

Biological Opinion

Harms Mill Dam Removal Project on the Elk River in Lincoln County, Tennessee

FWS Project Code 2022-0071594



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Executive Summary

This document transmits the U.S. Fish and Wildlife Service (Service) combined formal conference/consultation based on the Service's review of the proposed removal of Harms Mill Dam on the Elk River in Lincoln County, Tennessee, and its effects to the federally endangered boulder darter (*Etheostoma wapiti*), endangered Alabama lampmussel (*Lampsilis virescens*), endangered slabside pearl mussel (*Pleuroaia dolabelloides*), endangered cracking pearl mussel (*Hemistena lata*), threatened rabbitsfoot (*Quadrula cylindrica*), endangered shiny pigtoe (*Fusconaia cor*), endangered snuffbox (*Epioblasma triquetra*), threatened longsolid (*Fusconaia subrotunda*), and Tennessee pigtoe (*Pleuroaia barnesiana*) and Tennessee clubshell (*Pleurobema oviforme*), two mussels currently proposed for listing as endangered in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). The biological opinion also considers effects to federally designated critical habitat (DCH) for the slabside pearl mussel and federally endangered fluted kidneyshell (*Ptychobranthus subtentus*). Your request for formal consultation was received on June 23, 2023.

The project proponent is the Tennessee Wildlife Resources Agency (TWRA), the property owner of Harms Mill Dam. This combined formal conference/consultation is based on information provided in the May 2023, biological assessment (BA) prepared by Griggs and Maloney Incorporated for TWRA and submitted by the U.S. Army Corps of Engineers (Corps) on June 23, 2023, with a request for formal consultation to the Service. The BA concluded that the proposed action would likely adversely affect the boulder darter, Alabama lampmussel, slabside pearl mussel, cracking pearl mussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, Tennessee clubshell, and DCH for the slabside pearl mussel and fluted kidneyshell. The Tennessee pigtoe and Tennessee clubshell are being covered in the conference opinion at the request of the action agency.

On July 18, 2023, the Service advised the Corps that we concurred with its likely to adversely affect determinations for the boulder darter, Alabama lampmussel, slabside pearl mussel, cracking pearl mussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, Tennessee clubshell, and DCHs, formal consultation had been initiated, and the combined formal conference/consultation opinion should be provided no later than November 29, 2023.

The Service has concluded that the proposed action is not likely to jeopardize the continued existence of the boulder darter, Alabama lampmussel, slabside pearl mussel, cracking pearl mussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell, and is not likely to adversely modify or destroy DCH for the slabside pearl mussel and fluted kidneyshell. The Service reached this conclusion by examining the current status of these species, the environmental baseline for the action area, and various possible effects to these species (including all consequences of the proposed federal action, and cumulative effects of other non-federal future actions that may occur in the action area, including state, tribal, local or private activities, and are reasonably certain to occur in the action area). Our analysis was then measured against the definition of jeopardy, defined in the "Biological and Conference Opinions" section of this document.

The Service has determined that the proposed action may adversely affect and result in incidental take of the boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell. For the biological opinion, incidental take would be exceeded when the take exceeds 1,873 boulder darters, 172 Alabama lampmussel, 345 slabside pearlymussels, 689 cracking pearlymussels, 1,034 rabbitsfoot, 172 shiny pigtoes, 172 snuffboxes, and 689 longsolids, which is what has been exempted from the prohibitions of section 9 by this biological opinion. Reasonable and prudent measures (RPMs) to minimize the take, and terms and conditions (T&Cs), that must be observed when implementing those RPMs, have been included in the biological opinion. If the conference opinion for the Tennessee pigtoe and Tennessee clubshell is adopted in the biological opinion following a listing or designation under section 4 of the ESA, incidental take would be exceeded when the take exceeds 5,514 Tennessee pigtoes and 172 Tennessee clubshells, which would be exempted from the prohibitions of section 9 upon adoption of the biological opinion.

Table of Contents

Executive Summary	2
Table of Contents	4
Consultation History	5
Biological and Conference Opinions	8
1. Description of the Proposed Action	9
1.1 Action Area	10
1.2 Conservation Measures	12
2. Status of the Species	13
3. Environmental Baseline	24
3.1. Status of the Species within the Action Area	26
3.2. Factors Affecting Species Environment within the Action Area	29
3.3. Designated Critical Habitat	29
3.3.1 Slabside Pearlymussel	29
3.3.2 Fluted Kidneyshell	30
3.4. Status of Critical Habitat in the Action Area.....	31
4. Effects of the Action	32
4.1. Stressor: Boulder Darter Collection and Relocations.....	33
4.2. Stressor: Mussel Sweeps and Relocations.....	35
4.3. Stressor: Instream Construction	36
4.4. Stressor: Heavy Equipment Operation	38
4.5. Stressor: Riparian Removal/Soil Disturbance	40
4.6. Summary of Effects.....	42
5. Cumulative Effects	44
6. Conclusion	44
7. Incidental Take Statement	45
7.1 Amount or Extent of Take Anticipated	46
7.2 Effect of the Take	52
7.3 Reasonable and Prudent Measures	52
7.4 Terms and Conditions	53
8. Conservation Recommendations	56
9. Reinitiation Notice	56
References Cited	58
APPENDIX A	68

Consultation History

- July 7, 2021 Tennessee Wildlife Resources Agency (TWRA) hosted a site visit that at the Harms Mill Dam to discuss the potential removal of the Harms Mill Dam on the Elk River, Lincoln County, Tennessee. Participants included personnel from the U.S. Army Corps of Engineers (Corps), TWRA, Tennessee Valley Authority (TVA), U.S. Fish and Wildlife Service (Service), Tennessee Department of Conservation (TDEC), Lincoln County (Mayor's Office and EMA), Tennessee Tech University (TTU), The Nature Conservancy (TNC), Griggs and Maloney Engineering, and a local landowner. The meeting discussed permitting of this project, but also discussed the engineering, historical, biological, and public communication aspects of this project.
- March 28, 2023 The Corps transmitted a Biological Assessment (BA) and requested informal Section 7 consultation on the Harms Mill Dam removal project. The Corps determined that the project would have No Effect (NE) on the Cumberland monkeyface (E), dromedary pearlymussel (E), finereyed pigtoe (E), and the monarch butterfly (C). The Corps also determined that the project May Affect, but would Not Likely Adversely Affect (MA-NLAA) the Indiana bat (E), gray bat (E), northern long-eared bat (E), Alabama lampmussel (E), birdwing pearlymussel (E), cracking pearlymussel (E), shiny pigtoe (E), slabside pearlymussel (E), snuffbox mussel (E), rabbitsfoot mussel (T), boulder darter (E), round hickorynut (T), longsolid mussel (T), Tennessee clubshell (Petitioned), and Tennessee pigtoe (Petitioned). They also noted that impacts to the DCH for the Indiana bat and slabside pearlymussel would be short-lived and not alter features essential for conservation.
- April 11, 2023 TWRA hosted a Teams meeting with the Corps, TVA, Service, TWRA, TDEC, TNC, and Griggs and Maloney to discuss the timing and steps forward to accomplishing the required environmental reviews and permitting applications for the proposed Harms Mill Dam removal to continue facilitation of the project within the proposed timeline.
- May 3, 2023 TWRA hosted a Teams meeting with Conservation Fisheries Inc. (CFI) and the Service to discuss a conservation measure that involves temporarily holding boulder darters collected before dam removal activities and returning them after the removal. CFI agreed to help estimate the number of fish that might be impacted by the action and provide methods for the collection.
- May 5, 2023 The Service responded to the Corps March 28, 2023, request for informal Section 7 consultation on the Harms Mill Dam removal project. Due to anticipated impacts from the project and potential for the boulder darter and several listed mussels to occur within the action area, the Service did

not concur with the MA-NLAA determinations for the boulder darter, Alabama lampmussel, rabbitsfoot, slabside pearlymussel, longsolid mussel, cracking pearlymussel, shiny pigtoe, and snuffbox. While not currently listed, the Tennessee pigtoe and Tennessee clubshell could also be impacted by the proposed removal. The Service did concur with the MA-NLAA determinations for the Indiana bat, northern long-eared bat, gray bat, birdwing pearlymussel, and round hickorynut. The Service requested that determinations be made for slabside pearlymussel and fluted kidneyshell DCH occurring within the action area. The Service requested an updated BA and determinations for the species and DCH that had not received concurrence from the Service before responding to the concurrence request.

- May 8, 2023 CFI provided an estimated number of boulder darters that may occur within the habitat downstream of Harms Mill Dam. CFI also provided methods of collection to complete the capture of darters for temporary removal and holding.
- June 16, 2023 The Corps transmitted a revised BA dated May 2023, and requested formal Section 7 consultation on the Harms Mill Dam removal project. The Corps determined that the project would have NE on the birdwing pearlymussel, Cumberland monkeyface, and dromedary pearlymussel. The Corps also determined that the project would MA-NLAA the birdwing pearlymussel and round hickorynut. Formal consultation was requested to address the May Affect, Likely to Adversely Affect (MA-LAA) determination made for the boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell, and the MA-LAA to DCH determination for the slabside pearlymussel and fluted kidneyshell.
- June 21, 2023 The Service and Corps had a phone conversation to discuss discrepancies in the Corps' effects determination in the June 16, 2023, letter requesting initiation of formal Section 7 consultation on the Harms Mill Dam removal project. The Corps decided it would send a new letter correcting these discrepancies with the determinations.
- June 23, 2023 The Corps transmitted a revised Biological Assessment (BA) dated May 2023, and a letter dated June 23, 2023, that requested formal Section 7 consultation on the Harms Mill Dam removal project. The Corps determined that the project would MA-LAA boulder darter, Alabama lampmussel, rabbitsfoot, slabside pearlymussel, longsolid mussel, cracking pearlymussel, shiny pigtoe, snuffbox, and two species petitioned for listing, Tennessee pigtoe and Tennessee clubshell. A MA-LAA determination was also made for designated critical habitat for the slabside pearlymussel and fluted kidneyshell. A MA-NLAA determination was

made for the birdwing pearlymussel, round hickorynut, and fluted kidneyshell and NE determinations made for Cumberland monkeyface, dromedary pearlymussel, and fine-rayed pigtoe as they are believed extirpated from the action area. The transmittal email states that this letter and BA replaces any determinations made in the Corps' June 16, 2023 letter, and to disregard the letter of June 16.

July 18, 2023

The Service initiated formal consultation with the Corps on the proposed Harms Mill Dam removal project on the Elk River in Lincoln County, Tennessee. This letter concurred with the MA-LAA determinations in the Corps' letter of June 23, 2023 for the boulder darter, Alabama lampmussel, rabbitsfoot, slabside pearlymussel, longsolid, cracking pearlymussel, shiny pigtoe, snuffbox, and two species petitioned for listing, Tennessee pigtoe and Tennessee clubshell. The Service indicated that a final BO would be provided to the action agency by November 29, 2023.

August 22, 2023

The Service proposed listing of three freshwater mussels under the Endangered Species Act as endangered species. This proposed listing includes the Tennessee pigtoe and Tennessee clubshell, both of which will be addressed in this conference/formal biological opinion for the proposed Harms Mill Dam removal.

Biological and Conference Opinions

A biological opinion is the document required under the ESA that states the opinion of the Service as to whether a proposed federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of DCH. Similarly, a conference opinion is required for a proposed species when an action agency determines that a project may jeopardize its continued existence or result in the destruction or adverse modification of proposed DCH. This combined formal conference/consultation addresses the effects to the boulder darter, Alabama lampmussel, slabside pearl mussel, cracking pearl mussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell and DCHs for the slabside pearl mussel and fluted kidneyshell resulting from the proposed removal of Harms Mill Dam in Lincoln County, Tennessee.

Critical habitat includes specific areas within a geographic area, occupied by the species at the time it was listed, that are essential to the conservation of threatened and endangered species and that may need special management or protection. DCH may also include areas that were not occupied by the species at the time of listing but are essential to its conservation. The ESA requires federal agencies to use their authorities to conserve threatened and endangered species and to consult with the Service about actions that they carry out, fund or authorize to ensure that they will not destroy or adversely modify critical habitat that has been federally designated under the ESA (this requirement applies only to federal agency actions or federally-funded or permitted activities; it is not applicable to activities carried out by private landowners, unless there is a federal “nexus”, e.g., federal funds or authorizations involved). The prohibition against destruction and adverse modification of critical habitat protects such areas in the interest of conservation. The action area lies within DCH for the slabside pearl mussel (Unit SP10) and fluted kidneyshell (Unit FK22). Therefore, DCH for these species will be considered as part of this consultation and discussed further in the biological opinion.

“To jeopardize the continued existence of a listed species” means to engage in an action that reasonably would be expected to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species (50 CFR §402.02). This combined formal conference/consultation examines whether the activities associated with proposed removal of Harms Mill Dam in the Elk River is likely to jeopardize the continued existence of the boulder darter, Alabama lampmussel, slabside pearl mussel, cracking pearl mussel, rabbitsfoot, snuffbox, shiny pigtoe, longsolid, Tennessee pigtoe, and Tennessee clubshell.

Section 9 of the ESA and regulations issued under section 4(d) of the ESA prohibit the taking of endangered and threatened species, respectively, without special exemption. Federal agencies may obtain such exemption through the “Incidental Take Statement” of a biological opinion that supports a non-jeopardy finding for their proposed actions. Incidental take is take that results from a federal action, but is not the purpose of the action. It may be allowable when the Service approves it through an incidental take statement. The statement includes the amount or extent of anticipated take due to the federal action, RPMs to minimize the take, and T&Cs that must be observed when implementing those RPMs.

1. Description of the Proposed Action

The proposed action will consist of the removal and demolition of the abandoned powerhouse and dam located at Elk River mile (ERM) 77.04 (Figure 1) in their entirety using standard, heavy civil-works type equipment. Construction will require installation of the site entrance, installation of erosion control best manage practices (BMPs), construction of a river access road (clean shot rock), removal of accumulated wood debris along the existing dam, installation of upstream cofferdam (if necessary), and construction of gravel pad above water levels for equipment to work from in the river. The contractor will have adequate supplies of floating silt curtains, bulk bags for temporary cofferdams, silt fences for erosion control, and emergency cleanup spill kits.

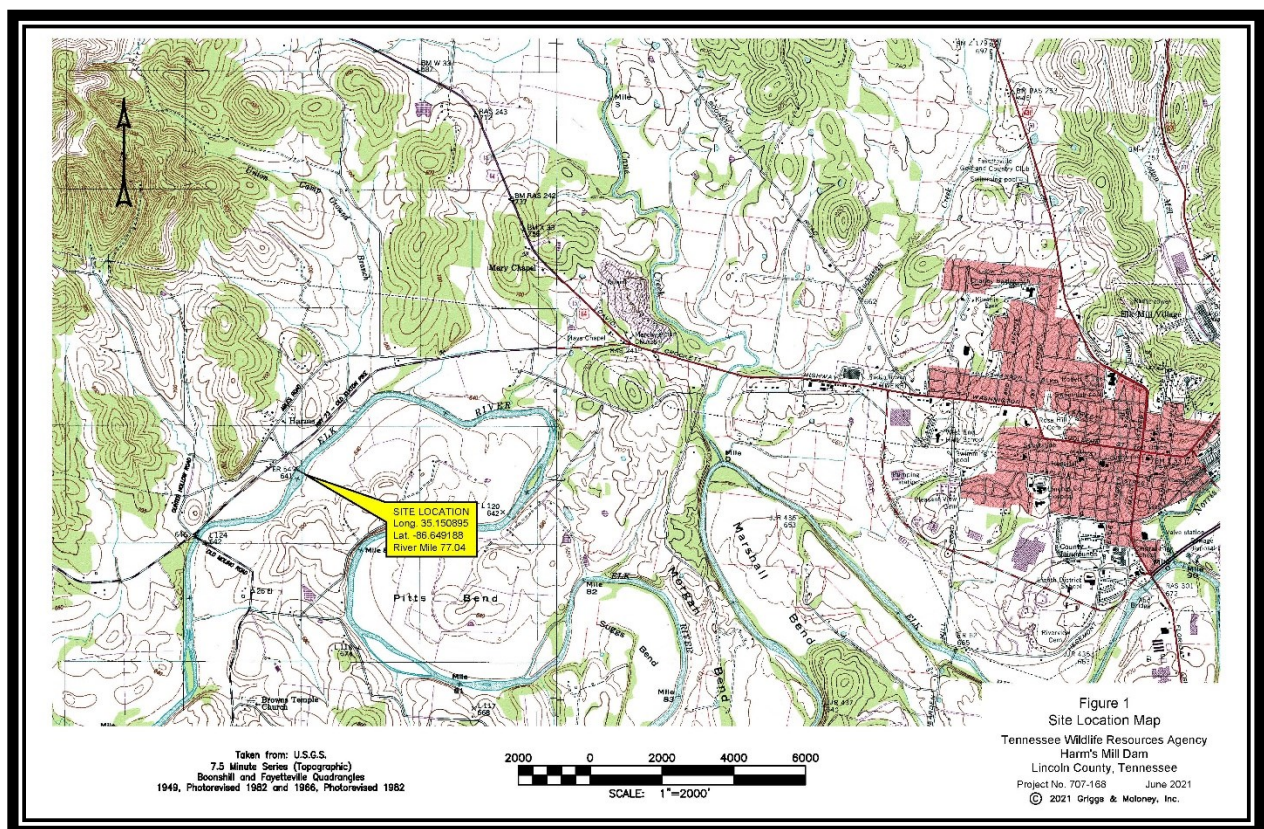


Figure 1. Topographic map showing the approximate location of Harms Mill Dam on the Elk River at ERM 77.04 in Lincoln County, Tennessee. Map borrowed from the biological assessment (Griggs and Maloney 2023).

