Biological Opinion / Conference Opinion

Hurricane Creek Mine #2

FWS ECOSphere Project Code: 2024-0148993

Prepared by:

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Executive Summary

A Biological Opinion (BO) is the document required under the Endangered Species Act (ESA) that states the opinion of the U. S. Fish and Wildlife Service (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 designated critical habitat (DCH). Similarly, a conference opinion (CO) is required for a proposed species when a federal action agency determines that a project may jeopardize its continued existence or result in the destruction or adverse modification of proposed designated critical habitat. A CO addresses only species or critical habitat "proposed" for listing and includes the same analyses as a BO. This BO/CO addresses the effects to the federally threatened blackside dace (*Phoxinus [=Chrosomus]*), federally endangered northern long-eared bat (*Myotis septentrionalis*), and proposed endangered tricolored bat (*Perimyotis subflavus*) resulting from surface coal mining and reclamation as authorized by Hurricane Creek Mining, LLC, at Hurricane Creek Surface Mine Number 2 (the Action), Claiborne County, Tennessee under Permit 3341 issued by the federal Office of Surface Mining Reclamation and Enforcement (OSMRE), which has assumed primary regulatory responsibility for issuing permits under the Surface Mining Control and Reclamation Act (SMCRA) in Tennessee.

Northern long-eared and tricolored bats are presumed to be present within the Action Area because of their detection during acoustic and netting surveys. Also, permanent (persistent) blackside dace populations are not known to occur in stream sections affected by the proposed action. However, during the time frame in which water quality of these streams could be affected by elevated conductivity due to surface mining activities, migrating blackside dace traveling through this area could be affected. Therefore, OSMRE also prudently assumed presence of blackside dace in its Biological Assessment (BA) as a consideration of the potential for elevated conductivity to persist in affected watersheds and, therefore, to affect blackside dace movement through stream reaches that are not typically occupied.

Reasonable and prudent measures (RPMs) to minimize the take and their implementing terms and conditions (T&Cs) that must be observed when implementing the RPMs are specified in this biological opinion. RPMs include ensuring that the proposed Action (including avoidance, minimization, and other conservation measures) is implemented as described in OSMRE's BA and in this BO. T&Cs include: inspecting for strict compliance with all permit commitments; analysis of stream water quality and biological monitoring data to verify accuracy of predicted stream water and habitat quality impacts resulting from the proposed mining; collaborating with partners and assisting in assessment of trends in stream water quality and blackside dace populations in the affected watersheds in an effort to estimate accuracy of the predicted level of blackside dace incidental take and to identify if/when the authorized level may be approached; implementing adaptive management actions as needed (as identified through analysis of

compliance, monitoring, and blackside dace population trends); and annually reporting these results. Likewise, success of revegetation and subsequent effects to bat roosting habitat will be monitored.

The Service has determined that the proposed action could result in removal of up to 496 acres (ac) of suitable bat roosting habitat and 341 ac of noise/vibration and lighting effects with associated incidental take of northern long-eared and tricolored bats, if listed. Habitat acts as a surrogate to the number of individual bats that are expected to be incidentally taken for this action. The action could also result in the incidental take of up to six blackside dace individuals potentially occupying 9.8 miles of streams in the watersheds where water and habitat quality would be affected by mining, with this number of individuals and habitat diminishing over time with successful reclamation. The incidental take included in this BO is authorized for OSMRE until such time as the agency no longer maintains regulatory authority (i.e., through Phase III Bond Release).

ACKNOWLEDGEMENTS

With sincere gratitude, we would like to acknowledge the following U.S. Fish and Wildlife Service staff for their significant contributions to this BO:

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CONSULTATION HISTORY

This section lists key events and correspondence during the course of this consultation. A complete administrative record of this consultation is on file in the U.S. Fish and Wildlife Service's (Service) Tennessee Ecological Services Field Office (TNFO).

Date	Event	Participants	Discussion Topic
Dec.17, 2024	Service letter to OSMRE	Service	Service recognized request for initiation of formal consultation
Nov.18, 2024	BA provided to Service	OSMRE (Matt Moran)	BA provided to Service
April 30, 2024	National Pollutant Discharge Elimination System (NPDES) Notice of Determination	Tennessee Department of Environment and Conservation (TDEC)	Document completion
Dec. 13, 2023	Service letter to OSMRE	Service	Adequacy of Fish and Wildlife Protection and Enhancement Plan.
Sept. 26, 2023	Preliminary mine site visit	OSMRE, TDEC, Tennessee Wildlife Resources Agency (TWRA), The Nature Conservancy (TNC), applicant	Proposed mining and reclamation plan

BIOLOGICAL OPINION

1 INTRODUCTION

A biological opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (Service) under the Endangered Species Act (ESA) of 1973, as amended, as to whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

A BO evaluates the effects of a Federal Action, which include all consequences of the Action and from non-Federal actions unrelated to the proposed Action (cumulative effects), relative to the status of listed species and critical habitat. A Service opinion concluding that a proposed Federal action is not likely to jeopardize species and is not likely to destroy or adversely modify critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA. "Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, 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 that species (50 CFR §402.02).

