensitive viewers.	NPS *Management Policies 2006*, Sections 4.4.2.1 and 9.1.3.1	FHWA

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Appendix C – Issues and Impact Topics Considered But Dismissed From Detailed Analysis

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ISSUES AND IMPACT TOPICS CONSIDERED BUT DISMISSED FROM DETAILED ANALYSIS

The National Park Service (NPS) identified a range of issues and impact topics to evaluate in this environmental assessment (EA). Impact topics are resources or values that are analyzed for each of the alternatives and are discussed because issues have been identified. During internal, agency, and public scoping, NPS staff identified potential issues that could result from implementation of the proposed alternatives. The NPS *National Environmental Policy Act (NEPA) Handbook* (NPS 2015) provides specific guidance for determining whether to retain issues for detailed analysis. Issues should be retained for consideration and discussed in detail if:

- the environmental impacts associated with the issue are central to the proposal or of critical importance;
- a detailed analysis of environmental impacts related to the issue is necessary to make a reasoned choice between alternatives;
- the environmental impacts associated with the issue are a big point of contention among the public or other agencies; or
- there are potentially significant impacts to resources associated with the issue.

If none of the considerations above apply to an issue, it was dismissed from detailed analysis. Issues and impacts topics dismissed from detailed analysis, including their dismissal rationale, are described below.

The following impact topics and issues were initially considered but were ultimately dismissed from detailed analysis, as explained below. These dismissed issues are not potentially significant, are not critical to choosing among alternatives, and/or are not controversial. These issues are described below with the reason(s) that further analysis was not warranted.

Archeological Resources

Archeological resources are the remains of past human activity and records documenting the scientific analysis of these remains. Archeological features are typically buried but may extend aboveground; they are commonly associated with prehistoric peoples but may be products of more contemporary society (NPS 1998). In 2021, archeologists meeting the Secretary of the Interior's Standards for that discipline completed a survey of the 8D corridor for archeological resources (WSP 2021). In addition to one previously recorded site, the 2021 investigation identified 18 new archeological sites, 4 isolated finds (individual artifacts that are not part of a larger archaeological site), and 21 loci (discrete archeological features). Of those sites, two were considered potentially eligible for listing in the National Register of Historic Places. One site is well outside the area of potential disturbance associated with the proposed action. A second site is also outside the area of potential disturbance but is located adjacent to the potential disturbed area; this archeological site would be avoided during future design efforts and protected during construction. Based on the findings of a Phase I Archeological Survey for the project (WSP 2021), Great Smoky Mountains National Park (the park) made a preliminary determination that alternatives would have no effect on archeological resources.

All consultation with the state historic preservation office is summarized in chapter 4 of the EA and will be documented in the decision document for this project. As detailed in appendix B, if previously unidentified archeological sites, components, and/or human remains are identified during construction activities, the contractor would cease all construction work in the immediate area, secure the area, and notify the Superintendent and the Park Archeologist immediately.

Air Quality

The project area is located in Sevier County, which is in a maintenance area for the 1997 ozone standard. Roadway construction would require the use of heavy construction vehicles and motorized equipment that could contribute emissions that affect local air quality; however, impacts from construction would be temporary and below the de minimis threshold and would not trigger a General Conformity Rule Determination. While temporary impacts would occur during the construction period, no new permanent sources of air emissions would be associated with the project, and no long-term impacts on air quality are anticipated after completion of the proposed action. During construction of Section 8D, carbon monoxide, ozone, and nitrogen oxides would not increase significantly. A temporary increase in fugitive dust from construction activity would adversely affect air quality in the short term. Dust suppression measures such as roadway sprinkling during dry and windy conditions would reduce fugitive dust by 50%. Impacts would be short term, ending after the construction period, which may extend across multiple construction seasons. Section 8D is not anticipated to draw new visitors to the airshed, so it is assumed that emissions from vehicles would be similar to existing conditions with no long-term impact on air quality. Vehicles traveling on the Foothills Parkway (Parkway) would not contribute significantly to cumulative impacts on air quality. If the action alternative is selected for implementation, the project would also be evaluated for Transportation Conformity by various agencies (the metropolitan planning organization, Tennessee Department of Transportation, Federal Highway Administration, US Environmental Protection Agency, and the NPS), which ensures transportation projects do not affect the attainment status of an airshed. As a result, this topic was dismissed from detailed analysis.

Socioeconomics and Environmental Justice

Section 8D's proximity to the park, as well as the area's regional economy are both heavily dependent on tourism. Sevier County exhibits a strong tourism-based economy, and the proposed action is anticipated to have minimal effects on the number of visitors to the park and Section 8D of the Parkway. Construction of Section 8D would have short-term, beneficial impacts on the local economy during the construction period because of the temporary demand for regional construction-related labor. However, the proposed action is not anticipated to induce long-term, beneficial impacts on the local economy or affect overall visitation to the park. Although the project would convert existing land to transportation-related use, minimal effects on property tax revenues are expected because no businesses or residences would be acquired, and the affected land is publicly owned. Improved access to recreational opportunities along Section 8D could have a positive effect on property values, including rental properties, thus indirectly increasing tax revenues over time.

Additionally, concentrations of businesses, community facilities, and public services that cater to environmental justice (EJ) populations are not present in the project area. Displacements of low-income or minority residents are not anticipated under the proposed action because right-of-way acquisition is not required. The proposed action would be constructed to minimize effects, to the extent possible, on EJ populations surrounding the NPS-managed land. Construction-related impacts would include noise, lighting, and dust. However, construction activities are anticipated to affect the general population equally, including minority and low-income residents.

Additional long-term and beneficial effects are anticipated with the proposed action, which would benefit all travelers through the project area equally. These benefits include improving local connectivity and access between communities, community facilities, and emergency vehicles, as well as providing new roadway connections for visitors along the Parkway. No adverse effects are anticipated where EJ populations are identified in the project area. The identified EJ communities in Gatlinburg and Pigeon Forge are outside the census tracts that encompass the project area. Such distance provides them with a buffer for noise and dust associated with construction activities. Therefore, there would not be

disproportionately high and adverse effects on the EJ populations identified within the project area. The proposed action is anticipated to provide minimal, beneficial socioeconomic effects to the economy and would not disproportionately affect low-income or minority populations. As a result, this topic was dismissed from detailed analysis.

Lightscapes

The proposed action does not include installation of lighting along Section 8D, outside of lighting within the tunnel. If necessary, construction lighting would follow all applicable requirements. As a result, this topic was dismissed from detailed analysis.

Soundscapes

In December 2021, acoustical monitoring was completed for seven sites for a period of 7 or 25 days within both the Section 8D and Metcalf Bottoms corridors. A Soundscape Study Report was prepared for the project, and a revised draft was published in March 2023 (WSP 2023).

Under the proposed action, there would be new roadway vehicle traffic throughout the Section 8D corridor from Wears Valley Road to the interchange at the Gatlinburg Spur (Spur). Traffic noise modeling predicted that 4% of the Section 8D study area (85 to 86 acres) would be exposed to a future peak traffic hour L_{A50} sound level at or above the key sound level of 60 decibels (dB) for speech interference; however, those locations are all on the eastern edge of the Section 8D project area, adjacent to the Spur. The orientation of the sound level contours parallel to the Gatlinburg Spur show that noise from the Spur rather than from Section 8D would be dominant in the area. Peak hour traffic noise levels are not predicted to exceed 60 dB L_{A50} or 66 dB L_{Aeq} (equivalent continuous sound pressure level) at any residential receptor locations.[1] Future peak hour traffic noise levels are predicted to exceed the L_{Anat} of 27 dB[2] (the daytime median at Flat Branch, which was the most remote site in the study) in 81% to 82% of the Section 8D study area, which is equivalent to 1,733 to 1,745 acres. Human-generated noise, primarily from vehicles and aircraft, would continue to adversely affect the Section 8D corridor, similar to existing conditions. During the peak traffic hour, future Section 8D roadway traffic noise levels would exceed the natural ambient sound level in most of the corridor and the existing ambient sound level in more than half of the corridor in proximity to the Section 8D roadway. Traffic noise is not expected to adversely affect the ability for hikers or visitors to speak at normal conversational volumes in proximity to the Section 8D roadways; however, speech interference similar to existing conditions is expected to occur near Wears Valley Road and the Gatlinburg Spur, which are already developed. Thus, under the proposed action's future conditions, traffic noise is expected to increase peak daytime hour sound levels above existing conditions, but adverse impacts on visitor experience and residences are not expected. Potential impacts on wildlife from the change in soundscapes is analyzed in the EA under "Biological Resources."

The predominant construction activities associated with the proposed action are expected to be earth removal, hauling, grading, paving, pile driving for bridge construction, and blasting or boring for the proposed tunnel. These activities would cause temporary and localized construction noise impacts. During daytime hours, the predicted effects of these impacts could be temporary speech interference in the vicinity of the construction equipment and audible construction noise at a considerable distance. If construction occurs during evening and nighttime hours near residential areas, noise from steady-state

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[1] L_{A50} is the metric used to describe A-weighted sound pressure levels (L), in decibels, exceeded 50% of the time. Put another way, half of the time, the measured levels of sound are greater than the LA50 value.

[2] The natural sound conditions in parks, which would exist in the absence of any human-caused noise sources. L_{Anat} is the preferred metric to represent baseline or reference conditions for determining the affected environment. Quantitatively, the NPS considers the natural ambient level to be the 50th percentile sound level that exists in the absence of anthropogenic noise.

construction activities such as paving could be audible and may affect nighttime activities (e.g., sleep). Noise from sporadic evening and nighttime construction equipment such as backup alarms and lift gate closures (e.g., slamming of dump truck gates) would be perceived as distinctly louder than the existing steady-state acoustic environment. Extremely loud construction noise activities associated with pile driving and blasting would provide sporadic and temporary construction noise impacts in the vicinity of those activities.

Traffic noise exposure from the three bridge options is generally expected to be similar to each other and to existing conditions. In this area, the existing acoustic environment is dominated by traffic noise from the Spur, which would remain the same in the future. The Low Bridge Option would result in slightly higher noise levels and more of the project area exceeding several of the key sound level values compared to the High-Linear Bridge and High-Curvilinear Bridge Options. Based on the acoustical modeling results published in the 2023 Soundscape Study Report, selection of the future bridge option is not expected to have a large effect on the future acoustical environment in the Section 8D corridor. As a result, this topic was dismissed from detailed analysis.

Biological - Lichens

Smith and Davison (1992) reported no occurrences of rare, threatened, or endangered lichens.[3] A follow-up survey in 2021 by Lendemer (2022) found 229 lichen and allied fungus species across the project area. The federally endangered *Cetradonia linearis* (listed as *Gymnoderma lineare* [60 *Federal Register* 3557]) was not located, and suitable habitat for the species was not observed. This lichen grows only in areas of high humidity, such as high-elevation vertical rock faces that are frequently bathed in fog or in deep gorges at lower elevations (USFWS 1997); hence, it is highly unlikely that the taxon occurs in the project area below the level of detectability. The State of Tennessee does not include lichens on its list of threatened and endangered species. Lendemer (2022) found potentially suitable habitat for two rare lichen species, *Peltigera hydrothyria* (synonym: *Hydrothyria venosa*) and *Rinodina brodoana*; however, neither species was located, and their occurrence is unlikely given past land use history and current habitat fragmentation. The Lendemer survey noted the absence of suitable habitat for several sensitive lichen species in US Forest Service Region 8 and listed as threatened by the International Union for Conservation of Nature. In summary, most lichen species in the project area are common; communities varied considerably among survey plots, and most species present in the project area were not present in any one plot. Based on this information, the construction of Section 8D would not affect any special status lichen, and lichens in general would not be adversely impacted. As a result, this topic was dismissed from detailed analysis.

[3] Lichens are not plants; rather, they are symbiotic organisms composed of a mutualistic association between a fungus and one or more photosynthetic partners, typically green algae or cyanobacteria. This partnership allows lichens to grow in a variety of environments like rocky surfaces and tree bark.

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Appendix D – Draft Combined Statement of Findings

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United States Department of the Interior
National Park Service
Great Smoky Mountains National Park

Foothills Parkway Section 8D

DRAFT
Statement of Findings for Director's Order #77-2 Floodplain Management and Director's Order #77-1 Wetland Protection

July 2024

Recommended:	____________________________	______________
	Superintendent, Great Smoky Mountains National Park	Date
Certification of Technical Adequacy and Servicewide Consistency:	____________________________	______________
	Chief, Water Resources Division	Date
Approved:	____________________________	______________
	Director, Region 2	Date

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STATEMENT OF FINDINGS

INTRODUCTION

The National Park Service (NPS), in partnership with the Federal Highway Administration (FWHA) Eastern Federal Lands Highway Division, is proposing to construct Section 8D of the Foothills Parkway (Parkway). The Section 8D corridor extends approximately 9 miles between Wears Valley and the Gatlinburg Spur (the Spur), in Sevier County, Tennessee. The Parkway is part of Great Smoky Mountains National Park (the Park).

This Statement of Findings was prepared to evaluate the impacts to floodplains and wetlands for the construction of Foothills Parkway Section 8D. Its purpose is to comply with NPS wetland protection and floodplain management procedures, which is required by Executive Order (E.O.) 11988, "Floodplain Management," E.O. 11990, "Protection of Wetlands," and E.O. 13690, "Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input." NPS Director's Order (D.O.) #77-2 and its accompanying *Procedural Manual #77-2* (NPS 2002) provide procedures to comply with E.O. 11988. NPS D.O. #77-1: Wetland Protection and *Procedural Manual #77-1* (NPS 2016) provide NPS policies and procedures to comply with E.O. 11990. E.O. 13690 was issued to establish a Flood Risk Management Standard for federally funded projects to improve the nation's resilience to floods, and to ensure new federal infrastructure will last as long as intended.

This combined (floodplain and wetland) Statement of Findings is being prepared because constructing Section 8D would occur within a regulatory floodplain, and adversely impact wetlands. It must be included with the finding of no significant impact (FONSI) to complete the National Environmental Policy Act (NEPA) compliance process. A Floodplain Statement of Findings must describe the rationale for siting the proposed action within a floodplain site, disclose the amount of risk associated with the chosen site, and explain flood mitigation plans. A Wetland Statement of Findings must document the impacts of the proposed action on wetlands, provide the rationale for identifying a preferred alternative that has adverse impacts on wetlands, and explain why no alternatives with less wetland impacts were practicable.

PROJECT BACKGROUND

The project consists of constructing Section 8D of Foothills Parkway between Wears Valley and the Spur within the existing NPS-managed corridor. The action is needed to provide recreational opportunities, support tourism, improve the transportation network inside and outside the Park, and fulfill the intent of federal and state legislation authorizing construction of the Foothills Parkway.

To date, approximately 38.6 miles of the 72-mile Parkway have been constructed and are open to motor vehicles. In the *Foothills Parkway Master Plan*, the designated route for the Parkway was identified as "Route 8." For planning purposes, as shown figure 1 (inset), Route 8 is divided into a series of sections referred to as Sections 8A through 8H (NPS 1968). Sections 8A, 8G, and 8H, which together compose approximately 22.5 miles, were completed and opened for public use in the 1960s. In 2018, Sections 8E and 8F, approximately 16.1 miles, were completed and opened to the public. Three of the eight sections (Sections 8B, 8C, and 8D) have not been constructed.

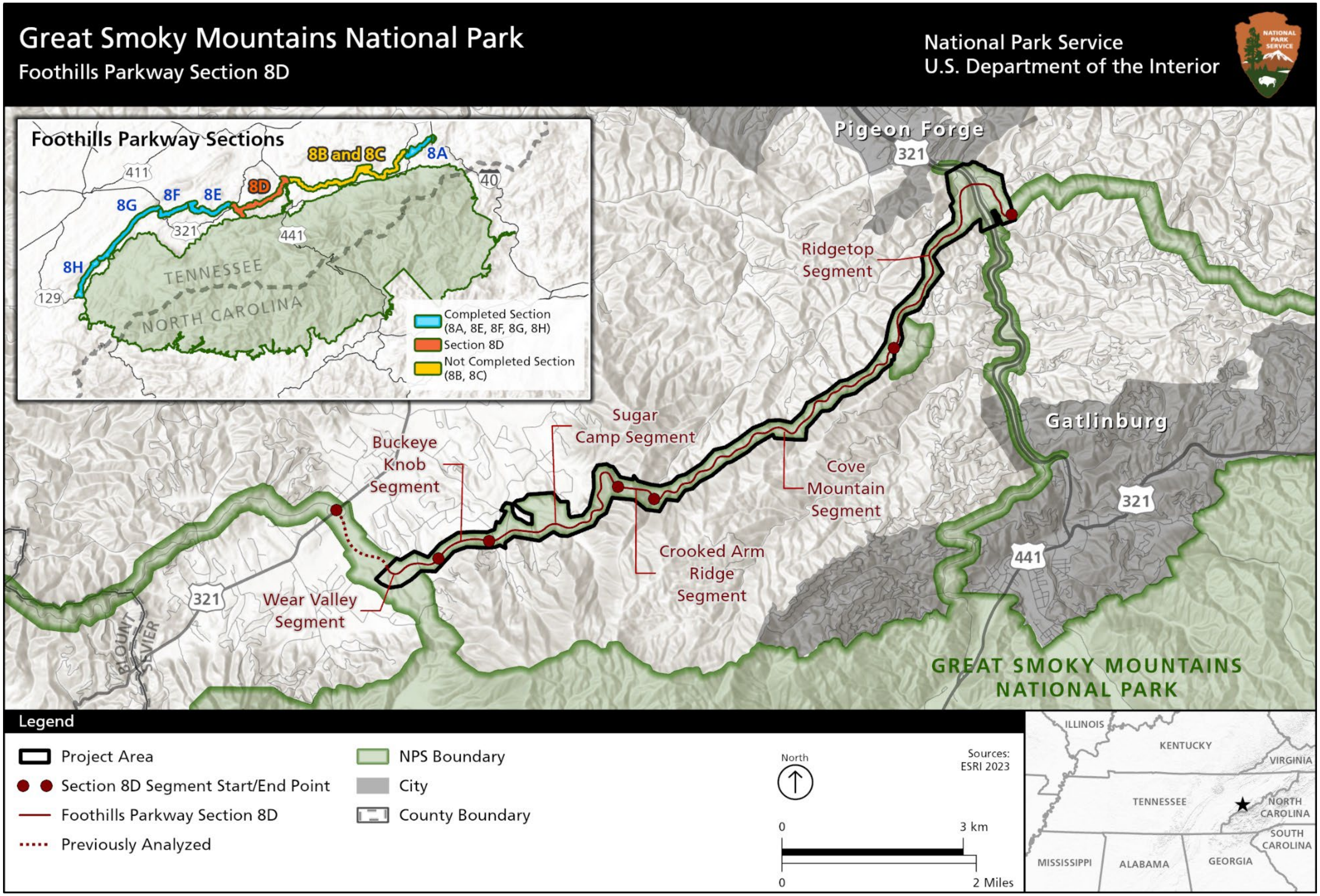

FIGURE 1. PROJECT AREA

PROPOSED ACTION

A detailed description of the proposed action (alternative 2, the preferred alternative) is provided in chapter 2 of the environmental assessment (EA). Under alternative 2, the NPS and FHWA Eastern Federal Lands Highway Division would construct approximately 9 miles of Section 8D within the existing NPS-managed corridor. A proposal to construct the first mile of Section 8D, from Wears Valley Road through Wears Valley just west of Katy Hollar Road, was previously analyzed in the *Wears Valley Mountain Bike Trail EA* (NPS 2022a) and a FONSI was issued in May 2022 (NPS 2022b). The first mile of Section 8D was not reanalyzed in the EA.

The asphalt roadway would consist of two, 12-foot wide lanes, striped at 11 feet. Sheet flow, vegetated swales, and other site-specific stormwater best management practices (BMPs) would provide drainage. Paved shoulders approximately 3 feet wide could be used in sharper curves. Grass shoulders would be maintained along most of the roadway, with widths varying based on terrain and aesthetics. Steel-backed timber guardrails or stone veneer concrete core guard walls would be constructed where necessary. This typical section is consistent with the NPS *Park Road Standards* (NPS 1984) and with the constructed sections of the Parkway. Pull-offs and parking areas would be located throughout Section 8D to offer opportunities for visitors at scenic vistas and specific cultural or natural features, and for unplanned emergency stops. Section 8D would also include one tunnel in the Crooked Arm Ridge segment, approximately 1,200 feet long (figure 1). Drainage would be provided through grass ditches, vegetated swales, sheet flow, or appropriate stormwater BMPs. Roadway materials and aesthetic considerations would also be consistent with the sections of the Parkway already constructed.

Pursuant to NPS D.O. #77-2: Floodplain Management, the proposed project would qualify as "Class I Action" because it involves constructing a man-made feature which, by its very nature, requires individuals to occupy the site, is prone to flood damage, or results in impacts to natural floodplain values in accordance with NPS floodplain management procedures (NPS 2002). For Class I Actions, the Base Floodplain (100-year flood) is the regulatory floodplain. There are no Class II or Class III actions under the proposed action.

The design elements relevant to potential floodplain and wetland impacts are detailed below.

Spur Bridge and Interchange Bridge Options

The proposed action includes the construction of two bridges over the West Prong of the Little Pigeon River (West Prong), both as part of a new interchange connecting the Parkway and the Spur. Bridge abutments would be constructed above the 100-year regulatory floodplain (the Base Floodplain); however, the two bridges would each require two piers to be built within the 100-year floodplain of the West Prong, of which one would be located within the river channel of the West Prong.

One of three proposed Spur bridge options would be constructed as part of the Parkway, in one of three locations, depending on which bridge options is selected (figure 2). The second bridge, a new interchange bridge over the West Prong, would be constructed in one of two locations, depending on which of two interchange options is selected (figure 3). The Spur bridge and interchange bridge options have not been identified. Therefore, this Statement of Findings analyzes the maximum impacts of these options: The Spur bridge and interchange bridges are described below and detailed further for the preferred alternative in the EA.

The NPS is considering three Spur bridge design options where Section 8D would cross over the Spur and West Prong, including:

1) Low Bridge Option: This option would cross the Spur and West Prong at the lowest elevation and would cross the Spur just South of Caney Creek Road, approximately 2,900 feet north of the existing bridge at Gum Stand Road. It would consist of three separate bridges: (1) a 605-foot bridge over an unnamed ephemeral tributary to Caney Creek, over a ravine with a depth of 60 feet

to the deck elevation; (2) a 400-foot bridge spanning the West Prong and the Spur, with a minimum height of 50 feet above the Spur roadway; and (3) a 210-foot bridge over Gnatty Branch and Gnatty Branch Road, with a minimum vertical clearance of 16.5 feet.

2) High-Curvilinear Bridge Option: This option would cross the Spur at a higher elevation than the Low Bridge Option, and with a more direct curvilinear alignment, approximately 1,900 feet north of the existing bridge at Gum Stand Road. It would consist of three separate bridges: (1) a 620-foot bridge over an unnamed ephemeral tributary to Caney Creek, with a depth of 65 feet to the deck elevation; (2) a 1,165-foot bridge spanning the West Prong and the Spur, with a minimum height of 134 feet above the Spur roadway; and (3) a 170-foot bridge over a gated two-track service road, with a depth of 26 feet to the deck elevation. This option would minimize hillside cuts.

3) High-Linear Bridge Option: This option would cross the Spur at a higher elevation than the Low Bridge Option, and with a more direct linear alignment, approximately 1,900 feet north of the existing bridge at Gum Stand Road. It would consist of three separate bridges: (1) a 300-foot bridge over an unnamed ephemeral tributary to Caney Creek, with a depth of 60 feet to the deck elevation; (2) a 1,020-foot bridge spanning the West Prong and the Spur, up to 1,020 feet with a minimum height of 122 feet above the Spur roadway; and (3) a 175-foot bridge over a gated two-track service road, with a depth of 26 feet to the deck elevation.

The NPS is considering two potential interchange bridge options at the Spur as part of a new interchange, with supporting loops and ramps, that would be constructed to maintain the flow of traffic between the Parkway and the Spur (figure 3). Constructing the interchange bridge would require the existing access point between the Spur and Gnatty Branch Road to be shifted approximately 1,200 to 1,500 feet north. Under design option 1, the proposed interchange bridge would be located approximately 400 feet north of the existing bridge at Gum Stand Road; under option 2, it would be located approximately 250 feet north of the existing bridge. Under option 1, only traffic entering or exiting the Parkway would use the new interchange and bridge, and local traffic movements between northbound and southbound segments of the Spur would continue to use the existing Gum Stand Road bridge. Under option 2, the existing bridge at Gum Stand Road would be removed and all traffic entering or exiting Section 8D, including local traffic, would use the proposed interchange access and new bridge.