Starting at the far-right riverbank (facing upstream) (Figure 2), the dam and apron remnants will be removed by mechanized equipment (e.g., track hoe, hoe-ram, pneumatic hammer). The dam wingwall will remain in place to serve as riverbank protection and reduce the use of hard armoring on the far right riverbank. Activities will be performed, to the greatest extent practicable, in the dry work site by diverting water from the work site through installing temporary water bladder cofferdams upstream from the work area and operating equipment atop temporary gravel pads constructed from native stone riverine deposits that will be obtained in the

immediate vicinity of the work site. The work will be coordinated with TVA in order to ensure water levels are low and maintained throughout the project construction. All construction equipment will be operated from below the dam. Material removed will be taken to an upland area along Old Elkton Road owned by the county of Lincoln (Tennessee) and used as fill. The demolition scenario previously described will be repeated at each section of the dam as activities proceed across the ~61 m span. It is estimated that approximately 841 m³ of concrete will be removed during this project.

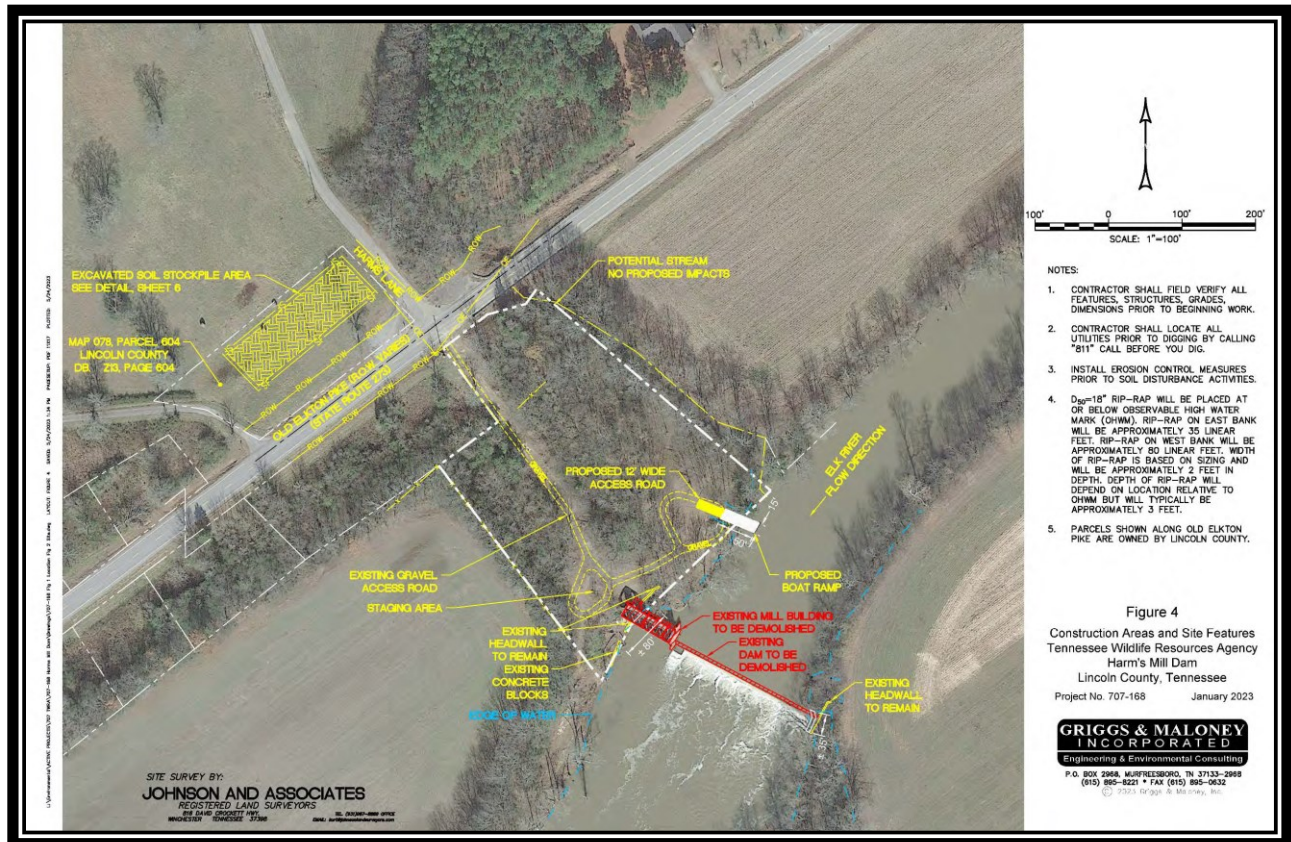


Figure 2. Aerial map showing the site layout and proposed construction locations. Map borrowed from the biological assessment (Griggs and Maloney 2023).

All work will be performed during low flow conditions and coordinated with TVA to ensure water levels are kept low during removal of the dam as previously mentioned. BMPs to address erosion and sediment will be implemented and maintained during construction activities. Upon removal of the dam and powerhouse, all material used for the construction access including gravel pads will be removed and restored back to the original grade and conditions. Any streambanks will be stabilized with nonwoven geotextile and rip-rap as needed. Other disturbed areas will also be stabilized and seeded. A boat launching platform will also be incorporated into the project to provide access for emergency response personnel and recreational users of the river. Project duration is estimated as 4-6 weeks.

1.1 Action Area

The portion of the action area in which construction (construction footprint) would occur is primarily contained within the TWRA-owned parcel (1.1 hectares) and consists of the powerhouse, dam, and staging area (Figure 2). In-stream construction activities would be limited to an estimated area 91 meters (m) upstream and downstream of the dam (1.0 hectares), while an upland disposal for burial of demolition debris will be located near (adjacent to) TWRA's property, located west of Harms Lane and north of Highway 273 (Figure 2). The proposed disposal area is approximately 18.3 m by 61.0 m (0.11 hectares).

However, by definition, the action area also encompasses an area where proposed activities can cause measurable or detectable changes in land, air, and water or to other measurable factors that may elicit a response in the species or critical habitat addressed under the consultation. The action area is not merely limited to the footprint of the action and should consider the chemical and physical impacts to the environment resulting from the action. The action area for the proposed project would include all areas in water impacted by project pre-implementation, implementation, and post-implementation operations. The aquatic action area for this project would extend from the Harms Mill Dam (ERM 77.04) upstream approximately 320 m, which is currently considered the extent of the impoundment formed by Harms Mill Dam, and downstream from Harms Mill Dam approximately 2.0 kilometers (km) to ERM 75.7 (TVA's fixed long-term mussel monitoring station) (Labeled as Shoal 3 in Figure 3).

The Service estimates that the action area totals approximately 128,204.4 m² of terrestrial and aquatic habitat. The terrestrial area within the action area is estimated at approximately 12,221.5 m² (TWRA parcel and adjacent disposal area) and includes equipment staging, maintenance, and construction disposal areas. The aquatic portion of the action area is estimated to be a total of 116,000 m². This includes a project footprint (dam and 91.44 m upstream and downstream of dam) of approximately 9,995.7 m² where construction or in-stream cofferdams and rock pads may occur or be placed. The total aquatic action area includes 2.32 km of the Elk River extending 320 m above the dam and continuing 2 km downstream to the TVA fixed mussel monitoring site, an area of stream approximately 116,000 m² [50 meters average river width x 2,320 meters total length].

This 128,204.4 m² area has been identified as the action area because the Service believes that effects of the action, as a whole, may affect the boulder darter, Alabama lampmussel, slabside pearl mussel, cracking pearl mussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell as a result of pre-implementation activities (collection and relocation), implementation activities (installation/removal of cofferdam/rock pad, heavy equipment operation, and deconstruction of the Harms Mill Dam), and post-implementation operations [water quality and habitat impacts following project completion (e.g., temporary increases in suspended sediment levels, streambed movement, etc.) and/or as a result of potential project failures (e.g., riverbank sloughing, etc.) in areas where soil disturbance has occurred]. Additionally, areas that may be affected by the proposed action will include areas of suitable habitat upstream and downstream of the Harms Mill Dam site. The action area will be further discussed in the “**EFFECTS OF THE ACTION**” section of this consultation.

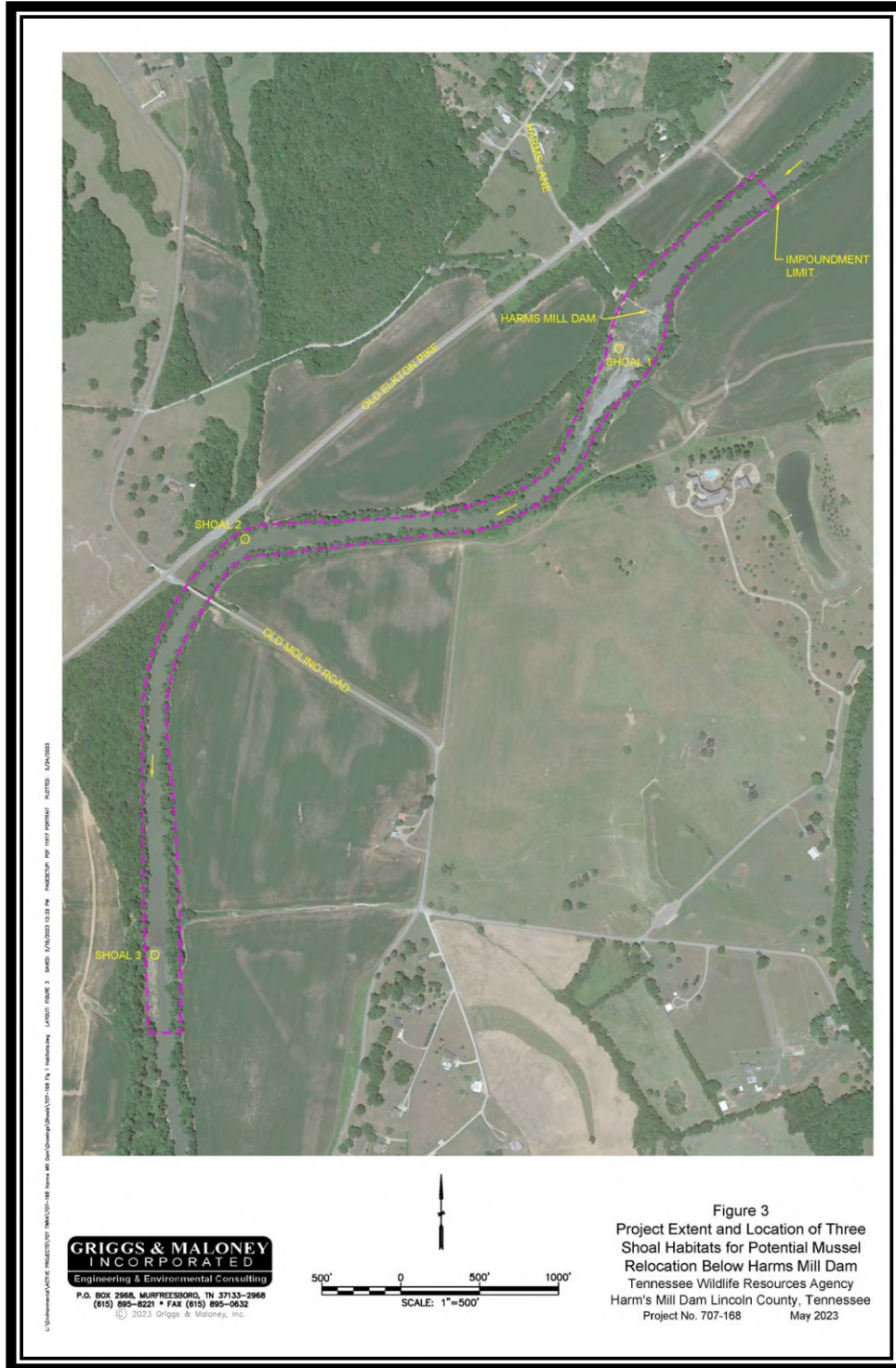


Figure 3. Aerial photograph map showing the in-stream action area extent with shoal habitats identified. Map borrowed from the biological assessment (Griggs and Maloney 2023).

1.2 Conservation Measures

The following measures were taken from TWRA's BA (Griggs and Maloney 2023) and will be implemented to minimize impacts and assess species response to the proposed action to the boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, Tennessee clubshell, and DCH:

1. Upon authorization by the Service and prior to commencement of work within the Elk River, collecting, handling, and relocating the Boulder Darter as a result of sweeps within the immediate footprint and downstream shoal of the project area will be conducted by TWRA and Conservation Fisheries, Inc. (CFI) in order to minimize mortality associated with the removal project from physical crushing of boulder darters. TWRA will conduct a pre-removal collection in which as many boulder darters as possible will be collected, transported to, and held at CFI, until removal has been completed. TWRA and CFI will attempt to collect at least 30 boulder darters immediately downstream of Harms Mill and hold them at CFI's facility in Knoxville, TN. TWRA expects no more than 50 individual boulder darter's to be collected. CFI will use a portion of these fish for spawning and propagation work. These remaining fish will be returned to the site following completion of the removal project, and some individuals propagated at CFI may be returned to the site to offset any mortality.
2. Upon authorization by the Service and prior to commencement of work within the Elk River, a mussel sweep will be conducted to collect individual mussels from within the immediate footprint and downstream shoal of the project area. Any mussels collected would be relocated to the shoal located at ERM 75.7 (TVA's fixed long-term mussel monitoring station) at the lower extent of the action area. The mussel sweep would be conducted by TWRA biologists.
3. TWRA will initiate a multi-year monitoring program to assess the response of freshwater mussels and fishes to the removal of the Harms Mill Dam. This monitoring program will begin one (1) year following removal of the dam and be continued annually for a minimum of five (5) years. After the 5th year, monitoring will be at years 7 and 9 (post dam removal), and then years 12 and 15 (post dam removal). Monitoring will include detection/non-detection surveys of fish and mussels to document their occurrence and potential colonization of the project area and areas upstream of the current location of Harms Mill Dam.
4. All work will be performed during low flow conditions and coordinated with TVA to ensure water levels are kept low during removal of the dam as previously mentioned.
5. BMPs to address erosion and sediment will be implemented and maintained during construction activities.

2. Status of the Species



Boulder darter

The boulder darter was listed as an endangered species on September 1, 1988 (USFWS 1988). A recovery plan addressing the boulder darter was approved on July 27, 1989 (USFWS 1989a). Critical habitat has not been designated for this species.

The boulder darter is considered endangered primarily due to the construction of dams, which impounded much of the Tennessee River and the lower portions of its tributaries and caused significant population declines throughout the species range. Toxic chemical spills, siltation, improper pesticide use, and cold-water releases from Tims Ford Reservoir remain threats to the boulder darter (USFWS 1989a; 2023a). Additional threats include gravel dredging, poor agricultural practices, disturbance of riparian corridors, and changes in channel morphology (USFWS 2017).

The only naturally occurring population of boulder darters occurs in low numbers in the Elk River drainage. The entire known range of the existing Elk River boulder darter population continues to be affected by upstream operation of Tims Ford Dam and the downstream presence of Wheeler Reservoir. Cold-water releases from Tims Ford Reservoir have likely suppressed population size and limited distribution in the Elk River. Propagation and reintroduction efforts by Conservation Fisheries, Incorporated (CFI) in the Elk River have shown some success with surveys recording observations of propagated individuals at release sites (USFWS 2023a). CFI has not done any boulder darter monitoring or reintroduction work in the Elk River since 2016 (USFWS 2023a). While a population persists, full recovery will be dependent upon the success of the Tennessee Valley Authority's (TVA) modified operations and maintenance (O&M) at Tims Ford Dam, removal of Harms Mill Dam to restore hydrology and habitat connectivity in the Elk River, continued propagation and reintroduction to augment the Elk River population, and establishment of additional populations in other watersheds.