Similarly, a conference opinion (CO) is required for a proposed species when a federal action agency determines that a project may jeopardize its continued existence or result in the destruction or adverse modification of proposed designated critical habitat. A CO addresses only species or critical habitat "proposed" for listing and includes the same analyses as a BO. While the prohibitions of the ESA do not yet apply under a CO, a CO follows the same regulations (50 CFR §402.14) and must meet the same standards as a BO, so that the former may be adopted as the latter after the Service issues a final decision listing a species or designating critical habitat.

The federal action agency for this consultation/conference is the Office of Surface Mining Reclamation and Enforcement (OSMRE), and the Federal Action addressed in this document is the Hurricane Creek Mine #2 (the Action). This combined BO/CO addresses effects to the northern long-eared bat (*Myotis septentrionalis*), tricolored bat (*Perimyotis subflavus*), and blackside dace (Phoxinus [=*Chrosomus*] *cumberlandensis*) resulting from surface mining activities at Hurricane Creek Mine #2, in Claiborne County, Tennessee. For simplicity, this document will collectively be referred to as "BO" throughout this document. Any distinctions between formal consultation and conference procedures will be specifically addressed as necessary. Considerations of the proposed tricolored bat in this BO should not be construed as an indication that it will or will not be proposed for listing at some point in the future.

Critical habitat is the specific areas within the geographic area, occupied by the species at the time it was listed, that contain the physical or biological features that are essential to the conservation of threatened and endangered species and that may need special management or protection. Critical habitat may also include areas that were not occupied by the species at the time of listing but are essential to its conservation. The prohibition against destruction and adverse modification of critical habitat protects such areas in the interest of conservation. Critical habitats for the blackside dace, northern long-eared bat, and tricolored bat have not been designated at this time. Therefore, designated critical habitat will not be considered as part of this consultation or discussed further in this BO.

Section 9 of the Act and regulations issued under section 4(d) of the Act prohibit the taking of endangered and threatened species, respectively, without special exemption. Federal agencies may obtain such exemption through the "Incidental Take Statement" (ITS) of a BO that supports a non-jeopardy finding for their proposed actions. Incidental take occurs as a result of a federal action but is not the purpose of the action. It may be allowed when the Service approves it through an ITS. The ITS includes the amount or extent of anticipated take due to the federal action, reasonable and prudent measures (RPMs) to minimize the take, and terms and conditions (T&Cs) that must be observed when implementing those RPMs.

In this BO, the Service has determined that the proposed Action may result in incidental take of the northern long-eared bat, tricolored bat, and blackside dace. For this BO / CO, the incidental take for **northern long-eared bats would be exceeded when greater than 496 acres (ac) of suitable forested habitat would be removed**, which has been exempted from the prohibitions of section 9 by this BO. Should the tricolored bat be listed under the ESA, then incidental take for **tricolored bats would be exceeded when the same 496 ac would be removed. The level of incidental take would be exceeded for the blackside dace when six fish within approximately 9.8 miles of suitable stream habitat would be incidentally taken.**

2 PROPOSED ACTION

The proposed Hurricane Creek Mine #2 is located in Claiborne County, Tennessee within a 1,184-acre (ac) permit area (see Figure 2-1), approximately five miles southeast of the junction of Tennessee State Highway 90 and Valley Creek Road. The proposed mine site includes the Bennett's Fork watershed (which drains to Yellow Creek, in Kentucky); but it drains primarily to Valley Creek, Tackett Creek, and their tributaries, which are within the Clear Fork watershed (Figure 2-2). As identified in the *Consultation History* section (page vii, above) of this BO, the application for a Surface Mining Control and Reclamation Act (SMCRA) permit was submitted to OSMRE by Hurricane Creek Mining in February 2023.

The mining authorized by the issued permit would result in removal of coal from the Sterling, Strays, and Poplar Lick coal seams located at approximately 2,280, 2,486, and 2,240 ft elevations, respectively (Figure 2-5). The mining and associated activities would disturb a maximum of 635 acres within the permit boundary (See Table 1) over the 10-year operation period authorized by the permit and included in the mine plan. Approximately 70 percent of this area is forested. The mining would be accomplished using combinations of contour mining and auger/highwall mining methods.

The mine is expected to annually produce approximately 360,000 tons, and the life-of-mine production is estimated at approximately 1,800,000 tons. Existing roads would be used to access the site by equipment and personnel. However, all roads would require some upgrades to satisfy SMCRA standards and additional commitments of the permit.

Table 1: Acreage and associated land cover / actions.