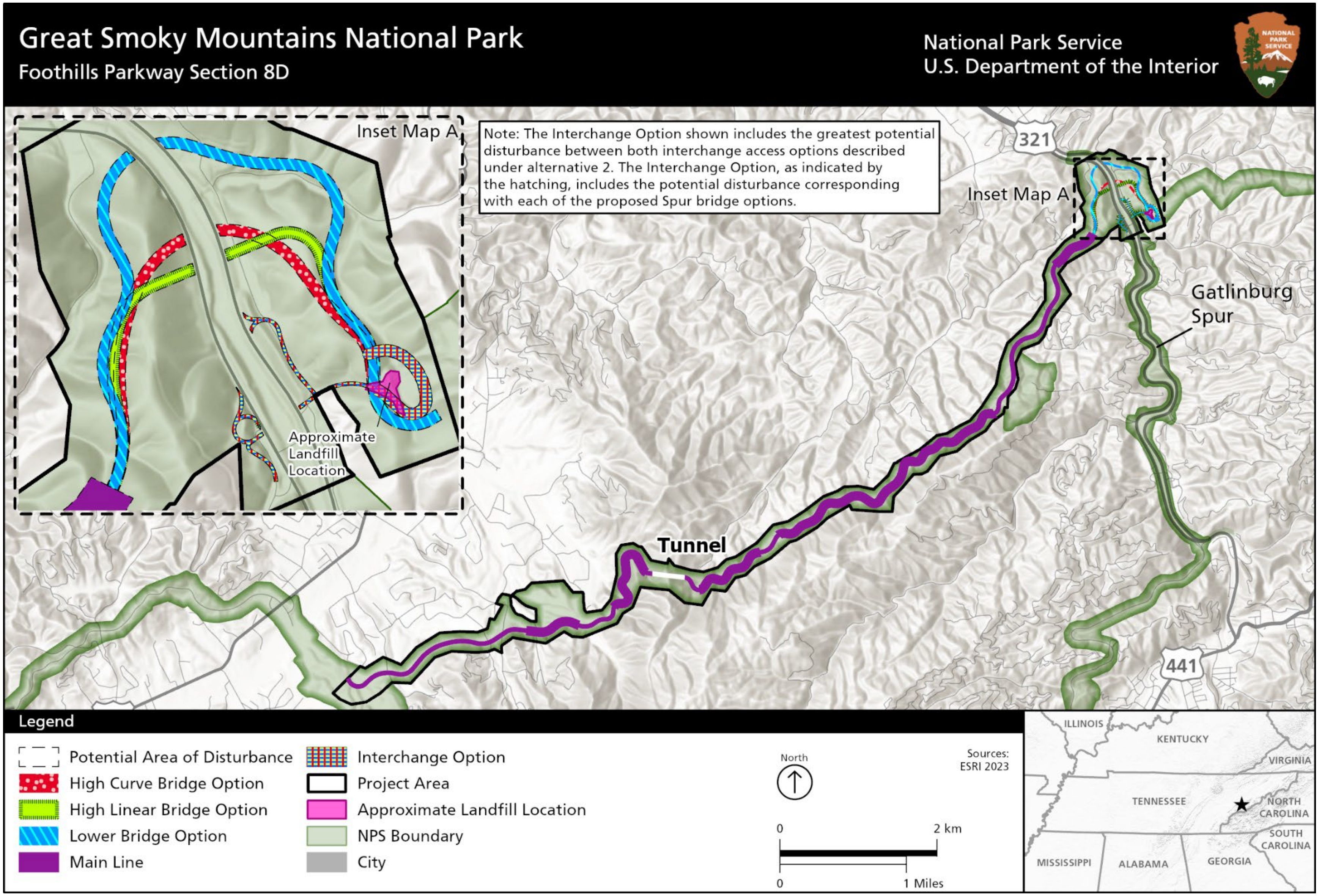

FIGURE 2. PROPOSED ACTION

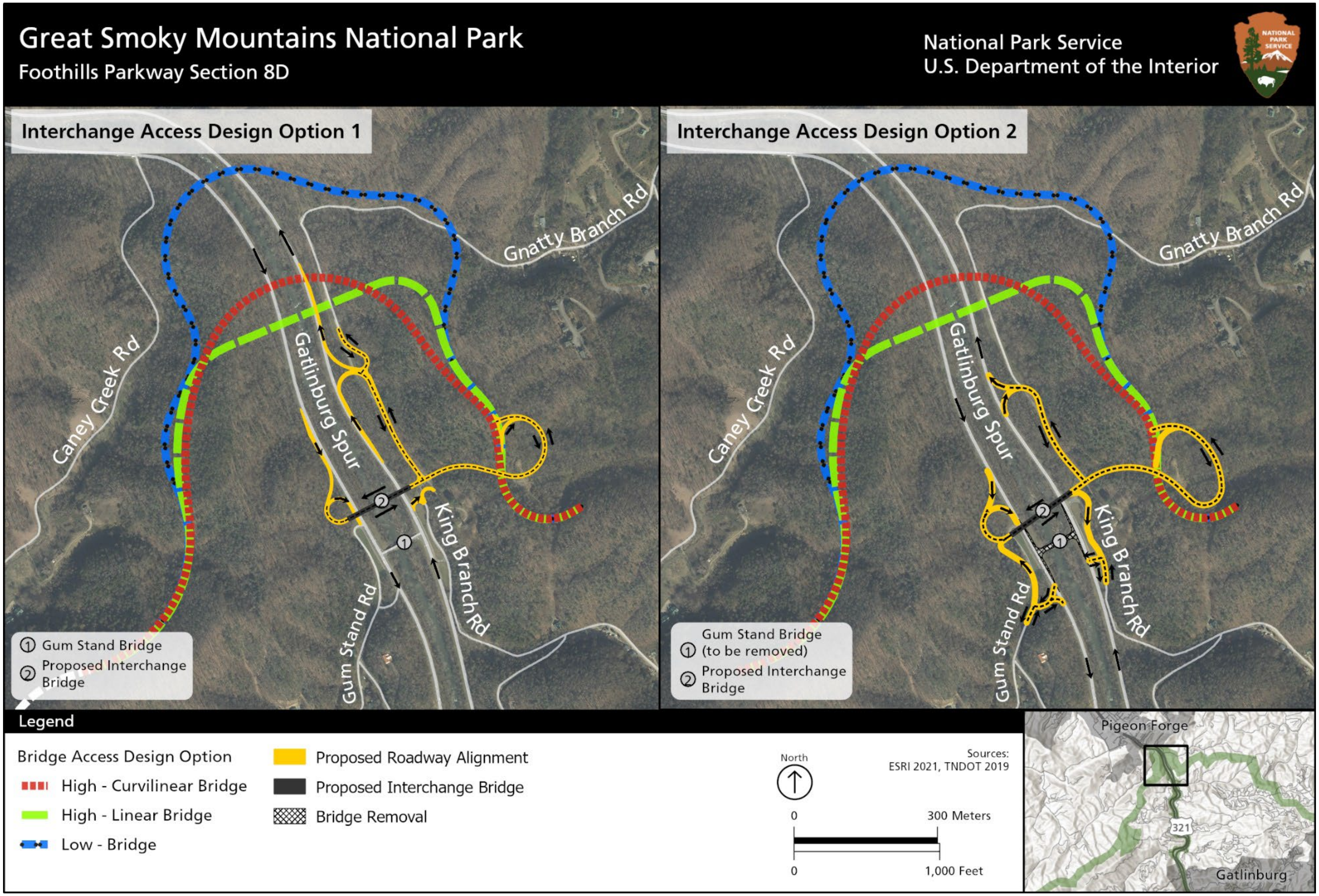

FIGURE 3. SPUR INTERCHANGE BRIDGE OPTIONS

Other Bridges and Culverts

In addition to the two bridges proposed over the West Prong, the conceptual design includes 20 bridges on the mainline crossing over existing roads, streams, and deep ravines. These bridges are labeled with numbers 4 to 23 in the maps in Appendix A. Moving from west to east, bridges would be built over Robeson Road , Buckeye Road, Cove Mountain Road; and cross three named streams: Rymel Branch, Mill Creek, and Caney Creek.

The typical cross section for these bridges has a total width of approximately 33 feet, which includes two 12-foot travel lanes (one in each direction), paved shoulders, and a concrete bridge guardrail (parapet). As detailed in the conceptual design, bridges would vary in length from approximately 100 feet to 1,200 feet, with three bridges approaching 1,200 feet long but most ranging from of 200 to 600 feet. The bridges would vary in height, alignment, and geometry, and may require slope cuts or retaining walls based on their locations along Section 8D. Bridge materials and design aesthetic would be consistent with the constructed sections of the Parkway.

The conceptual design calls for 43 culverts along the mainline, labeled with numbers 1 to 43 in the maps provided in Attachment A. Of these mainline culverts, 17 are proposed as box culverts to provide for unimpeded conveyance of flood flows and passage of aquatic biota, as open-bottom culverts are strongly encouraged by The Tennessee Department of Environment and Conservation (TDEC) for waters of the state. Fifteen of these would convey the flow of a riverine wetlands, and two would convey the flow of a wet-weather-conveyances. These box culvert locations include where the Parkway would be crossed by Machine Branch, King Hollow Branch, and Sugar Camp Branch. The remaining 26 culverts proposed along the mainline would be traditional drainage pipes. The conceptual design also calls for five pipe culverts associated with the Spur interchange options, labeled with numbers 44 to 48 in the maps in Attachment A. One of these five pipe culverts (number 44) would not be required unless the Low Bridge Option were selected.

In general, guidelines provided for use in subsequent design phases would include the following:

- Bridges and structures would be designed according to the FHWA Project Development and Design Manual. Culverts are designed for 25-year flood events; bridges are designed for 50-year flood events. Culverts and bridges in the regulatory floodplain would be designed for a 100-year storm event.
- The Parkway would span large ravines and streams with bridges and maintain an undisturbed riparian buffer to the maximum extent practicable.
- All required permits for stream/wetland impacts would be obtained prior to construction.

SITE DESCRIPTION

The project is located between Gatlinburg, Tennessee, and Pigeon Forge, within the Lower French Broad River (06010107) Hydrologic Unit Code (HUC) watershed (509,776 acres). At a finer scale, the project area is within the Upper West Prong Little Pigeon River subwatershed (12-digit HUC 060101070206) and Waldens Creek subwatershed (12-digit HUC 060101070205) (NWQMC 2021).

The NPS has reinitiated planning efforts for Section 8D now that Sections 8E and 8F are complete. The NPS completed an EA and issued a FONSI for the Wears Valley Mountain Bike Trail System within the 10-mile 8D corridor in May 2022. The Wears Valley Mountain Bike Trail System EA addresses construction of the first mile of Foothills Parkway Section 8D to provide access to the proposed mountain bike trails. The project area for Section 8D consists of the remaining 9 miles of the Section 8D Parkway corridor from Wears Valley to the Spur. Details regarding the existing conditions in the project area are provided in chapter 3 of the EA, under “Affected Environment” for applicable resources topics.

For planning purposes, Section 8D is subdivided into six segments based on topography and other natural features. The boundaries for these six segments, including the Spur, are detailed in figure 1 and are referenced in this Statement of Findings for consistency.

The West Prong is the largest stream within the project area, located at the eastern end at the intersection of Section 8D and the Spur, in the Ridgetop segment. Its channel width in the project area ranges from 50 to 90 feet wide, but spans 180 feet where an in-stream island occurs just below the existing bridge at Gum Stand Road. The West Prong originates in the Park, where it generally parallels Newfound Gap Road (Highway 441) before exiting the Park near the Gatlinburg entrance. Upstream of the project area, the West Prong flows through the City of Gatlinburg before reentering the Park at the south end of the Spur. The Spur is a 4.2-mile segment of US 441/US 321 managed by the NPS between Pigeon Forge and Gatlinburg. The West Prong flows north between the northbound and southbound lanes of the Spur, with several bridges connecting intersections on either side. Downstream of the project area, the West Prong flows through Pigeon Forge and then merges with the main stem of the Little Pigeon River in Sevierville, and then flows until it meets the French Broad River below Douglas Lake. Other than the West Prong, streams in the project area are first- and second-order (headwater) streams draining relatively steep terrain. These creeks have well-defined stream channels and little or no floodplain development.

All creeks draining the project area ultimately flow into the West Prong. From west to east on the mainline, Section 8D would cross Machine Branch, King Hollow Branch, Sugar Camp Branch, Ryrnel Branch, and several unnamed tributaries that drain directly into Cove Creek. These streams are located within the Buckeye Knob and Sugar Camp segments (figure 1). From the Crooked Arm Ridge segment to Grindstone Ridge in the Cove Mountain segment, Section 8D would cross Mill Creek and several of its unnamed tributaries. To the east of Grindstone Ridge to the Spur, through the Cove Mountain and Ridgetop segments, Section 8D would cross Caney Creek and its tributaries that drain the area east of Grindstone Ridge. The Caney Creek confluence with the West Prong is just downstream of the project area, alongside the Spur. Also, Gnatty Branch flows into the West Prong on the east side of the West Prong in the vicinity of the proposed Spur bridge and interchange bridge. Two tributaries to Gnatty Branch occur within the project area where the proposed Parkway would connect with the Spur.

Floodplain Delineation and Characterization

The Federal Emergency Management Agency (FEMA) National Flood Hazard Layer data was first reviewed to identify floodplains within the project area. The only portion of the project area with mapped floodplains occurs along the West Prong, where one of three bridge options and one of two interchange options with the Spur would be constructed. Floodplains in this area are classified as Zone A, where FEMA (2009) has mapped flood hazard areas with a 1% annual chance of flooding (i.e., located within the 100-year floodplain). In Zone A, detailed analyses have not been performed and no depths or base flood elevations (BFEs) are known.

Because the FEMA (2009) flood mapping is over 10 years old and does not include BFEs, the US Army Corps of Engineers (USACE) flood mapping for Sevier County (USACE 2021) was used to determine the 100-year floodplain (figure 3). This study developed hydrologic and hydraulic models to evaluate the 1% annual chance exceedance (100-year) floodplain, the 0.2% annual chance exceedance (500-year) floodplain, and the associated BFEs along the West Prong. To spot check floodplain elevations, LiDAR data for Tennessee were obtained from the US Geological Survey (USGS) 3D Elevation Program (USGS 2023).

The FEMA floodplain mapping for the Section 8D corridor is limited to West Prong and there are no mapped floodplains associated with any other streams in the project area. All locations are classified as Zone X, which are areas with minimal flood risk and above the 500-year flood level (FEMA 2009). Although there are no regulatory floodplains associated with other streams in the project area, there may be other locations considered to be flood-prone where Section 8D would cross over perennial or

intermittent streams, or ephemeral channels (i.e., wet weather conveyances). In the absence of floodplain mapping and stream gauges on these streams, the TR-55 model, a hydrologic analysis procedure developed by the US Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) (1986), and was used for the largest perennial streams to estimate the magnitudes extreme floods. The modeling technique estimates storm runoff for designing culverts and other stormwater management structures by determining watershed characteristics, hydrologic data, and hydraulic design principles to calculate peak discharge, runoff volume, and time of concentration for a watershed. These predicted flood flows were then evaluated based on the local topography, and bridge/culvert design dimensions were determined to ensure that the structures would safely convey the expected flows without causing issues like overtopping, erosion, or structural failure.

Floodplain Values

Floodplain values within the project area are associated with the West Prong and include the ability of the floodplain to absorb increased water flows, recharge groundwater, and provide floodplain habitat. Floodplains in the project area provide wildlife habitat for wetland and riparian species, allow for flood storage, and facilitate conveyance.

The narrow valley of the West Prong inherently limits the extent of the floodplain, but this also means that the existing plant communities are crucial for maintaining natural floodplain values. In addition, the West Prong floodplain has been affected by the construction of the Spur and other existing roads and bridges in the project vicinity (e.g., Caney Creek Road, Gum Stand Road, and Gnatty Branch Road). The use of fill material from rock cuts and scree slopes to build the Spur has created large embankments, further constraining the West Prong floodplain and its associated riparian vegetation. Preserving and enhancing these narrow strips of vegetation is important for the preservation of floodplain values. Despite the impacts of the Spur, the natural values of the West Prong floodplain are exceptionally valuable, especially considering the urbanized areas upstream (Gatlinburg) and downstream (Pigeon Forge).

Floodplain values associated with all streams in the project area other than the West Prong are primarily associated with contributing to ecosystem quality and sustaining wildlife and other natural resources. The functions and values of flood-prone areas alongside these small streams are described under "Wetland Delineation Results," below table 2.

Flood Conditions and Hazards

The floodplain values described above are crucial because the adjacent mountainous terrain can lead to flash floods and other types of flooding during heavy rainfall events. Flooding events/flash floods are not uncommon in Sevier County. Due to the high elevations in the Park, average annual precipitation is relatively high, ranging from 58 inches to 86 inches, with some higher elevations receiving over 70 inches of snowfall annually (Sevier County 2024). Runoff from this precipitation has the potential to lead to high stream flows. The West Prong can overflow its bank during localized high precipitation events, although it has not flooded onto the Spur roadway in recent years.

Other streams crossed by Section 8D, include the following named streams: Machine Branch, King Hollow Branch, Sugar Camp Branch, Rymel Branch, Mill Creek, and Caney Creek. These are small mountain streams that convey water from catchments that are all less than 0.5 square miles. They generally have a steep channel gradient and are thus characterized as rushing cascades, with occasional waterfalls. Intense rain events can cause rapid increases in water levels and high-water velocities. However, dense riparian vegetation and adjacent forests provide floodplain stability. Flood hazards include erosion and sediment transport, which can affect water quality and stream habitats. Due to the relatively small drainage basin area, the small streams crossing Section 8D recede quickly following flood events.

Site-Specific Flood Risks

The Spur serves more than 49,000 vehicles per day between Pigeon Forge and Gatlinburg. Within the project area, the Spur is outside the 100-year floodplain of the West Prong, except for the Gum Stand Road Bridge piers (figure 3). Portions of the Spur upstream of the project area are within the 100-year floodplain of the West Prong, totaling approximately 2,500 feet in the vicinity of the Gatlinburg Wastewater Treatment Plant between Wiley Oakley Drive and Norton Creek. In addition to transportation routes, there is low-density residential development on surrounding private lands. Park visitors traveling on the Spur in the vicinity of the proposed Section 8D bridge (one of three options) would be vulnerable to flood risks when the West Prong overflows its bank during high flow events.

While there are no stream gauges within the project area, information on flood conditions can be obtained by reviewing historic hydrographs at upstream and downstream locations on the West Prong. The flood stage of the West Prong is estimated to be 8 feet at a gauge on the West Prong above Gatlinburg, approximately 5 miles upstream of the project area (USGS station 03469251, located downstream of the Sugarlands Maintenance Area at 35.6995° N, 83.5272° W). Since January 2020, the West Prong has exceeded this flood stage once or twice per year, for a total of six occasions (USGS 2024). During such high flow events, flows are generally contained within the channel of the West Prong through the project area. Recent flooding events during the last decade, particularly in 2018, 2020, and 2024, have damaged public infrastructure and private lands downstream of the project area, and upstream in Gatlinburg. There is no historical data or regional hydrological analysis to evaluate the recurrence interval of flooding on other small streams in the project area.

The upstream of the project area in and around Gatlinburg is currently served by an emergency notification system public-warning siren as part of its all-hazard notification system. Sevier County Emergency Management Agency, in partnership with the cities of Sevierville, Pigeon Forge, Gatlinburg, and Pittman Center and the Great Smoky Mountains National Park, has expanded the City of Gatlinburg's flood warning system. The system includes field sensors and a web-based software that monitors streams, rivers, and precipitation levels across the county. This software triggers alerts when potential flooding situations are detected, allowing officials to broadcast early warnings to residents and emergency responders for the protection of lives and property (Sevier County 2024).

In the event of flooding along the West Prong, the city can activate the system to broadcast warning tones and voice messages to alert visitors and Park staff of an emergency and provide evacuation routes and other critical information. The siren was installed in late 2017 and was activated for the July 2022 flood event that impacted the region. Park staff also monitor weather data from the National Weather Service and existing weather stations in the Park. The existing stream flow gauge on the West Prong, described above, is available to monitor real-time stream levels (https://staging.waterdata.usgs.gov/monitoring-location/03469251/#parameterCode=00065&period=P7D&showMedian=false).

Wetland Mapping

Wetland Delineation Methods

During summer 2022, WSP wetland scientists confirmed the locations of wetlands within the project area. A desktop review identified the general locations, extent, and character of potential wetlands that could occur within the project area. WSP first evaluated existing park wetland/stream documentation and GIS data to identify previously mapped features. Wetland scientists reviewed existing maps and databases, which included aerial photography, USGS 7.5-minute topographic maps, county soil surveys (USDA-NRCS 2020a), the Web Soil Survey (USDA-NRCS 2020b), the National Wetlands Inventory (USFWS 2020), and the National Hydrography Dataset (USGS 2020). Wetland scientists then conducted a field survey and perimeter mapping of all potential wetland areas, which included ground truthing previously mapped wetlands.

The wetland delineation field work was performed in accordance with the 1987 USACE Wetlands Delineation Manual (USACE 1987), and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont, Version 2.0 (USACE 2012). The wetland delineation field work was also performed in accordance with NPS D.O. #77-1: Wetland Protection, the NPS *Procedural Manual #77-1: Wetland Protection* (NPS 2016), and the Federal Geographic Data Committee Classification of wetlands and deep-water habitats of the United States (Wetlands Classification Standard) (FGDC 2013). The non-developed, unpaved portions of the study area, with the exception of active stream channels, have both vegetation and soils, and as such were investigated for both USACE- and NPS-regulated wetlands based on all three wetland parameters of hydrophytic vegetation, hydric soil, and wetland hydrology. Water features were delineated in accordance with the USACE Jurisdictional Determination Instructional Guidebook (USACE and EPA 2007), and the guidelines in the USACE Regulatory Guidance Letter No. 05-05, Ordinary High Water Mark Identification Regulatory Guidance Letter (USACE 2005). Because stream widths varied widely going upstream or downstream, stream widths were approximated based on watershed area in order to quantify riverine wetland acreage. Since bankfull channel dimensions are strongly correlated to drainage area in the southern Appalachian streams with undeveloped watersheds (Zink et al. 2012), the regression equation developed by Rivenbarck and Jackson (2004) provided an approximation of riverine wetland area.

Wetland Delineation Results

The project area includes approximately 1.2 acres of delineated wetlands. Based on the field investigation, three classes of wetlands and three riverine designations were identified in the project area using the Cowardin classification system (Cowardin et al. 1979). The palustrine wetlands are listed in table 1 and comprise palustrine forested wetland, palustrine scrub-shrub wetland, and palustrine emergent wetland. Figures A-1 through A-26 in Attachment A show the delineated wetlands in the project area. Table 1 provides the page number where each feature is located.

TABLE 1. PALUSTRINE WETLANDS WITHIN THE PROJECT AREA

Wetland ID	Cowardin Classification	Code	Acres	Attachment A Map Page No.
AJ-J	Palustrine, Emergent	PEM	0.129	A-1
AJ-B-W	Palustrine, Emergent	PEM	0.120	A-2 & A-3
AJ-E-W	Palustrine, Emergent	PEM	0.013	A-2 & A-3
AJ-N-W	Palustrine, Emergent	PEM	0.003	A-4
AJ-S-W	Palustrine, Scrub-Shrub	PSS	0.007	A-4 & A-6
AJ-R-W	Palustrine, Forested	PFO	0.109	A-4, A-6, & A-8
AJ-T-W	Palustrine, Scrub-Shrub	PSS	0.011	A-5
AJ-X-W	Palustrine, Forested	PFO	0.027	A-5
AJ-AD-W	Palustrine, Forested	PFO	0.619	A-5, A-7, & A-8
AJ-AH-W	Palustrine, Scrub-Shrub	PSS	0.109	A-7
AJ-AN-W	Palustrine, Emergent	PEM	0.005	A-8
AJ-AL-W	Palustrine, Scrub-Shrub	PSS	0.005	A-8
AJ-AO-W	Palustrine, Emergent	PEM	0.028	A-8
MD-K-W	Palustrine, Forested	PFO	0.005	A-22
MD-E-W	Palustrine, Forested	PFO	0.025	A-23 & A-26
JBAQ	Palustrine, Forested	PFO	0.003	A-23 & A-24

Wetland ID	Cowardin Classification	Code	Acres	Attachment A Map Page No.
AB-C-W	Palustrine, Scrub-Shrub	PSS	0.024	A-25 & A-26
		Total	**1.244**	

Wetland AJ-J (PEM) is a seasonally saturated wetland dominated by herbaceous vegetation and is adjacent to a regularly maintained farm/hay field. The wetland performs a variety of functions such as storing surface and subsurface water, nutrient cycling, and particulate retention; it also provides wildlife habitat and breeding habitat for amphibians.

Wetland AJ-B-W (PEM) is a seasonally saturated wetland dominated by herbaceous vegetation and is surrounded by a regularly maintained farm/hay field. Dominant herbaceous species include dotted smartweed (*Persicaria punctata*). The wetland performs a variety of functions such as storing surface and subsurface water, nutrient cycling, and particulate retention; it also provides wildlife habitat and breeding habitat for amphibians.

Wetland AJ-E-W (PEM) is a seasonally saturated wetland dominated by herbaceous vegetation and is adjacent to a regularly maintained farm/hay field. Dominant herbaceous species include jewelweed (*Impatiens capensis*). The wetland performs a variety of functions such as storing surface and subsurface water, nutrient cycling, and particulate retention; it also provides wildlife habitat and breeding habitat for amphibians.

Wetland AJ-N-W (PEM) is a seasonally saturated wetland dominated by herbaceous vegetation and is adjacent to Stream AJ-M-S. Dominant herbaceous species include jewelweed. The wetland performs a variety of functions such as storing surface and subsurface water, nutrient cycling, and particulate retention; it also provides wildlife habitat and breeding habitat for amphibians.

Wetland AJ-S-W (PSS) is a temporarily to seasonally flooded scrub-shrub wetland that is located adjacent to Stream AJ-P-S and is dominated by woody vegetation less than 20 feet tall. Dominant species include sweet birch (*Betula lenta*), great laurel (*Rhododendron maximum*), white ash (*Fraxinus americana*), poison ivy (*Toxicodendron radicans*), and richweed (*Collinsonia canadensis*). The wetland contributes groundwater discharge and reduces downstream particulate loading to Stream AJ-P-S, which helps to maintain stream flow and improve water quality. It also provides breeding, nesting, and feeding habitat for an assortment of wildlife.

Wetland AJ-R-W (PFO) is a seasonally saturated deciduous forest that is located adjacent to Streams AJ-P-S and AJ-Q-S. Dominant plant species include American hornbeam (*Carpinus caroliniana*), green ash (*Alnus serrulata*), buckeye (*Aesculus flava*), spicebush (*Lindera benzoin*), fowl mannagrass (*Glyceria striata*), and jewelweed (*Impatiens capensis*). The wetland contributes groundwater discharge and reduces downstream particulate loading to Streams AJ-P-S and AJ-Q-S, which helps to maintain stream flow and improve water quality. It also provides breeding, nesting, and feeding habitat for an assortment of wildlife.

Wetland AJ-T-W (PSS) is a temporarily to seasonally flooded scrub-shrub wetland that is located adjacent to Stream AJ-P-S and is dominated by woody vegetation less than 20 feet tall. Dominant species include American hornbeam (*Carpinus caroliniana*), white ash (*Fraxinus americana*), and jewelweed (*Impatiens capensis*). The wetland contributes groundwater discharge and reduces downstream particulate loading to Stream AJ-P-S, which helps to maintain stream flow and improve water quality. It also provides breeding, nesting, and feeding habitat for an assortment of wildlife.

Wetland AJ-X-W (PFO) is a seasonally saturated deciduous forest that directly drains to Stream AJ-U-S (King Hollow Branch). Dominant plant species include American beech (*Fagus grandifolia*), common serviceberry (*Amelanchier arborea*), American holly (*Ilex opaca*), and jewelweed (*Impatiens capensis*). The wetland contributes groundwater discharge and reduces downstream particulate loading to King

Hollow Branch, which helps to maintain stream flow and improve water quality. It also provides breeding, nesting, and feeding habitat for an assortment of wildlife.

Wetland AJ-AD-W (PFO) is a seasonally saturated deciduous forest that is located in a valley between Stream AJ-U-S (King Hollow Branch) and Stream AJ-AF-S (Sugar Camp Branch). Dominant plant species include red maple (*Acer rubrum*), tuliptree (*Liriodendron tulipifera*), eastern sweetshrub (*Calycanthus floridus*), sweetgum (*Liquidambar styraciflua*), Southern lady fern (*Athyrium asplenioides*), and poison ivy (*Toxicodendron radicans*). The wetland contributes groundwater discharge and reduces downstream particulate loading to King Hollow Branch and Sugar Camp Branch, which helps to maintain stream flow and improve water quality. It also provides breeding, nesting, and feeding habitat for an assortment of wildlife.