The Service published the final rule for "Establishment of a Nonessential Experimental Population (NEP) for Two Fishes (Boulder Darter and Spotfin Chub) in Shoal Creek, Tennessee and Alabama" (70 FR 17916-17927) on April 2, 2005, which allowed for the reintroduction of boulder darters within their historical range in Shoal Creek, tributary to the Tennessee River. Although successful wild reproduction and recruitment have been observed in Shoal Creek over quite a few years, these preliminary results from reintroductions and observations of resulting

wild recruitment are still too early to determine that an established, viable population exists in Shoal Creek without more extensive survey efforts (USFWS 2023a).

Due to its limited distribution and continued threats, the boulder darter continues to be in danger of extinction throughout its range. The recovery priority number for the boulder darter is 5, indicating that the degree of threat remains high and potential for recovery remains low. More information about the species life history, distribution, population dynamics, threats, and recovery can be found in the listing rule (USFWS 1988), recovery plan (USFWS 1989a), and most recent status review (USFWS 2023a).



Alabama lampmussel

The Alabama lampmussel was listed as an endangered species on June 14, 1976 (USFWS 1976). A recovery plan addressing the Alabama lampmussel was approved on July 2, 1985 (USFWS 1985). Critical habitat has not been designated for this species.

The final listing rule cited the destruction, modification or curtailment of Alabama lampmussel habitat or range, overutilization, and disease or predation as its primary reasons for listing. Habitat destruction or modification is presently the greatest threat to this species. Since agriculture is the predominant streamside land use, voluntary partnerships with private landowners to implement conservation practices, easements, and/or best management practices on their properties are vital to the continued existence of the lampmussel.

The Alabama lampmussel continues to be in danger of extinction due to persistent threats in its highly restricted range. Natural populations are known to occur in the upper Paint Rock River, Alabama, and Emory River, Tennessee. However, these natural populations have a relatively low abundance. The species has been reintroduced into the lower Paint Rock River, Bear Creek, Estill Fork, Sequatchie River, Shoal Creek, and Elk River. Surveys are needed to assess survival, reproductive success, and recruitment at reintroduced sites and evaluate whether reintroduced populations are established and viable as defined in the recovery plan. More information about the species life history, distribution, population dynamics, threats, and recovery can be found in the listing rule (USFWS 1976), recovery plan (USFWS 1985), and the most recent status review (USFWS 2020a).



Slabside pearl mussel

The slabside pearl mussel was listed as an endangered species on September 26, 2013 (USFWS 2013b). A recovery plan for the slabside pearl mussel has not yet been approved. Therefore, no recovery criteria are identified.

The final listing rule cited the destruction, modification or curtailment of slabside pearl mussel habitat or range as its primary reasons for listing. Primary threats to this species include impoundments, mining, oil and gas exploration, sedimentation, chemical contaminants, drastic temperature alterations, recurring drought and flooding, and population fragmentation and isolation. The construction of dams within the range of the slabside pearl mussel has resulted in major and enduring effects to the species by isolating populations, altering physical habitat, blocking upstream and downstream movement, and changing flow and temperature regimes.

Based on available information, the overall population of the slabside pearl mussel is declining rangewide. Although some historical occurrences had not been surveyed since the 1980s, populations were known to be extant in 13 of the 30 Tennessee River tributary systems at time of listing (USFWS 2013b). In 2014, a new population was discovered in the Little River in Blount County, Tennessee (Schilling et al. 2017). Additional surveys are needed to fully document the status of both this Little River population and the Sequatchie River population, which was determined in 2021 to still be extant (Dinkins et al. 2023). Populations in the Elk River and Bear Creek appear to be stable and show at least some recruitment potential. The Middle and upper North Fork Holston Rivers have undergone drastic declines over the past 20 years, while the Clinch River population has been in a long-term decline. The Paint Rock River and Duck/Buffalo River populations are healthy and characterized by recent recruitment and a multiple age-class structure, with the Duck River representing a stronghold population for the species (USFWS 2021a). These populations will likely be considered as source populations for any propagation and/or translocation recovery efforts (reintroductions or augmentations).

The recent die-offs in the Clinch River and the enigmatic declines that have occurred in other populations demonstrate the precarious status of freshwater mussels and reveal an important gap in our understanding of threats. Because of its distribution in small, isolated populations, its continued vulnerability to threats, and the low to moderate resiliency of extant populations, we believe that the slabside pearl mussel continues to be in danger of extinction throughout all of its range. More information about the species life history, distribution, population dynamics, threats,

and recovery can be found in the listing rule (USFWS 2013b) and the most recent status review (USFWS 2021a).



Cracking pearl mussel

The cracking pearl mussel was listed as an endangered species on September 28, 1989 (USFWS 1989b). A recovery plan addressing the cracking pearl mussel was approved on July 9, 1991 (USFWS 1991). Critical habitat has not been designated for this species.

Habitat loss from impoundments, water quality deterioration attributed to coal mining and other land use practices, and chemical spills are the main reasons for the decline of this species (USFWS 1991; USFWS 2019a). Impacts associated with the reduction or elimination of its larval host species by these same factors has likely contributed to population losses as well (USFWS 1989b). Disease likely represents a new threat to the cracking pearl mussel based on data from the recent die-offs in the Clinch River. The relationship of the die-offs to potential pathogens continues to be investigated (USFWS 2019a).

Historically, the cracking pearl mussel was a widespread species, endemic to the Ohio River drainage. It occurred in the Ohio River main channel and many of its large tributaries in Alabama, Pennsylvania, Illinois, Indiana, Ohio, and Kentucky. It has since been extirpated from most historical locations (Watters et al. 2009, Haag and Cicerello 2016). The cracking pearl mussel is currently believed to be extant only in the Clinch and Elk Rivers (Jones et al. 2018, Haag and Cicerello 2016, Williams et al. 2008). In the Clinch River, it occurs in approximately 41 miles of the main channel, from Swan Island, Hancock County, Tennessee, (Clinch River Mile 172) upstream to Clinchport, Scott County, Virginia, (Clinch River Mile 213) (Hubbs, pers. comm., 2019; Jones et al. 2018). Ahlstedt (pers. comm., 2010) reported that the cracking pearl mussel is actively recruiting, based on some of the small sized specimens he has observed, and is doing well in the Clinch River. In the Elk River, it is currently known from approximately 42 miles of the main channel, from about one river mile downstream of the Tennessee and Alabama state line, Limestone County, Alabama (ERM 34) to Harms Mill, Lincoln County, Tennessee, (ERM 76) (Hubbs, pers. comm., 2019). No new populations of

cracking pearlymussel have been successfully established, and no new populations have been discovered.

Recent propagation work has established that cracking pearlymussel is a short-term brooder and can have multiple broods (USFWS 2019a). In 2019, the TWRA's Cumberland River Aquatic Center successfully propagated cracking pearlymussel using logperch (*Percina caprodes*) and greenside darter (*Etheostoma blennioides*) as hosts (Hua 2021). A three-year study to further investigate fish host suitability by the Virginia Department of Wildlife Resources' Aquatic Wildlife Conservation Center added six suitable darters to the list of known fish hosts (Lane et al. 2021). Cracking pearlymussel has also recently been produced through in-vitro culture (Hua 2022).

Threats to the species' continued existence persist in the Clinch River population as evidenced by the annual die-off of thousands of mussels of various species from 2016-2019 (Richard 2019, pers. comm., as cited in USFWS 2019a). Knowledge of the species' biology, habitat requirements, and response to threats is incomplete. The two isolated populations of cracking pearlymussel are extremely vulnerable to extirpation from stochastic or catastrophic events. More information about the species life history, distribution, population dynamics, threats, and recovery can be found in the listing rule (USFWS 1989b), recovery plan (USFWS 1991) and the most recent status review (USFWS 2019a).



Rabbitsfoot

The final rule listing rabbitsfoot as a threatened species was published September 17, 2013 (USFWS 2013a). A recovery plan addressing the rabbitsfoot was approved on March 2, 2023 (USFWS 2023b).

The rabbitsfoot was listed due to destruction, modification, or curtailment of habitat or range, inadequate existing regulatory mechanisms, and other manmade factors. Threats include declines in water quality, altered hydrology, riparian habitat fragmentation, and deterioration of instream habitat.

Rabbitsfoot populations tend to be widely scattered in isolated concentrations with low abundance. Currently, biologists consider rabbitsfoot extant in 63 of 148 rivers, representing a

57% decline in historical occurrence. Of the 63 extant rivers, 24% of populations are considered stable or improving, 11% are considered declining, and the status of 65% (41 populations) is unknown due to a lack of new information.

Captive propagation, augmentation, and reintroduction may be necessary to increase resiliency and achieve sufficient redundancy in the future. Due to the restricted range of the rabbitsfoot, geographic isolation of most extant populations, and small population size, this mussel species is likely suffering genetic isolation and reduced adaptive capacity throughout much of its range, resulting in lower representation.

Given the sustained threats and the current and expected future decreases in population resiliency, the rabbitsfoot is still likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. More information about the species life history, distribution, population dynamics, threats, and recovery can be found in the listing rule (USFWS 2013a) and the latest status review (USFWS 2021b).



Shiny pigtoe

The shiny pigtoe is a Cumberlandian species restricted to the middle and upper Tennessee River system and has always been considered rare. It was listed as endangered on June 14, 1976 (USFWS 1976). A recovery plan addressing the shiny pigtoe was approved on July 9, 1984 (USFWS 1984a).

At time of listing, threats to the shiny pigtoe were identified as habitat fragmentation and loss, alteration from impoundments, operation of hydroelectric dams, mining, wastewater discharges, water withdrawal, competition and displacement by non-native species, and the runoff of silt and other pollutants from ground disturbance activities. Surviving populations continue to be experience these threats.

There are currently five known populations of shiny pigtoe – one in the North Fork Holston River in Virginia, one each in the Clinch and Powell rivers, both crossing the Virginia-Tennessee state line, one in the Elk River in Tennessee, and one in the Paint Rock River in Alabama. The species was rediscovered in the Elk River in 2021, where it had not been seen in approximately 35 years (Ford 2021).

In order to recover the shiny pigtoe in the upper Tennessee River drainage, it will be necessary to augment existing populations and to reintroduce the species into appropriate habitat within its historical range. This will require propagation technology to be developed as extant populations are too small to allow direct translocation of adult animals to accomplish these goals.

More information about the species life history, distribution, population dynamics, threats, and recovery can be found in the listing rule (USFWS 1976), recovery plan (USFWS 1984a), and the most recent status review (USFWS 2021c).



Snuffbox

The snuffbox was listed as an endangered species on February 14, 2012 (USFWS 2012). A recovery plan has not yet been completed for the snuffbox. Critical habitat has not been designated for this species.

The final listing rule identified habitat loss and degradation from impoundments, channelization, chemical contaminants, mining, and sedimentation as the primary reasons for listing the snuffbox. This species continues to decline due to the effects of habitat destruction, poor water quality, contaminants, and other factors. Although there are ongoing attempts to alleviate some threats, it appears that all the populations are experiencing significant threats, many without obvious or readily available solutions.

The snuffbox is currently considered extant in 82 streams in Alabama, Arkansas, Illinois, Indiana, Kentucky, Michigan, Minnesota, Missouri, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, Wisconsin, and Ontario, Canada. Records indicate that the species historically occurred in at least 213 streams and lakes and also historically occurred in Iowa, Kansas, Mississippi, and New York. The species has been extirpated from the lower Missouri River

system and now only occurs in 7 streams in the upper Great Lakes sub-basin, 10 streams in the lower Great Lakes sub-basin, 4 streams in the upper Mississippi River sub-basin, 49 streams in the Ohio River System, 1 stream in the Cumberland River System, 6 streams in the Tennessee River System, and 5 streams in the lower Mississippi River sub-basin. Across the species' current range, only six percent of the extant populations are large and stable or improving. Since listing, there has been no significant change in the species' spatial distribution, abundance, or historical range.

Successful propagation techniques for the snuffbox are fairly well established. Propagation and augmentation and/or reintroduction of snuffbox are ongoing in Indiana, Kentucky, Minnesota, Tennessee, Wisconsin, and Virginia. Cultured snuffbox produced from these efforts have been placed into the Clinch, Powell, and Duck Rivers in Virginia and Tennessee. The success of these efforts has not yet been determined.

Due to its declining status and ongoing threats, the snuffbox continues to be in danger of extinction throughout its range. The recovery priority number for the snuffbox is 5, indicating that the degree of threat remains high and potential for recovery remains low. More information about the species life history, distribution, population dynamics, threats, and recovery can be found in the listing rule (USFWS 2012), recent status review or species status assessment reports (USFWS 2019b, USFWS 2022b).



Longsolid

The final rule to list the longsolid as a threatened species was published on March 9, 2023 (USFWS 2023c). A recovery plan for the longsolid has not yet been approved. Therefore, no recovery criteria are identified.

The longsolid was listed due to habitat degradation or loss from a variety of sources (e.g., dams and other barriers, resource extraction); degraded water quality from chemical contamination and erosion from development, agriculture, mining, and timber operations; mortality from dredging; residual impacts (reduced population size) from historical harvest; and the proliferation of

invasive, nonnative species. These threats also contribute to the negative effects associated with the species' small population size.

The longsolid is currently found in the Ohio, Cumberland, and Tennessee river basins, with a range spanning the states of Alabama, Kentucky, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. It is considered extirpated from Georgia, Indiana, and Illinois. Additionally, it is classified as an endangered species by the State of Ohio and considered to have various levels of concern, imperilment, or vulnerability by the States of Alabama, Kentucky, North Carolina, Pennsylvania, Tennessee, Virginia, and West Virginia. Overall, the longsolid is presumed extirpated from 63 percent (102 of 162 populations) of its historically occupied populations, including 6 populations (the entirety) in the Great Lakes basin, 65 populations in the Ohio River basin, 9 populations in the Cumberland River basin, and 26 populations in the Tennessee River basin. Of the current populations, 3 (5 percent) are estimated to be highly resilient, 9 (15 percent) are estimated to be moderately resilient, and 48 (80 percent) are estimated to have low resiliency (USFWS 2022c).

Given current and future decreases in resiliency, populations become more vulnerable to extirpation from stochastic events (particularly the small populations that are linearly distributed), in turn, resulting in concurrent losses in representation and redundancy. Predictions of the longsolid's habitat conditions and population factors in the future suggest possible extirpation of between 18 (3 percent) and 44 (73 percent) currently extant populations unless additional conservation is implemented and effective (USFWS 2022c).

More information about the species life history, distribution, population dynamics, threats, and recovery can be found in the listing rule (USFWS 2023c) and the latest status review (USFWS 2022c).



Tennessee pigtoe

The Tennessee pigtoe is endemic to the Tennessee River drainage and occurs in Alabama, Georgia, North Carolina, Tennessee, and Virginia, and is presumed extirpated from Mississippi (USFWS 2023d). It was petitioned to be listed on April 20, 2010, as part of the petition by the Center for Biological Diversity to list 404 species in the southeastern United States as

endangered or threatened under the Endangered Species Act of 1973 (CBD 2010; 76 USFWS 2011; USFWS 2022a). The Service published a proposed rule on August 22, 2023 to list the Tennessee pigtoe as endangered under the Endangered Species Act (USFWS 2023d).

The proposed listing rule indicated the primary threats to the Tennessee pigtoe include large impoundments, urban development, energy development, and agriculture (USFWS 2023d). Organic and chemical pollution, siltation from logging and agricultural activities, altered and impounded river channels, and toxic mine runoff continue to have severe impacts on this species (NatureServe 2023).

Tennessee Pigtoe has lost between 42-62 percent of its former range and currently occurs in only 43-63 watersheds out of 114 within its historical range (USFWS 2020b). These populations are severely fragmented throughout former range and occur in low population densities. Impoundments along the Tennessee River resulted in extirpation from the mainstem, but the Tennessee pigtoe continues to persist in eastern and middle Tennessee in small and medium-sized rivers. Overall, populations are experiencing a high rate of decline (NatureServe 2023).

More information about the species life history, distribution, population dynamics, threats, and recovery can be found in the listing rule (USFWS 2023d) and the Species Status Assessment (USFWS 2020b).



Tennessee clubshell

The Tennessee clubshell was once common in the Cumberland and Tennessee River systems and is currently found in Alabama, Georgia, Kentucky, North Carolina, Tennessee, and Virginia (USFWS 2023d). This species initially underwent a status Review of Invertebrate Wildlife for Listing as Endangered or Threatened Species in 1984 (USFWS 1984b) and was officially petitioned for listing on April 20, 2010, as part of the petition by the Center for Biological Diversity to list 404 species in the southeastern United States as endangered or threatened under

the Endangered Species Act of 1973 (CBD 2010; USFWS 2011; USFWS 2022a). The Service published a proposed rule on August 22, 2023 to list the Tennessee pigtoe as endangered under the Endangered Species Act (USFWS 2023d).

The proposed listing rule indicated the primary threats to the Tennessee pigtoe include large impoundments, urban development, energy development, and agriculture (USFWS 2023d). Like other freshwater mussels, the Tennessee clubshell is at risk from habitat degradation in streams and the surrounding watershed, barriers to aquatic connectivity, contaminants, and diseases. This species continues to experience declines from poor land uses, pollution, and siltation (NatureServe 2023).