Acreage	**Land Cover / Actions**
925	Entire project area footprint
528 (635 maximum)	Area of surface mining and associated activities (clearing / grubbing)
346	Re-mining area
126	Pre-SMCRA acreage
635	Permitted area of surface mining
290	Permitted area of auger (underground) mining
391 (496 maximum)	Suitable bat habitat to be disturbed
28	Ponds and drainage control structures
70	Existing roads
71	Road upgrades
67	Existing haul roads to be retained post-reclamation
41	Area of vegetation previously removed to construct haul roads
454	Area to be re-vegetated (planted to trees)

Approximately 346 acres of the permit area that was mined prior to the enactment of SMCRA will be "re-mined" during this project. As a result, approximately 6.5 miles of previously abandoned highwall will be reclaimed. Highwall is a term used in reference to the cliff-like remnant of previous mining, usually conducted before the passage of SMCRA. Depending on safety issues, environmental site stability and economics, the mine plan (OSMRE 2024a) includes re-mining of these abandoned, previously mined areas to salvage coal that was left behind and using the remaining overburden to reclaim as much length of highwall as possible. Reclamation of the highwall would result in blending the mined highwall into the surrounding terrain to approximate the original contour of the land prior to mining.

The actions that comprise this mining and reclamation project include: preparation of ponds and drainage control areas, access road upgrading, auger drilling and rehabilitation of drill sites, biological surveys (aquatic and terrestrial), debris removal (including burning), dust abatement, excavation of overburden, excavation of coal, maintenance and fueling of vehicles and equipment on-site; geomorphic, hydrology, hydraulics, and sediment transport analysis field work; geotechnical investigation, highwall / auger and strip mining, transporting coal off-site, hydrological surveys, use of portable lighting equipment, installation of de-watering pumps, machinery removal, management of wastewater for mining, overburden removal, preparation of the project site (terrestrial), stockpiling of overburden on-site, removal of structures, restoration of site contours, restoration of vegetation, and restoration of wetlands.

Two to three bore holes (maximum of 10) are expected to be drilled at the top of the face-up wall to facilitate provision of detailed geologic information relative to auger activities. The holes would be capped immediately upon completion of boring activities.

Land will be prepared for mining of a maximum 635 acres of surface area, and tree clearing will be conducted during the period of October 15 to March 31. Debris removal (i.e., "clearing and grubbing") would be needed only for an estimated 454 ac of this area as mining advances for highwall and auger drilling. The length of highwall is approximately 37,000 ft.

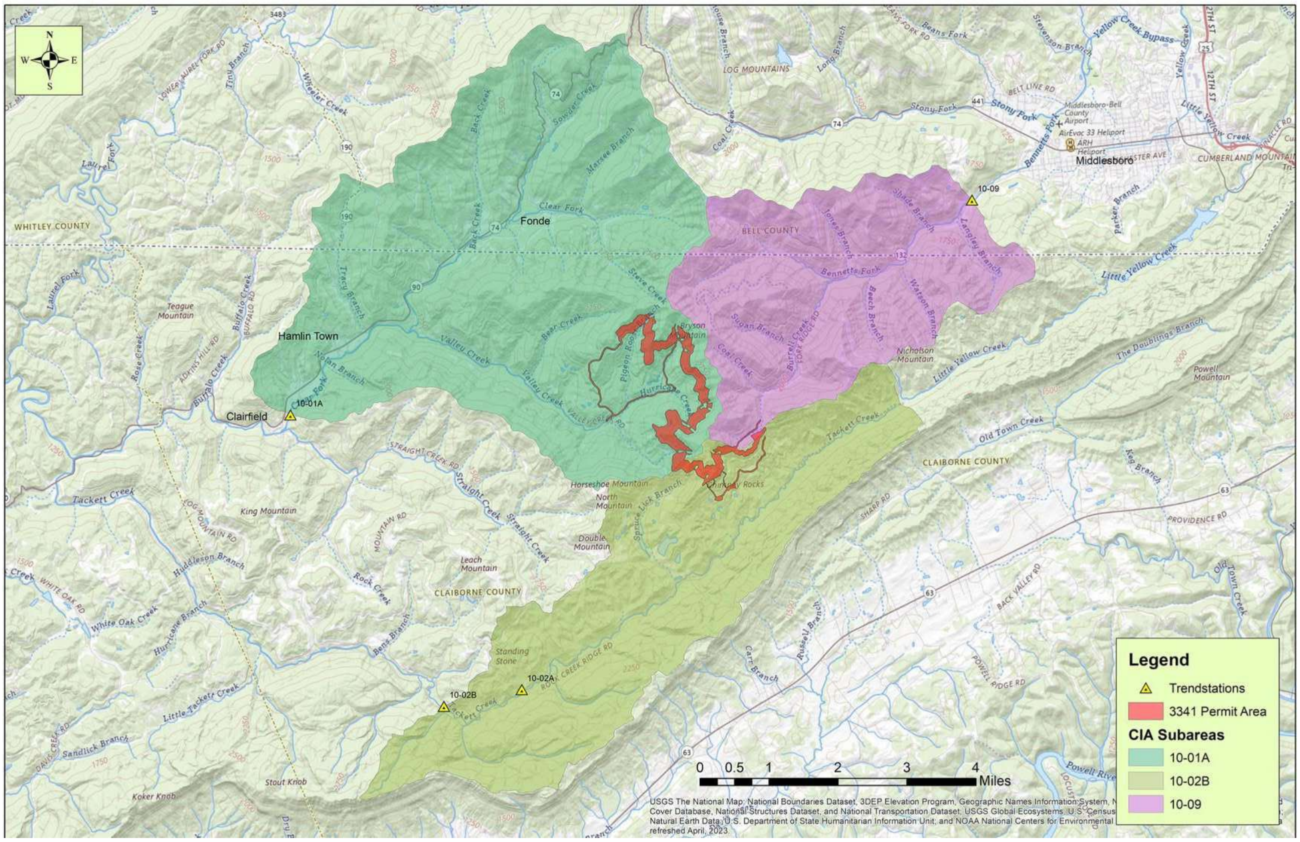

Figure 2-1. General location of the Hurricane Creek Mine #2 project site, with three Cumulative Impact Analysis (CIA) Subareas delineated by colored shading.