Wetland AJ-AH-W (PSS) is a temporarily to seasonally flooded scrub-shrub wetland adjacent to Stream AJ-AG-S and is dominated by woody vegetation less than 20 feet tall. Dominant species include green ash (*Fraxinus pennsylvanica*), brook-side alder (*Alnus serrulata*), and white turtlehead (*Chelone glabra*). The wetland contributes surface and groundwater discharge and reduces downstream particulate loading to Stream AJ-AG-S. Other functions include storing surface and subsurface water, nutrient cycling, and particulate retention. The wetland provides wildlife habitat as well as breeding habitat for amphibians.

Wetland AJ-AN-W (PEM) is a seasonally saturated wetland adjacent to Stream AJ-AF-S (Sugar Camp Branch) and is dominated by herbaceous vegetation. Dominant herbaceous species include jewelweed (*Impatiens capensis*) and Japanese stiltgrass (*Microstegium vimineum*). The wetland contributes surface and groundwater discharge and reduces downstream particulate loading to Sugar Camp Branch. Other functions include storing surface and subsurface water, nutrient cycling, and particulate retention. The wetland provides wildlife habitat as well as breeding habitat for amphibians.

Wetland AJ-AL-W (PSS) is a temporarily to seasonally flooded scrub-shrub wetland adjacent to Stream AJ-AF-S (Sugar Camp Branch) and is dominated by woody vegetation less than 20 feet tall. Dominant species include great laurel, common violet (*Viola sororia*), and spicebush (*Lindera benzoin*). The wetland contributes surface and groundwater discharge and reduces downstream particulate loading to Sugar Camp Branch. Other functions include storing surface and subsurface water, nutrient cycling, and particulate retention. The wetland provides wildlife habitat as well as breeding habitat for amphibians.

Wetland AJ-AO-W (PEM) is a temporarily to seasonally saturated wetland located in a low spot where water accumulates before flowing downhill that is dominated by herbaceous vegetation. Dominant herbaceous species include jewelweed (*Impatiens capensis*). The wetland performs a variety of functions such as storing surface and subsurface water, nutrient cycling, and particulate retention; it also provides wildlife habitat and breeding habitat for amphibians.

Wetland MD-K-W (PFO) is a seasonally saturated deciduous forest located upslope from a tributary to Caney Creek. Dominant plant species include red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), and jewelweed (*Impatiens capensis*). The wetland reduces downstream particulate loading to Caney Creek, which helps to maintain stream flow and improve water quality. It also provides breeding, nesting, and feeding habitat for an assortment of wildlife.

Wetland MD-E-W (PFO) is a seasonally saturated deciduous forest that directly drains to stream MD-B-CS (Gnatty Branch) before draining into West Prong Little Pigeon River. Dominant plant species include red maple (*Acer rubrum*), box elder (*Acer negundo*), and jewelweed (*Impatiens capensis*). The wetland contributes groundwater discharge and reduces downstream particulate loading to Gnatty Branch, which helps to maintain stream flow and improve water quality. It also provides breeding, nesting, and feeding habitat for an assortment of wildlife.

Wetland AB-C-W (PSS) is a temporarily to seasonally flooded scrub-shrub wetland adjacent to stream AB-B-S and is dominated by woody vegetation less than 20 feet tall. Dominant species include common serviceberry (*Amelanchier arborea*) and smallspike false nettle (*Boehmeria cylindrica*). The wetland

contributes surface and groundwater discharge, and reduces downstream particulate loading to Stream AB-B-S, which is an unnamed tributary to Gnatty Branch. Other functions include storing surface and subsurface water, nutrient cycling, and particulate retention. The wetland provides wildlife habitat as well as breeding habitat for amphibians.

The project area includes approximately 61,000 feet (11.5 miles) of riverine wetlands, classified as follows: upper perennial (approximately 52,000 feet, 85 percent); intermittent (approximately 4,700 feet, 8 percent), and ephemeral (approximately 4,300 feet; 7 percent) (table 2). The total acreage of these riverine wetlands is approximately 16.1 acres, of which the West Prong comprises 6.8 acres. All delineated features are classified as “riverine systems” in accordance with the FGDC (2013) Wetlands Classification Standard, as they are all contained within a channel that is not dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. The substrate of streams surveyed consisted of bedrock, boulders, rock, cobbles, or gravel with occasional patches of sand. Due to the high gradient, there is very little floodplain development along the delineated streams. Upper perennial streams are characterized by a high gradient and some water flows all year, except during years of extreme drought (FGDC 2013). Intermittent streams include channels that contain flowing water only part of the year. When the water is not flowing, it may remain in isolated pools or surface water may be absent. Several delineated streams have both perennial and intermittent reaches within the project area. The ephemeral streams only exist for a short period of time in response to precipitation or groundwater fluctuations.

TABLE 2. RIVERINE WETLANDS WITHIN THE PROJECT AREA

Stream ID	Cowardin Classification	Distance (Feet) within Project Area	Width	Acreage within Project Area	Notes	Attachment A Map Page No.
AJ-E-S	R6	216	10	0.050	Losing (sinking) stream	A-1 & A-2
AJ-A-S	R6	613	5	0.070	--	A-2 & A-3
AJ-D-S	R3/R4	984	9	0.203	Losing (sinking) stream	A-2 & A-3
AJ-M-S	R3/R4/R6	1,258	6	0.173	Losing (sinking) stream	A-4
AJ-O-S	R6	40	2	0.002	--	A-4
AJ-F-S	R3	1,358	14	0.436	Named: Machine Branch	A-4 & A-6
AJ-G-S	R3	27	5	0.003	--	A-4 & A-6
AJ-H-S	R3	22	5	0.003	--	A-4 & A-6
AJ-I-S	R6	22	4	0.002	--	A-4 & A-6
AJ-J-S	R3	62	5	0.007	--	A-4 & A-6
AJ-K-S	R3	189	10	0.043	--	A-4& A-5
AJ-L-S	R3	38	5	0.004	--	A-4 & A-6
AJ-P-S	R3	2,650	5	0.304	--	A-4, A-5, & A-6
AJ-Q-S	R3	730	6	0.101	--	A-4 & A-6
AJ-U-S	R3	2,649	8	0.487	Named: King Hollow Branch	A-5, A-6, & A-8
AJ-V-S	R3/R4/R6	440	4	0.040	Upper portions are intermittent and ephemeral, and lower portion is perennial	A-5
AJ-W-S	R4	20	3	0.001	--	A-5
AJ-Y-S	R3	1,875	9	0.387	Side channel of named stream (King Hollow Branch); flows into King Hollow Branch approx. 2,000 feet downstream of Section 8D.	A-5, A-6, & A-8
AJ-AA-S	R4	22	3	0.002	--	A-6
AJ-AB-S	R6	97	2	0.004	--	A-6
AJ-AC-S	R3	1,978	5	0.227	Channel through wetland AJ-AD-W	A-6 & A-8
AJ-AE-S	R3/R4	82	4	0.008	Upper portion is intermittent and lower portion is perennial	A-5, A-6, & A-8
AJ-AF-S	R3	4,187	15	1.442	Named: Sugar Camp Branch	A-5, A-7, & A-8

Stream ID	Cowardin Classification	Distance (Feet) within Project Area	Width	Acreage within Project Area	Notes	Attachment A Map Page No.
AJ-AG-S	R3	231	5	0.027	--	A-7
AJ-AM-S	R4	17	3	0.001	--	A-8
AJ-AI-S	R6	49	2	0.002	--	A-8 & A-9
AJ-AJ-S	R3	59	3	0.004	--	A-8
AJ-AK-S	R3	179	4	0.016	--	A-8
AJ-AP-S	R3	333	4	0.031	--	A-8 & A-9
MD-Z-CS	R3/R4	950	5	0.109	Upper portion is intermittent and lower portion is perennial	A-9
MD-U-CS	R3	1,074	5	0.123	Named: Rymel Branch	A-9, A-10, & A-12
MD-X-CS	R3	135	3	0.009	--	A-10
MD-V-CS	R3	2,677	5	0.307	--	A-10, A-11, & A-12
MD-W-CS	R3	784	4	0.072	--	A-11
MD-Y-CS	R3	497	4	0.046	--	A-11 & A-12
AJ-AQ-S	R3	1,610	5	0.185	Named: Mill Creek	A-11, A-12, & A-13
AJ-AR-S	R6	157		0.000	--	A-11, A-12, & A-13
AJ-AS-S	R3/R4	573	5	0.066	Upper portion is intermittent and lower portion is perennial	A-11, A-12, & A-13
AJ-AT-S	R4	33	3	0.002	--	A-11 & A-13
MD-AB-CS	R3	1,035	8	0.190	--	A-13
MD-AA-CS	R3	662	5	0.076	--	A-13
MD-AC-CS	R3	194	5	0.022	--	A-13
AB-Q-S	R3	925	5	0.106	Seeps throughout	A-13
AB-P-S	R3	969	4	0.089	Low velocity; seep fed	A-13
AB-O-S	R3	880	6	0.121	Seep fed; low velocity	A-14
AB-N-S	R3	704	6	0.097	Moderate velocity; seep fed	A-14
AB-M-S	R3	990	5	0.114	Low velocity	A-14
MD-AD-CS	R6	806	4	0.074	--	A-15

Stream ID	Cowardin Classification	Distance (Feet) within Project Area	Width	Acreage within Project Area	Notes	Attachment A Map Page No.
AB-L-S	R3	688	5	0.079	Low velocity; seep fed	A-15
AB-G-S	R3	150	3	0.010	Fed by groundwater from AB-F-S, channels separated by rocky berm	A-16
AB-F-S	R3	1,223	7	0.197	Named: Caney Creek; braided in several locations; medium velocity	A-15 & A-16
AB-I-S	R4	103	5	0.012	No flow, but defined banks. potential flow during wet periods	A-16
AB-H-S	R3/R4	437	4	0.040	Tributary to Caney Creek; low velocity	A-16
AB-J-S	R3	280	5	0.032	Low velocity; fans out and loses definition at ATV trail	A-16 & A-17
MD-T-CS	R4	566	5	0.065	--	A-16 & A-17
AB-K-S	R3/R4	850	5	0.098	Tributary to Caney Creek; low velocity; perennial on upstream end	A-17
MD-S-CS	R3	1,004	5	0.115	--	A-17
MD-Q-CS	R3	1,222	5	0.140	--	A-18
MD-P-CS	R4	457	4	0.042	--	A-18
MD-O-CS	R3	1,177	5	0.135	--	A-18
MD-N-CS	R4	271	4	0.025	--	A-18
AB-E-S	R3/R4	684	5	0.079	Tributary to Caney Creek; low velocity; Intermittent flow from seep, transitions to perennial downstream of debris/sediment jam	A-18
MD-M-SC	R3	1,130	5	0.130	--	A-19
MD-L-CS	R4	308	5	0.035	--	A-21 & A-22
MD-J-CS	R3	364	5	0.042	--	A-22
MD-I-CS	R6	182	5	0.021	--	A-22 & A-25
MD-H-CS	R6	1,082	5	0.124	--	A-22, A-24, & A-25
MD-G-CS	R6	142	4	0.013	--	A-22 & A-25
MD-F-CS	R6	580	5	0.067	--	A-22, A-24, & A-25
AB-D-S	R3	2,360	15	0.813	Caney Creek channel, medium velocity; ~10 feet wide; delineated left bank	A-23 & A-24

Stream ID	Cowardin Classification	Distance (Feet) within Project Area	Width	Acreage within Project Area	Notes	Attachment A Map Page No.
JBA-S	R3	3,776	70	6.400	Named: West Prong Little Pigeon River; totals 33.7 acres within project area	A-23, A-24, & A-25
JBAI-S	R3	647	30	0.430	Side channel of the West Prong	A-25
JBAJ-S	R6	47	2	0.002	Ephemeral drainage into the West Prong	A-24
JBAP-S	R3	273	7	0.038	Side channel of the West Prong	A-23
MD-B-CS	R3	1,968	16	0.723	Named: Gnatty Branch	A-23, A-24, & A-26
MD-D-CS	R3	445	6	0.061	--	A-23 & A-26
MD-C-CS	R6	142	3	0.010	--	A-24 & A-26
MD-A-CS	R6	98	2	0.004	--	A-24
AB-A-S	R3	2,083	5	0.239	Tributary to Gnatty Branch; low velocity; flows underground through a culvert for approximately 150 feet between delineated segments; next to the roadway	A-24, A-25, & A-26
AB-B-S	R3	183	3	0.013	Flows into a tributary to Gnatty Branch; low velocity	A-25 & A-26
JBAH-S	R3	379	3	0.026	--	A-25

* Cowardin Codes: R3 = Upper Perennial, Riverine
R4 = Intermittent, Riverine
R6 = Ephemeral, Riverine

Riverine wetlands within the project area provide essential habitat for a wide range of species including various fish species including wild trout, salamanders, and numerous birds that rely on these habitats for nesting and feeding. The dense vegetation and clean water create a diverse food web, supporting both terrestrial and aquatic life forms. During prior planning efforts for constructing Section 8D, the NPS surveyed fishes and benthic macroinvertebrates in potentially affected streams. Headwater streams above the project area were relatively undisturbed except for some residential development on Buckeye Knob. These streams had high abundance of pollution-sensitive mayfly, stonefly, and caddisfly taxa. In larger, lower elevation streams in the project area, there was an increase in total benthic invertebrate taxa and a decrease in pollution-sensitive taxa, likely due to increasing water temperatures. Small headwater tributaries near the proposed Parkway were too small or isolated to support fish, although downstream waters had fish communities. Mill Creek had a healthy, reproducing population of rainbow trout near the proposed Parkway. No threatened or endangered fish species were found, but small numbers of Tennessee dace, a species listed by TWRA as In Need of Management, were collected below the project area in Mill Creek and Cove Creek. Fish were rare or absent in the sampled stream reaches nearest to Section 8D, probably as a result of low or intermittent stream flows or natural barriers to upstream movement. Caney Creek, Machine Branch, and Cove Creek were similar in that their fish communities were dominated by common minnows: blacknose dace, creek chubs, central stonerollers, and saffron shiners.

Riverine wetlands contribute clean water that flows into larger downstream water bodies. TDEC classifies the West Prong and all surface waters in the Park as Exceptional Tennessee Waters. Upstream of the project area, the West Prong flows through Gatlinburg; downstream, it flows through Pigeon Forge; and then in Sevierville, merges with the main stem of the Little Pigeon River. Human activities have caused the West Prong to be listed as impaired under 303(d) of the Clean Water Act (CWA) where it flows through the project area. The main sources of water quality degradation in the West Prong are from nonpoint sources associated with existing residential septic systems, sanitary sewer overflows, and stormwater runoff (TDEC 2022). As an impaired waterway not meeting its designated uses, it is anticipated that TDEC and the US Environmental Protection Agency will continue to enforce pollution controls as required by the CWA. Notably, the proposed expansion of the Gatlinburg Wastewater Treatment Plant, which is near its capacity limit, plans to increase its capacity from 3.0 million gallons per day to 4.5 million gallons. This expansion is intended to improve the quality of wastewater effluent released into the West Prong, potentially reducing pollutant loads and enhancing water quality over the long term.

During prior planning efforts for Section 8D, pre-construction water quality monitoring documented baseline conditions, which are likely similar today due to the lack of extensive development in the upstream watersheds. Turbidity was low, even during higher flows. Dissolved oxygen values showed no indication of severe oxygen depletion at any of the stations sampled. Nitrate concentrations were typical of healthy forest ecosystems. In summary, monitoring data indicated that water quality conditions for aquatic biota in streams was good, although the low alkalinity of some systems (except Cove Creek) suggested a high risk of stream acidification and heavy metal availability to the food chain. The project area could include soils and bedrock with unweathered pyrite, including in locations around the proposed Crooked Arm Ridge Tunnel. However, none of the streams measured in the project area had a pH approaching the low values of other streams in the Park known to be influenced by pyritic zones.

Riverine wetlands in the project area are also important for water flood regulation, as they accommodate excess rainfall during storms and slowly release water during dry periods. Geomorphologically, the wetlands generally have stable stream banks and limited erosion due to the limited degree of contemporary human disturbance in their watersheds. However, multiple culverts installed under a "pioneer road" built in the early 1990s for drilling to test the underlying geology of Section 8D were undersized and most have been washed out or bypassed (NPS 1994).

From a recreational and cultural perspective, the riverine wetlands offer scenic beauty and tranquility. However, there are no existing public roads or trails in the project area and very few humans likely enter the project area.

JUSTIFICATION FOR THE USE OF THE FLOODPLAIN AND WETLANDS

The potential impact on floodplains under the proposed action is justified because impacts are unavoidable; none of the proposed options considered would completely eliminate impacts on floodplains. In order to meet the project's purpose and need, Section 8D would have to cross floodplains of the West Prong and connect the Spur. The narrow transportation corridor (park boundary) designated for the Foothills Parkway make construction of Section 8D impossible without the use of floodplains. Potential alternative sites for bridges of the West Prong and its floodplain are constrained by steep terrain that is not suitable for construction without substantial earthwork that would be more damaging to Park resources than the proposed bridge options. Finally, potential locations for bridge support structures (i.e., piers) are limited by the location of the north and southbound lanes of the Spur on separate sides of the West Prong. Also, the proposed project area and associated floodplain have already been disturbed by existing transportation infrastructure. A bridge over the West Prong would minimize impacts, and three options for the bridge alignment have been evaluated and are analyzed herein for the sake of comparison and to inform the record of decision.

The potential impact on wetlands under the proposed action is justified because avoiding impacts is not feasible without substantially increasing on-site excavation or importation of fill material due to the steep slopes. Alternative Parkway alignments for Section 8D are also not feasible because the road must be constructed within the boundary of park lands designated for the Parkway. Therefore, it is not feasible to construct Section 8D while completely avoiding wetlands.

EVALUATION OF ALTERNATIVES

If practicable alternative sites are identified, it is NPS policy as set forth in NPS D.O. #77-2, to give preference to locating, or relocating, the proposed action at an alternative site outside and not affecting the regulatory floodplain. Non-flood-prone sites must be identified and evaluated for all proposed actions when it is determined that the action will occur within a floodplain or wetland. There are no practicable non-floodplain location for constructing a Section 8D bridge over the West Prong. The lands within the NPS Section 8D corridor were acquired decades ago and there are no other potential locations to cross the floodplain of the West Prong.

The EA prepared for this project considered two alternatives, including the no action alternative. Under alternative 1 (no action alternative) the NPS would not construct Section 8D of the Foothills Parkway, which would not fulfill the 1944 US Congressional intent. No new environmental impacts would occur from the no action alternative. Under alternative 2, the NPS would construct Section 8D of the Foothills Parkway. the Section 8D roadway would be a two-lane roadway with 12-foot travel lanes in each direction, striped at 11 feet. Paved shoulders approximately 3 feet wide could be used in sharper curves. Grass shoulders would be maintained along most of the roadway, with widths varying based on terrain and aesthetics. Given that the EA only analyzes one action alternative, several design considerations have been taken into account to address construction challenges due to the mountainous terrain throughout Section 8D, which would require a combination of cut-and-fill construction methods, retaining walls, and bridges. For example, several bridges are proposed to span large ravines and streams, and a karst management plan would be developed as part of final design. A detailed description of the proposed action, including these design considerations are provided in chapter 2 of the EA.

IMPACT AVOIDANCE AND MINIMIZATION

The NPS has followed the sequence of avoiding, minimizing, and compensating for wetland and floodplain impacts. Every practicable effort would be made to maintain the integrity of the affected wetlands and their attendant organisms and physical/biological processes. Avoidance would be the preferred approach during the design process, but design would also be used to minimize any potential impacts. Specifically, when complete avoidance is not possible, the NPS would limit soil and vegetation removal for cut/fill slopes and grading wherever possible, and avoid or minimize changes to the existing topography by mimicking the visual character of the native landscapes and preserving existing vegetation where possible. A complete list of resource protection measures are provided in appendix B of the EA, of which the applicable measures would include:

- Preserve an undisturbed riparian buffer to the maximum extent practicable.
- Implement sediment and erosion control measures consistent with the permitting requirements and recommendations contained in the TDEC Tennessee Erosion and Sediment Control Handbook (TDEC 2012, or latest edition) including revegetation, to minimize erosion and visual scars. File a Notice of Intent with TDEC to obtain coverage under the Tennessee Construction General Permit (Permit Number TNR100000). Develop a site-specific stormwater pollution prevention plan in accordance with Part 5 of the General Permit.
- Develop and implement a water quality monitoring program similar to previous Parkway monitoring (e.g., Privette 2017). Monitoring would be conducted at a representative sample of surface water and groundwater sites within and downstream of Section 8D. Monitoring would be conducted prior to, during, and after construction and would include surface water and selected drinking water sources (springs and wells).
- Adhere to the conditions of any CWA section 404 and 401 permits to minimize potential impacts on streams and wetlands during any in-water work or ground disturbance in the vicinity of aquatic resources.
- Implement a monitoring and remediation period of two years following completion of construction for purposes of assessing the impact of construction activities on stream crossings and wetlands. Use the monitoring and remediation phase to identify any construction-related impacts to streams and wetlands that require restoration, repair, or other mitigation. At minimum, conduct such monitoring immediately after construction is completed and at least once each spring and fall for two years following the completion of construction, and after any significant flood event. If the monitoring indicates that the stream crossing was not properly constructed/restored, undertake measures to correct the problem.

PROJECT IMPACTS

Permanent and temporary adverse impacts of the proposed action are discussed separately below.

PERMANENT IMPACTS

A potential area of disturbance (AOD) was developed that encompasses the area where the Parkway would be constructed along the Section 8D corridor (figure 2). The AOD represents the maximum limits of disturbance in the project area, which would be refined further during final design. The AOD varies slightly, depending on the Spur bridge options described above, but generally ranges from 326 acres to 331 acres. The AOD was developed with two different widths, which assumes the disturbance would be approximately 200 feet wide in locations without challenging topography or where bridges would likely be constructed, and approximately 400 feet wide in locations where areas of larger cut-and-fill may be needed or where the design may need flexibility to address topographic or environmental constraints. To

better approximate the minimum limits of disturbance, the estimated cut-and-fill areas, plus an additional 5 feet, from the conceptual design plans has also been analyzed in the EA. The boundaries of both the AOD and the cut-and-fill lines are shown in the figures in Attachment A.

To account for the maximum level of potential disturbance on wetlands and floodplains, this analysis uses the bridge with the largest potential disturbance, the high-curvilinear bridge option (Bridge 2B), which would have one pier within the channel of the West Prong and a second pier in the floodplain east of the river. Conceptual design plans were used to identify the location, height, and span (width) of bridge structural components (e.g., abutments location) to assess each proposed bridge's vulnerability to flooding and to design appropriate flood protection measures. Figure 4 shows the proposed bridge support structures of each Spur bridge and interchange bridge option with respect to the floodplain. Topographic (LiDAR) data showing the elevation of the project area and surrounding terrain was also reviewed to confirm floodplain boundaries and assess flood risks.

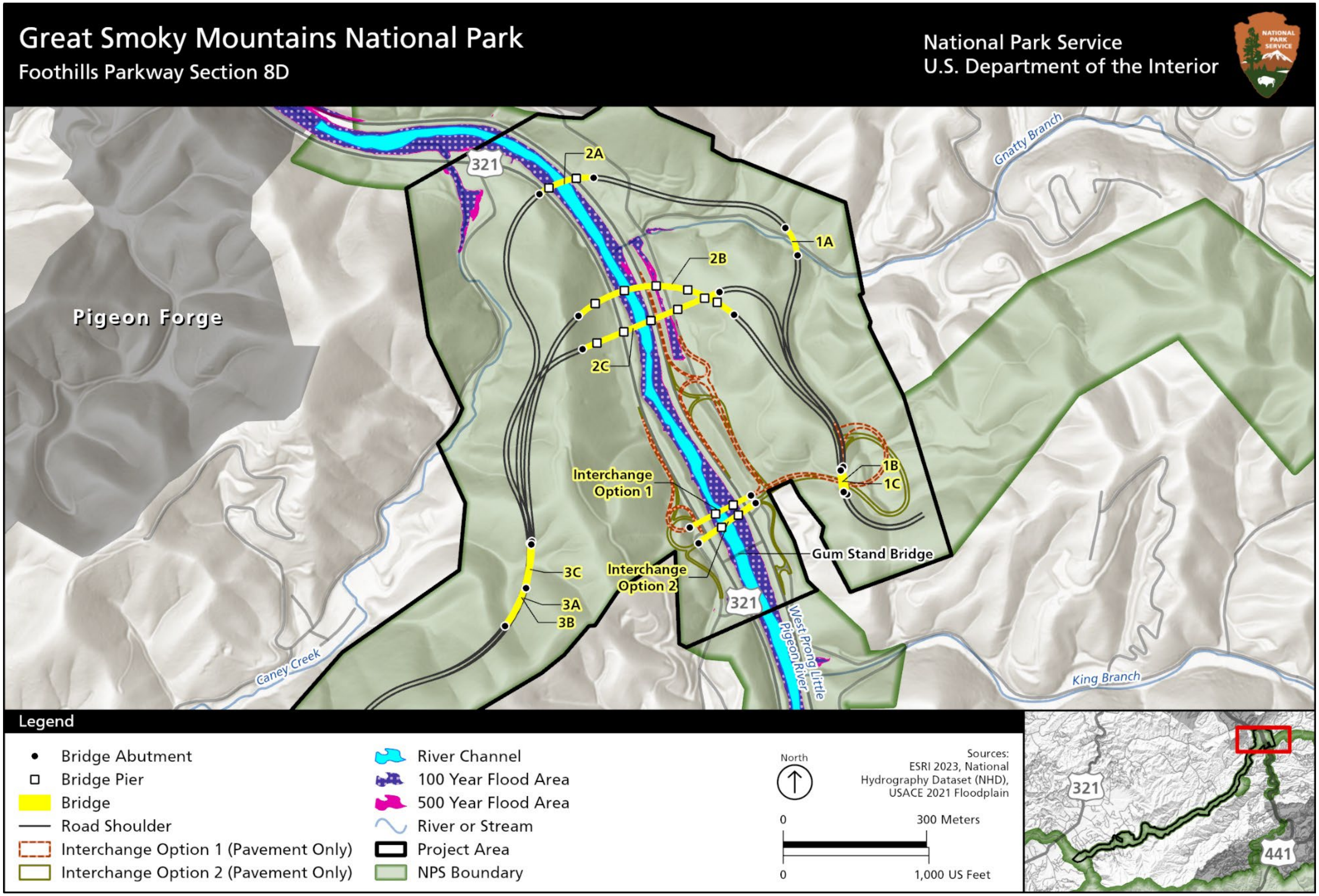

FIGURE 4. PROPOSED BRIDGE INFRASTRUCTURE OVER THE WEST PRONG AND ITS FLOODPLAIN

Permanent Floodplain Impacts

Constructing two new bridges over the West Prong and its floodplain would disturb terrestrial and aquatic habitats within the floodplain. Table 3 provides a summary of permanent impacts to the regulatory floodplain from constructing one of the three proposed bridge options, and second bridge as part of one of two interchange bridge options, In total, these new bridge piers would permanently occupy approximately 0.082 acres (3,600 square feet) within the 100-year floodplain. Under interchange option 2, the existing bridge at Gum Stand Road would be removed, eliminating its two bridge piers within the West Prong floodplain (and channel). These piers are approximately 30 feet by 10 feet, resulting in a gain of 600 square feet and a net permanent impact within the floodplain of 0.068 acres (3,000 square feet). Both proposed bridges over the West Prong would have one support pier located within the channel of the West Prong. These impacts are discussed further below under "Wetland Impacts," and Figures A-24 and A-25 in Attachment A show the locations of these impacts.