The Tennessee clubshell occurs in only 34-63 watersheds compared to at least 150 historically (USFWS 2020b). Where the Tennessee clubshell was once widespread, it now occurs in restricted and fragmented populations. All of the known extant populations are at risk of decline and extirpation from external threats. Because of these factors, long-term viability of the species is in question. Conservation can only be assured by maintaining native biodiversity, hydrologic function, and securing protection of species occurrence areas and upstream reaches (NatureServe 2023).

More information about the species life history, distribution, population dynamics, threats, and recovery can be found in the listing rule (USFWS 2023d) and the Species Status Assessment (USFWS 2020b).

3. Environmental Baseline

The Elk River downstream of Harms Mill Dam is a relatively deep river with a few shoal habitats conducive to supporting boulder darters and freshwater mussels. Three shoal habitats exist in this reach with one shoal (i.e., shoal 1, Figure 3) extending from the dam downstream approximately 200 meters (Lat. 35.14978, Long. -86.64924), one small shoal (i.e., shoal 2, Figure 3) located approximately 880 meters downstream of the dam (Lat. 35.14657, Long. -86.65608, just above Molina Rd. bridge), and one large shoal complex (i.e., shoal 3, Figure 3) located approximately 1.8 km downstream of the dam (Lat. 35.13905, Long. -86.65902) (TVA monitoring station ERM 75.7).

Historically, the boulder darter, Alabama lampmussel, slabside pearl mussel, cracking pearl mussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell have been negatively impacted by TVA's O&M activities at Tims Ford Dam (USFWS 1989a; USFWS 1989b; USFWS 2006). Hydropower operations resulted in fluctuating water levels and dewatering areas of suitable habitat in the Elk River. Peaking flows from the dam have resulted in daily water level fluctuations of over 1.5 m in the mainstem at the Alabama state line (Shepard et al. 2009), contributing to erosion of streambanks, sedimentation of stream substrate, and decreased suitable instream habitat and habitat diversity. Native fish and mussel populations have been adversely affected by the extreme variations in flow and temperature related to historical operation of the turbine at Tims Ford Dam. Releases of cold water through the hydroturbine reduced stream temperatures in the tailwaters throughout the entire Elk River

from Tims Ford Dam to the backwaters of Wheeler Reservoir, 215.6 km downstream. It is believed that cold-water releases from Tims Ford Reservoir suppressed the boulder darter population size and limited their distribution in the Elk River. Water temperature fluctuations, excessive sedimentation, and low densities (or absence) of appropriate fish hosts, as a result of hydroturbine operations, likely hindered the reproductive success of freshwater mussels (TVA 2008).

TVA has improved the quality of water releases from Tims Ford Dam through an aeration project as part of its Reservoir Release Improvements Program. In 2005, TVA initiated formal consultation with the Service regarding routine O&M of TVA's water control structures. As a result of this consultation, which concluded in 2006 (USFWS 2006), TVA began to modify O&M at Tims Ford Dam in 2008 by reducing turbine operations and providing a combination of releases via the spillway and sluice of 5.6 to 8.5 m³ per second (200 to 300 cubic feet per second-cfs) in an attempt to more closely simulate natural flow regimes and seasonal water temperatures downstream from the dam. These modifications are anticipated to aid in recovery of the boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, snuffbox, rabbitsfoot, shiny pigtoe, longsolid, Tennessee pigtoe, and Tennessee clubshell. Current minimum summer-flow releases at the dam average 6 m³ per second (210 cfs). TVA has foregone use of the large hydrogenation unit at Tims Ford Dam during these critical periods (USFWS 2017).

TVA altered tailwater releases from Tims Ford Dam in 2008, reducing the severity of flow fluctuations and increasing water temperatures to provide more ecologically suitable conditions for imperiled aquatic species downstream of the dam. Results have been positive for listed mussels (Amacker, pers. comm., 2020). In addition, the changes in O&M at Tims Ford Dam have likely provided approximately 48.3 additional river kilometers (rkm) of habitat suitable for boulder darters by warming and stabilizing Elk River temperatures from approximately ERM 119 at Beans Creek, Lincoln County, Tennessee, downstream to ERM 90 at Fayetteville. It is hoped that the species will be able to expand its range into these upstream reaches.

Portions of the Elk River and its tributaries are listed as impaired by the State of Tennessee on their Final Year 2022 303(d) LIST (TDEC 2022). Impairments identified on the list as occurring in these waterbodies include *Escherichia coli*, physical substrate habitat alterations, other anthropogenic substrate alterations, flow alteration, nitrate/nitrite, unionized ammonia, total phosphorous, iron, manganese, whole effluent toxicity, sludge deposits, polychlorinated biphenyls (PCBs), low dissolved oxygen, alteration in streamside or littoral vegetative cover, loss of biological integrity due to siltation, biological integrity loss due to undetermined cause, nutrients and thermal modification. Pollutant sources (point and non-point) on the list are identified as pasture grazing, animal feeding operations, unrestricted cattle access, upstream impoundment, contaminated sediments, industrial commercial site, urbanized high density area, municipal urbanized area, municipal point source, major municipal point source, stormwater discharge, municipal point source discharges, discharges from a MS4 (municipal separate storm sewer system) area, collection system failure, land development, channelization, sand/gravel/rock mining, silviculture, non-irrigated crop production, specialty crop production, and off-road vehicles (TDEC 2016).

3.1. Status of the Species within the Action Area

Boulder darter

The boulder darter is currently known from approximately 64.6 miles of the Elk River in Giles and Lincoln counties in Tennessee, and Limestone County in Alabama. The current distribution in the Elk River extends from confluence with Wells Creek in Lincoln County (TN) downstream to Shoal Creek in Limestone County, Alabama. Boulder darter current distribution also includes the lower portions of three Elk River tributaries: the lower 2.1 miles of Richland Creek (Giles County, TN); the lower 0.5 miles of Indian Creek, (Giles County, TN); and 0.5 miles of Shoal Creek (Limestone County, AL). In recent years, CFI has continued monitoring the shoals below Harms Mill Dam as a way of collecting breeders from the Elk River population for propagation efforts with this species and has collected 39 boulder darters in the Elk River at this site (Rakes et al. 2020 & 2021; Petty et al. 2023). To assist TWRA with their biological assessment for this proposed action, CFI developed an estimate of boulder darter occupancy in the habitat immediately downstream of the dam based off of previous monitoring and by making some habitat usage assumptions based on their experience with the fish. CFI estimated that approximately 450-650 total individual boulder darters (adult and juveniles) may occupy the 3,000 square meters of habitat downstream of this dam (Baxter pers. comm., 2023).

Alabama lampmussel

The Alabama lampmussel was not recorded in the immediate proximity of the Harms Mill Dam (ERM 77.04) during a recent TWRA survey (Wisniewski 2022). However, the species has been reported from the TVA monitoring station located at ERM 75.7 as recently as 2012 (TVA 2021, unpublished monitoring data). Previously extirpated from the Elk River, TWRA and Alabama Department of Conservation and Natural Resources (ADCNR) biologists have reintroduced this mussel back to the Elk River at ERM 32, 33, and 75.7. Between 2010 and 2012, 1,462 individuals of Alabama lampmussel were reintroduced at ERM 75.7 (Johnson and Hubbs 2012). Suitable habitat does not exist in the action area immediately upstream of Harms Mill Dam. Immediately downstream of the dam, TWRA indicated shoal areas provide potential mussel habitat (Wisniewski 2022). No natural recruitment has yet been documented, but reintroduced animals have been recaptured during different monitoring efforts. Because suitable habitat is likely present and there are no evident barriers to migration for fish hosts between the dam and the TVA monitoring station located at ERM 75.7, we believe that the Alabama lampmussel could be present within the action area.

Slabside pearl mussel

The slabside pearl mussel was not recorded in the immediate proximity of the Harms Mill Dam (ERM 77.04) during a recent TWRA survey (Wisniewski 2022). However, the species has been reported from the TVA monitoring station located at ERM 75.7 as recently as 2021 (TVA 2021, unpublished monitoring data). Suitable habitat does not exist in the action area immediately upstream of Harms Mill Dam as the species prefers shoal areas with moderately flow in small streams to medium size rivers. Immediately downstream of the dam, TWRA indicated shoal areas provide potential mussel habitat (Wisniewski 2022). Multiple age classes have been recovered at the TVA long-term monitoring sites in the Elk River, indicating some potential for

recruitment. Because suitable habitat is likely present and there are no evident barriers to migration for fish hosts between the dam and the TVA monitoring station located at ERM 75.7, we believe that the slabside pearl mussel could be present within the action area.

Cracking pearl mussel

The cracking pearl mussel was not recorded in the immediate proximity of the Harms Mill Dam (ERM 77.04) during a recent TWRA survey (Wisniewski 2022). However, the species has been reported from the TVA monitoring station located at ERM 75.7 as recently as 2015 (TVA 2021, unpublished monitoring data). Suitable habitat does not exist in the action area immediately upstream of Harms Mill Dam as the species prefers shallow riffles and shoals. Immediately downstream of the dam, TWRA indicated shoal areas provide potential mussel habitat (Wisniewski 2022). Multiple age classes have been recovered at the TVA long-term monitoring sites in the Elk River. Service and TWRA biologists have also recently collected broodstock of cracking pearl mussel from the Elk River for captive propagation efforts with this species, indicating potential for recruitment. Because suitable habitat is likely present and there are no evident barriers to migration for fish hosts between the dam and the TVA monitoring station located at ERM 75.7 in other downstream habitats, we believe that the cracking pearl mussel could be present within the action area.

Rabbitsfoot

The rabbitsfoot was not recorded in the immediate proximity of the Harms Mill Dam (ERM 77.04) during a recent TWRA survey, though, relict shell material of rabbitsfoot was documented during this survey (Wisniewski 2022). However, the species has been reported from the TVA monitoring station located at ERM 75.7 as recently as 2021 (TVA 2021, unpublished monitoring data). Suitable habitat does not exist in the action area immediately upstream of Harms Mill Dam as the species prefers shallow riffles and shoals. Immediately downstream of the dam, TWRA indicated shoal areas provide potential mussel habitat (Wisniewski 2022). Multiple age classes have been recovered at the TVA long-term monitoring sites in the Elk River. Because suitable habitat is likely present and there are no evident barriers to migration for fish hosts between the dam and the TVA monitoring station located at ERM 75.7 in other downstream habitats, we believe that the rabbitsfoot could be present within the action area.

Shiny pigtoe

The shiny pigtoe was not recorded in the immediate proximity of the Harms Mill Dam (ERM 77.04) during a recent TWRA survey (Wisniewski 2022). However, the species has been reported from the TVA monitoring station located at ERM 75.7 as recently as 2021 (TVA 2021, unpublished monitoring data; Ford 2021). Suitable habitat does not exist in the action area immediately upstream of Harms Mill Dam as the species prefers riffle and shoal areas in moderate to fast-flowing streams and rivers. Immediately downstream of the dam, TWRA indicated shoal areas provide potential mussel habitat (Wisniewski 2022). The shiny pigtoe remains very rare within the Elk as the collection of one individual from the Elk River in 2021 represents the first live record of this species from the system since 1980 (Ford 2021). Because

suitable habitat is likely present and there are no evident barriers to migration for fish hosts between the dam and the TVA monitoring station located at ERM 75.7, we believe that the shiny pigtoe could be present within the action area.

Snuffbox

The snuffbox was not recorded in the immediate proximity of the Harms Mill Dam (ERM 77.04) during a recent TWRA survey though relict shell material of rabbitsfoot was documented during this survey (Wisniewski 2022). However, the species has been reported from the TVA monitoring station located at ERM 75.7 as recently as 2012 (TVA 2021, unpublished monitoring data). Suitable habitat does not exist in the action area immediately upstream of Harms Mill Dam as the species prefers shallow riffles in swift current with sand and gravel substrate. Immediately downstream of the dam, TWRA indicated shoal areas provide potential mussel habitat (Wisniewski 2022). Multiple age classes have been recovered at the TVA long-term monitoring sites in the Elk River. Because suitable habitat is likely present and there are no evident barriers to migration for fish hosts between the dam and the TVA monitoring station located at ERM 75.7 in other downstream habitats, we believe that the snuffbox could be present within the action area.

Longsolid

The longsolid was not recorded in the immediate proximity of the Harms Mill Dam (ERM 77.04) during a recent TWRA survey (Wisniewski 2022). However, the species has been reported from the TVA monitoring station located at ERM 75.7 as recently as 2015 (TVA 2021, unpublished monitoring data). While not observed during TVA's 2021 mussel surveys at ERM 75.7, the longsolid was observed at this site in each previous sampling event (2008, 2012, and 2015) (TVA 2021, unpublished monitoring data). Suitable habitat does not exist in the action area immediately upstream of Harms Mill Dam as the species prefers shallow riffles and shoals. Immediately downstream of the dam, TWRA indicated shoal areas provide potential mussel habitat (Wisniewski 2022). Multiple age classes have been recovered at the TVA long-term monitoring sites in the Elk River. Because suitable habitat is likely present and there are no evident barriers to migration for fish hosts between the dam and the TVA monitoring station located at ERM 75.7 in other downstream habitats, we believe that the longsolid could be present within the action area.

Tennessee pigtoe

The Tennessee pigtoe was recently recorded in the immediate proximity of the Harms Mill Dam (ERM 77.04) during a recent 2022 TWRA survey (Wisniewski 2022). During this survey, ten live individuals were found including several sub-adult (lengths of 21, 28, 39 millimeter), indicating recent recruitment at this site (Wisniewski 2022). This species has also been reported from the TVA monitoring station located at ERM 75.7 as recently as 2021, when 8 individuals were found in quadrat samples (TVA 2021, unpublished monitoring data). Suitable habitat does not exist in the action area immediately upstream of Harms Mill Dam as the species prefers riffles, shoals, and high gradient streams with stable substrates composed predominantly of coarse sand, gravel, and cobble (USFWS 2023d). Immediately downstream of the dam, TWRA

recorded the presence of this mussel and suitable mussel habitat (Wisniewski 2022). Multiple age classes have been recovered at the immediately downstream of the dam and at the TVA long-term monitoring sites in the Elk River. Because this mussel and suitable habitat have been recently documented, we believe that the Tennessee pigtoe could be present within the action area.

Tennessee clubshell

The Tennessee clubshell was not recorded in the immediate proximity of the Harms Mill Dam (ERM 77.04) during a recent TWRA survey (Wisniewski 2022). However, the species has been reported from the TVA monitoring station located at ERM 75.7 as recently as 2015 (TVA 2021, unpublished monitoring data). While not discovered during TVA's 2021 mussel surveys at ERM 75.7, it was discovered at this site in previous sampling events (2008 and 2015) (TVA 2021, unpublished monitoring data). Suitable habitat does not exist in the action area immediately upstream of Harms Mill Dam as the species prefers riffles, shoals, and high gradient streams with stable substrates composed predominantly of coarse sand, gravel, and cobble (USFWS 2023d). Immediately downstream of the dam, TWRA indicated shoal areas provide potential mussel habitat (Wisniewski 2022). Multiple age classes have been recovered at the TVA long-term monitoring sites in the Elk River. Because suitable habitat is likely present and there are no evident barriers to migration for fish hosts between the dam and the TVA monitoring station located at ERM 75.7 in other downstream habitats, we believe that the Tennessee clubshell could be present within the action area.

3.2. Factors Affecting Species Environment within the Action Area

The area surrounding the project is rural with the surrounding land use being primarily in row crops, pasture, and hayfields. The floodplain has been largely cleared for agricultural purposes, with exception to riparian areas along the river. Riparian buffers have average widths of approximately 15-30 m (50-100 feet) in the vicinity of the project.

Approximately 63.6 km in the Upper Elk River Watershed are listed as impaired by the State of Tennessee due to concerns for *Escherichia coli*, dissolved oxygen, temperature, and flow regime modification (TDEC 2022). Siltation, caused by excessive releases of sediment into waterways from activities such as poor agricultural practices (absence of pasture-rotation plans, failure to restrict grazing during wet periods, lack of contour farming practices, not establishing permanent vegetative cover, failure to return crop residue to the soil, etc.) results in significant impacts to aquatic life (Waters 1995). These pollutants tend to increase concentrations of nutrients and toxins in the water and alter the chemistry of affected streams, such that habitat and food sources for aquatic species, including fish and freshwater mussels, are negatively impacted.

3.3. Designated Critical Habitat

3.3.1 Slabside Pearlymussel

Critical habitat was designated for the slabside pearlymussel on September 26, 2013 (USFWS 2013c). In total, 13 critical habitat units were designated, encompassing approximately 970 rmi

of stream channel in Alabama, Mississippi, Tennessee, and Virginia for the slabside pearl mussel, including Unit SP10 (Figure 4):

The Elk River (Unit SP10) from its inundation at Wheeler Reservoir in Limestone County, Alabama, upstream approximately 102 rmi to its confluence with Farris Creek at the Franklin and Moore county line in Tennessee.