Contemporaneous reclamation of backfill and vegetation will occur as mining continues along the highwall, facilitating exposure of only 1,500 ft of highwall for mining at any point in time.

Overburden removal will be maintained within the permitted area. Since highwall development is limited to 1,500 linear ft and contemporaneous reclamation will occur, overburden will not be transported a significant distance from its point of origin and will be contained and/or vegetated if it remains at a site of relocation for more than 60 days. Approximately 36,000 ft of highwall / auger mining is expected to occur on multiple seams over a 5- to 10-year period, with reclamation to conclude within ten years of the initiation of clearing/grubbing activities.

The coal will be hauled on internal roads to Tackett Creek Road or Valley Creek Road to its junction with Tennessee State Route 132 and will follow TN 132 to its junction with Kentucky State Route 186 (Bennett's Fork Road). The coal will then be hauled approximately 2.5 miles along KY 186 to the Double Mountain Mining, LLC preparation plant in Bell County, Kentucky (Department for Surface Mining Reclamation and Enforcement Permit No. 807-8082) where it will be processed for shipment. After being processed, the coal will be transported approximately 83 miles via railroad to Eastman Chemical Company in Kingsport, Tennessee.

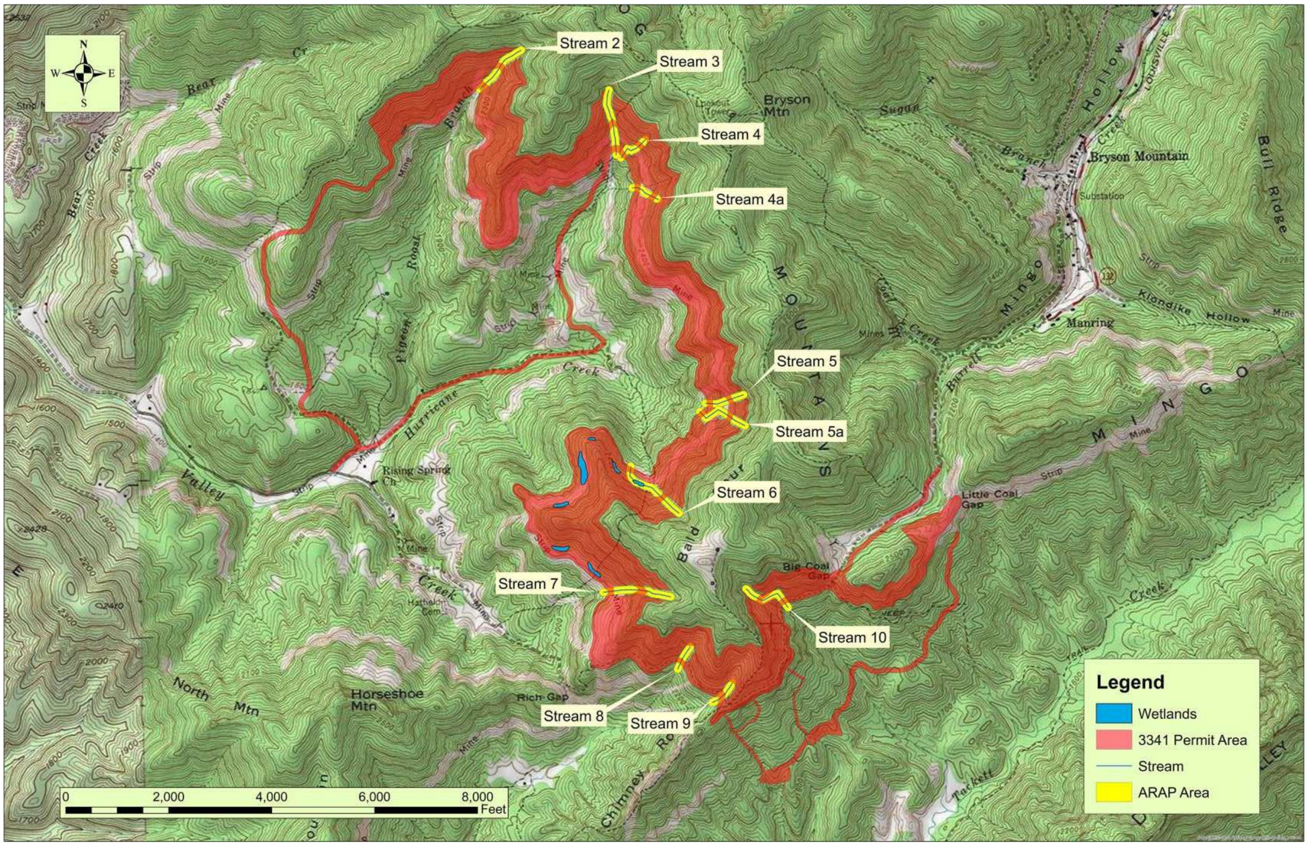

Figure 2-2. Location of jurisdictional waters and proposed Aquatic Resource Alteration Permit areas for road crossings.