TABLE 3. PROPOSED PERMANENT FLOODPLAIN IMPACTS BY ACTIVITY TYPE

Activity Type	Area of Impact within the 100-year Floodplain	Notes
Low Bridge Option (Bridge 2A)		
Bridge Abutments and other Support Structures	0	One 30 foot x 25 foot piers within the regulatory floodplain
Support Piers	750 ft^2	
High-Curvilinear Bridge Option (Bridge 2B)		
Bridge Abutments and other Support Structures	0	Two 30 foot x 30 foot piers within the regulatory floodplain
Support Piers	1,800 ft^2	
High-Linear Bridge Option (Bridge 2C)		
Bridge Abutments and other Support Structures	0	Two 30 foot x 30 foot piers within the regulatory floodplain
Support Piers	0	
Interchange Option 1		
Bridge Abutments and other Support Structures	0	Two 30 foot x 30 foot piers within the regulatory floodplain
Support Piers	1,800 ft^2	
Interchange Option 2		
Bridge Abutments and other Support Structures	0	Two 30 foot x 30 foot piers within the regulatory floodplain
Support Piers	1,800 ft^2	

Within potentially flood-prone areas crossed by the mainline of Section 8D, 17 of 37 delineated streams (riverine wetlands) are proposed to be spanned by bridges, avoiding direct floodplain impacts. Culverts are proposed for installation at the remaining 20 stream crossings, including 15 box-culverts and 5 pipe culverts. The acreage of permanent impacts from these culverts is detailed below under "Permanent Wetland Impacts."

Federal Flood Risk Management Standard

Pursuant to E.O. 13690, "Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input," federal agencies must choose one of three methods for establishing a higher vertical flood elevation beyond the guidelines provided in E.O. 11988.

The NPS used the "500-year floodplain" approach identified by the Federal Flood Risk Management Standard to evaluate the flood elevation and corresponding flood hazard area for project siting, design, and construction. Based on the floodplain delineation by USACE (2021), all proposed structural components, except for the four bridge piers proposed for construction within the 100-year floodplain, would be located above the 500-year floodplain (figure 4). In addition, all proposed access roads and ramps associated with the two the interchange options would occur above the 500-year floodplain, except for a very small sliver (less than 1 square foot) of road surface under interchange option 1.

Potential Risks to Human Health and Safety

The preferred alternative does not include construction of habitable structures in the floodplain. Human use of the floodplain would include motorists on the Parkway at its intersection with the Spur. The Spur serves local communities, commuters, Park visitors, and Park staff. Traffic volumes on the Spur are particularly high during daily peak commuting hours and throughout the Park's peak visitation season(s). Inundation of this major road could impact travelers on Section 8D and hamper or prevent vehicular travel during an extreme flood event. However, the West Prong river channel is relatively deep, with base flows approximately 15 to 25 feet below the bench where the northbound or southbound lanes of the Spur is located. This provides for substantial flood flow conveyance before the river overtops its banks.

Park visitors driving along Section 8D of the Parkway would cross some flood-prone areas despite the absence of any regulated floodplain in these locations. During heavy rain events or flood events, water levels within creeks crossed by the Parkway could rise rapidly and potentially cause concerns, leading to hazardous driving conditions and potential road washouts. Additionally, flooding could weaken road foundations and cause structural damage to bridges, culverts, and roadways, increasing the risk of accidents and injuries. In general, a prolonged period of intense rain for about 12 to 24 hours can create extreme flood conditions. Gates located Walland and at the Spur would allow for closure of the area if warranted; there is no need for others along Section 8D. Also, scenic overlooks would not be constructed within the vicinity of flood-prone areas because scenic vistas are located on ridges or exposed uplands. Additional measures discussed below under "Floodplain Mitigation" would be implemented to minimize the potential of flooding or the adverse impacts of the proposed action to the extent that risks to human health and safety would be negligible.

Potential Risks to Property

Specific new capital investments within the floodplain under the preferred alternative would include bridges within flood-prone areas of upper perennial and streams, which do not have extensive floodplain development. The NPS would only place bridge support piers within the floodplain except where it is unavoidable due to no alternative design options. On the mainline, the proposed bridges would not have any piers located within a stream channel, which would reduce risks to property. Increased flooding at the proposed bridge locations is not expected to occur because the bridges would be designed to ensure a "no-rise condition" in upstream water surface elevations. All culverts would be appropriately sized to provide unimpeded conveyance of flood flows as determined during final design. Risks to property would be minimized by following FHWA *Design Standards for Highways in National Flood Insurance Program Mapped Floodplains* (FHWA 1986). The installation of these culverts would not cause any potential for increased flood risk to property.

Potential Risks to Floodplain Values

Floodplains provide an array of natural and physical resource values, including natural flood control, erosion control, groundwater recharge, habitat for vegetation and wildlife, and recreational opportunities. Construction of a bridge across the West Prong and the Spur would occur within the regulatory floodplain. While Section 8D would not cross any regulatory floodplain other than adjacent to the West Prong, it would cross numerous perennial streams that may experience high flood flows and construction activities would temporarily impact natural floodplain values along these streams.

Construction activities would disturb soils and could cause compaction, reducing plant growth. Site restoration techniques, including those for soil compaction, would prevent localized impacts to groundwater recharge and permeability characteristics. Construction techniques would also minimize changes to natural karst processes. Measures would also be implemented to avoid and minimize impacts on karst features consistent with the *Tennessee Erosion and Sediment Control Handbook* (TDEC 2012 or latest edition) and *Appendix B - Stormwater Design Guidelines for Karst Terrain of the Tennessee Permanent Stormwater Management and Design Guidance Manual* (TDEC and UT 2014, or latest edition), as applicable. The NPS would seek to maintain the inherent integrity of the karst topography's natural processes and features, including its surface and subsurface drainage patterns, caves, biological resources, spring flows, and groundwater and surface water quality and quantity, which include drinking water supplies. The design and construction planning have taken all practicable measures to reduce geologic hazards associated with karst topography that could threaten the safety of park visitors and staff and the long-term viability of the park infrastructure. Further detail on the NPS design objectives for Section 8D segments underlain by karst is provided below under "Minimizing Unavoidable Impacts."

Constructing Section 8D would cause a loss of vegetation due to clearing and new impervious roadway, as well as the fragmentation of habitat for wildlife. Loss of vegetation would cause a minor permanent impact on surface water infiltration into groundwater. Protective measures will be documented in a site-specific revegetation plan and stormwater pollution prevention plan in accordance the Tennessee Construction General Permit (see "Minimizing Unavoidable Impacts").

Installing culverts at stream crossings could remove or alter benthic and streambank habitats that aquatic species use. In addition to the bridges proposed for the Spur bridge option, the installation of 20 bridges and up to 48 culverts could alter streamflow; however, impacts would be temporary and minor because an appropriately culvert design would be selected to maintain current flows and avoid or minimize long-term impacts. Using properly-sized culverts at stream crossings, including Machine Branch, King Hollow Branch, and Sugar Camp Branch, would reduce impacts on floodplain values through the retention of aquatic habitat by placing the bottom invert below stream grade and placing natural streambed material inside. Spanning 17 stream crossings along the mainline, including Rymel Branch, Mill Creek, and Caney Creek, would avoid impacts to these potentially flood-prone sites. Installing culverts at other stream crossings, would remove or alter benthic and streambank habitats that aquatic species use.

The new roadway could alter the natural flow of water during floods, potentially affecting the floodplain's ability to absorb and dissipate flood energy via effects on erosion and sedimentation processes. Installation of bridges and culverts could also temporarily alter streamflow. However, several design considerations and BMPs would be implemented to manage stormwater effectively and minimize erosion. For example, roadside drainage systems would effectively capture and channel runoff without overwhelming natural conveyances, as culverts, ditches, and swales would be designed to manage water flow and reduce the velocity of runoff. Vegetated buffers would be maintained or restored immediately following disturbance in order to filter runoff, trap sediment, and stabilize the soil. Also, if necessary to address karst-related drainage problems, either a filtration system, retention/sediment basin, or both would be used to temporarily store and/or treat runoff, help manage peak flow rates, and reduce the potential for downstream erosion or water quality impacts. Overall impacts of stormwater on floodplain values would be temporary with these and other protective measures in place.

As a result, the proposed action would alter floodplain functions to some degree. Impacts, however, would be minimal because the 3,000 to 3,300 square feet of bridge support piers within the floodplain would not alter or constrict flood waters. As such, increased flooding as a result of channel constriction is not expected to occur. The proposed flyover bridge would be constructed using techniques outlined in the TDEC's Aquatic Resource Alteration Permit and the USACE section 404 permit. In addition, the proposed action would likely not significantly reduce water infiltration because the increase in impervious surface would be minor compared to the surrounding development and existing roadway. The proposed action would not noticeably alter the existing stormwater runoff volumes or patterns. To minimize

stormwater impacts further, NPS would file a Notice of Intent with the TDEC to obtain coverage under the General National Pollutant Discharge Elimination System Permit for Discharges of Stormwater Associated with Construction Activities and would develop a site-specific stormwater pollution prevention plan in accordance with Part 3 of the General Permit.

Permanent Wetland Impacts

Four palustrine wetlands are located within the AOD for the mainline (AJ-N-W, AJ-AO-W, AJ-AD-W, and AJ-E-W). These wetlands are all located west of the tunnel within the Crooked Arm Branch Segment. Two of these wetlands (AJ-AO-W and AJ-E-W) would be avoided as they are located greater than 50 feet from the proposed Section 8D centerline and could be protected during construction. Wetland AJ-AO-W would be avoided entirely as it is located outside of the proposed cut-and-fill area (Attachment A, pp. A-8 and A-9). Wetland AJ-E-W is located greater than 50 feet from the proposed Section 8D centerline and the final design will avoid impacts to this wetland (Attachment A, pp. A-2 and A-3). The other two wetlands within the AOD for the mainline (AJ-N-W and AJ-AD-W) would be avoided because they would be spanned by proposed bridges. Although these wetlands could experience some minor short-term impacts associated with stormwater runoff during construction, adverse impacts would be minimized by appropriate erosion prevention and sediment control measures.

One palustrine wetland (AB-C-W) is located within the proposed ramp areas for both interchange options at the Spur (Attachment A, pp. A-25 & A-26). Impacts to this wetland would be unavoidable because some cut and fill is likely required in this area. It is assumed that the entire 0.024-acre wetland would be permanently impacted. Table 4 provides a summary of permanent wetland impacts.

TABLE 4. PROPOSED PERMANENT WETLAND IMPACTS

Wetland ID	Cowardin Classification	Permanent Impacts (Acres)	Notes
AB-C-W	PSS	0.024	This 0.024-acre wetland would be impacted by access roads and ramps associated with interchange options 1 and 2. It is assumed that the entire wetland would be permanently impacted regardless of the selected interchange option.
JBA-S	R3	0.041	Two 30 foot x 30 foot piers proposed to be located within the channel of the West Prong, one for the for the proposed Spur bridge and one for the proposed interchange bridge.
AB-L-S	R3	0.006	A 90-foot-long, 3 foot x 3 foot box culvert (No. 8) would be installed within the channel.
MD-AD-CS	R6	0.008	A 90-foot-long, 4 foot x 3 foot box culvert (No. 9) would be installed within the channel.
AB-M-S	R3	0.010	A 90-foot-long, 5 foot x 3 foot box culvert (No. 10) would be installed within the channel.
AB-N-S	R3	0.012	A 90-foot-long, 6 foot x 4 foot box culvert (No. 11) would be installed within the channel.
AB-O-S	R3	0.012	A 90-foot-long, 6 foot x 4 foot box culvert (No. 12) would be installed within the channel.

AB-P-S	R3	0.008	A 90-foot-long, 4 foot x 3 foot box culvert (No. 13) would be installed within the channel.
AB-Q-S	R3	0.008	A 90-foot-long, 4 foot x 3 foot box culvert (No. 14) would be installed within the channel.
MD-AA-CS	R3	0.006	A 90-foot-long, 3 foot x 3 foot box culvert (No. 15) would be installed within the channel.
MD-AB-CS	R3	0.017	A 90-foot-long, 8 foot x 5 foot box culvert (No. 16) would be installed within the channel.
AJ-AF-S	R3	0.022	An 81-foot-long, 12 foot x 8 foot box culvert (No. 23) would be installed within the channel of Sugar Camp Branch.
AJ-AI-S	R6	0.012	A 90-foot-long, 6-foot diameter pipe culvert (No. 24) would be installed within the channel.
AJ-U-S	R3	0.016	A 78-foot-long, 9 foot x 6 foot box culvert (No. 27) would be installed within the channel of King Hollow Branch.
AJ-P-S	R3	0.013	An 81-foot-long, 7 foot x 5 foot box culvert (No. 30) would be installed within the channel.
AJ-F-S	R3	0.014	A 62-foot-long, 10 foot x 7 foot box culvert (No. 31) would be installed within the channel of Machine Branch.
AJ-D-S	R3/R4	0.019	A 90-foot-long, 9 foot x 6 foot box culvert (No. 39) would be installed within the channel.
AJ-E-S	R6	0.011	A 60-foot-long, 8 foot x 6 foot box culvert (No. 41) would be installed within the channel.
MD-O-CS	R3	0.010	A 90-foot-long, 5-foot diameter pipe culvert (No. 43) would be installed within the channel.
MD-D-CS	R3	0.012	A 90-foot-long, 6-foot diameter pipe culvert (No. 44) would be installed within the channel.
AB-A-S	R3	0.025	Two 90-foot-long, 6-foot diameter pipe culverts (Nos. 45 & 47) would be installed within the channel, at different locations.
AB-B-S	R3	0.012	A 90-foot-long, 6-foot diameter pipe culvert (No. 46) would be installed within the channel.
	Total	**0.318**	

Of the approximately 61,000 feet of riverine wetlands within the project area, approximately 14,300 feet would be located within the AOD. Table 4 provides a summary of permanent impacts on riverine wetlands due to culvert installation. Impacts to the West Prong (JBA-S) include the construction of a pier within the river channel to support two new bridges (figure 3). These piers would measure approximately 30 feet by 30 feet and two of them would permanently impact up to approximately 0.041 acres (1,800 squares feet) of riverine wetland. Impacts from culverts are calculated based on dimensions of the proposed structures. For the 17 proposed box culverts for which the TR-55 model was run, as described above under "Floodplain Delineation and Characterization," the area of permanent impacts was determined using the longest side of the box culvert. For the remaining 31 pipe culverts, the dimensions

were assumed to be 6 feet wide based on the USFWS (2024) culvert guidance for ecological function that states the culvert width should be a minimum of 1.0 times the bankfull width and 6 feet is the approximate stream width of the small streams in the project area. All culverts are assumed to be 90 feet long, unless otherwise determined by the TR-55 model. In total, there would be approximately 0.310 acres (13,511 square feet) of permanent impacts to 22 riverine wetlands from bridge and culvert installation.

TEMPORARY IMPACTS

During construction of the Spur bridge and interchange bridge, temporary impacts to floodplains are expected due to the removal of adjacent vegetation and alteration of the existing topography, which could cause erosion and sedimentation. Impacts to the West Prong would be largely avoided by preserving an undisturbed riparian buffer to the maximum extent practicable. Additionally, temporary impacts to the West Prong would be largely avoided because ground-level activities would be minimized during the construction of elevated bridges. All cut-and-fill areas and proposed bridge abutments would occur above the regulatory floodplain. In-water construction would be scheduled during low-flow periods to minimize the impact on water flow and aquatic life by reducing the amount of sediment disturbed during construction. Appropriate measures would be taken to maintain normal downstream flows and to minimize flooding. Cofferdams would also be used around pier footings to create a dry work area within the river. Soil materials excavated for footings in or near the water would be removed and relocated to prevent the material from being washed back into the West Prong. Any temporary fill would be placed in a manner and consist of materials that will not be eroded by expected high flows. Following completion of construction, temporary fill would be entirely removed to an upland area and the affected areas would be restored to pre-construction elevations. The affected areas would also be revegetated as appropriate. These protective measures would ensure that temporary impacts to floodplain values and wetland functions and values of the West Prong would be inconsequential.

Along the mainline of Section 8D, temporary impacts within potentially flood-prone areas would generally be avoided at 17 stream crossings that would be spanned by bridges, as ground-level construction activities within the floodplain could be avoided. Where culverts are proposed at the remaining 20 stream crossings, temporary impacts would be avoided by constructing bridges that would span riverine wetland and adjacent flood-prone areas. Impacts would further be avoided by providing an undisturbed riparian buffer to the maximum extent practicable. Some direct temporary impacts could include the displacement of wetland vegetation and soil during the installation of bridge abutments and culverts; however, design would seek to avoid or minimize any disturbance in wetlands and floodplains to the extent possible. Indirect temporary impacts to wetlands could also include the alteration of water flow patterns and soil compaction due to excavation and earthmoving activities. Additionally, the installation of stream diversion structures during culvert installation would cause temporary, localized changes in riverine wetland hydrology.

MITIGATION

FLOODPLAIN MITIGATION

The following floodplain risk mitigation measures would be implemented under the proposed action:

- The Park would support and coordinate with the Sevier County Emergency Management Agency and the City of Gatlinburg in their emergency flood warning systems, including the development of a communication protocol to receive real-time alerts and feeds into the Park’s monitoring and alert systems.
- Develop and update flood response plans that incorporate data and alerts from the Sevier County and Gatlinburg systems.

- The structures and facilities would be designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program "Floodplain Management Criteria for Flood-Prone Areas" (44 CFR Part 60.3) and in accordance with any state or county requirements for flood-prone areas.
- Potential risks to human health and safety would be mitigated with bridge design that places the bridge deck elevation well above the level of a 100-year flood event.
- Potential risks to property would be mitigated by following the FHWA's *Design Standards for Highways in National Flood Insurance Program Mapped Floodplains* (FHWA 1986).
- To mitigate risk to floodplain values (stormwater storage capacity and infiltration), elevation of fuel storage and hazardous materials or waste storage above the 500-year floodplain would reduce the risk of a release that could adversely affect floodplain values.

The proposed action would incorporate the described impact avoidance and minimization techniques to protect human health/life, minimize risk to capital investment, and preserve natural and beneficial floodplain values. The proposed action would not alter flood elevations and would not have permanent effects on floodplain functions and negligible effects on floodplain values; therefore, no additional floodplain mitigation would be required.

WETLAND MITIGATION

In the course of developing and implementing the proposed action, the NPS must seek to avoid impacts on wetlands wherever practicable. Wetland mitigation includes avoidance, minimization, and compensation. As described under "Justification for Use of Floodplains and Wetlands," avoiding wetlands altogether is not possible given the limited area of the NPS-managed corridor and other site constraints. However, the NPS would minimize adverse impacts to wetlands by designing Section 8D to reduce wetland degradation or loss and by using the BMPs listed in Appendix 2 of NPS Procedural Manual #77-1 (NPS 2016). Minimization measures also include the resource protection measures listed above under "Evaluation of Alternatives."

After avoidance and minimization have been applied to the maximum practicable extent, remaining wetland impacts must be offset through wetland compensation. For the NPS, compensation refers primarily to restoring natural wetland functions in degraded or former natural wetland habitats on NPS lands. In accordance with Procedural Manual #77-1, the NPS requires a minimum of 1:1 mitigation ratio for the replacement of lost wetland acres. The NPS will employ a 5:1 mitigation ratio to compensate for loss of riverine wetland function. Applying this ratio to the 0.318 of wetland impacts, the NPS would provide mitigation via planting native woody vegetation on 1.59 acres of nearby riverine wetland buffers (compensation sites). The proposed mitigation would be provided through the Cades Cove Stream Restoration Project (figure 5).

The NPS will plant a 50-foot wide forested buffers on both sides of five stream channels (table 5) at an average density of 300 native woody stems/acre. The streams within the compensation site are stable but lack fully forested buffers. After planting, permanent site protection will be provided through an agreement stipulating how the buffer area adjacent to the project streams may be managed. Compensation sites are located along approximately 4,700 linear feet of streams with 100-foot buffers (50 feet on either side) that equate to 11 acres of possible mitigation. The NPS will provide mitigation on 1.67 acres of wetland habitat within these 11 acres. This is to account for areas that may have non-wetland areas within 50 feet of the streams. A wetland delineation will be performed to identify the acreage of wetland habitats available for mitigation.

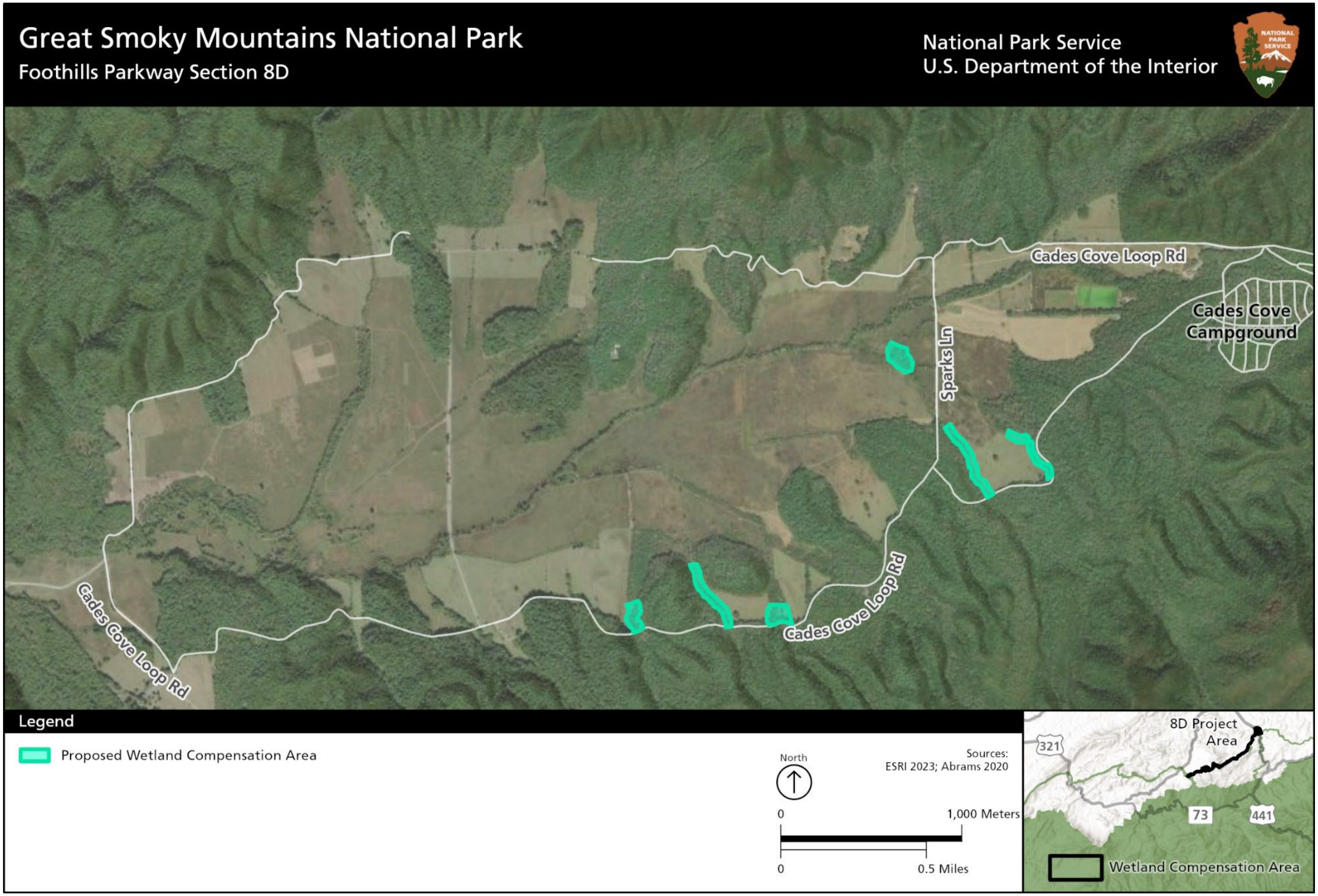

FIGURE 5. PROOPSED WETLAND MITIGATION

TABLE 5. PROPOSED CADES COVE STREAM RESTORATION

Stream Name	Reach ID	Length (Linear Feet)	Acres
Oliver Branch	OL-01	1426.4	3.27
Unnamed Tributary to Oliver Branch	UO-01	679.1	1.56
Bunting Branch	BU-01	332.0	0.76
Unnamed Tributary to Bunting Branch	UB-01	362.4	0.83
Sea Branch	SE-01	1,901.1	4.63
	Total	**4,701.0**	**11.05**

Current Condition of Streams

The proposed compensation sites are currently in poor condition and functionally impaired due to past agricultural practices. Channelization, realignment, and riparian clearing have created discontinuity in aquatic and terrestrial habitats. Features such as meandering planforms, appropriate channel geometries, diverse riffle substrates, large woody debris, overhanging vegetation, stable and self-maintaining pool habitats, and native, vegetated riparian corridors are present immediately upstream of the project area. A description of each stream reach within the compensation area is provided below.

Unnamed Tributary to Oliver Branch: The Unnamed Tributary to Oliver Branch enters the project area as a stable E4b with limited buffer on stream left after passing through a culvert at the Cades Cove Loop Road. Shortly after entering the Cades Cove valley bottom, the channel transitions to a F4 stream type in the bottom with eroding banks and limited bedform diversity. The channel has developed intermittent benches in some areas in response to widening and subsequent deposition. This condition is in response to historic channelization. The riparian buffer on stream left is managed as pasture and the stream right riparian buffer contains some mature trees along the terrace but is otherwise dominated by early successional vegetation.