The following essential physical or biological features (previously referred to as primary constituent elements) of the critical habitat for slabside pearl mussel include (USFWS 2013c):

- Riffle habitats within large, geomorphically stable stream channels (channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without aggrading or degrading bed elevation).
- Stable substrates of sand, gravel, and cobble with low to moderate amounts of fine sediment and containing flow refugia with low shear stress.
- A natural hydrologic flow regime (magnitude, frequency, duration, and seasonality of discharge over time) necessary to maintain benthic habitats where the species is found, and connectivity of rivers with the floodplain allowing the exchange of nutrients and sediment for habitat maintenance, food availability for all life stages, and spawning habitat for native fishes.
- Water quality with low levels of pollutants and including a natural temperature regime, pH (between 6.0 to 8.5), oxygen content (not less than 5.0 milligrams/liter), hardness, and turbidity necessary for normal behavior, growth, and viability of all life stages.
- The presence of abundant fish hosts, which may include the popeye shiner (*Notropis ariommus*), rosyface shiner (*N. rubellus*), saffron shiner (*N. rubricroceus*), silver shiner (*N. photogenis*), telescope shiner (*N. telescopus*), Tennessee shiner (*N. leuciodus*), whitetail shiner (*Cyprinella galactura*), white shiner (*Luxilus albeolus*), and eastern blacknose dace (*Rhinichthys atratulus*), necessary for recruitment of the slabside pearl mussel.

3.3.2 Fluted Kidneyshell

Critical habitat was designated for the fluted kidneyshell on September 26, 2013 (USFWS 2013c). In total, 24 critical habitat units encompassing approximately 1,181 rmi of stream channel in Alabama, Kentucky, Tennessee, and Virginia were designated for the fluted kidneyshell, including Unit FK22 (Figure 4):

The Elk River (Unit FK22) from its inundation at Wheeler Reservoir in Limestone County, Alabama, upstream approximately 102 rmi to its confluence with Farris Creek at the Franklin and Moore County line in Tennessee.

The following essential physical or biological features (previously referred to as primary constituent elements) of the critical habitat for these mussels (USFWS 2013c) include:

is believed to be occupied by the species in low numbers. This unit was considered unoccupied by the fluted kidneyshell at the time of designation. In 2016, fluted kidneyshells from Clinch River stock were introduced in the Elk River by the TWRA at Winding Stair Bluff (ERM 34) (TWRA 2020), recent monitoring by TWRA in June 2023 documented persistence of this effort by recollecting one of these translocated animals (Wisniewski pers. comm., 2023). Before this, fluted kidneyshell was last collected in the Elk River in the late 1960's (Isom et al. 1973). We do not expect fluted kidneyshell to be present within the action area.

Unit SP10 and FK22 includes approximately 102 rmi of the Elk River from its inundation at Wheeler Lake in Limestone County, Alabama, upstream to its confluence with Farris Creek at the county line between Franklin and Moore Counties, Tennessee (Figure 4). While the Elk River is a State-owned navigable water, the surrounding land within the unit is almost entirely private land, except for any small amount that is publicly owned in the form of bridge crossings and road easements and a small portion that is within TVA-owned lands near Wheeler Reservoir (78 FR 59555).

Within these units, the slabside pearlymussel and fluted kidneyshell and their habitats may require special management considerations or protection to address potential adverse effects associated with agricultural activities (livestock), water withdrawals, lack of adequate riparian buffers, construction and maintenance of State and county roads, and nonpoint source pollution originating in headwater reaches.

4. Effects of the Action

Based on the proposed construction, and the size, volume, and morphology of the Elk River within the action area, we anticipate the effects of this action extend from the Harms Mill Dam upstream approximately 320 meters, which is currently the impoundment formed by Harms Mill Dam. Effects of the project will extend from Harms Mill Dam downstream approximately 2.0 km to ERM 75.7. These project extents were selected based on the following criteria: 1) The relative location of habitat known to support several species protected under the U.S. Endangered Species Act of 1973 as amended; and 2) The findings of Sethi et al. (2004) which investigated the response of freshwater mussels (mussel density decreased) due to the removal of the Rockdale Dam, a comparable lowhead dam on Koshkonong Creek in south central Wisconsin.

Sethi et al. (2004) repeatedly sampled mussels at a site within a former impoundment on Koshkonong Creek and at two sites located 0.5 km downstream and 1.7 km downstream of a removed dam. No live mussels were found within the formerly impounded portion of the study area on any occasion. However, the investigation found that mussel density decreased significantly for several species 3-years post removal at both sites with the most substantial declines occurring at the site 0.5 km downstream of the dam. These declines were attributed to increased bed load of silt and sand at these sites due to the release of these particles which were stored behind the dam. Similarly, Cooper (2011) and Sherman (2013) reported that sediment transport post dam removal was the primary threat to mussels occurring downstream of dams.

Because of the elevation difference between the upstream and downstream reaches of the Harms Mill Dam, some sedimentation is expected downstream as the stream channel changes after removal of the dam. Headcutting after dam removal could scour sediment from the river bottom and deposit it downstream. Mussel mortality due to sediment loads observed by Sethi et al. (2004) could, therefore, also occur downstream of Harms Mill Dam after it is removed. The movement of bed load and deposition of sediment following removal of the Harms Mill Dam could also bury boulder and crevice habitat used by boulder darters for spawning where they deposit their eggs in cluster on the underside of boulders or slabrocks.

The BA, however, reported an investigation of the depth and substrate of the impoundment behind Harms Mill Dam and indicated that little sediment load was present and most substrate appeared to be bedrock. We presume that the low volume of finer sediments upstream of Harms Mill Dam is related to a breach in the base of the dam that occurred sometime prior to 2012, and which has transported those finer sediments downstream within the last 10 or more years. The low sediment load upstream of the dam should, therefore, result in minimal downstream deposition of sediment and reduced adverse impacts to aquatic species as compared to those found by Sethi et al. 2004.

4.1. Stressor: Boulder Darter Collection and Relocations

Boulder darters are a crevice-spawning species, requiring habitats that have boulder/slab rock substrates in areas with moderate to fast current (O'Bara and Etnier 1987). The shoal immediately downstream of the dam is recognized as some the best habitat for the boulder darter and is utilized as one of the most reliable brood stock collection spots for propagation efforts by CFI. While the removal of Harms Mill Dam will likely provide long-term benefits to the boulder darter by removal of a significant barrier to migration, it is likely that sediment and bed load will shift and could cover or bury these crevice and boulder habitats temporarily (i.e., approximately 3 months). As such, the collecting, holding, and returning boulder darters from and back to the site during dam deconstruction will minimize harm to the boulder darter by avoiding the temporary effects of the dam removal.

Applicable Science – Boulder Darter Holding and Re-release: CFI will lead the effort to collect, hold, and re-release boulder darters from the shoal downstream of the Harms Mill Dam site. CFI are the foremost experts as it regards working with the boulder darter, with over two decades of surveying and captive propagation with this species (Ruble et al. 2016; Service 2023) and having developed protocols for controlled propagation and population monitoring of boulder darter (Petty 2020). CFI will utilize the institutional knowledge gained from over 20 years of working with the boulder darter to minimize impacts to the fish during capture, holding, and release to further minimize more severe harass or harm from leaving them in place during deconstruction of the dam.

Effects Pathway 1

Action Categories – Preconstruction boulder darter collection sweeps and temporary holding of individuals at CFI facility before re-release to the Harms Mill site post-construction action.

Stressor – Collection, handling, and transport to CFI, and eventual return to collection site.

Exposure (time) – Less than 24 hours (initial collection and return trips), for collection and transport to and from CFI facility. Individuals would be held for approximately three (3) months before being released back into the Harms Mill site. Data would be collected on age, reproductive status (if appropriate at time of survey), and sex. Recovered individuals would be held in aerated tanks for transport to CFI. At the CFI facility, CFI will hold up to 68 adults in a system, or up to 168 juveniles in a system. Three holding systems have been allocated to this effort with a minimum holding of 189 adults and a maximum holding of 504 juveniles. This number would be in addition to 30 adult boulder darters collected as brood stock by CFI for on-going captive propagation efforts for this species. Animals returned to the site will also be held and transported in aerated tanks before release at site.

Exposure (space) - The entire footprint of the downstream shoal 3,000 m² at Harms Mill Dam would be thoroughly searched for boulder darters.

Resource affected – Boulder darter individuals (adults and juveniles)

Individual response – Stress and possible mortality (low probability) to individuals during collection, handling, holding, and return efforts. While we expect to have no mortality from collection, handling, or holding, there is some possibility that fewer individuals will be returned to the river than collected. Some of the individuals produced at CFI using retained breeders from this effort will be returned to Harms Mill the following year to offset any losses from this population due to dam deconstruction and associated measures that are intended to minimize take.

Effect – Mortality or harm to individuals that are overlooked or inadvertently damaged during the collection sweep. Efforts to collect, house, and return individuals may result in low levels of adverse effects including mortality, reduced fitness, and diminished reproductive success, though the ultimate goal is to minimize mortality and harm.

Conservation and Minimization Measures – As required by Term and Condition 1 in Section 7.4, personnel of CFI and the TWRA shall sweep shoals immediately downstream of the Harms Mill Dam (3,000 m²) initially utilizing hand methods (kick-seining) until a spawning group (total of 30 fish) are collected and then utilizing “electro-seining” (electrofishing at the lowest practical setting to get the fish to move out of the rocky habitats into the seines, with minimal effect on the fish from electricity use). Captured boulder darters will be taken to CFI for holding (up to 504 individuals depending upon the age composition of fish captured) and captive propagation (total of 30 adult fish) and those not held for captive propagation will be held for approximately 3 months before re-release to the Harms Mill site.

Interpretation – The boulder darter collection sweeps in the shoal immediately downstream of Harms Mill Dam would likely overlook some individuals and result in effects, though minimal,

to those recovered. Boulder darters will be collected for the purpose of returning captured individuals to the site following the deconstruction of the dam as a way to minimize significant impacts (more extreme levels of harm and mortality). It is expected that the majority of individuals relocated to avoid potential for harm during the dam removal process would recover from the effects of the capture and holding and be returned to the site. However, those boulder darters captured could experience a short-term reduction in fitness, growth, and reproductive success.

4.2. Stressor: Mussel Sweeps and Relocations

Mussels are long-lived and have a complex life cycle, making assessment of long-term effects difficult (e.g., effects of water quality changes, long-term relocation effects, impacts to host species, etc.). The size of a population and its natural variance over time are important characteristics affecting a species' response to disturbance factors. For the Alabama lampmussel, slabside pearl mussel, cracking pearl mussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell, as with most freshwater mussel species, information regarding population characteristics such as critical size (i.e., a population threshold that is too low to recover from environmental stochasticity), variability (sex ratios, density, genetic viability, recolonization rates) and stability (the species' ability to resist change or dramatic fluctuations over time) is limited or unavailable. The complex life cycle of mussels increases the probability that weak links in their life history will preclude successful reproduction and recruitment.

Applicable Science – Mussel Sweeps and Relocations: Relocating mussels has long been considered a viable option to protect individuals occurring within the footprint of a project. However, some mussels could be overlooked during relocation efforts (Strayer and Smith 2003). In a mussel mark/recapture study in Alabama, Service biologists tagged approximately 900 mussels over a period of 24 months and estimated that only about 10% of mussels present at the site were recovered in the initial three-pass sweep of the area. Furthermore, untagged individuals comprised nearly 35% of the mussels recovered in the final monthly sweep, suggesting that mussel relocations should be viewed only as a minimization measure (Ford and Grunewald 2015).

Studies have shown that handling and air exposure for short durations (e.g., up to four hours) is not particularly damaging to freshwater mussels. Thicker shelled species have greater than 90% survival after air exposure of up to four hours (Waller et al. 1995). However, the biological responses of mussels associated with removal and relocation efforts has varied. An evaluation of available literature on mussel relocations as a conservation and management tool indicated a high variability in survival rates across the studies, suggesting that appropriate site selection may play an important part in the success of relocations (Waller et al. 1995). Adverse effects are possible with relocated individuals, including mortality, and reduced fitness and reproductive success. Survival after relocation greatly hinges on selecting a proper recipient site that contains suitable habitat in areas where substrates are stable and mussel species with similar habitat preferences are present (Mittiga and St. Aubin 2013).

Effects Pathway 2

Action Categories – Preconstruction mussel sweeps

Stressor – Collection, handling, marking, and release at the recipient site

Exposure (time) – Less than 24 hours, depending on the depth of water, the shoal downstream of Harms Mill Dam will be surveyed using snorkeling and tactile search (hand grubbing for mussels) as appropriate. Data would be collected on age, reproductive status (if appropriate at time of survey), and sex. Recovered individuals would be marked (shellfish tags or scored with a rotary tool, stored in mesh bags submerged in a shaded location of the stream until the sweep is completed, and ultimately transported to the TVA’s fixed long-term monitoring site located at ERN 75.7.

Exposure (space) - The shoal located immediately downstream of the Harms Mill Dam will be searched thoroughly for mussels.

Resource affected – Mussel individuals (adults and juveniles)

Individual response – Valve closure and cessation of feeding activities during collection, handling, and relocation efforts.

Effect – Mortality or harm to individuals that are overlooked during the survey effort. While being of low probability, efforts to establish at the recipient site may result in adverse effects including mortality, reduced fitness, and diminished reproductive success if a mussel is unable to establish or acclimate to the recipient site.

Conservation and Minimization Measures – As required by Term and Condition 2 in Section 7.4, TWRA and other participating agency biologists shall sweep a minimum of three passes and relocate any mussels from the shoals immediately downstream of the Harms Mill Dam to the fixed long-term TVA mussel monitoring site located at ERM 75.7.

Interpretation – The mussel sweep in the footprint of the rock pads would likely overlook some individuals (see section 4.3 for effects to overlooked mussels) and result in effects to those recovered. Mussels that are recovered during the sweep would be relocated to a preapproved recipient site. It is expected that the majority of individuals relocated would acclimate to conditions at the recipient site and recover from the effects of the relocation. However, mussels could experience a short-term reduction in fitness, growth, and reproductive success.

4.3. Stressor: Instream Construction

Deconstruction of the Harms Mill Dam and the installation/removal and operation of rock pads or temporary cofferdams in the Elk River could result in inadvertent crushing or burying of mussels that are overlooked during mussel sweeps. Also, disturbance of the streambed could create sedimentation and cause settled contaminants to re-suspend, resulting in ceased siphoning activity by mussels and dispersal of boulder darters and host fish from the action area.

Applicable Science – Instream Construction: Sensitive periods for the boulder darter include the spawning and larval life stages, which occur during the period of April 1 through July 31 (Rakes et al. 2009; Rakes and Shute, pers. comm., 2014). Slabside pearl mussel, cracking pearl mussel, rabbitsfoot, snuffbox, fine-rayed pigtoe, longsolid, Tennessee pigtoe, and Tennessee clubshell are short-term brooders (Ortmann 1921; Neves 1991; Lane 2019, pers. comm., as cited in USFWS 2019; Ferraro et al. 2021; Fobian 2007; J.W. Jones, USFWS, pers. comm., 2012 as cited in USFWS 2021c; Gordon and Layzer 1989; Ortmann 1917 as cited in NatureServe 2023; Weaver et al. 1991 as cited in NatureServe 2023), with more sensitive time periods overlapping between April 15 and August 31. Alabama lamp mussel on the other hand is a long-term brooder and is gravid from late summer or autumn into the following summer (Williams et al. 2008).

Sediment has been shown to abrade and/or suffocate bottom-dwelling algae and other organisms by clogging gills, reducing aquatic insect diversity and abundance, impairing fishes (e.g., boulder darter and potential mussel fish hosts) feeding behavior by altering prey base and reducing visibility of prey, impairing reproduction by burying nests. Together these effects negatively impact growth, survival and reproduction (Waters 1995; Knight and Welch 2001).

Wood and Armitage (1997) identified at least five impacts of sedimentation on fish, including: (1) reduction of growth rate, disease tolerance, and impairment of gill function; (2) reduction of spawning habitat and egg, larva, and juvenile development; (3) modification of migration patterns; (4) reduction of food availability through the blockage of primary production; and (5) reduction of foraging efficiency. Suspended sediment (turbidity), originating from disturbed upstream areas, also has the potential to cause increased vulnerability of adults to predation, induce physiological stress, cause increased parasitism, and result in simplification of community structure (Meyer and Sutherland 2005; Newcombe and Jensen 1996).