Return of surface elevations to approximate original contour is required upon completion of mining. The mine site will be re-vegetated immediately following completion of mining and site grading to minimize erosion, and erosion control measures will be utilized as appropriate. Beneficial tree species for bats as specified in the Bat Protection and Enhancement Plan will be planted during the earliest appropriate season. It is estimated that approximately 500 acres of timber will be removed for up to 5 years and that 600 ac of permitted area will be improved overall as wildlife habitat, with an ultimate benefit to bats relative to current conditions and suitable roosting habitat.

2.1 Action Area

For purposes of consultation under ESA §7, the project's Action Area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02).

2.1.1 Action Area for Northern Long-eared Bat and Tricolored Bat

Direct effects due to noise from blasting and operation of mining equipment may affect the terrestrial animals (northern long-eared bat and tricolored bat) included in this BO. Therefore, the action area evaluated for this Biological Opinion includes an additional 175-m buffer area around the permit boundary. The action area for bats is comprised of the Surface Disturbance and Blasting Buffer polygons identified on Figure 2-3. The surface disturbance polygon provided was 540 ac, as calculated through use of GIS data; and it is between the 500 ac intended surface disturbance and the 635 ac maximum allowance. The addition of a 175-m buffer (437 acres) was added to this polygon for effects of blasting, noise, and vibration. The 175-m buffer includes a 50-meter lighting buffer for bats, and the auger area is almost entirely within the 175-m buffer (Figure 2-3).

The permit authorizes disturbance of 635 ac as the greatest area of potential disturbance; but maximum disturbance is likely to be 500 ac. Of the 635 ac of permitted surface area, 346 ac are "remining" area; however, the greater part of this area has since been reforested. The existing land cover types are currently as follows: shrub/scrub = 3.6% (23 ac), deciduous forest = 73.2% (465 ac), ground herbaceous = 0.7% (5 ac), mixed forest = 4.9% (31 ac), evergreen forest = (0.6%) (4 ac), and existing roads = 16.9% (107 ac). For bat habitat, 635 ac of vegetation removal can be considered for "worst-case scenario", up to 496 ac of which is forested bat habitat (465 ac deciduous + 31 ac mixed). The entire mined and remined areas will be revegetated with suitable tree species for bats and is expected to function as suitable bat roosting habitat after 40-50 years. Using the same proportion of forested area (73.2% deciduous and 4.9% mixed), 341 ac of the 437-ac Blasting Buffer could be considered forested bat habitat.

Total extent of the Bat Action Area, then, includes approximately 635 ac of surface disturbance area (496 of which is forested bat habitat, resulting in harm to bats) plus approximately 437 ac of noise/vibration/lighting buffer area (341 of which is forested bat habitat, resulting in harassment to bats); 71 ac of roads upgrade; and approximately 5 ac of sediment ponds outside these surface areas. The entire Bat Action Area is approximately 1,148 ac.

2.1.2 Action Area for Blackside Dace

The potential for indirect water quality impacts from sediment deposition, dissolved solids, selenium, and dissolved ions (contributing to conductivity) that could result in effects to aquatic insects and fish downstream of the permit footprint is part of the action. The action area is comprised of second- and third-order streams and their tributaries in the headwaters of Valley Creek, Bear Creek, Pigeon Roost Branch, Hurricane Creek, upper Tackett Creek, and tributaries of Tackett Creek in the Clear Fork watershed; and Burrell Creek in the Yellow Creek watershed.

The Blackside Dace Action Area involves 460.5 ac, which includes 200-ft buffers along 9.8 miles of stream (2.5 mi of Spruce Lick Branch, 3.1 mi Tackett Creek, and 4.2 mi of tributaries).