Oliver Branch: Oliver Branch enters the project area near the culvert at Cades Cove Loop Road as a stable B3 stream type. Shortly after it exits the culvert, it runs adjacent to a ridge and its riparian corridor is mowed on stream right. As Oliver Branch leaves the ridge and continues into the Cades Cove valley bottom, it transitions to G4 stream type. It exhibits raw eroding banks, compromised bank vegetation, and little aquatic habitat. The bed is generally planar in form and contains elevated levels of fine sediment. Riparian vegetation is dominated by early successional species on stream left and has limited width on stream right. The G4 stream type continues to its confluence with McCaulley Branch. The riparian corridor is managed as pasture after the confluence with the unnamed tributary to Oliver Branch.

Unnamed Tributary to Bunting Branch: The Unnamed Tributary to Bunting Branch enters the project as a B4 stream type after it passes through a culvert at Cades Cove Loop Road. Unnamed Tributary to Bunting Branch has a managed riparian corridor with varying widths until shortly before its confluence with Bunting Branch.

Bunting Branch: Bunting Branch begins at Cades Cove Loop Road as a stable B4 stream type dominated by coarse gravel and cobble. Shortly after passing through the culverts at Cades Cove Loop Road, Bunting Branch presents a narrow band of riparian vegetation before regaining a more mature riparian buffer before its confluence with unnamed tributary to Bunting Branch.

Sea Branch: Sea Branch enters the project area as a B3 stream type after it passes through a culvert at the Cades Cove Loop Road and quickly transitions to a C4 stream type in the Cades Cove valley bottom. Its substrate consists of a mix of cobbles, gravels, and sand. The riparian corridor on stream right is

maintained as pasture; however, some mature trees can be found along the top of right bank. The channel is stable until it nears the culvert crossing on Sparks Lane where some lateral migration is occurring in response to a lack of bank vegetation on stream right. Downstream of the Sparks Lane crossing, Sea Branch changes to an E4b stream type that has experienced a cycle of downcutting due to channelization. Although bank heights are relatively low, the channel is vertically and laterally unstable, which is demonstrated by headcuts and lateral bank erosion. Additionally, the channel lacks appropriate crosssectional geometry and meander pattern. Little to no woody bank or riparian vegetation is present until Sea Branch nears its confluence with Rowans Creek. Some mature trees are present along the terrace, but they generally do not provide stability or shading. The profile is dominated by riffle habitat.

Post-Restoration Condition of Streams

The Cades Cove Stream Restoration Project provides an opportunity to restore riparian wetlands on project streams and provide both geomorphic continuity and habitat connectivity that has not been present since before settlement and modification of Cades Cove. Planting native woody vegetation within riverine wetlands would serve to restore the natural wetland functions in degraded wetland habitats on NPS lands. The reestablishment of native riparian vegetation would enhance habitat for terrestrial and aquatic species and serve to stabilize stream banks, and thus reduce erosion and sedimentation in the streams. After five growing seasons, the riparian buffers are expected to be functional in that the density of woody stems would provide continuous woody riparian habitat with shading over the riverine wetlands. The vegetation would be well-established, contributing to the overall wetland functions and values. Based on a 5:1 mitigation ratio provided, it is expected that the proposed compensation will replace the lost wetland functions and values caused by the proposed action.

Schedule for Project Completion

This project will be constructed as a single effort and will be completed prior to the end of construction of Foothills Parkway Section 8D.

Timeframe for Full-Functioning Wetlands

It is anticipated that it will take five growing seasons to achieve fully functioning riverine wetlands.

Monitoring and Maintenance of Compensation Areas

The compensation areas will be evaluated at the end of the next growing season following planting and for four additional years thereafter. Monitoring will be carried out between June and September of each monitoring period. At a minimum, the annual monitoring report will:

- Reference the regulatory permits authorizing the project activity
- Include a summary of the work accomplished
- Include photographs of new planting areas with the photo locations identified on a plan view figure of the project site
- Include the following information from the photo stations:
    - Photographs from the station
    - Density of woody stems (survival of plantings)
    - Species composition of woody vegetation as well as an indication of dominant species
    - Identification of invasive species and an estimated percent cover.
    - Recommended corrective measures that are planned to control undesirable species.

Performance Criteria

If the woody vegetation plantings have not successfully established within the monitoring time periods, the NPS may be required to augment the plantings to meet required density. After the five-year time period, additional monitoring requirements will be determined if needed.

Funding Source for Compensatory Mitigation

The cost of compensatory mitigation has been factored into the construction cost of the project and is consistent with D.O. 77-1, Section 5.2.3.

COMPLIANCE

FLOODPLAIN COMPLIANCE

Based on the above analysis, the proposed structures and facilities would be designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR Part 60).

WETLAND COMPLIANCE

This document is required in order to comply with E.O. 11990. The NPS D.O. #77-1 and *Procedural Manual #77-1* provide policies and procedures to comply with E.O. 11990. Compliance with other agency regulations will be completed as appropriate and separately from this document; however, the mitigation measures set forth herein may be relied upon in fulfilling compliance with other applicable regulatory requirements.

CONCLUSIONS

FLOODPLAINS

As part the construction of Section 8D, the NPS proposes to build two bridges that would span the floodplain of the West Prong, which would both require two piers to be placed within the 100-year floodplain. This would result in a permanent impact of approximately 0.08 acres. However, if interchange option 2 were selected, the existing bridge at Gum Stand Road would be removed and the demolition of its two piers would reduce the overall floodplain impacts to of approximately 0.06 acres. This is the only portion of the project area where the regulatory floodplain has been defined. In other locations where Section 8D would cross streams or other flood-prone areas, bridges and culverts would reduce the risk of altering the hydrology of the floodplain culverts are proposed. The proposed action would incorporate the described impact avoidance and minimization techniques to protect human health/life, minimize risk to capital investment, and preserve natural and beneficial floodplain values. By spanning over the floodplain, bridges and culverts would minimize the disruption to the natural floodplain and help maintain the natural floodplain values, including wildlife habitat and vegetation. Other avoidance and minimization measures would limit impacts to the degree that overall risks from temporary impacts to floodplains would be minor. While the new Section 8D roadway may cause minor alterations to floodplain values, it would not alter the role of periodic floods in maintaining the health and diversity of floodplain ecosystems. Construction Section 8D would not alter flood elevations and would not have permanent effects on floodplain functions and negligible effects on floodplain values; therefore, no additional floodplain mitigation would be required.

WETLANDS

The proposed action would permanently impact 0.024 acres of one palustrine wetland (AB-C-W) in the vicinity of the Spur due to construction of the access roads/ramps associated with the two the interchange options at the Spur. Four additional palustrine wetlands occur within the AOD of Section 8D (AJ-N-W,

AJ-AO-W, AJ-AD-W, and AJ-E-W). However, these wetland could be protected from impacts during construction and would experience no adverse permanent impacts because they are either more than 50 feet from the Parkway centerline or would be spanned by bridges. An additional 0.253 acres of riverine wetlands would be permanently impacted by culvert installation, and 0.041 acres of riverine wetlands would be permanently impacted by the bridge pier installation within the of the channel of the West Prong. The total acreage of wetland impacts (0.318 acres) would be offset through compensatory mitigation aimed at riparian restoration on tributaries to Abrams Creek in the Cades Cove area of the Park. A mitigation ratio of 5:1 would translate to 1.59 acres of native woody plantings.

QUALIFICATIONS OF THE DELINEATORS

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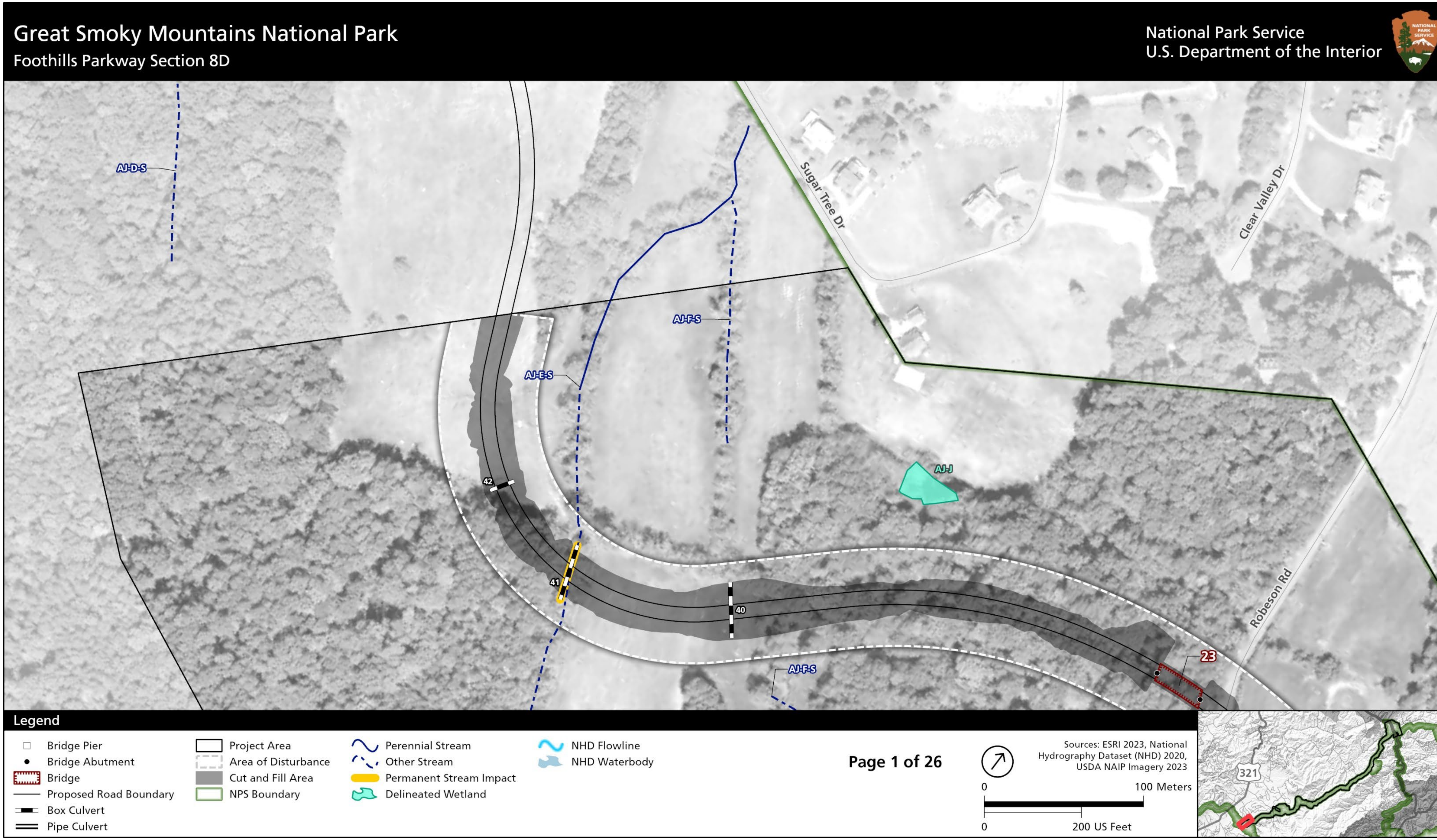
ATTACHMENT A
DELINEATED WETLANDS AND STREAMS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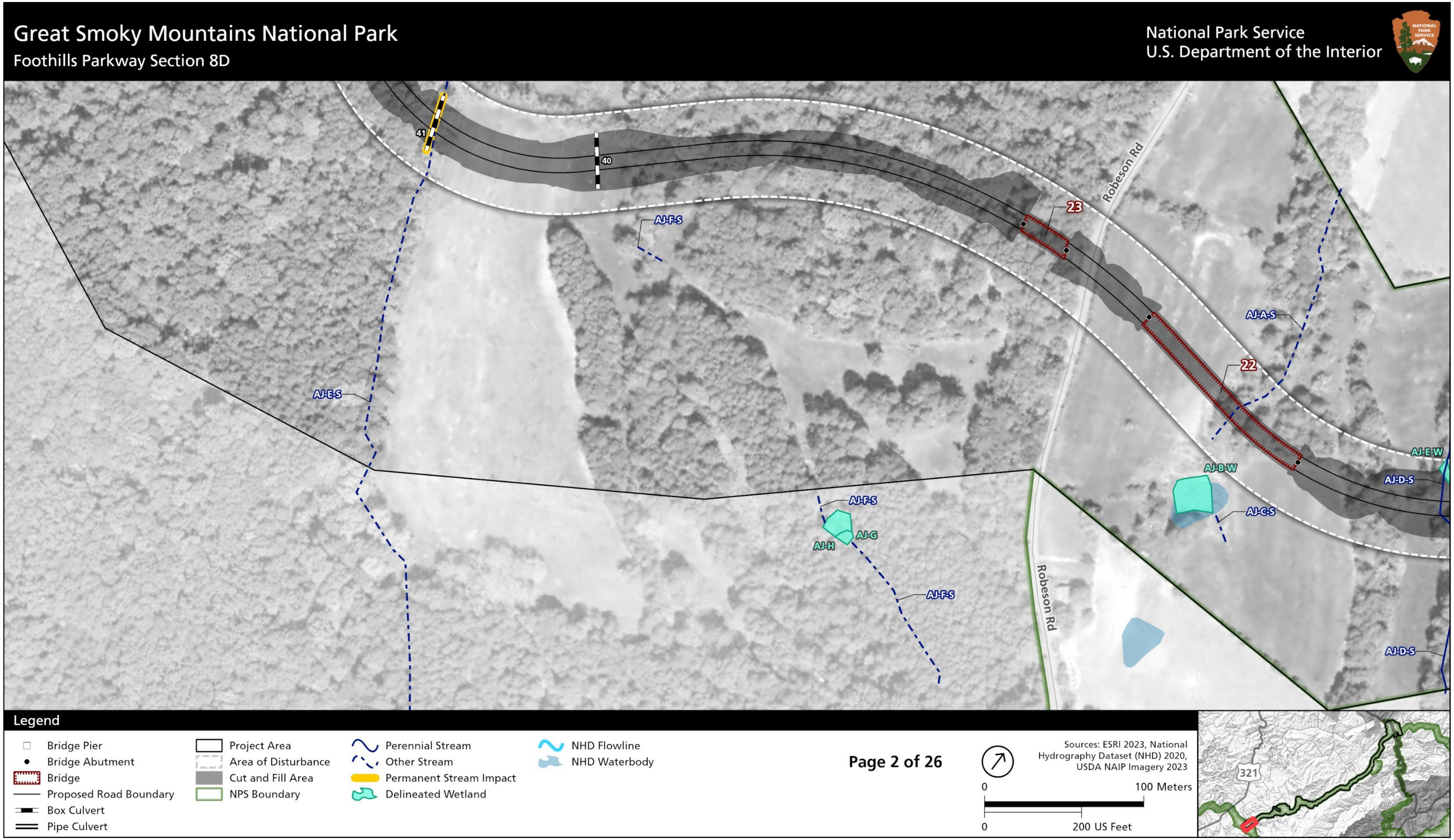

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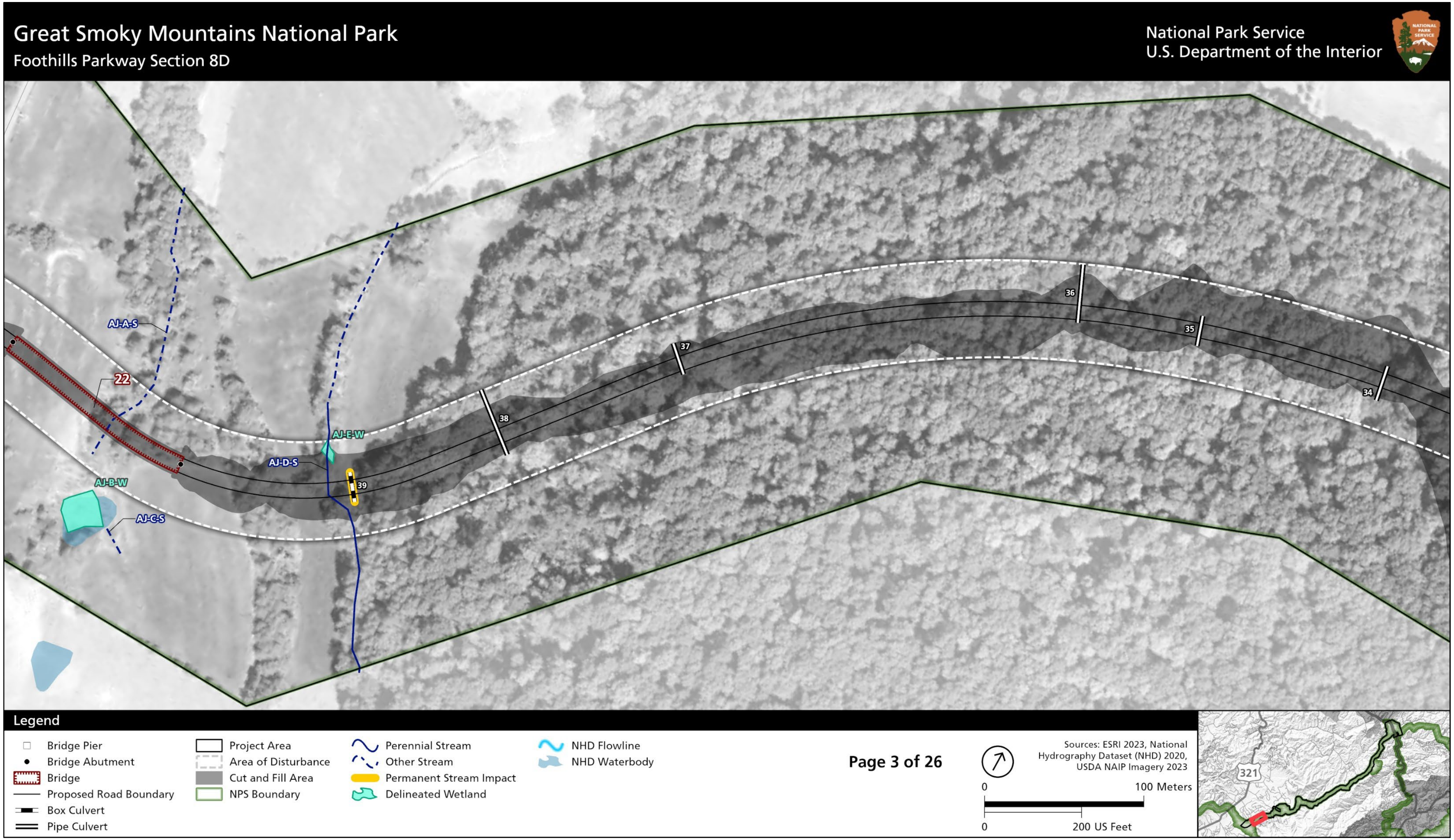

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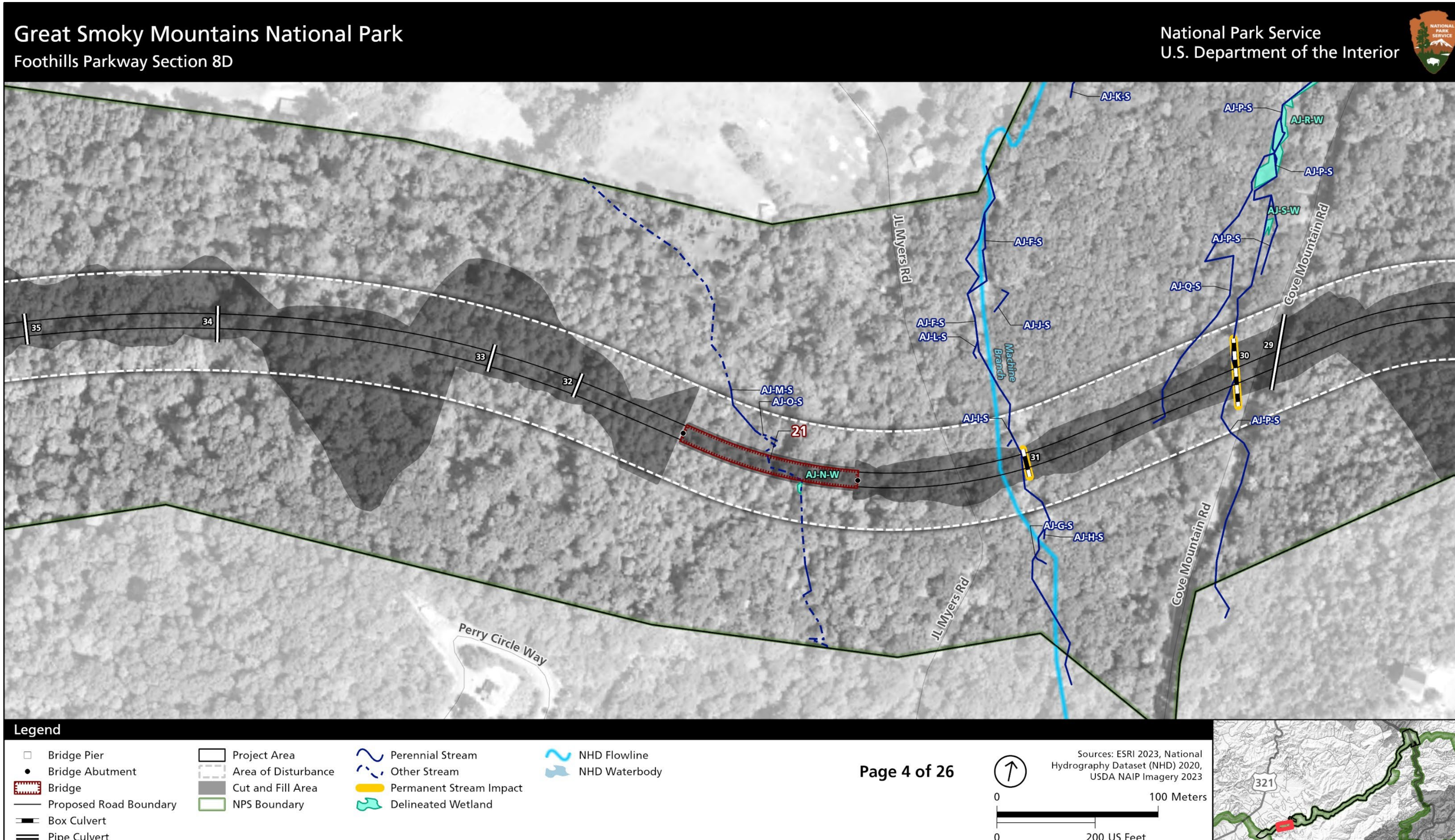
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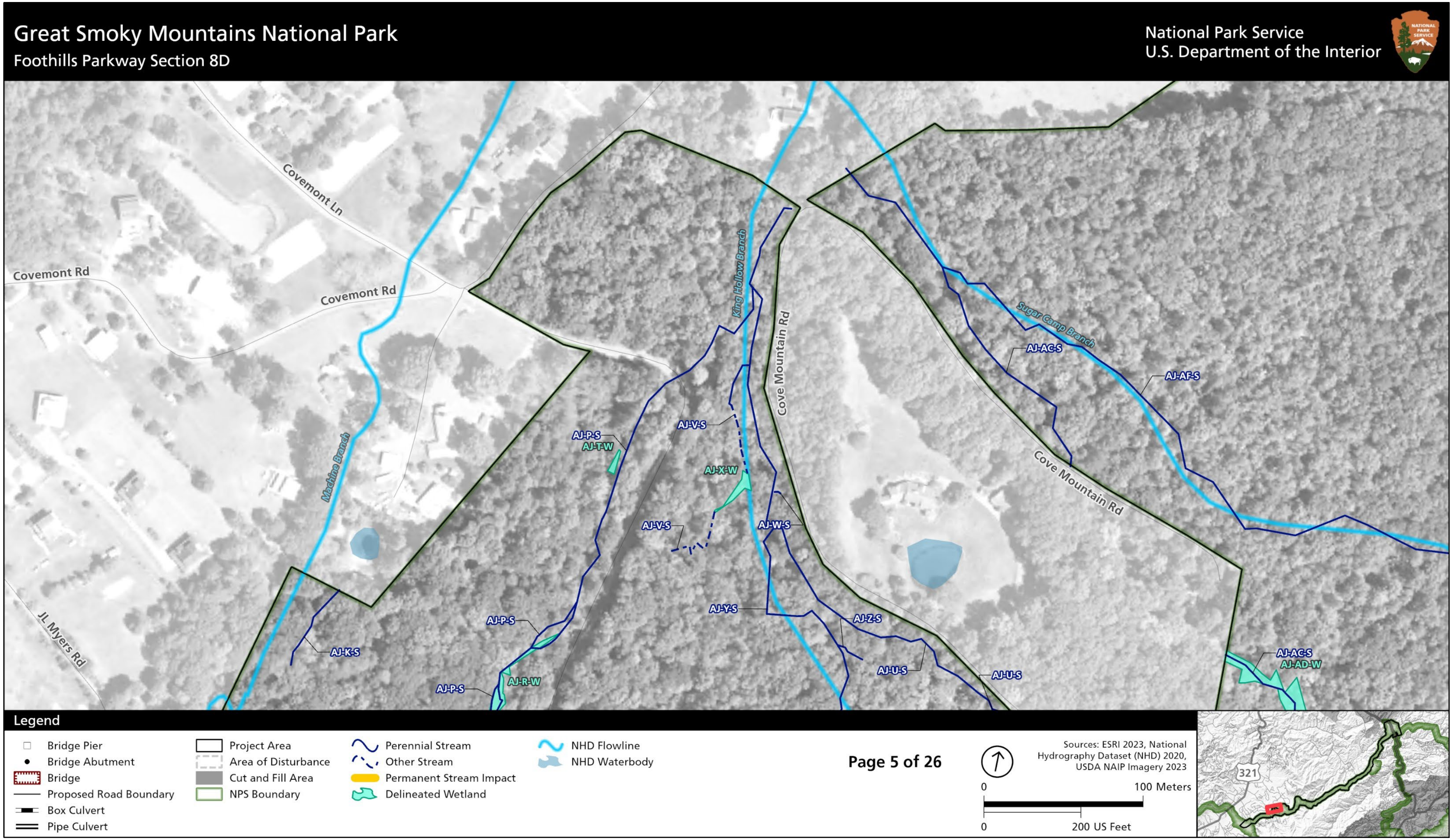
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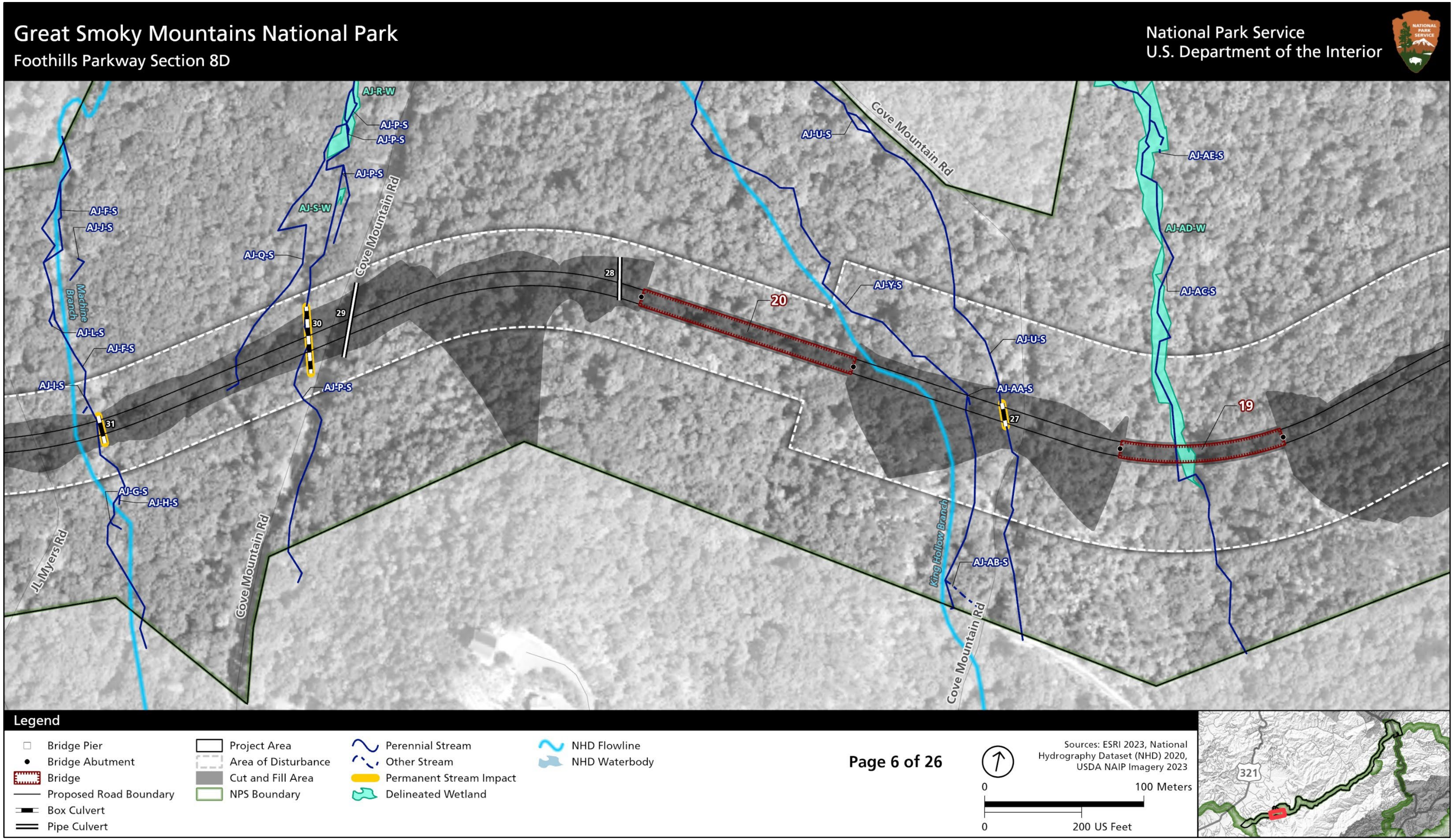