Feeding mollusks respond to heavy siltation by instinctive closure of their valves, presumably because irritation and clogging of the gills and other feeding structures occurs when suspended sediments are siphoned from the water column (Loar et al. 1980). These valve closures average 50% longer than closures for mussels in silt-free water, resulting in reduced feeding activity (Ellis 1936) and dilution of food sources (Dennis 1984; Widdows et al. 1979). Suspended sediment can interfere with fish gills and reduce encystment of glochidia (Beussink 2007). The mantle displays of two North American mussel species, *Ligumia nasuta* and *Ligumia subrostrata*, were shown to be inhibited during studies (Corey et al. 2006). New juveniles feed by ciliary currents on their foot and mantle. Gills are present at this stage only as buds and have no filtering abilities (Yeager et al. 1994) and are thus, extremely susceptible to impacts from polluted sediments. Increased turbulence and re-suspended silt have been shown to reduce freshwater mussel growth (Yokley 1976; Henley et al. 2000), oxygen consumption and nitrogen excretion (Aldridge et al. 1987), and juvenile mussel recruitment (Negus 1966; Brim Box and Mossa 1999) and sedimentation can affect host fishes (Brim Box and Mossa 1999). Disturbance of the substrate may re-suspend contaminants stored in the sediment (Watters 2000). As with sedimentation, mussels can tolerate or avoid short-term exposures to pollutants by valve closure, but most cannot withstand long-term exposure to contaminated water (Neves et al. 1997).

Effects Pathway 3

Action Categories – Deconstruction of the Harms Mill Dam and the installation/removal and operation of temporary rock pads/cofferdams.

Stressor – Crushing, Sedimentation, and Burying (physical burial of habitat features and mussels).

Exposure (time) – The fall period of year, this period will be of limited duration of exposure and restriction to time period when expected to be least harmful.

Exposure (space) – The entire aquatic portion of the action area, however the exposure for crushing will be limited to the actual construction area in proximity of the dam and rock pad.

Resource affected – Elk River, DCH, fish and mussels (adults and juveniles)

Individual response – Valve closure, increased burial times, and reduced feeding activities for mussels, and dispersal from the action area for fish during sediment releases.

Effect – Mortality or harm to mussels that are crushed. Reduced fitness to mussels, host fish, and boulder darters resulting from sedimentation upstream and downstream of the project footprint. High levels of sediment have been shown to dilute food sources, reduce feeding activity, lower oxygen intake and nitrogen excretion, and delay mussel growth. Fish experience deleterious effects from sedimentation in reduced growth rates, increased stress, impaired functions (i.e., feeding, breeding, and sheltering activities), etc.

Conservation and Minimization Measures – As required by Term and Condition 4 in Section 7.4, all work will be performed during low flow conditions and will be coordinated with TVA to ensure that water levels are kept low during removal of the dam. Installation of temporary bulk bags for cofferdams and/or floating silt curtains will be used to separate work from flowing waters and to contain concrete and rock debris, and work will be conducted in the fall of the year, a less sensitive period (non-spawn) for the boulder darter and all listed/proposed endangered mussels except for Alabama lampmussel which is a long-term brooder.

Interpretation – Mussels that are overlooked during the project pre-implementation sweeps could be harmed or killed by dam deconstruction activities and installation/removal of rock pads and/or heavy equipment operation on the rock pads. In addition, sediment could be resuspended by disturbance of the substrate during deconstruction activities including installation and removal of the rock pads, causing mussels to cease siphoning activities and fish to disperse from the action area. This could result in a short-term reduction in fitness, growth, and reproductive success.

4.4. Stressor: Heavy Equipment Operation

Use of heavy equipment along and adjacent to waterways increases the risk for introduction of fuels, lubricants, coolant, and hydraulic fluids into the riparian zone or water where they can injure or kill aquatic organisms. Additionally, noise and vibrations can have deleterious effects on boulder darters, mussels, and their host fish.

Applicable Science – Heavy Equipment Operation: Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain polycyclic aromatic hydrocarbons, which can cause lethal or acute and chronic sublethal effects on aquatic organisms (Neff 1985; Eisler 1987). The National Research Council (1982) indicated that sediment may act as a vector for delivering contaminants to streams. Juvenile mussels can readily ingest contaminants adsorbed to silt particles during normal feeding activities. These substances may result in mortality to aquatic organisms, or they may accumulate in their body tissues and result in subsequent adverse chronic effects. The life cycle of native freshwater mussels makes the reproductive stages especially vulnerable to pollutants (Ingram 1957; Stein 1971; Fuller 1974; Gardner et al. 1976). Goldsmith (et al. 2021) found that increased suspended solids in the water decrease food availability, interfere with respiration and feeding, and impede mussel–host relationships.

Construction vibration is believed to elicit a number of responses from mussels, including increased burial times, valve closure, and the possibility of aborted gametes or larvae. Mussels are generally known to be sensitive to disturbance and may close their shells and cease to siphon during periods of disturbance, interfering with feeding respiration, or reproduction (TVA 2010). In the laboratory setting, for example, female mussels have been stimulated to release glochidia by simply tapping the side of holding tanks. We assume, therefore, vibrations created from construction equipment could also stimulate females to prematurely release glochidia (USFWS 2014). Potential fish hosts and boulder darters may also be affected by reduced water quality and alterations in flow as a result of construction-related vibrations, inhibiting interactions with mussels necessary to complete their life cycle (TVA 2010).

Boulder darters in the action area could be affected by vibration, noise, or other construction-related disturbances (e.g., elevated turbidity levels) which interrupt normal feeding, breeding, or sheltering behaviors. Etnier and Williams (1989) speculated that although the species' actual food habits were still unknown, most fish of the *Nothonotus* subgenus fed on immature aquatic insects. Based on the findings in Zhu et al. (2018), we would expect these macroinvertebrate communities to recover within a year of the project.

Effects Pathway 4

Action Categories – Operation of Construction Equipment.

Stressor – Petroleum Leaks, Noise, and Vibration.

Exposure (time) – The fall period of year, this period will be of limited duration of exposure and restriction to time period when expected to be least harmful.

Exposure (space) – The entire aquatic portion of the action area, however it is anticipated that the severity of effects from the operation of heavy equipment will decrease significantly with distance from the Harms Mill Dam removal site.

Resource affected – Elk River, DCH, fish and mussels (adults and juveniles).

Individual response – Valve closure, increased burial times, and reduced feeding activities for mussels and dispersal from the action area for fish during sediment releases.

Effect – Mortality or harm to boulder darters, mussels, and host fishes that are unable to avoid exposure to petroleum pollutants if a leak or spill occurs. Construction vibration could affect mussel reproduction, feeding, and respiration. Host fish interactions with mussels are affected by reduced water quality and flow alterations resulting from construction.

Conservation and Minimization Measures – No motorized equipment will be allowed to operate directly in the Elk River during construction, and demolition of the dam will be conducted from rock pads placed within the river channel. Equipment staging areas will be located a minimum of 46 m (150 feet) from top of bank so that no oils, coolants, or other petroleum products are allowed to enter the river during periods of equipment inactivity. Construction equipment will be inspected before and after use to check for fluid leaks. Leaking equipment will be serviced to repair any fluid leaks. If the equipment cannot be repaired, it will be moved to a location such that fluid will not be allowed to enter the Elk River. Spill kits will be readily available on-site to allow for immediate response if a fluid leak occurs, and field personnel will be instructed on their proper use and disposal of contaminated material.

Interpretation - Leaking equipment or spills of petroleum-based contaminants (including grease, oil, petroleum, and detergents) from hydraulic, fuel, or power systems could also result in mortality to boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, snuffbox, fine-rayed pigtoe, longsolid, Tennessee pigtoe, and Tennessee clubshell in the vicinity of the spill and downstream due to resultant rapid water quality changes and inability of individuals to rapidly adjust their physiology. These toxic materials have the potential to affect water quality, food sources, and in turn respiration and feeding capabilities, as well as temporarily rendering DCH unusable. If Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, snuffbox, fine-rayed pigtoe, longsolid, Tennessee pigtoe, and Tennessee clubshell individuals could not avoid exposure by closing their shells, they would likely be harmed or killed from filtering water containing toxins. Boulder darters in the action area would likely be harmed or killed due to their inability to avoid exposure. Noise and vibration from construction activities affect feeding and reproductive activities for boulder darters, mussels, and host fish.

4.5. Stressor: Riparian Removal/Soil Disturbance

Site preparation will require clearing of upland and riparian vegetation for an area used for equipment staging. These exposed areas, if not properly stabilized, could experience significant erosion during rainfall events and result in sediment entering the Elk River.

Applicable Science – Riparian Removal/Soil Disturbance: Removal of riparian vegetation results in destabilization of streambanks and siltation. Silt settling on the stream bottom can smother eggs and larval fish, as well as benthic macroinvertebrates upon which adult fish feed (Starnes and Starnes 1981). This could potentially affect boulder darters, mussels, and mussel host fish use of the action area.

Potyondy et al. (1991) indicated that most of the surface erosion associated with construction in general (whether temporary or permanent) occurs in the first year and continues at a reduced, but relatively high rate for several years, depending upon local weather conditions. In general, the highest erosion rates are associated with construction activities, which can contribute sediment at a rate 300 times greater than from forested lands (USDA 1977).

Mussels cannot tolerate silt, which clogs their gills (Parmalee and Bogan 1998). Ellis (1936) found that mussels could not survive in substrate on which approximately 6 to 25 millimeters (0.25 to 1 inch) of silt was allowed to accumulate; death was attributed to interference with feeding and suffocation. Ellis (1936) further determined that siltation from soil erosion reduced light penetration, altered heat exchange in the water, and allowed organic and toxic substances to be carried to the bottom where they were retained for long periods of time. This results in further oxygen depletion and possible absorption of these toxicants by mussels (Harman 1974). Interstitial spaces in mixed substrates may become clogged with sediment (Gordon et al. 1992). When clogged, interstitial flow rates and spaces may become reduced (Brim Box and Mossa 1999), thus reducing habitat for juvenile mussels and some adults as well. A recent study of sediment impacts on mussels indicated a measurable decline in mussel biodiversity from substrate instability associated with scour (Goldsmith et al. 2021).

Effects Pathway 5

Action Categories – Removal of Vegetation and Site Preparation.

Stressor – Soil Destabilization and Erosion.

Exposure (time) – Site preparation, including canopy removal, would be a one-time event occurring at the beginning of the project implementation phase. Surface and streambank erosion could occur for the duration of deconstruction and removal if eddying occurs upstream of the rock pads, disturbed areas are not properly stabilized, or BMPs are inadequate or not functioning properly.

Exposure (space) - The entire action area, approximately 128,204.4 m² of terrestrial and aquatic habitat. This includes the terrestrial area within the action area, estimated at approximately 12,221.5 m² (TWRA parcel and adjacent disposal area) and includes equipment staging, maintenance, and construction disposal areas. The aquatic portion of the action area is estimated to be a total of 116,000 m². This includes a project footprint (dam and 91.4 m up- and downstream of dam) of approximately 1,000 m² where construction or in-stream cofferdams and rock pads may occur or be placed. The total aquatic action area includes 2.3 km of the Elk River extending 300 meters above the dam and continuing 2 km downstream to the TVA fixed mussel monitoring site, an area of stream approximately 11.6 hectares.

Resource affected – Elk River, DCH, fish and mussels (adults and juveniles)

Individual response – Valve closure, increased burial times, and reduced feeding activities for mussels and dispersal from the action area for fish during sediment releases and periods of excessive turbidity.

Effect – Mortality or harm to boulder darters, mussels, and host fish from siltation and instability of the stream bottom that can smother eggs and larval fish as well as benthic macroinvertebrates fish feed upon. Erosion reduces light penetration and ultimately results in oxygen depletion and possible increased absorption of toxicants by mussels. Substrate instability has been associated with a measurable decline in mussel biodiversity.

Conservation and Minimization Measures – Clearing of upland and riparian vegetation areas would be limited to what is necessary for construction and staging. Erosion controls and other approved BMPs would be utilized to prevent sediment and other construction-related materials from entering the Elk River. All disturbed areas will be temporarily stabilized as soon as possible and permanently stabilized upon project completion.

Interpretation – Site preparation for construction and removal of riparian areas could cause erosion to occur and sediment to enter the Elk River during periods of rainfall and higher flows if the disturbed areas were not properly stabilized. Excessive sediment and siltation could interfere with basic functions such as feeding, breeding, and sheltering for fish and mussels. These impacts range from a short-term reduction in fitness, growth, and reproductive success to chronic effects or even mortality.

4.6. Summary of Effects

Proposed Activities	Stressor 1 Boulder Darter Sweeps and Relocations	Stressor 2 Mussel Sweeps and Relocations	Stressor 3 Instream Construction	Stressor 4 Heavy Equipment Operation	Stressor 5 Riparian Removal/Soil Disturbance
Instream Construction (Cofferdam and Rock Pad)	X	X	X	X	X
Removal and Demolition of Dam and Powerhouse	X	X	X	X	X
Development of Staging and Maintenance Areas				X	X

In Summary:

The proposed action could potentially result in the following effects to boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell individuals:

- (a) harassment to individuals located immediately downstream of Harms Mill Dam as a result of boulder darter or mussel collection, handling, holding, and relocation efforts;

- (b) harm or mortality to remaining boulder darters or mussels in the project footprint (i.e., individuals not moved during fish or mussel sweeps) as a result of being crushed, buried, smothered, or physically impaired by placement and removal of riprap (rock pads) or from deconstruction materials or activities associated with the dam removal;
- (c) harm to remaining boulder darters or mussels in the project footprint from vibration, noise, or other construction-related disturbances as a result of being disrupted from normal behavior patterns (including feeding and/or sheltering), increasing stress, and therefore, vulnerability to disease or predation;
- (d) harassment to boulder darters or mussels as a result of turbidity and/or deposition of sediment during instream construction activities or as a result of erosion from equipment staging areas, obstructing their gills, reducing ability to feed and/or respire, and compelling mussels to cease siphoning activities;
- (e) harm or mortality to individuals as a result of being crushed or becoming physically impaired due to construction equipment or materials falling into the river; and
- (f) harm or mortality to individuals in the action area as a result of chemical pollution (spills of petroleum-based contaminants, etc.) accidentally entering the Elk River from leaking construction equipment; affecting water quality and food sources and, in turn, their respiration and feeding capabilities.

The proposed action could potentially result in the following effects to DCH for the slabside pearl mussel and fluted kidneyshell:

- (a) adverse effects to DCH within the project footprint by the temporary loss of natural substrate to temporary cofferdam or riprap for rock pad construction;
- (b) adverse effects to DCH by alteration of the natural hydrologic flow regime from installation of a temporary cofferdam or temporary rock pad in the channel affecting exchange of nutrients, sediment, and food availability;
- (c) adverse effects to DCH by loss of water quality resulting from a temporary increase in turbidity or introduction of other pollutants from dam deconstruction that could affect normal behavior, growth, and survival;
- (d) adverse effects to DCH by loss of water quality resulting from an accidental introduction of chemical pollutants from construction equipment that could affect normal behavior, growth, and survival; and
- (e) adverse effects to DCH resulting from project construction effects to living, foraging, and spawning areas of potential fish hosts.

5. Cumulative Effects

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation under section 7 of the ESA.

The area surrounding the project is very rural, with agriculture being the primary land use surrounding the site. Most of the land has been cleared at some point along the river bottom for row crops, pasture, and hayfields. Some forested areas are present along the steeper slopes and ridges. We are reasonably certain these land uses would continue and do not expect that the proposed project to appreciably change land use patterns.

It is unlikely that the proposed project would spur development or other state, tribal, local, or private actions in the area that might impact listed species or their critical habitats. At this time, we are not aware of any non-federal actions that are reasonably certain to occur in the action area. Therefore, cumulative effects, as defined by the ESA, are not anticipated to occur.

6. Conclusion

Listed species/critical habitat

In accordance with policy and regulation, the jeopardy analyses in this biological opinion rely on four components: (1) the Status of the Species, which evaluates the species' range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the Environmental Baseline, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the Effects of the Action, which determines the consequences of the proposed federal action to listed species or DCH; and (4) the Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the species and DCH.

The jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild. The jeopardy analyses in this biological opinion place an emphasis on consideration of the range-wide survival and recovery needs of the species and the role of the action area in the survival and recovery of the species as the context for evaluating the significance of the effects of the proposed federal action, taken together with cumulative effects.

After reviewing the current status of the boulder darter, Alabama lampmussel, slabside pearl mussel, cracking pearl mussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell, the environmental baseline for the action area, and the effects of the proposed removal of Harms Mill Dam on the Elk River (ERM 77.04), it is the Service's biological opinion that the project in Lincoln County, Tennessee, as proposed, is not likely to jeopardize the continued existence of the boulder darter, Alabama lampmussel, slabside

pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell.

It is the Service's biological opinion that the project is not likely to destroy or adversely modify DCH for the slabside pearlymussel and fluted kidneyshell. Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species. The anticipated adverse effects to DCH are temporary and are minimized by BMPs that will be implemented. The value of the DCH as a whole will not be appreciably diminished, and removal of this structure would restore connectivity of currently fragmented habitats by restoring a hydrologic flow regime that was previously impeded by the presence of the dam.