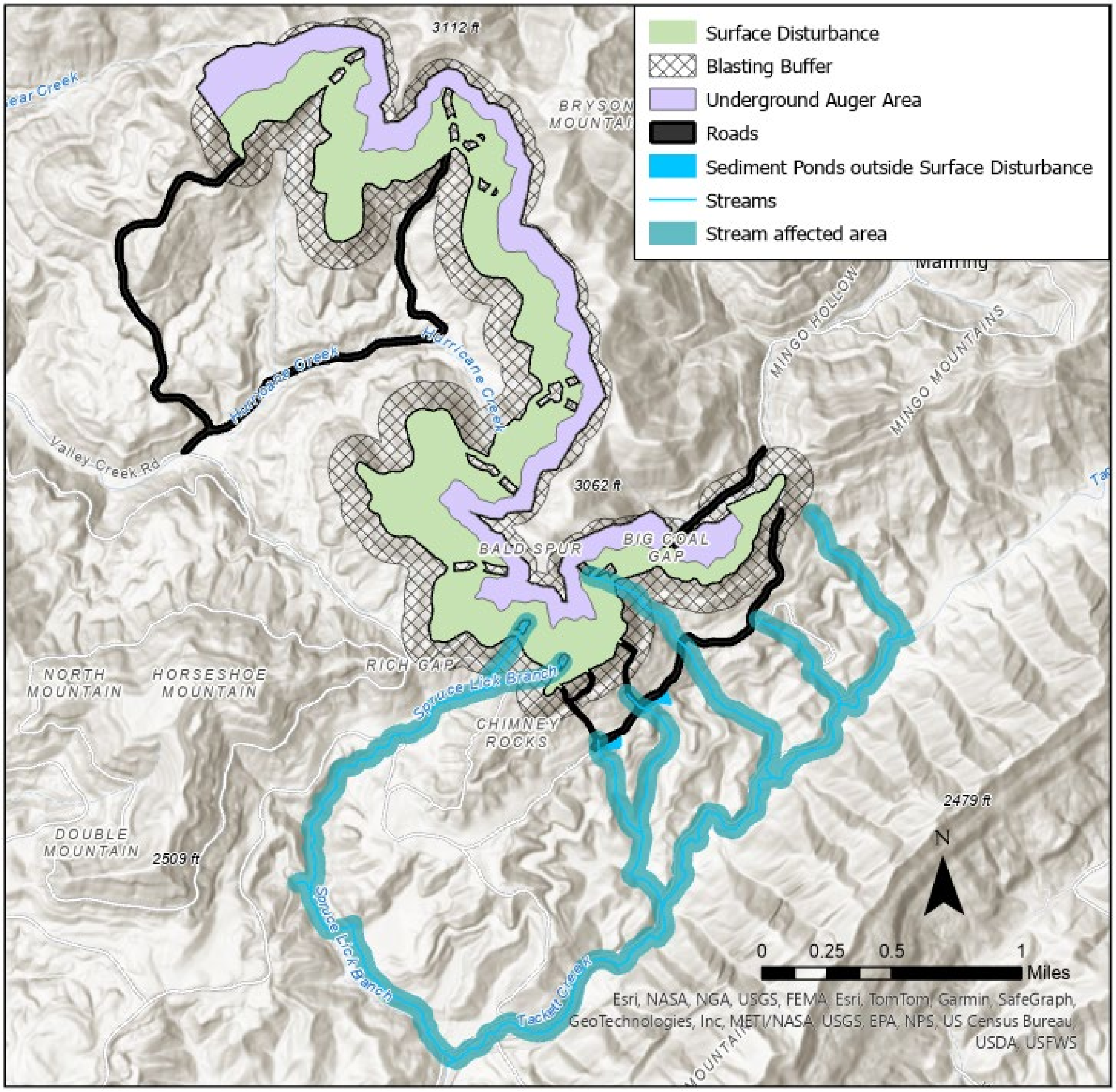

Figure 2-3. Action Areas for the bats (northern portions) and blackside dace (southern aquatic portions).

2.2 Description of the Proposed Action

This section discusses the various components of the mining and reclamation Action.

2.2.1 Road Construction, Upgrade, and Maintenance

Of the 107 ac of existing roads, 71 ac will be upgraded to facilitate the proposed mining, and some small sections will be constructed to open and improve roads. The existing roads were originally constructed in conjunction with logging, oil and gas exploration, and with pre-

SMCRA mining of coal seams in this and adjacent areas. Widths of the existing roadbeds average 20 to 50 feet. All the roads will require some degree of upgrading, and these upgrades will be completed as needed during the mining. There are 15 existing roads as depicted on the Mining and Operations Map and Environmental Resource Map that were provided with the permit application. Twelve of these existed prior to SMCRA and will be used to provide access across the skip areas on the Sterling and Stray coal seams. As specified in the permit application, some of these roads will have culverts restored/replaced and the ditches and sumps re-constructed. Some culverts will be replaced with a bottomless structure, as appropriate. Twenty-five roads within the permit boundary cross 11 stream segments (as specified in the permit application) that have been designated by the USACE as jurisdictional waters. Most of the streams crossed by these roads are in headwater areas that do not support fish assemblages at the locations of these stream crossings. Bottomless culverts are expected to be installed as necessary for one or more stream crossings.

Culverts will be covered and compacted with fill to the design depth or a minimum depth of one foot, whichever is greater. The road surface will be constructed a minimum of one (1) foot above the maximum headwater for the respective culvert to prevent overtopping of the road during storm events. The culvert inlet end will be protected by a rock head wall or other adequate structure. Water passing through these culverts or road surfaces will be discharged into drain ways with splash guards or into rip-rapped channels. Sumps will be constructed in these road ditches at or near culvert inlets and will be spaced at equal intervals along the roads to minimize sediment input to these stream segments from the road crossings. Sumps will be cleaned when the sediment level reaches 50 percent of the capacity.

Roads will be surfaced with durable rock, and the road surfaces will be sloped or crowned to prevent the pooling of water. Routine road maintenance will include grading, filling potholes, and replacing durable rock surface as needed. Additionally, re-vegetation and watering for dust control will take place as necessary.