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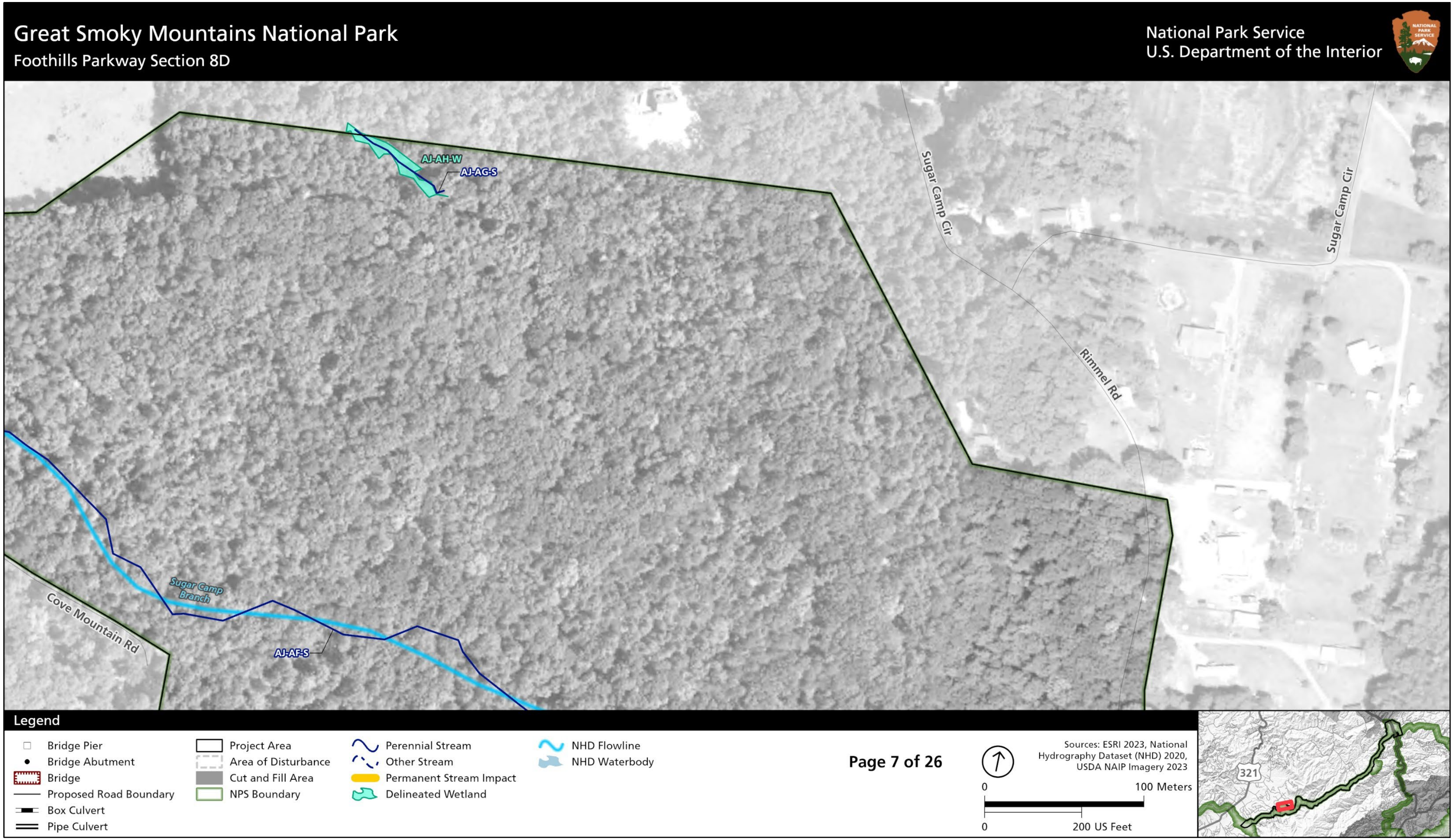
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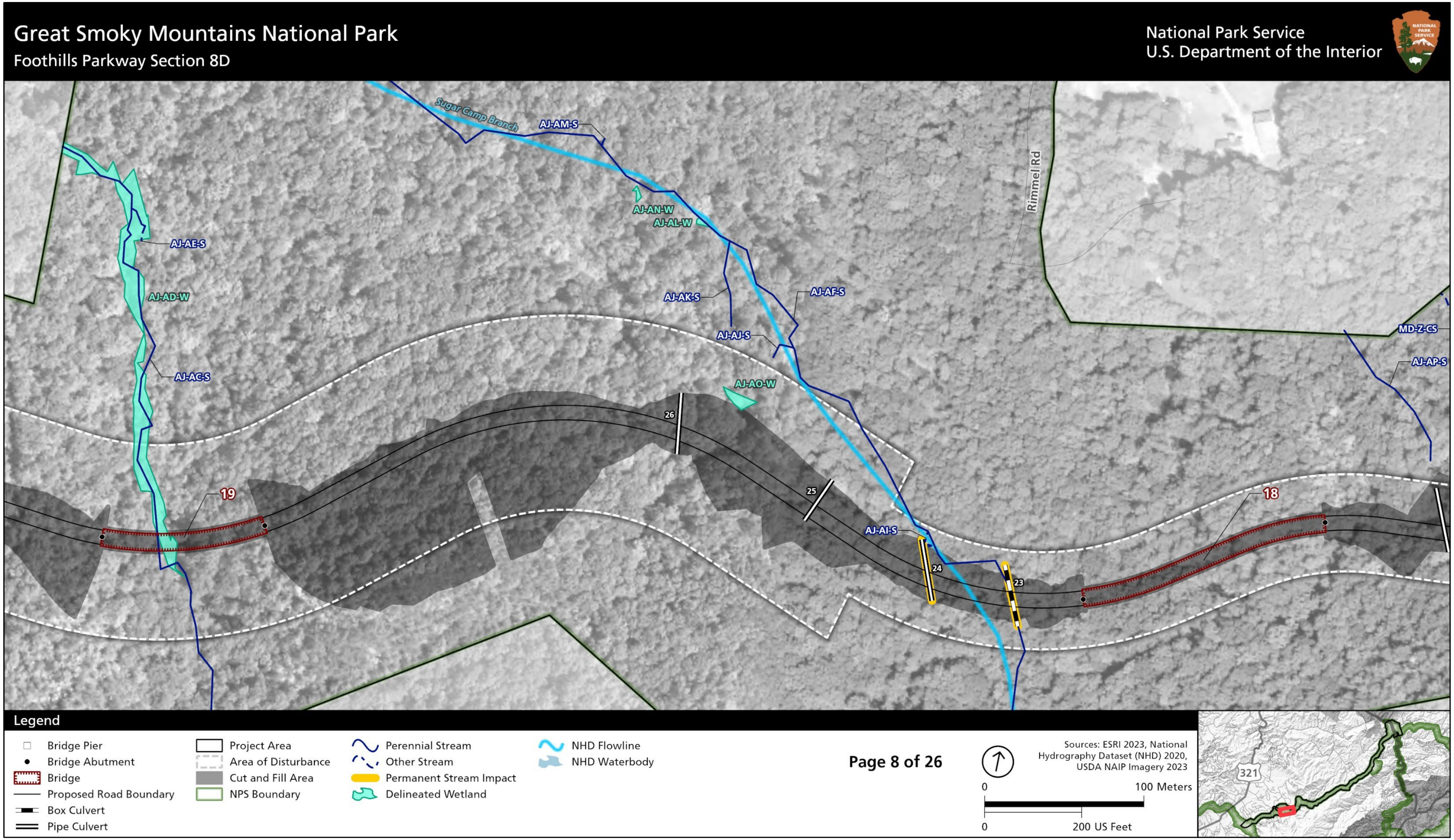

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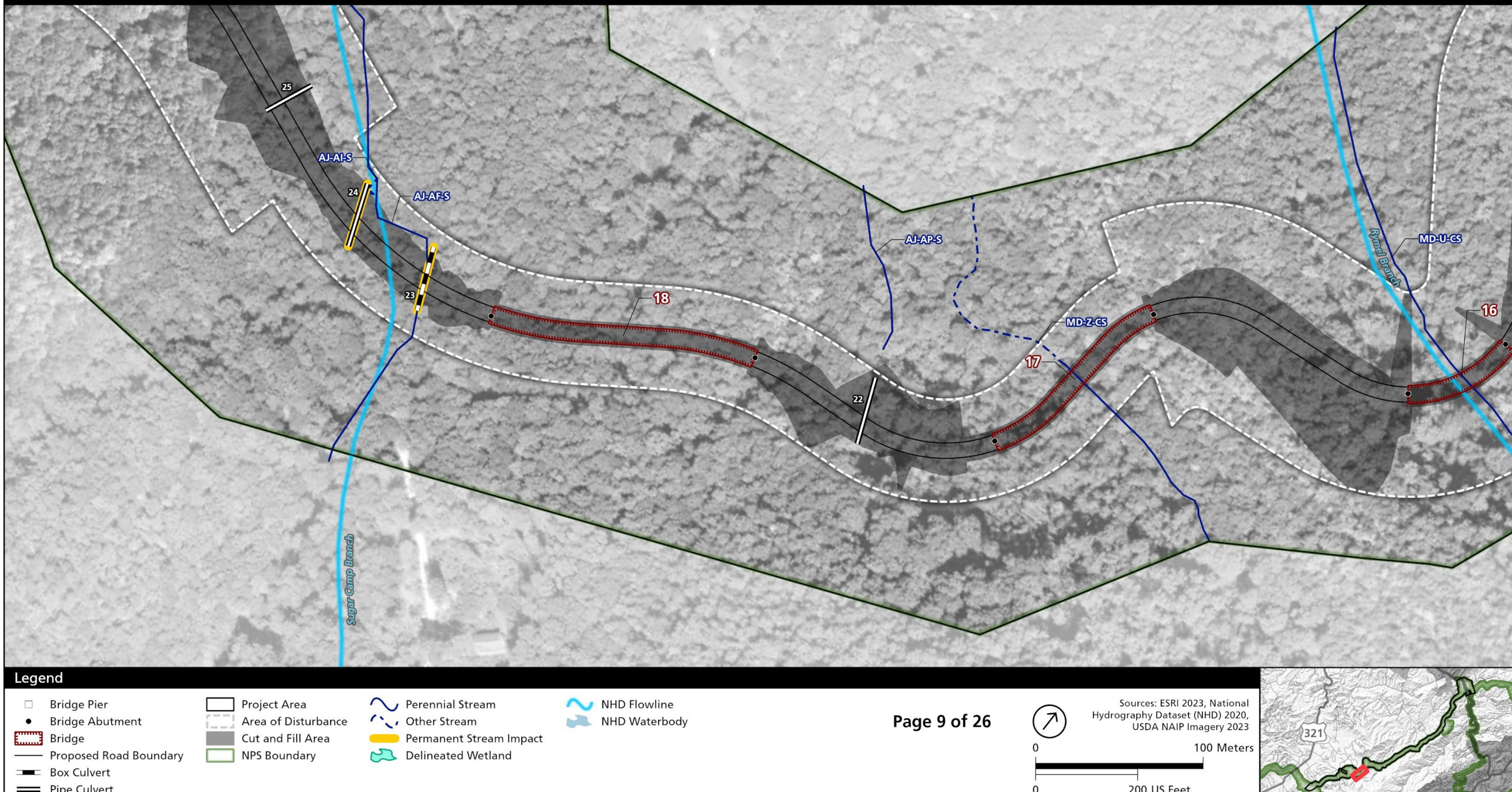
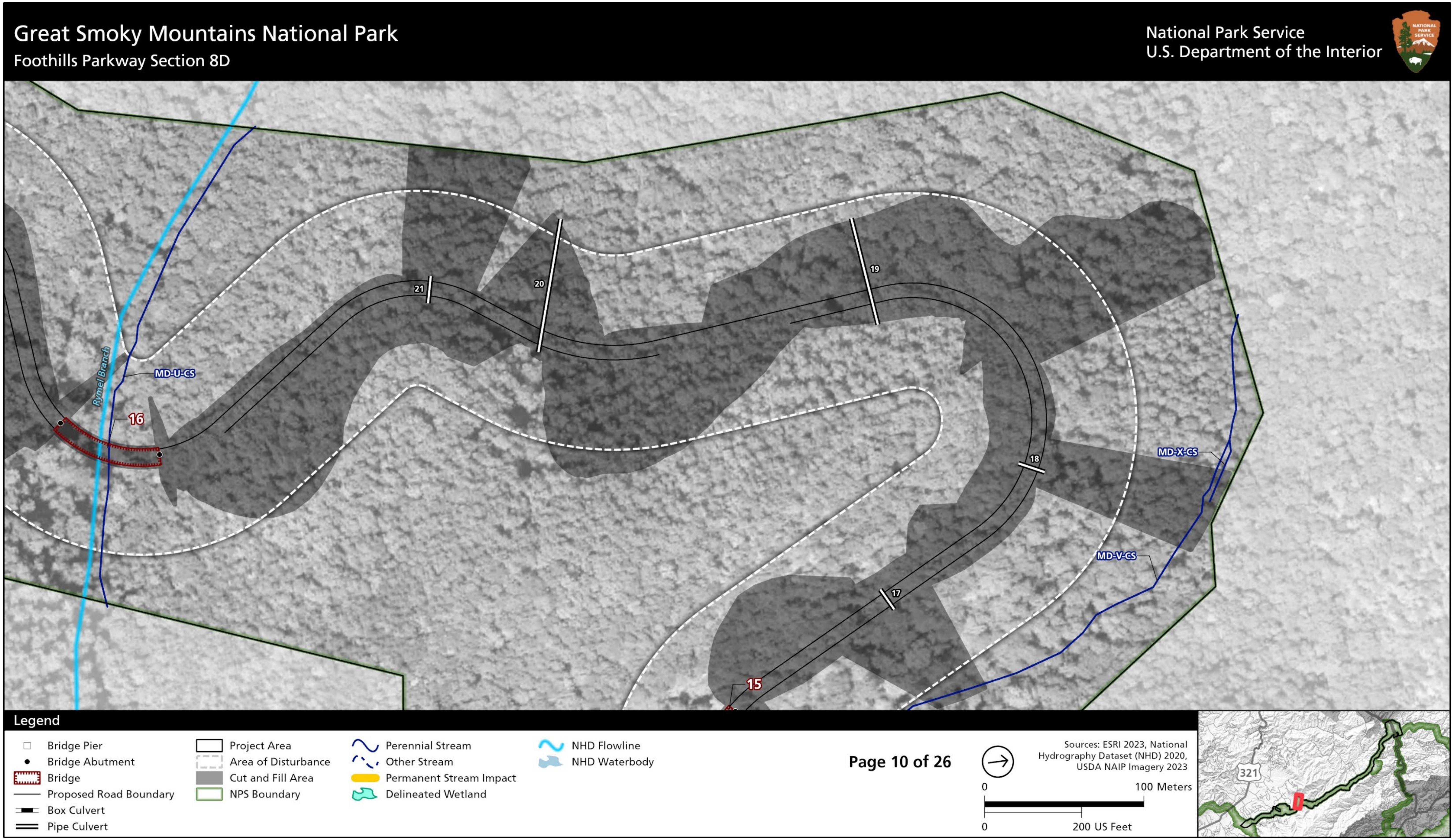
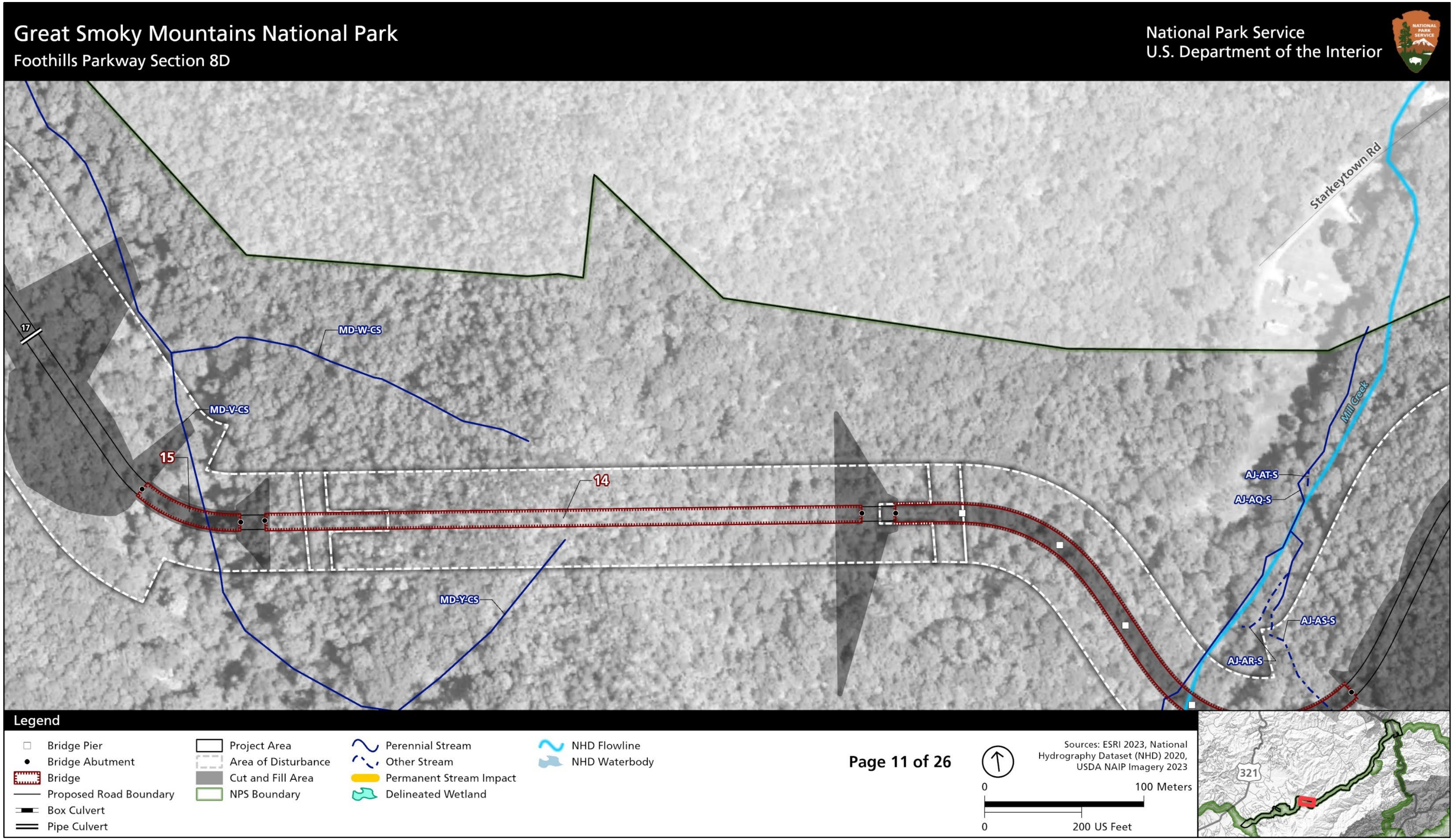
National Park Service
U.S. Department of the Interior



Page 9 of 26

Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023


Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
21
20
19
18
17
16
15
Rymel Branch
MD-U-CS
MD-X-CS
MD-V-CS
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 10 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321



Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
Starkeytown Rd
Mill Creek
MD-W-CS
MD-V-CS
MD-Y-CS
AJ-AT-S
AJ-AQ-S
AJ-AS-S
AJ-AR-S
17
15
14
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 11 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321

Great Smoky Mountains National Park
Foothills Parkway Section 8D

National Park Service
U.S. Department of the Interior

Legend

- Bridge Pier
- Bridge Abutment
- Bridge
- Proposed Road Boundary
- Box Culvert
- Pipe Culvert
- Project Area
- Area of Disturbance
- Cut and Fill Area
- NPS Boundary
- Perennial Stream
- Other Stream
- Permanent Stream Impact
- Delineated Wetland
- NHD Flowline
- NHD Waterbody