We have arrived at these conclusions because: 1) the action area would be small relative to the entire range of the boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell and overall extent of DCH for the slabside pearlymussel and fluted kidneyshell, 2) collection and relocation activities prior to the removal will minimize the number of individuals that would be affected by deconstruction activities executed during the project implementation phase, 3) the magnitude and duration of impacts to individuals and DCH from construction activities executed during the project implementation phase would be further minimized by adherence to additional conservation measures offered in the BA and incorporated into Terms and Conditions of this BO, 4) the presence of mussel host species, and anticipated species recovery rates within the action area, indicate a low probability for long-term impacts, and 5) restoring a more natural hydrologic regime and the shoal and riffle habitats that were previously inundated by the dam would benefit the boulder darter and these listed mussel species by allowing dispersal among previously isolated populations of these species.

Species proposed for listing

After reviewing the current statuses of the Tennessee pigtoe and Tennessee clubshell, the environmental baseline for the action area, the effects of the proposed removal of Harms Mill Dam on the Elk River (ERM 77.04), and the cumulative effects, it is the Service's conference opinion that the Harms Mill Dam removal, as proposed, is not likely to jeopardize the continued existence of the Tennessee pigtoe and Tennessee clubshell, as we anticipate these mussels will respond to the action similarly to other listed species of mussels; therefore, the analysis for the listed species is applicable for the proposed mussels.

7. Incidental Take Statement

Section 9 of the ESA and Federal regulation under section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm in the definition of "take" in the Act means an act which actually kills or injures wildlife. Such [an] act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns,

including breeding, feeding, or sheltering” (50 CFR 17.3). Harass is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.

Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the T&Cs of this Incidental Take Statement and occurs as a result of the action as proposed.

The measures described below are non-discretionary and must be undertaken by the Corps so that they become binding conditions of any grants, permits or contracts issued to the TWRA, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the Corps: (1) fails to assume and implement the T&Cs or (2) fails to require the TWRA to adhere to the T&Cs of the Incidental Take Statement through enforceable terms that are added to the grant, permit or contract, the protective coverage of section 7(o)(2) may lapse.

For the proposed species considered in the conference opinion, the prohibitions against taking endangered species under section 9 of the ESA or under a Section 4(d) rule for threatened species do not apply until the species are listed. If the conference opinion is adopted in the biological opinion following a listing or designation under section 4 of the ESA, the Reasonable and Prudent Measures, with their implementing Terms and Conditions, will be nondiscretionary. Terms and Conditions must be undertaken, for the exemption in section 7(o)(2) to apply.

7.1 Amount or Extent of Take Anticipated

Boulder Darter

The Service believes that incidental take of boulder darters, as a result of the action, will be difficult to detect for the following reasons: (1) boulder darters are small, inconspicuous fishes, spending much of their time in crevices between the substrate and large slab boulders, (2) locating a dead or impaired boulder darter in the Elk River would be difficult and highly unlikely, (3) boulder darters live in an environment in which river currents can easily carry a dead or injured individual downstream undetected for long distances, and (4) if a dead or injured individual was found, it would be difficult to attribute death or injury to the project.

However, the following level of take can be anticipated from impacts to stream features that provide habitat for this species. Because boulder darters are known to inhabit areas in warmwater streams with moderate to swift current velocity over boulder or slab rock substrate, effects to these habitat types within the action area could translate to reduced numbers of individuals. We anticipate that the extent of take will coincide with the level and duration of disturbance and the amount of suitable habitat altered by the action.

Estimated take of boulder darters was calculated with the help and species expertise of CFI (Table 1). CFI estimates that the area of occurrence for boulder darters immediately downstream

of Harms Mill Dam is approximately 3,000 m² with approximately 5% of this habitat suitable for nesting sites based on their catch rates of males when collecting broodstock for propagation (Baxter pers. comm. 2023). This assumes a mean male boulder darter density of approximately 0.05/m². Under this assumption, CFI estimates that there are approximately 150 male boulder darters within this habitat. CFI estimates that there are generally 2-3 female or juveniles per male which equates to approximately 300 to 450 females and juveniles in the habitat. Hence the combined population of boulder darters at the sites is estimated at approximately 450 to 600 total animals. However, the precision of these estimations is uncertain and therefore we adjusted these estimations by 10% which suggest that the population is approximately 495 to 660 total boulder darters in the known site.

Table 1: This table includes assumptions made by CFI in developing density estimates at the shoal located below Harms Mill Dam. This site is considered the most reliable brood stock site for ongoing boulder darter captive propagation efforts (Baxter pers. comm. 2023).

Assumptions made by CFI in developing estimates of densities within the Harms Mill shoal:
Assumption 1: Approximately 5 percent of the area containing suitable overall habitat contains adequate nesting sites (male defended range). This is based on previous catch rate of males when collecting brood stock (number of collection efforts to get males).
Assumption 2: Each male boulder darter has a “defended range” of approximately 1 m ² within overall nesting habitat (estimated based on field work).
Assumption 3: No more than 2 to 3 females or juveniles are present within a “defended range” CFI estimated this based on field work and observations of aggressive interactions in CFI aquaria when too many females or juveniles are present within a male’s “defended range”. At the CFI facility, “defended range” equals an individual tank.

Boulder darters have not been documented elsewhere in the action area, providing evidence that the remainder of the action area could be less suitable habitat. Because undocumented boulder darters could occur further downstream, however, we estimated the potential population in the remainder of the action area by applying an occupancy rate 10 times lower than the known population at Harms Mill. We then extrapolated a boulder darter population estimate based on the total amount of habitat between Harms Mill Dam downstream approximately 2 km (2,000 meters long x 50 meters wide = 100,000 m²) (see Table 2). This area encompasses approximately 97,000 m² of aquatic habitat (100,000 m² total habitat minus 3,000 m² optimal habitat). Assuming a boulder darter density of 10% of the known occupied sites, it is estimated that the less suitable pool and run habitat within the action area may harbor 970 to 1,213 total boulder darters. Therefore, the entire action area including the best-known habitat and less suitable habitat may harbor between 1,465 and 1,873 total boulder darters. CFI has not documented boulder darters in the action area outside of the known habitat patch. While this methodology provides for a quantitative reflection of our professional judgement on boulder darter densities throughout the action area, we may have overestimated the population, and incidental take estimates should be viewed as a conservative appraisal of the adverse effects to boulder darters that may result from the action.

Within the action area, we estimate an occurrence of 1,873 boulder darters may occur within the 100,000 m² of aquatic habitat occurring downstream of the Harms Mill Dam (Table 2). We believe that 100 percent of the boulder darters within the action area will be taken (Table 4). Of

those, we believe that 99 percent or 1,854 will be taken in the form of harass, while the remaining 1 percent of boulder darters (19 individuals) will be taken in the form of mortality or harm (Table 4). Refer to the Effects of the Action discussion in Section 4 above for a narrative of predicted impacts occurring from construction and boulder darter arking efforts.

Table 2: Estimated number of boulder darters in the Harms Mill Dam removal action area. Table shows the estimated number of boulder darters (by sex) in optimum habitat (shoal immediately downstream of Harms Mill Dam) and in sub-optimal habitat (remaining aquatic habitat) in the action area.

Optimum Habitat (m²)	3,000	Sub-Optimal Habitat (m²)	97,000
Male Density (#/m ²)	0.05	Male Density (#/m ²)	0.005
# Males	150	# Males	485
# Females-Juveniles per male	2-3	# Females-Juveniles per male	1-1.5
# Females and Juveniles	300-450	# Females and Juveniles	485-728
Total Boulder Darters	450-600	Total Boulder Darters	970-1,213
10% adjustment	495-660		
Estimated Total Boulder Darters in Action Area		1,465-1,873	

Freshwater Mussels

We expect that incidental take of slabside pearlymussel, Alabama lampmussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell individuals, as a result of the action, will be difficult to detect for the following reasons: (1) they are rare species and are typically collected at rates as low as 1 in 10,000 individuals in mussel communities, (2) freshwater mussels are cryptic and tend to burrow into substrate in riffles and shoal areas, and at times, only their siphons are visible, (3) finding a dead or impaired specimen would be unlikely because such individuals would either remain buried beneath substrate or experience rapid decomposition, (4) losses could be masked by natural seasonal fluctuations in their numbers detectability, and (5) carcasses/injured individuals could be washed downstream with the currents.

Take was derived and estimated from using the mean densities of listed species estimated from TVA’s long-term monitoring site located at Elk River Mile 75.7 (TVA 2021, unpublished monitoring data) and the estimated occupied habitat for each of the species. Habitat was estimated for each shoal using the USGS Imagery Topo Layer. The total wetted shoal area of the TVA monitoring site was approximately 4,742 m², the wetted area of the middle shoal was 2,022 m², and the wetted area of the shoal area immediately downstream of the dam was approximately 11,225 m². However, during TWRA’s 2022 survey of the area immediately downstream of the dam, 84% of all mussels collected were found immediately adjacent to the outside bank of the island located on the right descending bank of the channel (TWRA 2022). In addition, previous visits to the site detected the Tennessee pigtoe in the small channel immediately between this island and the right descending shoreline. Therefore, it is assumed that potential habitat for listed mussels at this site includes only the channel between the island and the right descending

shoreline and the first 3 meters of substrate along the length of the channel side of the island which is estimated at approximately 1,272 m². It is believed this assumption is valid as the remainder of the site contains excessive amounts of silt and the majority of the main channel is believed to be highly unstable habitat as heavy sediment load deposition and flushing has been observed in this area over the past 3 years (J. Wisniewski, TWRA, personal observation). Using this adjusted shoal area for the shoal immediately downstream of the dam and adding the wetted area of the middle shoal and TVA monitoring site we assume an optimal habitat of 8,036 m² for mussels in the action area. Subtracting this optimal habitat from the estimated 100,000 m² of aquatic action area downstream of the dam, we estimate the remaining 91,964 m² to be sub-optimal for the purposes of estimating numbers of federally listed or proposed mussels.

Mussel densities for portions of the action area considered to provide optimal habitat were estimated using data from TVA's long-term monitoring site located at ERM 75.7 approximately 2 km downstream of Harms Mill Dam (TVA 2021, unpublished monitoring data). TVA collected monitoring data in 2008, 2012, 2015, and 2021, utilizing a 0.25-m² quadrat design with 39 samples taken in 2008 and 100 samples taken in each of 2012, 2015, and 2021. The mean densities of each listed species found at the site were estimated by dividing the total number of each species found among the 4 sampling occasions by the total area sampled over the 4 occasions (84.75 m²).

Estimated mean density for the proposed endangered Tennessee pigtoe was 0.32 individuals/m². Estimated density for the rabbitsfoot was 0.06 individuals/m². Estimated densities for the longsolid and cracking pearl mussel were 0.04 individuals/m². Estimated density of the slabside pearl mussel was 0.02 individuals/m². Estimated densities of the Alabama lamp mussel, snuffbox, shiny pigtoe, and Tennessee clubshell were all 0.01 individuals/m². These densities were used to estimate take in the optimal habitat (8,036 m²) for mussels in the action area (Table 3).

To estimate mean mussel densities for sub-optimal, non-shoal habitats (i.e., pools and runs with non-preferred/marginal habitat conditions and fewer host fish that also prefer riffles to pools and runs) that comprise the remaining aquatic action area, we assumed the species occur at considerably lower densities than were estimated for optimal habitats. For this reason, we derived estimates of mussel densities for sub-optimal habitats by applying an occupancy rate 10 times lower than the densities estimated for optimal habitat. Estimated mean density for the Tennessee pigtoe was 0.032 individuals/m². Estimated density for the rabbitsfoot was 0.006 individuals/m². Estimated densities for the longsolid and cracking pearl mussel were 0.004 individuals/m². Estimated density of the slabside pearl mussel was 0.002 individuals/m². Estimated densities of the Alabama lamp mussel, snuffbox, shiny pigtoe, and Tennessee clubshell were all 0.001 individuals/m². These densities were used to estimate take in the sub-optimal habitat (91,964 m²) for mussels in the action area (Table 3). While this methodology provides for a quantitative reflection of our professional judgement on mussel densities throughout the action area, we may have overestimated these populations, and incidental take estimates should be viewed as a conservative appraisal of the adverse effects to mussels that may result from the action.

Table 3: Estimated number of listed/proposed mussels in the Harms Mill Dam removal action area.

Federally Listed Species	Optimal Habitat			Sub-Optimal Habitat			Total Action Area
	Est. Density (#/m ²)	Habitat in Action Area (m ²)	Est. # Mussels	Est. Density (#/m ²)	Habitat in Action Area (m ²)	Est. # Mussels	Est. # Mussels
Alabama Lampmussel	0.01	8,036	80	0.001	91,964	92	172
Slabside Pearlymussel	0.02	8,036	161	0.002	91,964	184	345
Cracking Pearlymussel	0.04	8,036	321	0.004	91,964	368	689
Rabbitsfoot Mussel	0.06	8,036	482	0.006	91,964	552	1,034
Shiny Pigtoe Mussel	0.01	8,036	80	0.001	91,964	92	172
Snuffbox Mussel	0.01	8,036	80	0.001	91,964	92	172
Longsolid Mussel	0.04	8,036	321	0.004	91,964	368	689
Total							3,274
Federally Proposed Species							
Tennessee Pigtoe	0.32	8,036	2,572	0.032	91,964	2943	5,514
Tennessee Clubshell	0.01	8,036	80	0.001	91,964	92	172
Total							5,687

The following level of incidental take (Table 4) of slabside pearlymussel, Alabama lampmussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell can be expected by loss of suitable habitat or from relocating individuals. The Service believes if Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell individuals were present in the impact area of the proposed action, alteration of habitat, and/or crushing or physical injury would result in incidental take of these species. It should be noted that those individuals would likely not all be lethally taken; rather a small percentage of the take would be in the form of mortality or harm, with the remainder in the form of harassment, resulting from habitat impacts. We believe that only up to 1 percent of the mussels located in the 100,000 m² of aquatic action area below the dam (2 Alabama lampmussel, 3 slabside pearlymussels, 7 cracking pearlymussels, 10 rabbitsfoot mussels, 2 shiny pigtoes, 2 snuffbox mussels, 7 longsolids, 55 Tennessee pigtoes, 2 Tennessee clubshells) will be taken in the form of

mortality or harm from construction related activities. The remaining take will be in the form of harassment (170 Alabama lampmussels, 342 slabside pearlymussels, 682 cracking pearlymussels, 1,024 rabbitsfoot mussels, 170 shiny pigtoes, 170 snuffboxes, 682 longsolids, 5,459 Tennessee pigtoes, and 170 Tennessee clubshells) from either the mussel relocation or from the construction related activities in the 100,000 m² of aquatic action area below the dam. Refer to the Effects of the Action discussion in Section 4 above for a narrative of predicted impacts occurring from construction and mussel relocation efforts.

In summary, take is anticipated up to 1,873 boulder darters, 172 Alabama lampmussels, 345 slabside pearlymussels, 689 cracking pearlymussels, 1,034 rabbitsfoot, 172 shiny pigtoes, 172 snuffbox mussels, 689 longsolids, 5,514 Tennessee pigtoes, and 172 Tennessee clubshells present within the aquatic portion of the action area (100,000 m²) located below the dam (Table 4).

Table 4. Incidental take by activity and type is estimated for the boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell.

ACTIVITY	TAKE TYPE	LEVEL OF TAKE/AREA OF TAKE
construction	Lethal or Harm	19 boulder darters, 2 Alabama lampmussel, 3 slabside pearlymussels, 7 cracking pearlymussels, 10 rabbitsfoot mussels, 2 shiny pigtoes, 2 snuffbox mussels, 7 longsolids, 55 Tennessee pigtoes, 2 Tennessee clubshells (1% of all boulder darters and mussels present in 100,000 m ² action area below dam)
boulder darter arking	Harass	660 boulder darters (100% of boulder darters within 3,000 m ² shoal below Harms Mill Dam)
mussel translocation	Harass	1 Alabama lampmussel, 3 slabside pearlymussels, 5 cracking pearlymussel, 8 rabbitsfoot, 1 shiny pigtoe, 1 snuffbox, 5 longsolids, 41 Tennessee pigtoes, 1 Tennessee clubshell (10% of mussels within 1,272 m ² of shoal habitat below Harms Mill Dam)
construction	Harass	1,194 boulder darters, 169 Alabama lampmussel, 339 slabside pearlymussels, 677 cracking pearlymussels, 1,016 rabbitsfoot mussels, 169 shiny pigtoes, 169 snuffbox mussels, 677 longsolids, 5,418 Tennessee pigtoes, 169 Tennessee clubshells (all mussel not counted above as being taken in 100,000 m ² of stream habitat downstream of Harms Mill Dam)
Total Take from above activities: 1,873 boulder darters, 172 Alabama lampmussels, 345 slabside pearlymussels, 689 cracking pearlymussels, 1,034 rabbitsfoot mussels, 172 shiny pigtoes, 172 snuffboxes, 689 longsolids, 5,514 Tennessee pigtoes, and 172 Tennessee clubshells.		