After mining is completed, road ditches and culverts will remain to simplify future maintenance, promote positive post-mining drainage, and to reduce erosion and sediment loads to the receiving streams. As a result, an estimated 67 ac of existing haul roads will be retained within the permit boundary as permanent facilities in the post-mining environment.

2.2.2 Sediment Pond Construction and Maintenance

Sediment ponds are dugout structures designed and placed to control runoff and collect sediment throughout the mine permit boundary. Where possible, the structures are located in areas that will discharge into natural drainageways. Twenty-eight sediment ponds and a network of drainage ditches are included in this mine plan (Figure 2-4). Ponds associated with Permit 3341 will be reclaimed as minor wetland depressions as part of the wildlife enhancement plan.

New ponds will be constructed during dry, low flow periods whenever possible; and during construction, temporary sediment control measures consisting of two rows of straw bales and silt fences will be placed downstream of ponds or ditches when the drainageways are flowing. Topsoil and other material (rocks, gravel, boulders, sand, etc.) excavated during this construction will be stored nearby for later use in reclamation. Disturbance to vegetated areas around pond locations during construction will be minimized as much as possible. Sediment ponds and diversion ditches will be lined with claylike material, if available, or synthetic liners.

Sediment ponds will be checked periodically for structural weakness, erosion, and hazardous conditions. Inspections will be conducted monthly or after periods of significant precipitation events. Water quality monitoring for each pond will be conducted quarterly, and monthly monitoring will be conducted for ponds undergoing flow-through hydrology. Accumulated sediment will be removed with a backhoe or clamshell device when design sediment storage volume reaches a level of approximately 50 percent. Water will be sampled prior to sediment removal and would be chemically treated as necessary for improvement of water quality prior to de-watering of a pond by pumping or siphoning. Non-toxic sediments will be transported to an upland area, dried, and used as spoil or topsoil as appropriate. Toxic sediments will be disposed per approved materials handling plan and covered with a minimum of four feet of clean, non-toxic material.