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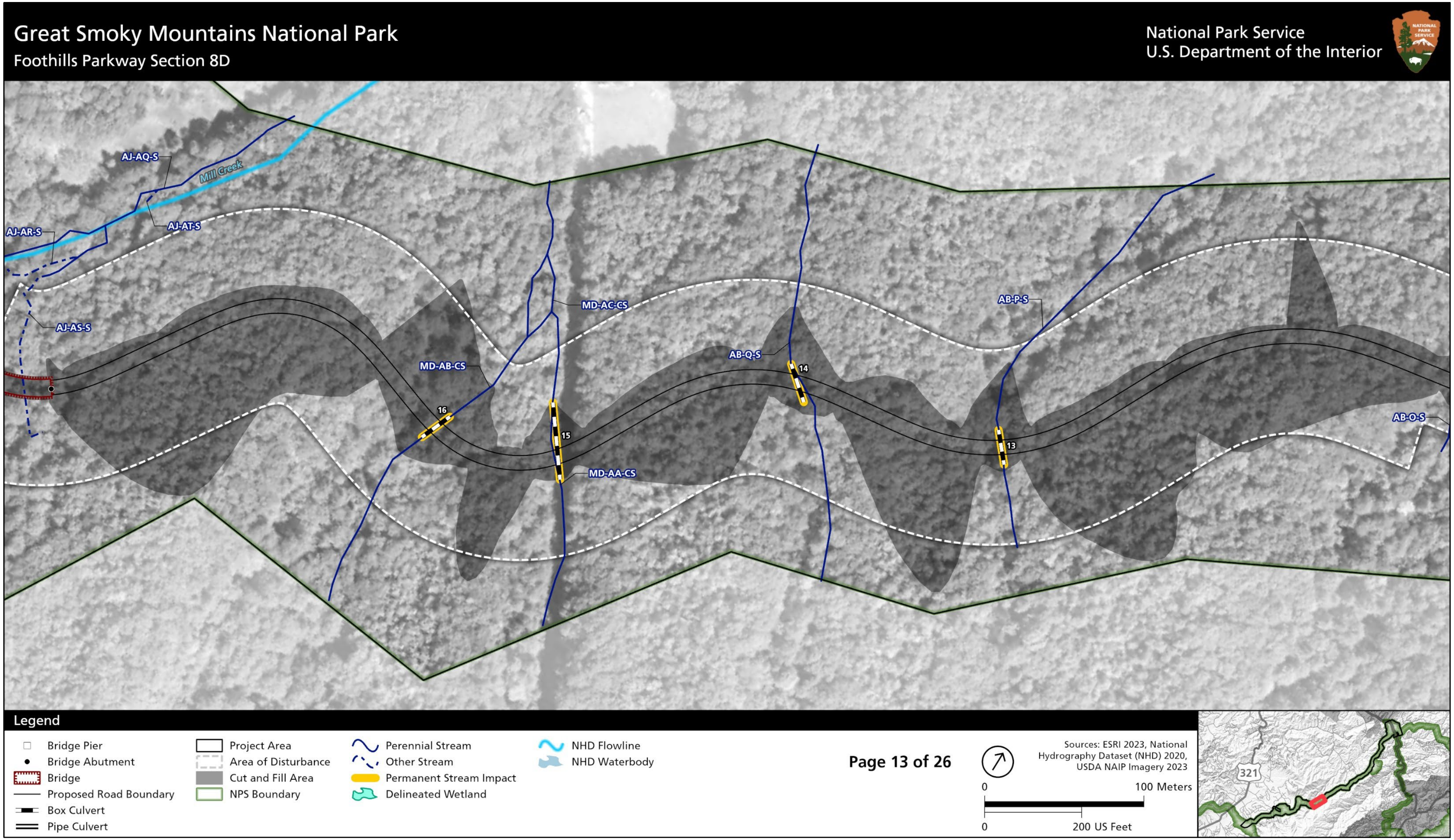
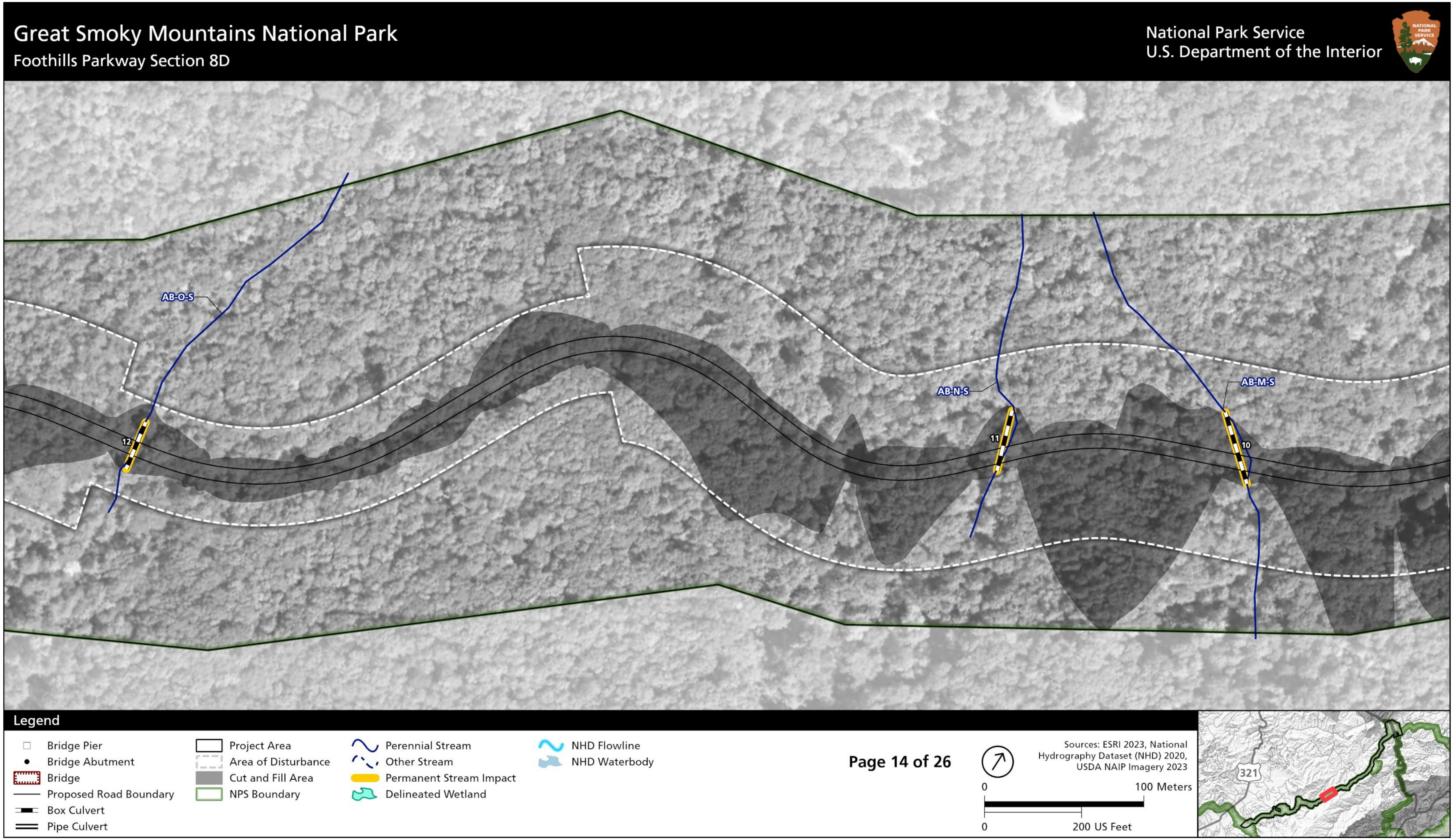
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023

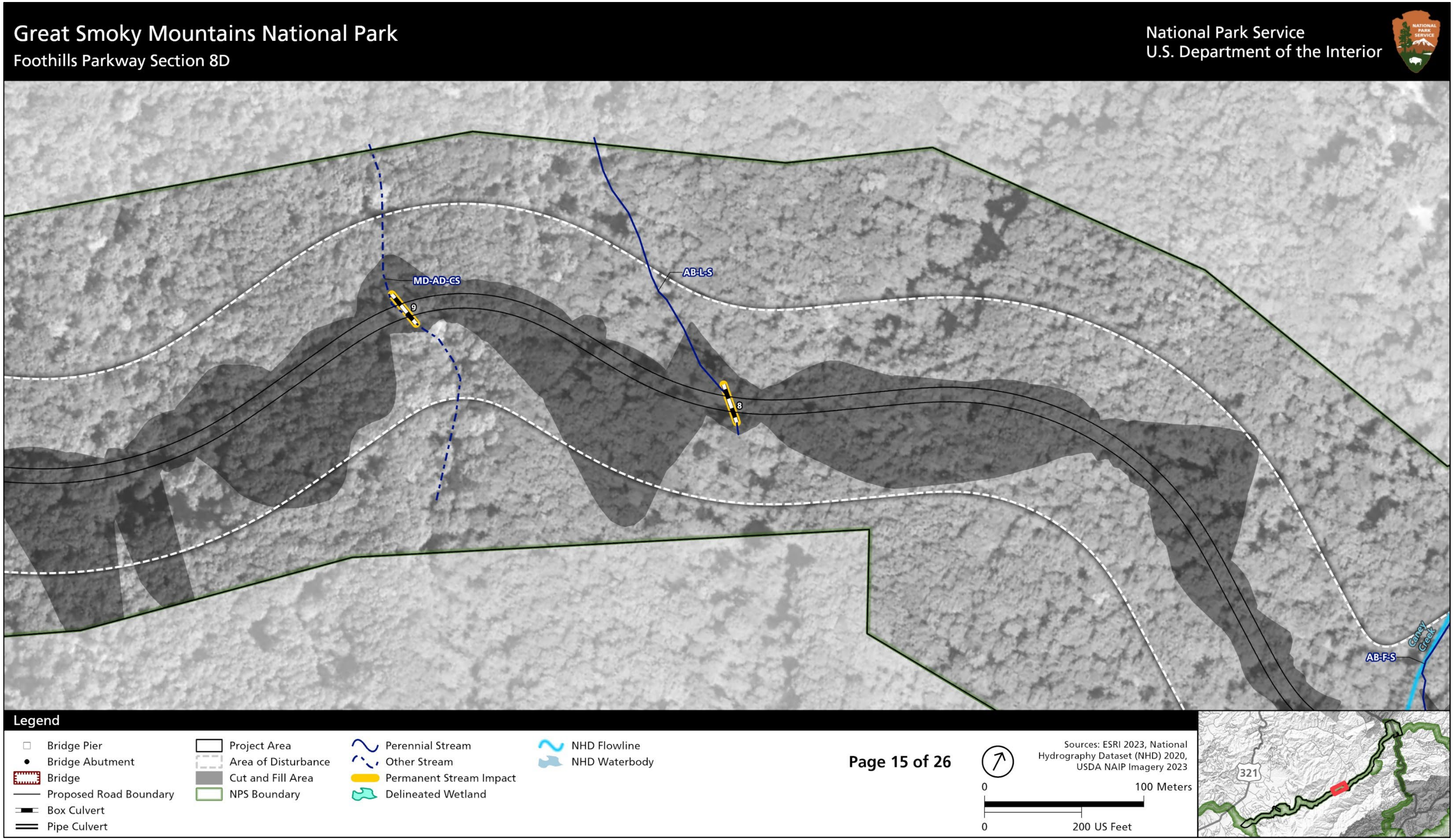
0 100 Meters
0 200 US Feet



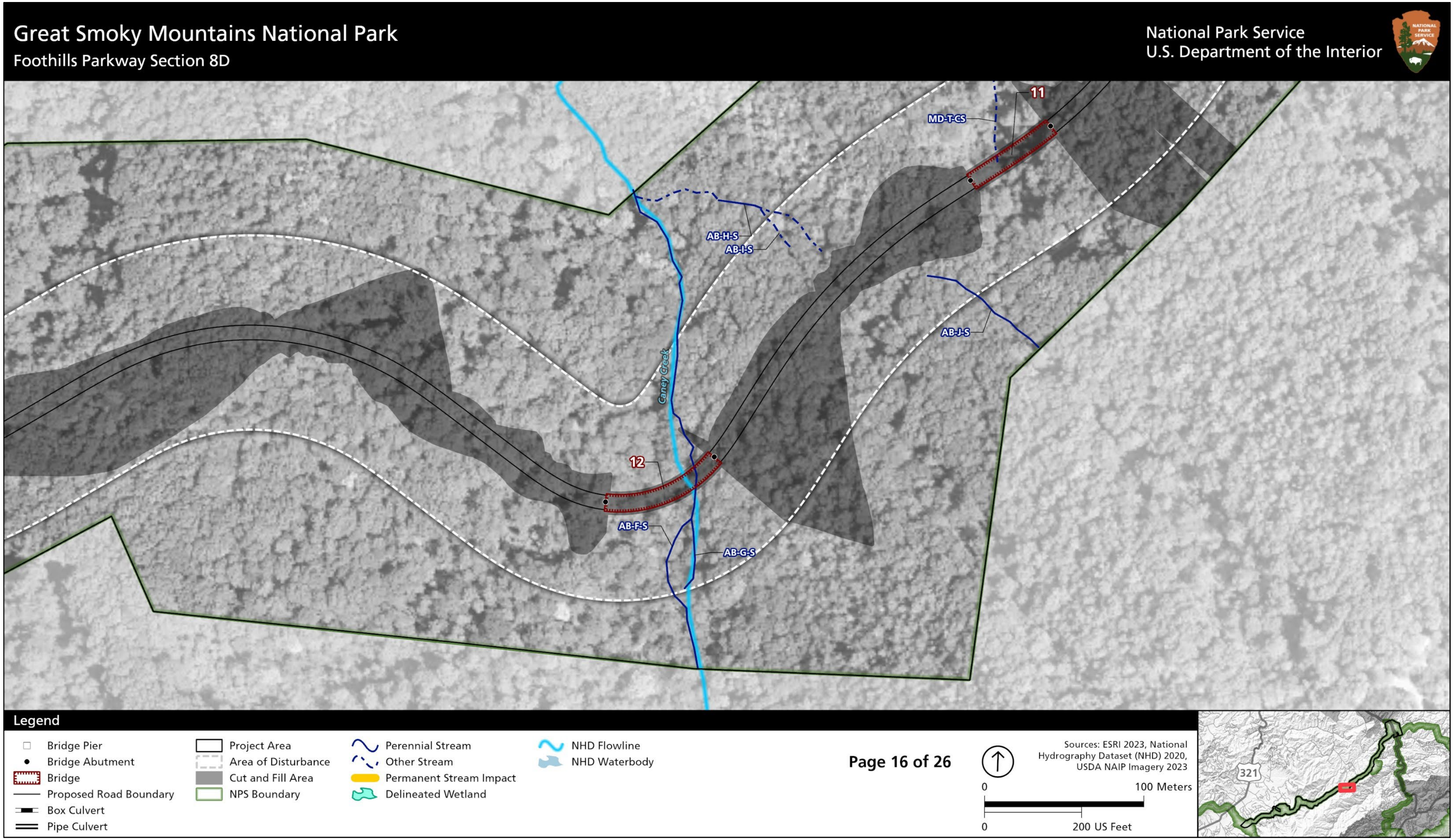
Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
AJ-AQ-S
Mill Creek
AJ-AR-S
AJ-AT-S
AJ-AS-S
MD-AC-CS
MD-AB-CS
MD-AA-CS
AB-Q-S
AB-P-S
AB-O-S
16
15
14
13
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 13 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321



Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
AB-O-S
AB-N-S
AB-M-S
12
11
10
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 14 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321



Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
MD-AD-CS
AB-L-S
9
8
AB-F-S
Carey Creek
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 15 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321



Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
11
MD-T-CS
AB-H-S
AB-I-S
AB-J-S
Caney Creek
12
AB-F-S
AB-G-S
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 16 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
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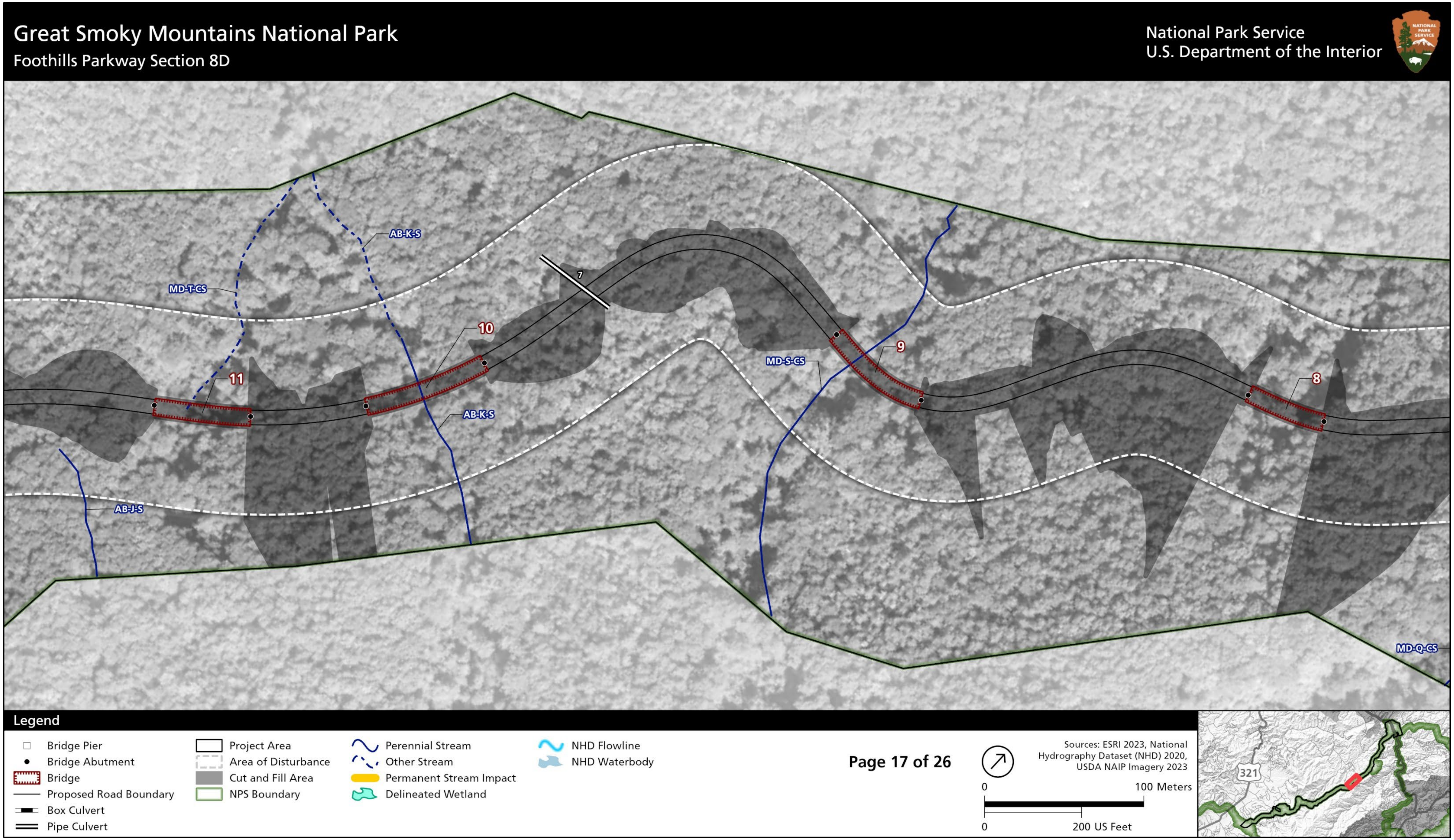
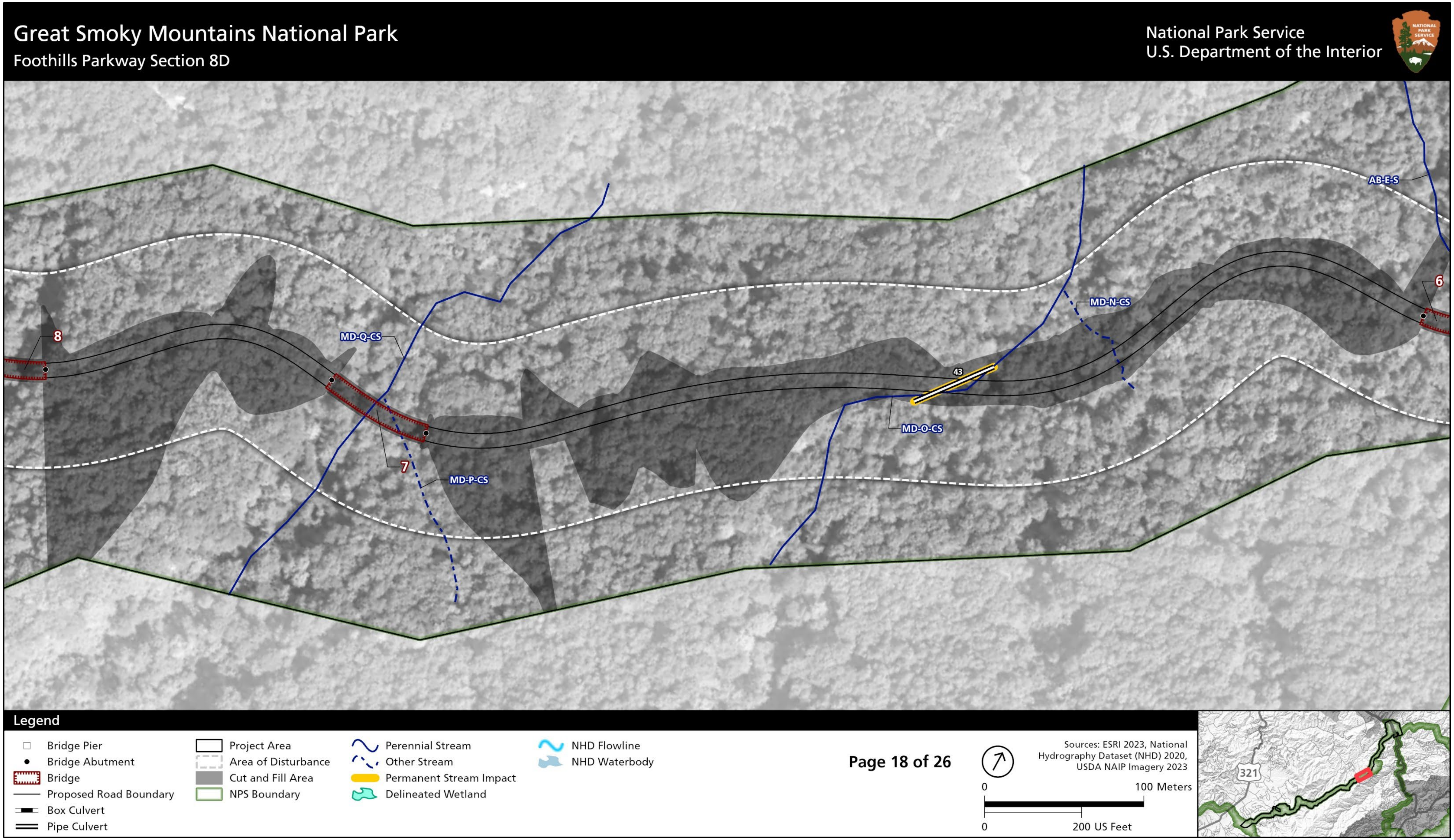
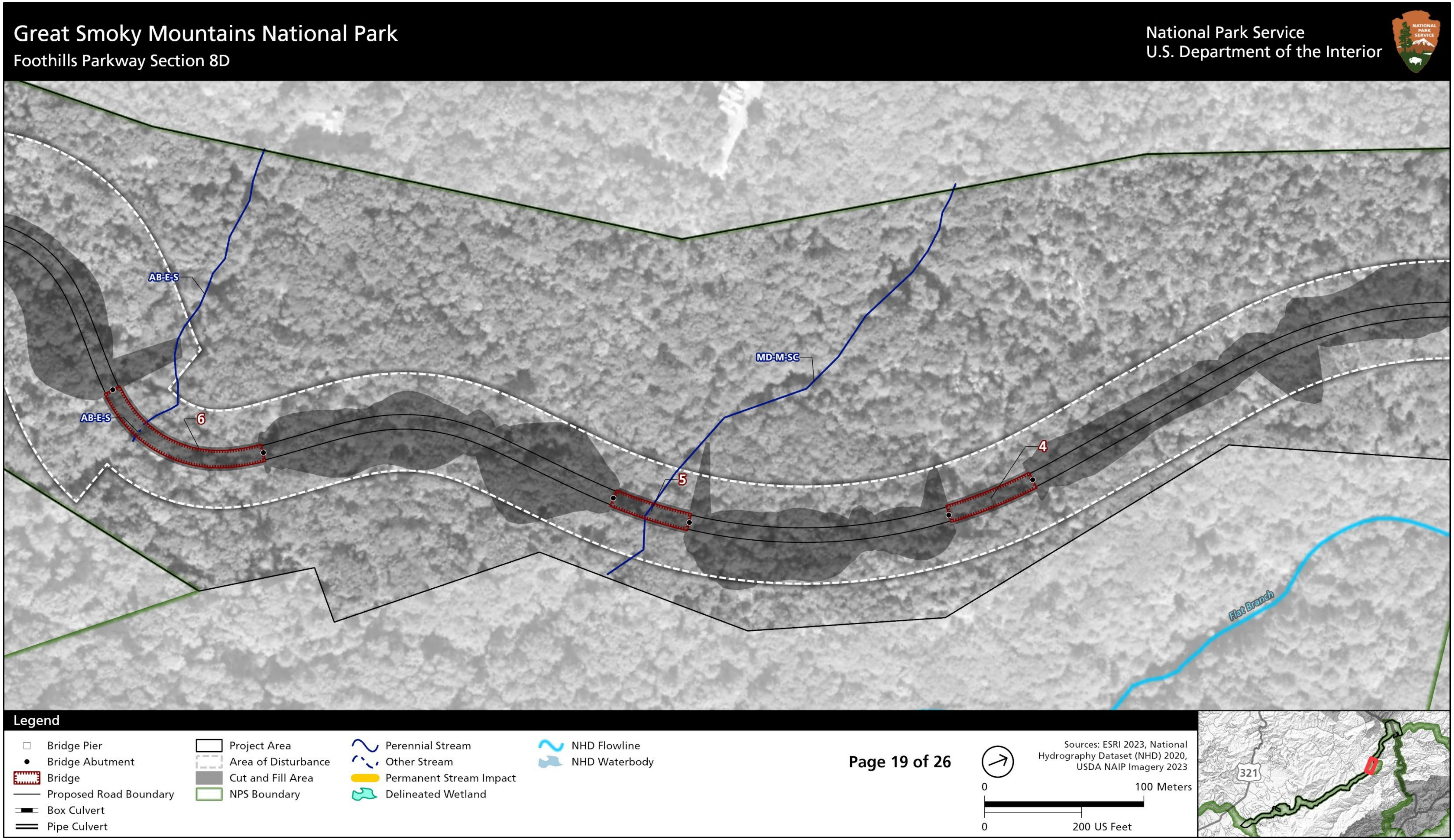
100 Meters
0
200 US Feet
321



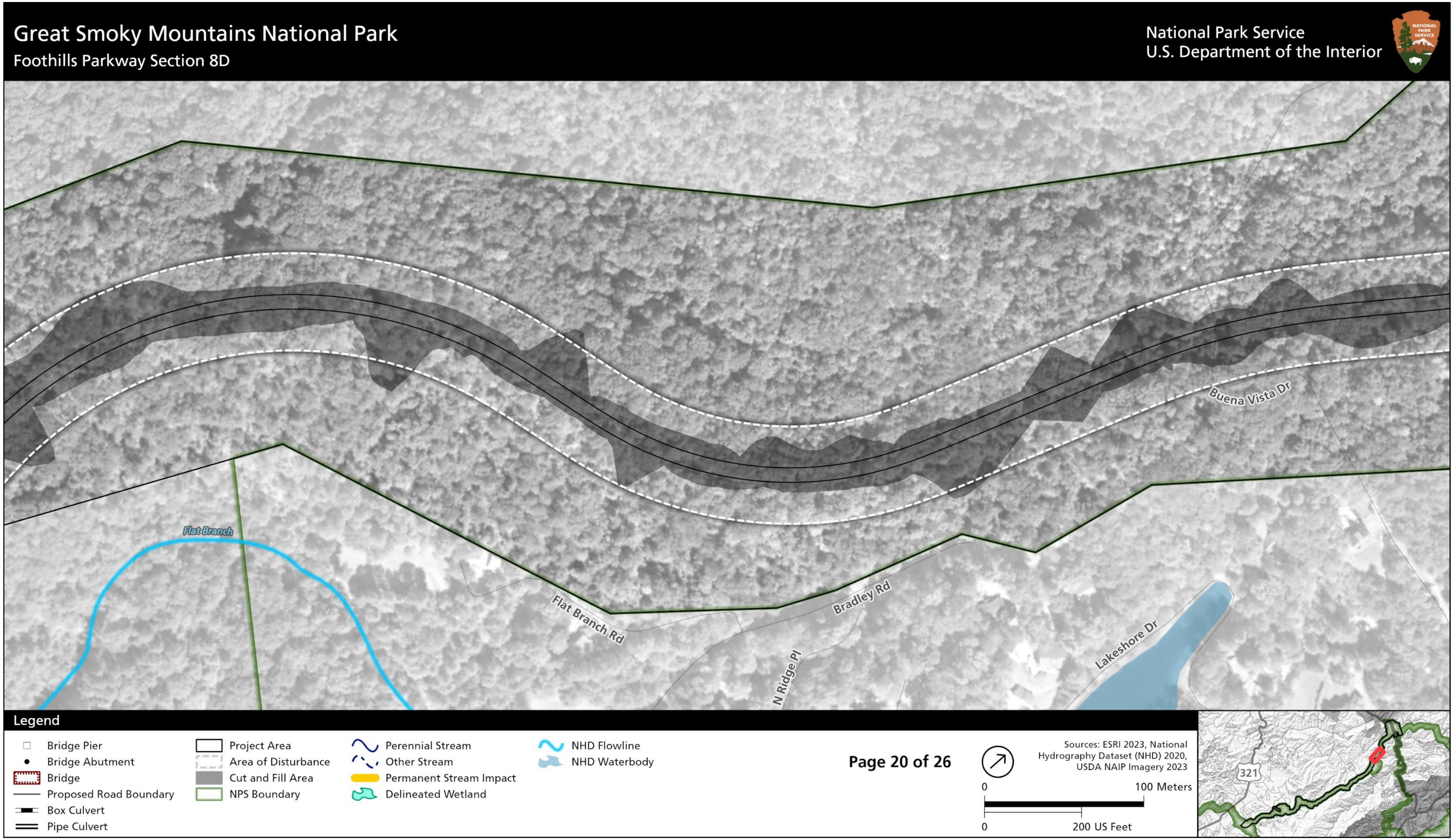
Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
AB-K-S
MD-T-CS
7
10
11
9
8
MD-S-CS
AB-K-S
AB-J-S
MD-Q-CS
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 17 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321



Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
AB-E-S
6
MD-N-CS
8
MD-Q-CS
43
MD-O-CS
7
MD-P-CS
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 18 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321



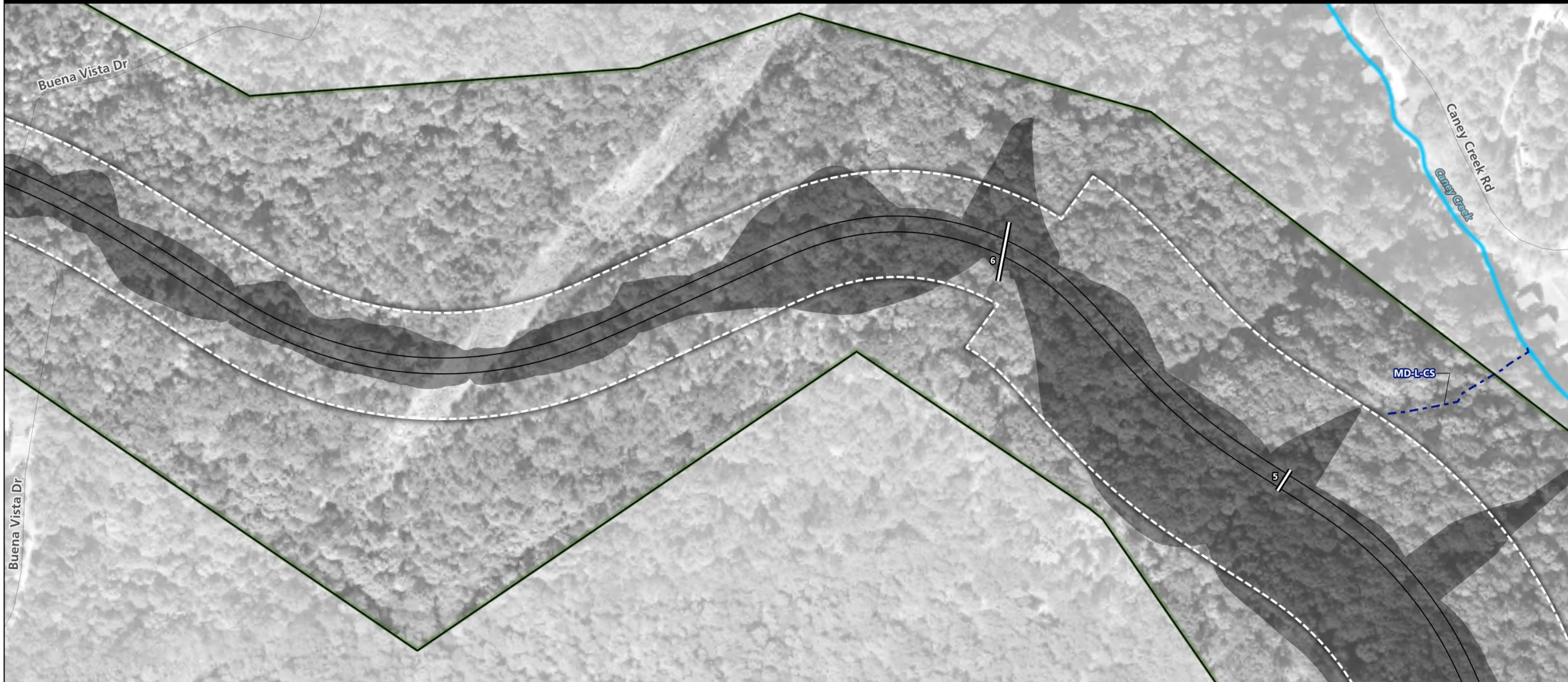
Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
AB-E-S
AB-E-S
MD-M-SC
6
5
4
Flat Branch
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 19 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321



Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
Buena Vista Dr
Flat Branch
Flat Branch Rd
Bradley Rd
N Ridge Pl
Lakeshore Dr
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 20 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321

Great Smoky Mountains National Park
Foothills Parkway Section 8D

National Park Service
U.S. Department of the Interior



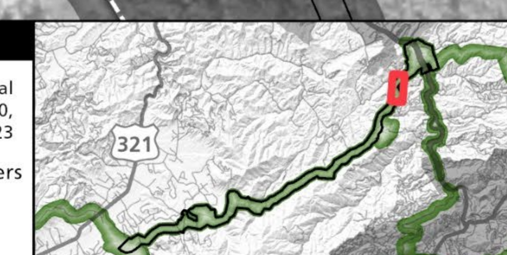
Legend

Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody

Page 21 of 26

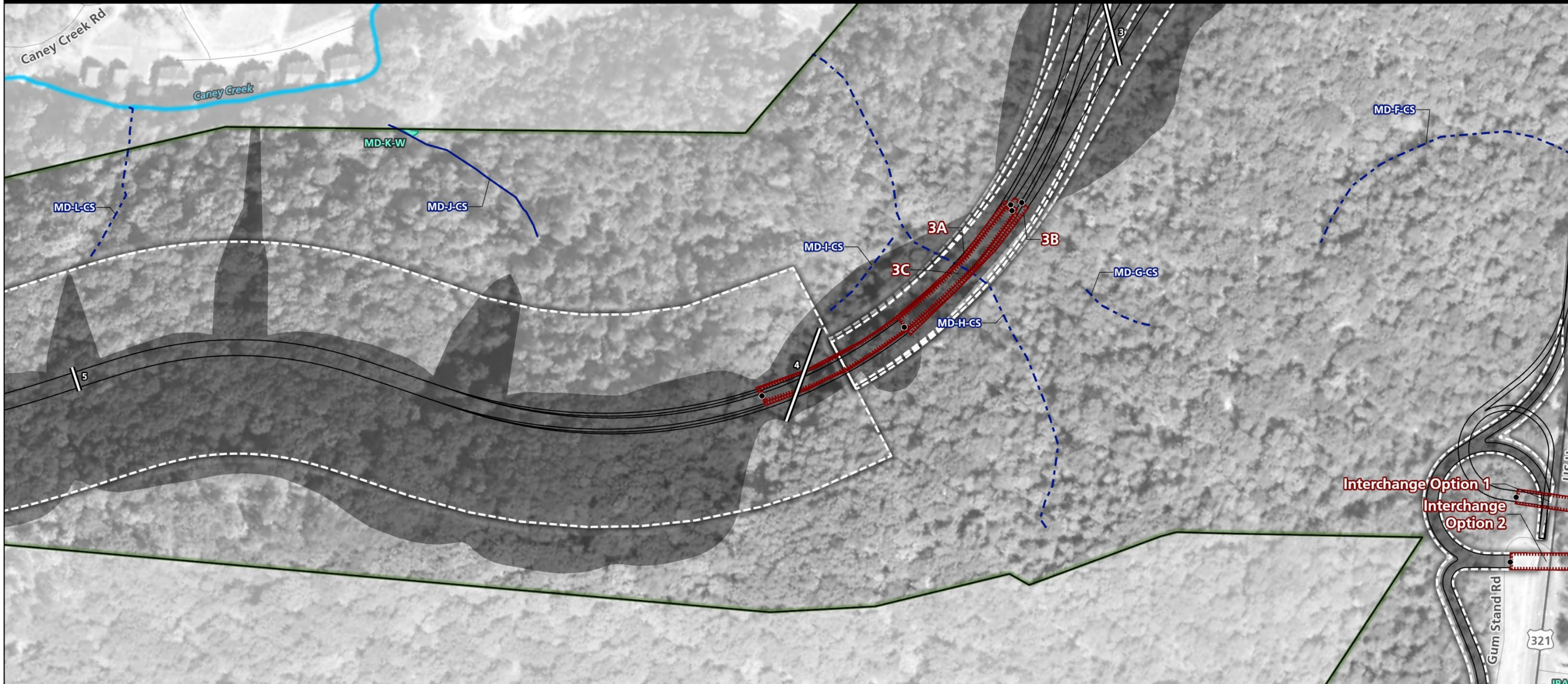
0 100 Meters
0 200 US Feet

Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023



Great Smoky Mountains National Park
Foothills Parkway Section 8D

National Park Service
U.S. Department of the Interior



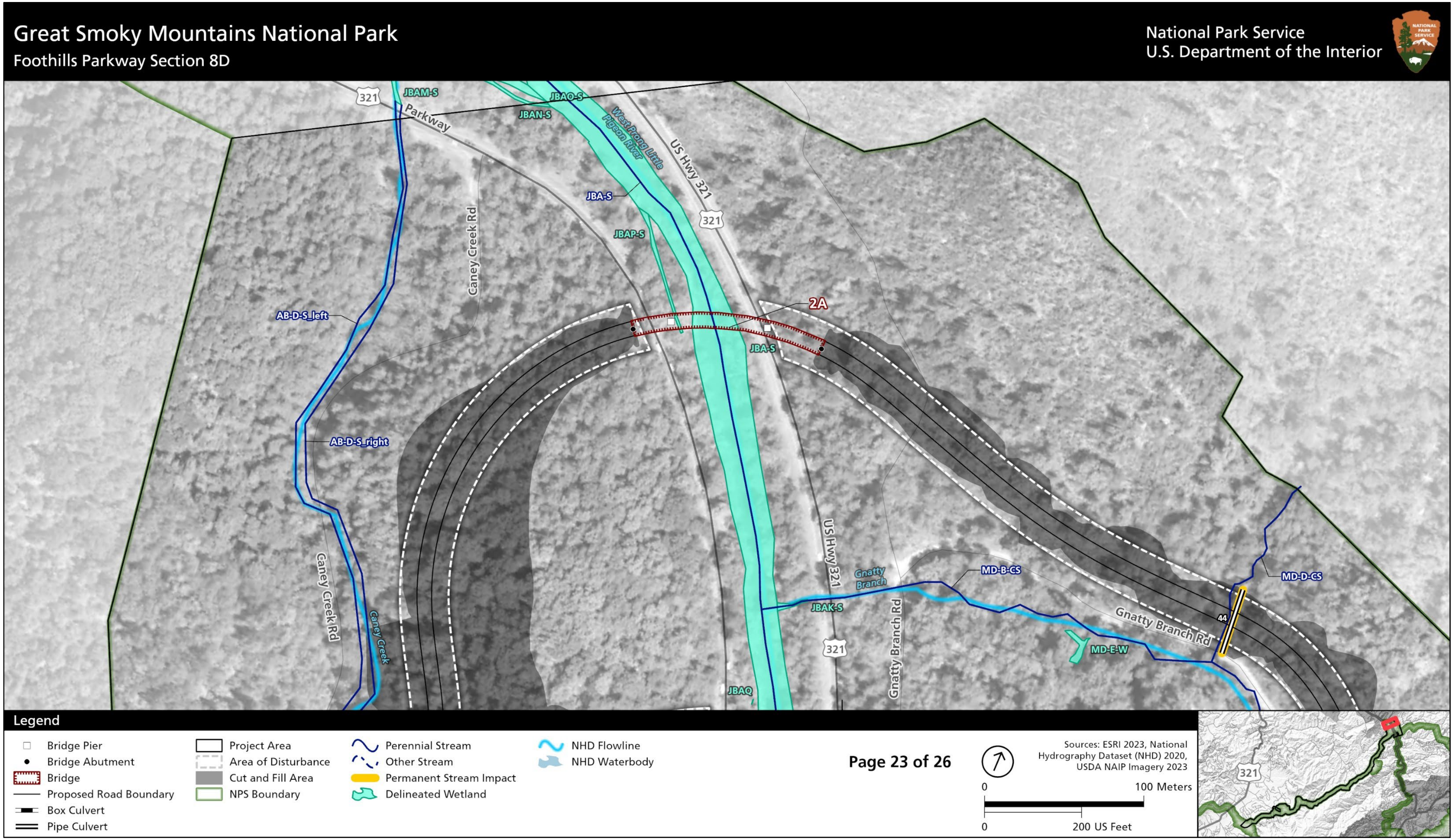
Legend

- Bridge Pier
- Bridge Abutment
- Bridge
- Proposed Road Boundary
- Box Culvert
- Pipe Culvert
- Project Area
- Area of Disturbance
- Cut and Fill Area
- NPS Boundary
- Perennial Stream
- Other Stream
- Permanent Stream Impact
- Delineated Wetland
- NHD Flowline
- NHD Waterbody

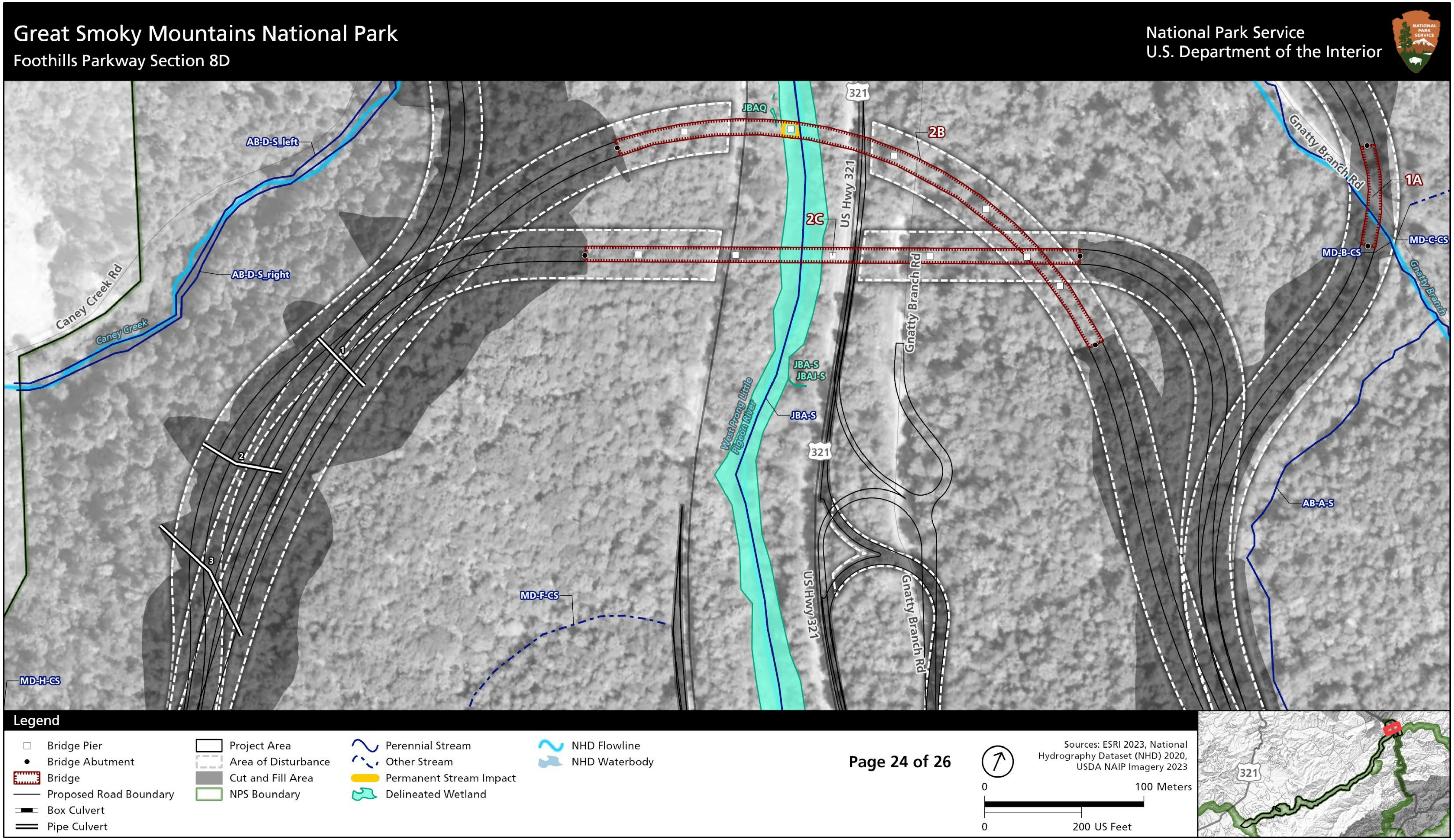
Page 22 of 26

0 100 Meters
0 200 US Feet

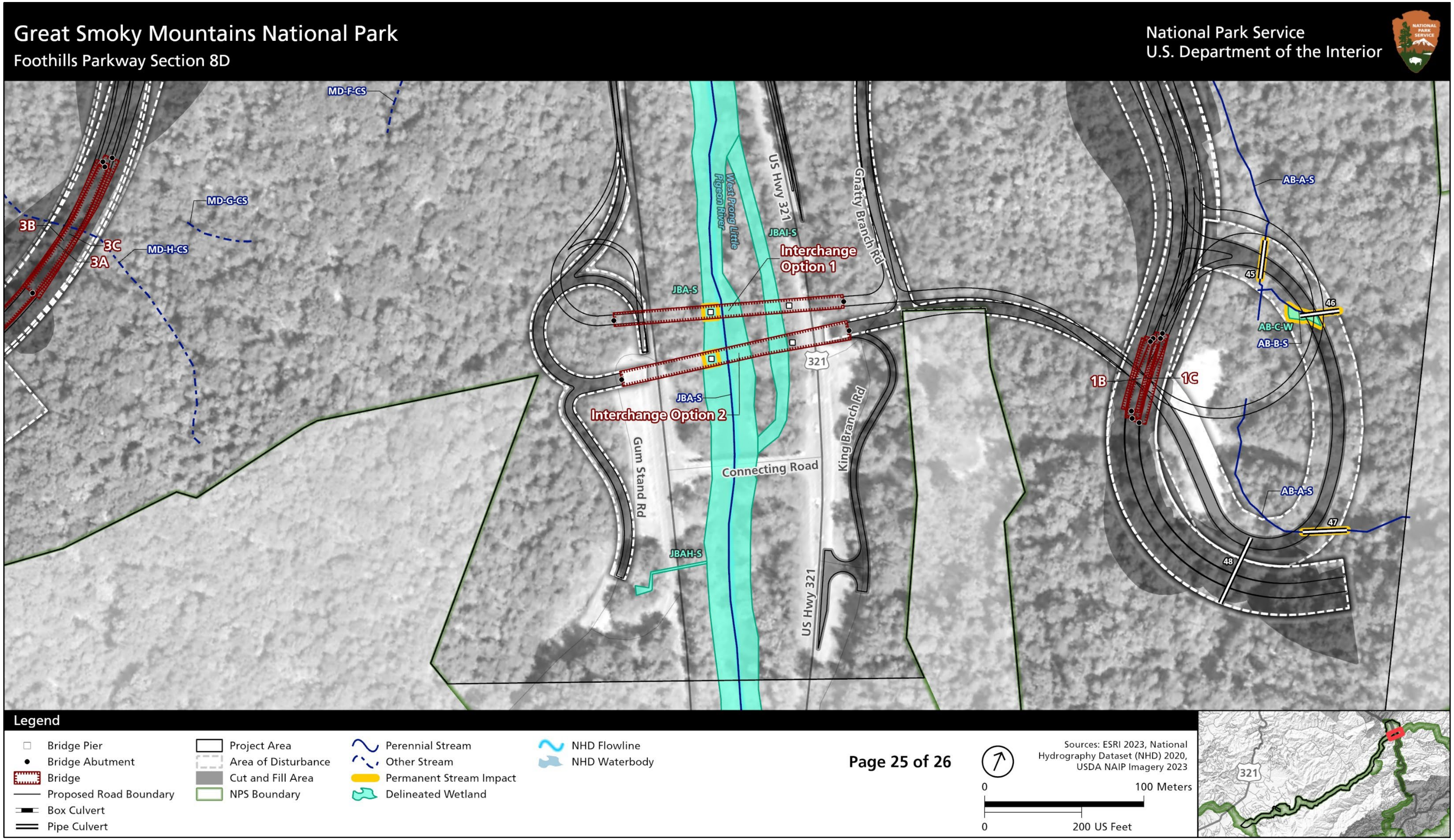
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023

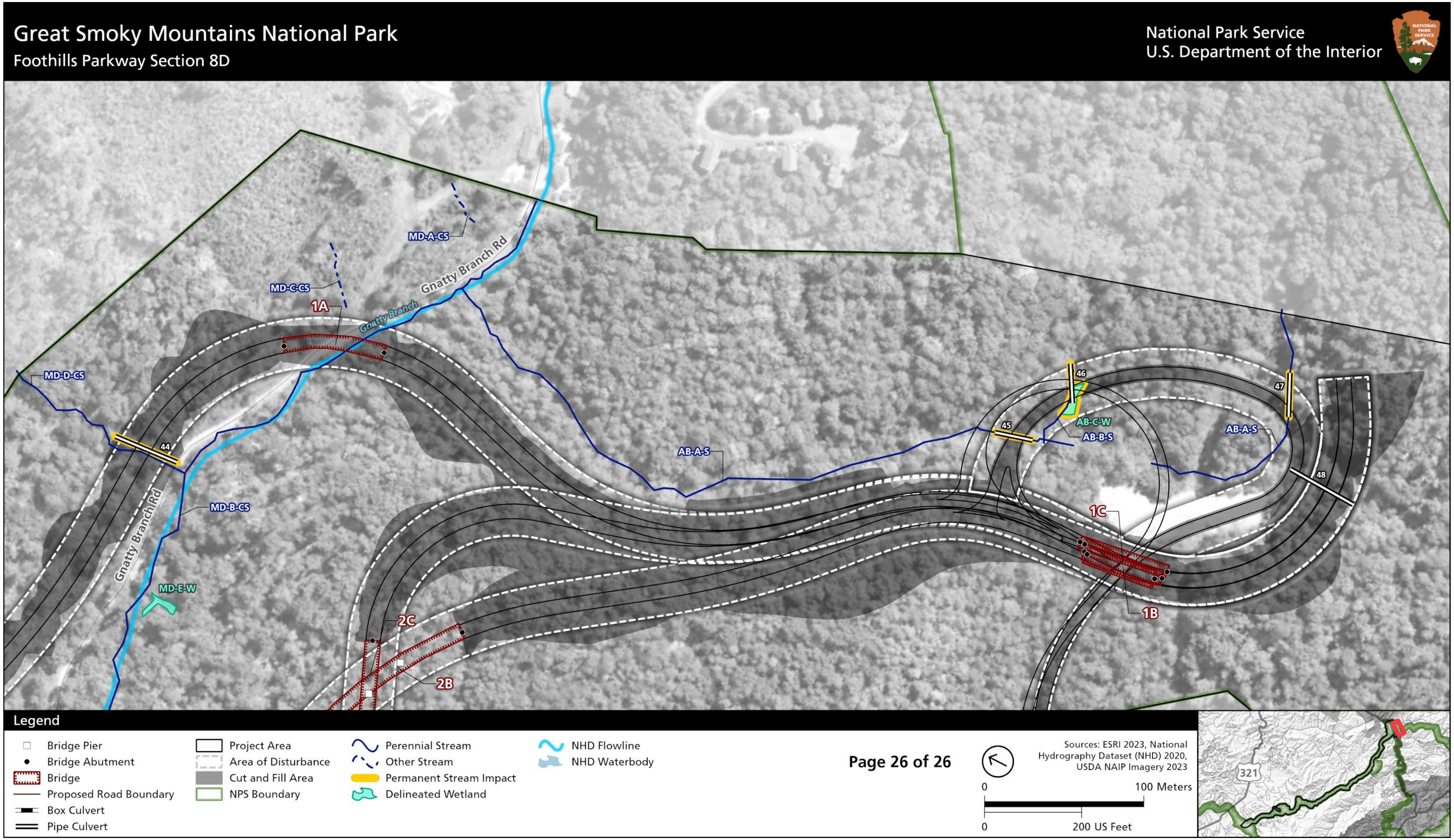


Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
JBAM-S
JBAO-S
JBAN-S
Parkway
West Prong Little Pigeon River
US Hwy 321
321
JBA-S
JBAP-S
Caney Creek Rd
2A
AB-D-S_left
AB-D-S_right
MD-B-CS
MD-D-CS
Gnatty Branch
Gnatty Branch Rd
JBAK-S
MD-E-W
Caney Creek
JBAQ
44
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 23 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet



Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
AB-D-S_left
AB-D-S_right
Caney Creek Rd
Caney Creek
JBAQ
2B
2C
US Hwy 321
321
1A
MD-B-CS
MD-C-CS
Gnatty Branch Rd
Gnatty Branch
JBA-S
JBAJ-S
West Prong Little Pigeon River
AB-A-S
MD-F-CS
MD-H-CS
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 24 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet


Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
MD-F-CS
MD-G-CS
MD-H-CS
3B
3C
3A
West Prong Little Pigeon River
US Hwy 321
Gnatty Branch Rd
JBAI-S
Interchange Option 1
JBA-S
JBA-S
Interchange Option 2
321
King Branch Rd
Gum Stand Rd
Connecting Road
JBAH-S
US Hwy 321
AB-A-S
45
46
AB-C-W
AB-B-S
1B
1C
AB-A-S
47
48
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 25 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321



Great Smoky Mountains National Park
Foothills Parkway Section 8D
National Park Service
U.S. Department of the Interior
MD-A-CS
MD-C-CS
1A
Gnatty Branch Rd
Gnatty Branch
MD-D-CS
44
MD-B-CS
Gnatty Branch Rd
MD-E-W
AB-A-S
2C
2B
45
46
AB-C-W
AB-B-S
47
AB-A-S
48
1C
1B
Legend
Bridge Pier
Bridge Abutment
Bridge
Proposed Road Boundary
Box Culvert
Pipe Culvert
Project Area
Area of Disturbance
Cut and Fill Area
NPS Boundary
Perennial Stream
Other Stream
Permanent Stream Impact
Delineated Wetland
NHD Flowline
NHD Waterbody
Page 26 of 26
Sources: ESRI 2023, National Hydrography Dataset (NHD) 2020, USDA NAIP Imagery 2023
0
100 Meters
0
200 US Feet
321