In the "Analyses for Effects of the Action" section, the Service determined that the proposed action would result in incidental take of boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell individuals in several forms including: (a) lethal or harm from:

1) inadvertent crushing or impairing of mussels in the project footprint during installation/removal of riprap and removal of the dam debris; 2) pollutants accidentally entering the stream from leaking construction equipment, affecting water quality and food sources, and in turn respiration and feeding capabilities of boulder darter and mussels, (b) harassment from: 1) boulder darter and mussel sweep within the downstream shoal and effects to these from collection, holding, and relocation activities, 2) increased turbidity and/or deposition of sediment as a result of construction activities obstructing gills of boulder darters and mussels, reducing ability to feed and/or respire, and compelling mussels to cease siphoning activities and host fish species to relocate outside of the action area.

7.2 Effect of the Take

We determined that the level of take that would occur would not result in jeopardy to the boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, nor the Tennessee pigtoe, and Tennessee clubshell, should these species be listed. The prohibitions against take of the species found in section 9 of the ESA do not apply until the species is listed. We have also determined that the project would not result in adverse modification or destruction of DCH, in part nor as a whole, for the slabside pearlymussel and fluted kidneyshell. Previous biological opinions completed for the boulder darter, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, and fine-rayed pigtoe within Tennessee, which identified incidental take, have been included in the table in Appendix A.

7.3 Reasonable and Prudent Measures

The Service believes the following RPMs are necessary and minimize impacts of incidental take of boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, Tennessee pigtoe, and Tennessee clubshell:

1. The Corps issuance of a Department of the Army (DA) permit will be conditioned to the applicant's (TWRA) compliance with all following reasonable and prudent measures (2-5) and the mandatory terms and conditions associated with incidental take of this final biological opinion (Section 7.4), so that any violation of incidental take would result in a violation of the DA permit special condition.

The special condition to be incorporated into the DA permit will be the required, standard special condition as follows:

Special Condition: "This Corps permit does not authorize you to take an endangered or threatened species, in particular the boulder darter, Alabama lampmussel, slabside pearlymussel, cracking pearlymussel, rabbitsfoot, shiny pigtoe, snuffbox, longsolid, nor the proposed endangered Tennessee pigtoe, and Tennessee clubshell. In order to legally take a listed species, you must have separate authorization under the ESA (e.g., an ESA Section 10 permit, or a BO under ESA Section 7, with "incidental take" provisions with which you must comply). The enclosed USFWS BO contains mandatory terms and conditions to implement the reasonable and prudent measures that are associated with "incidental take" that is also specified in the BO. Your authorization under this Corps permit is conditional upon your compliance with all of the mandatory terms and conditions associated with incidental take of the attached BO, which terms and conditions are incorporated by reference in this permit. Failure to comply with the terms and

conditions associated with incidental take of the BO, where a take of the listed species occurs, would constitute an unauthorized take, and it would also constitute noncompliance with your Corps permit. The USFWS is the appropriate authority to determine compliance with the terms and conditions of its BO, and with the ESA.”

2. TWRA will contract CFI biologists to collect and hold boulder darters from the shoal located immediately downstream of the Harms Mill Dam within 45 days before the anticipated dam deconstruction and return them to the site approximately 30 day after the dam removal.
3. TWRA will conduct a mussel relocation within 45 days before the anticipated dam removal at Harms Mill.
4. TWRA will initiate a multi-year monitoring program to assess the response of freshwater mussels and fishes to the removal of the Harms Mill Dam.
5. TWRA will ensure that construction BMPs are implemented and that an inspector with authority to shut the project down to be present at all times during construction actions.

7.4 Terms and Conditions

In order for the exemption from the take prohibitions of section 9 and of regulations issued under section 4(d) of the ESA to apply to the Action, the applicant must comply with the terms and conditions (T&Cs) of this statement, provided below. These T&Cs are mandatory. As necessary and appropriate to fulfill this responsibility, the Corps will require the applicant to implement these T&Cs through enforceable terms that are added to their permit.

1. Boulder darter recovery effort
 - a. TWRA and CFI biologists will collect as many boulder darters as possible, but not in exceedance of CFI holding systems and utilizing at least three full sweeps through the suitable shoal habitat at the site.
 - b. TWRA and CFI biologists will attempt to collect at least 30 adult boulder darters to produce a good spawning group (total of 30 fish, 8-10 males and 20-22 females) to hold at CFI for captive propagation work. These individuals will be collected utilizing hand methods (kick seining). CFI will maintain these breeders as part of previous captive propagation work and will not be released as part of the temporary removal effort. Some of the individuals produced at CFI the following year should be returned to Harms Mill to offset any losses from this population. CFI will consult with USFWS and TWRA to determine the appropriate number of individuals to return to the river in 2024 based on the number removed for this effort in 2023 and produced at CFI from this cohort, while considering the need for these propagates to also support reintroduction efforts at the Shoal Creek NEP.
 - c. TWRA and CFI biologists will attempt to collect up to CFI’s holding capacity (3 holding systems have been allocated for this effort). CFI can hold up to 68 adults, or up to 168 juveniles, in a system; therefore, 3 holding systems equate

to a minimum holding capacity of 189 adults to a maximum holding capacity of 189 adults to 504 juveniles. Methods will include collecting as many fish as possible using hand methods (kick seining), but as capture rate declines, the remaining fish can be collected via “electro-seining” (electrofishing at the lowest practical setting to get the fish to move out of the rocky habitats into the seines, with minimal effect on the fish from electricity use). Minimum effort should utilize 3 full sweeps of the available suitable habitat.

- d. Individual boulder darters captured and held at CFI as part of this effort, not including the 30 used for captive propagation efforts, will be returned for release to the Harms Mill site (post dam removal) after conferring with TWRA and Service biologists and if conditions are suitable (after approximately 3 months).
- e. TWRA will work with CFI biologists to prepare a report after returning captured boulder darters back to the site that documents this collection and release effort. This report will document numbers, age/size classes, and sex ratios of darters captured (if possible) and include methods and photos of the event. The report will be prepared within 90 days after returning individuals to the site and will be provided to the Corps, Service, and other participating agencies upon request.

2. Mussel translocation effort

- a. TWRA and other participating agency biologists (minimum of 6 persons) using mask/snorkel will be positioned laterally across the river channel and will use tactile and visual searches to collect mussels. Transects will begin on the downstream end of the island, located approximately 180 meters downstream of the dam, and extend in an upstream direction, ending approximately 10 meters below the dam (survey will not include the area immediately downstream of the dam due to potential safety issues). The search area will include the main channel and the small side channel located along the right descending bank below the powerhouse. Surveyors will place all mussels encountered into mesh bags to be held until processing. A minimum of three depletion passes will be conducted, however the effort from each pass will be recorded separately. Recovered individuals will be stored in mesh bags submerged in a shaded location of the stream until processing or until being transported to the shoal at ERM 75.7 for relocation.
- b. Mussels will be processed following each pass. Mussels will be identified to species, counted, measured, marked (shellfish tags or etched with a mark), and this data recorded. Mussels need to be marked so that future monitoring at TVA’s fixed station will be able to distinguish these translocated mussels from those naturally present at the site.
- c. Mussels will be relocated to the shoal at ERM 75.7 at the lower extent of the action area. Mussels will transported in coolers to the relocation site. Mussels will be kept cool (e.g., wetted burlap and ice packs) during transport to reduce stress to the individuals. Mussels will also be hand-placed in the substrate (partially into the substrate, anterior end down, mimicking the position in

- which they were originally found) at the relocation site to reduce stress to the individuals.
- d. The mussel sweep shall be conducted by TWRA personnel or other qualified biologists approved and supervised by TWRA.
 - e. TWRA will prepare a report documenting this mussel relocation. This report will document species, numbers, sizes, and sex (if possible), results from each transect pass, and will include methods and photos (i.e., species vouchers and habitat photos at both sites) of the event. The report will be prepared within 90 days after returning individuals to the relocation site and will be provided to the Corps, Service, and other participating agencies upon request.
3. Post removal monitoring effort for fish and mussel communities
 - a. TWRA will initiate a multi-year monitoring program to assess the response of freshwater mussels and fishes to the removal of the Harms Mill Dam. This monitoring program will begin one (1) year following removal of the dam and be continued annually for a minimum of five (5) years. After the 5th year, monitoring will be at years 7, 9, 12, and 15 (post dam removal). Monitoring will include detection/non-detection surveys of fish and mussels to document their occurrence and potential colonization of the downstream shoal area and areas upstream of the current location of Harms Mill Dam. Data and reports generated from this monitoring program will be shared with the Service, Corps, and other participating agencies upon request.
 4. All work will be performed during low flow conditions and coordinated with TVA to ensure water levels are kept low during removal of the dam as previously mentioned.
 5. BMPs to address erosion and sediment and chemical spills (e.g., machinery fuels or fluids) will be implemented and maintained during construction activities.
 - a. Disturbed areas will be temporarily stabilized as soon as possible and permanently stabilized upon project completion. All areas of disturbed soil where riprap is not installed will be seeded with an approved native or noninvasive herbaceous seed mix following construction.
 - b. If any project components fail during project implementation that could potentially result in additional incidental take to listed species or adverse effects to DCH, the Corps or TWRA shall contact the Service within 24 hours of becoming aware of the failure(s) and provide a written summary of remedial measures to address the failure(s). Project component failure(s) will be remedied as soon as possible.

Upon locating a dead, injured, or sick individual of an endangered or threatened species, initial notification must be made to the Fish and Wildlife Service Law Enforcement Office at 220 Great Circle Road, Nashville, Tennessee 37228 (telephone: 615/736-5532). Additional notification must be made to the U.S. Fish and Wildlife Service, Tennessee Field Office at 446 Neal Street, Cookeville, Tennessee 38501 (telephone: 931/254-9617). Care should be taken in handling sick

or injured individuals and in the preservation of specimens in the best possible state for later analysis of cause of death or injury.

The RPMs, with their implementing T&Cs, are designed to minimize the effect of incidental take that might otherwise result from the proposed action. The Service believes that no more than 1,873 boulder darters, 172 Alabama lampmussels, 345 slabside pearlymussels, 689 cracking pearlymussels, 1,034 rabbitsfoot mussels, 172 shiny pigtoes, 172 snuffboxes, 689 longsolids, 5,514 Tennessee pigtoes, and 172 Tennessee clubshells present within the entire action area (128,204.4 m² of terrestrial and aquatic habitat), but specifically within the 100,000 m² of the suitable aquatic action area located below Harms Mill Dam, will be incidentally taken due to project-related disturbances. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the RPMs provided. The TWRA must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the RPMs.

8. Conservation Recommendations

Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or DCH, to help carry out recovery plans, or to develop information. Implementation of conservation recommendations are part of a federal agency's Section 7(a)(1) responsibilities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species.

We offer the following conservation recommendations for consideration:

1. The Corps should use their authorities to the extent practicable, to support local initiatives in the Elk River watershed that promote good water quality and fish and wildlife habitat.
2. The Corps should integrate information about the presence and recovery success of listed species in the Elk River and the benefits of maintaining good water quality and habitat into their existing public outreach and community awareness efforts.

In order for us to be kept informed of actions to minimize or avoid adverse effects or benefit listed species or their habitats, we request notification if any of these conservation recommendations are carried out, or if any other conservation programs benefiting the species considered under this biological opinion, are implemented in fulfillment of the Corps' obligations under section 7(a)(1).

9. Reinitiation Notice

This concludes formal consultation on the action outlined in the consultation request. Based on the best information available at this time, we believe that your obligations have been fulfilled for all species that currently receive protection under the ESA. As written in 50 CFR Section 402.16, reinitiation of formal consultation is required where discretionary Corps involvement or

control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the Corps action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the Corps action is later modified in a manner that causes an effect to the listed species or critical habitat not considered in the biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease until reinitiation.

This also concludes the conference on the action outlined in the consultation request. You may ask the Service to confirm the conference opinion as a biological opinion issued through formal consultation if the Tennessee pigtoe or Tennessee clubshell is listed or critical habitat is designated. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

In the event of listing of the Tennessee pigtoe, or Tennessee clubshell as endangered/threatened and/or designation of critical habitat and any subsequent adoption of this conference opinion, the Federal agency shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect the species or critical habitat in a manner or to an extent not considered in this conference opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the species or critical habitat that was not considered in this conference opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The incidental take statement provided in this conference opinion does not become effective until the species is listed and the conference opinion is adopted as the biological opinion issued through formal consultation. At that time, the project will be reviewed to determine whether any take of the species or its critical habitat has occurred. Modifications of the opinion and incidental take statement may be appropriate to reflect that take. No take of the species or its critical habitat may occur between the listing of a species and the adoption of the conference opinion through formal consultation, or the completion of a subsequent formal consultation.

The Service appreciates the cooperation of the Corps during this consultation. We would like to continue working with you and your staff regarding this project. For further coordination, please contact Anthony Ford of my staff at 931/319-7747 or by email at anthony_ford@fws.gov.

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APPENDIX A

Incidental Take of Boulder Darter Provided from Previous Consultations in Tennessee

Biological Opinions Issued	Boulder Darter Numbers	Habitat
1992	0 individuals	N/A
2006	all individuals	below Tims Ford Dam from ERM 90 to ERM 120
2013	95% of population	entire range
2014	all individuals	1.1 ac
2022	20 individuals	20,582 m ²
2023	28 individuals	26,143 m ²

Incidental Take of Slabside Pearlymussel Provided from Previous Consultations in Tennessee

Biological Opinions Issued	Slabside Pearlymussel Numbers	Habitat
2006	4,753 individuals	2,138 m ² (23,013 ft ²)
2009	Excess of 1 out of every 100 individuals present annually	Tennessee and Cumberland Rivers
2012	mortality of all glochidia and juvenile mussels; 5% of subadult and adult mussels incidentally taken	N/A
2014	9,629 individuals	15.2 ac in the Clinch River
2015	131 individuals	3,727 ft ²
2015	1 % of individuals	21.4 rmi reach of Big South Fork Cumberland River
2017	all individuals	15,189 ft ²
2022	160 individuals	22,651 m ²
2022	553 individuals	34,514 m ²
2022	159 individuals	20,582 m ²
2023	199 individuals	26,143 m ²

Incidental Take of Cracking Pearlymussel Provided from Previous Consultations in Tennessee

Biological Opinions Issued	Cracking Pearlymussel Numbers	Habitat
1990	7 individuals	N/A
1992	0 individuals	N/A
1993	0 individuals	N/A
1996	30 individuals	
1999	no more than 25% of individuals in dredge sites (to be determined by density estimate made during pre-dredge survey)	N/A
2002	1 individual	N/A
2003	1 individual	N/A
2006	158 individuals	N/A
2006	all individuals	below Tims Ford Dam from ERM 53 to ERM 120
2009	mortality not to exceed 10% of individuals collected	N/A
2009	all individuals	N/A
2012	mortality of all glochidia and juvenile mussels; 5% of subadult and adult mussels incidentally taken	N/A
2013	all individuals	suitable habitat in 3.75 mi reach
2014	269 individuals	15.2 ac in the Clinch River
2022	340 individuals	20,582 m ²
2023	97 individuals	26,143 m ²

Incidental Take of Rabbitsfoot Provided from Previous Consultations in Tennessee

Biological Opinions Issued	Rabbitsfoot Numbers	Habitat
2012	mortality of all glochidia and juvenile mussels; 5% of subadult and adult mussels incidentally taken	N/A
2013	all individuals	14.46 acres
2014	231 individuals	15.2 ac in the Clinch River
2022	19 individuals	22,651 m ²
2022	173 individuals	34,514 m ²
2022	182 individuals	20,582 m ²
2023	47 individuals	26,143 m ²

Incidental Take of Shiny Pigtoe Provided from Previous Consultations in Tennessee

Biological Opinions Issued	Shiny Pigtoe Numbers	Habitat
2006	158 individuals	N/A
2006	all individuals	below Tims Ford Dam from ERM 85 to ERM 120
2012	mortality of all glochidia and juvenile mussels; 5% of subadult and adult mussels incidentally taken	N/A
2013	all individuals	1.8 mi of suitable habitat in the action area
2014	975 individuals	15.2 ac in the Clinch River

Incidental Take of Snuffbox Provided from Previous Consultations in Tennessee

Biological Opinions Issued	Snuffbox Numbers	Habitat
2012	mortality of all glochidia and juvenile mussels; 5% of subadult and adult mussels incidentally taken	N/A
2014	273 individuals	15.2 ac in the Clinch River
2022	385 individuals	20,582 m ²

Incidental Take of Longsolid Provided from Previous Consultations in Tennessee

Biological Opinions Issued	Fine-rayed Pigtoe Numbers	Habitat
2023	71 individuals	26,143 m ²