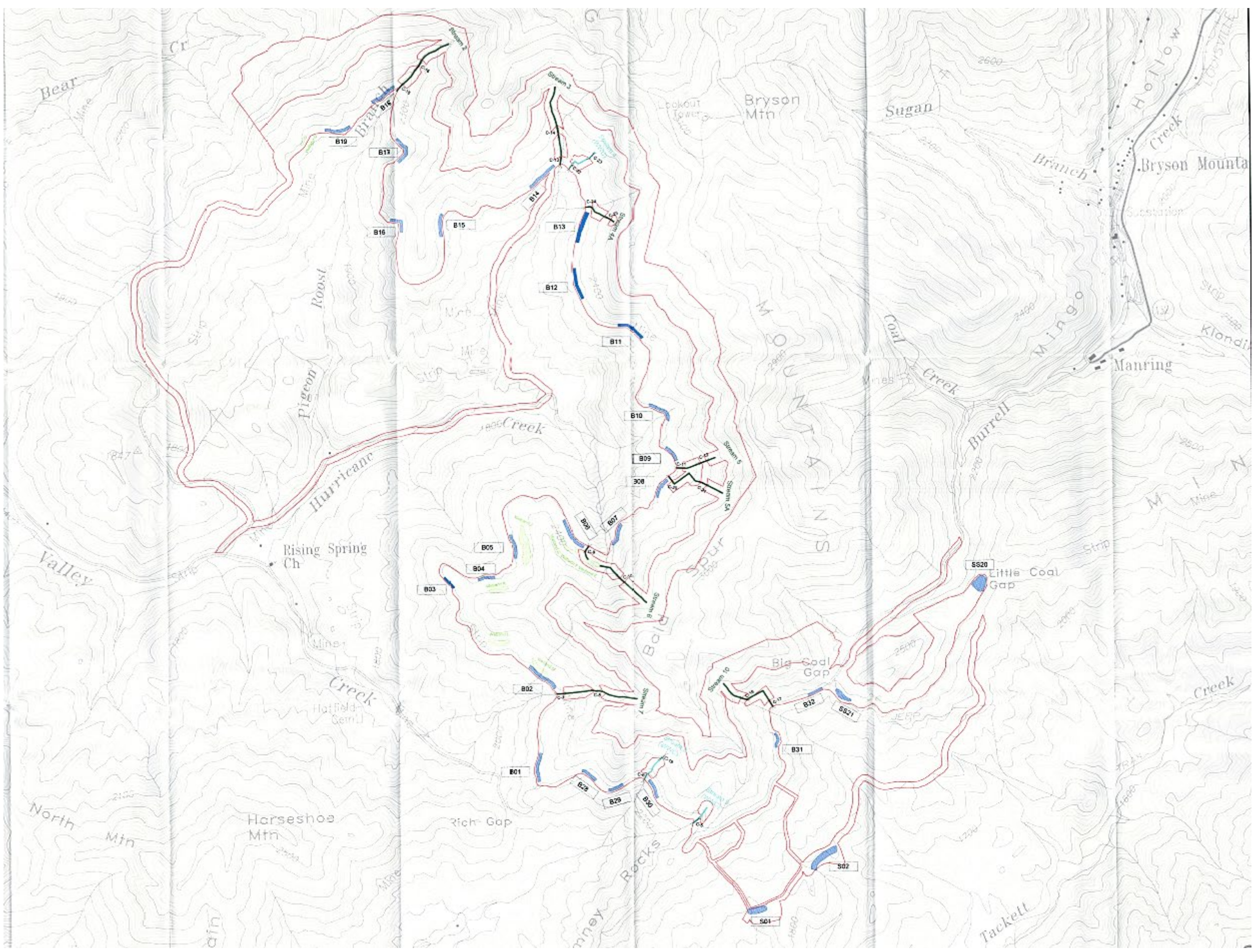

Figure 2-4. Sediment ponds permitted under TDEC Aquatic Resource Alteration Permit (ARAP).

2.2.3 Pre-mining Site Preparation

Bulldozers, front-end loaders, trucks, and graders will be used to clear timber and other vegetation in advance of mining and reclamation operations within the proposed permit area. The disturbed areas within the proposed permit area, with the exception of the haul roads and sediment ponds, will be reclaimed utilizing available spoil. However, if maximum cuts are not taken for purposes of safety, environmental site stability, or economic reasons, portions of the pre-law highwall on the Sterling coal seam may remain.

Clearing and grubbing will be conducted in advance of the mining operations. Timber which can be salvaged and marketed will be harvested and transported off site. All other woody vegetation encountered by mining or in construction of related facilities will be burned in a controlled manner, windrowed along the coal outcrop in a manner that will not cause instability, or placed into the final layer of growth medium before reclaiming. Timber harvest and tree clearing (approximately 500 ac [465 deciduous + 31 mixed + 4 evergreen]) for this mining project will also be done according to the dates (between October 15 and March 31) included in the mine plan's *Bat Protection and Enhancement Plan* (Bat PEP) that was developed based on guidance provided by the U. S. Fish and Wildlife Service (2014). OSMRE's inclusion of the Bat PEP is intended to benefit the northern long-eared bat as well as any tricolored bats that may use the project area.

2.2.4 Other Mine Facilities Placement and Use

No permanent support facilities are planned for this operation, with the exception of roads as described above. Temporary facilities associated with the mining operation and equipment support within the permit boundary may include a mine office (a small portable trailer approximately 12 ft by 60 ft), explosive storage magazines (10 ft by 10 ft structures), and storage buildings for equipment parts, reclamation supply and other materials. The explosive storage magazines will be located at distances prescribed by the Mine Safety Health Administration (MSHA) from active mining operations, but other locations may be needed. Storage units, mentioned above, will be mobile and will be located at various locations as needed throughout the permit area. Following completion of mining, these facilities will be removed at the time that they are no longer required for their intended uses.

2.2.5 Mining Operations

The proposed mining includes remining of the Sterling, Poplar Lick, and Stray coal seams (Figure 2-5). Hurricane Creek Mining will employ surface contour mining (i.e., excavation on the side of the mountain) and auger/highwall mining methods.

Surface contour methods involve excavation of coal from the side of the mountain, following the coal along the contour and moving around the mountain. Auger/highwall methods extract coal by drilling horizontal holes into the exposed coal outcrops along the highwalls with rotary shafts and hydraulic rams, moving along the length of the highwall.

The permit area contains 346 acres to be re-mined that is comprised of abandoned pre-law, strip-mined bench with little or no native topsoil. The re-mining portion of the project will remove the maximum amount of coal that is feasible (in terms of economics, environmental considerations, and safety). Re-mining of these areas could result in reclaiming up to an estimated 6.5 miles of pre-SMCRA highwall. These pre-SMCRA highwalls will be reclaimed using all available spoil material generated as the mining progresses. However, portions of highwall may remain on the Sterling coal seam at 2,280 feet elevation (see Fig 2-5), and the maximum projected cuts may not occur for reasons of safety, environmental, and economic considerations, as discussed above.

Several slides within the permit boundary have been attributed to instability of highwalls on some of the un-reclaimed pre-SMCRA areas. Buffer zones around areas that have previously been unstable have most likely re-vegetated naturally in the time that has passed since the slides. However, if existing slides are re-activated or new slides occur, vegetated buffers will be established and maintained, and drainage control features will be designed to route water away from the slide areas to prevent further movement of soil in these unstable areas. In addition, some areas may be completely avoided, or solid berms may be established around other un-reclaimed areas in order to minimize the likelihood of future slides.

Dozers, drills, loaders, trucks, graders, excavators, and augers will be used to mine the coal, construct, upgrade, and maintain roads and sediment control structures, to transport spoil and growth medium, and to reclaim all surface disturbances. It is expected that one spread of equipment will be used on the mine site. Mining will advance along the crest of the ridge with half of the entire ridge being excavated and coal removed. The mine sequence will begin on the eastern end of the project, thereby maximizing reclamation of the un-reclaimed highwall.

Blasting and/or equipment will be used to push spoil material into the previously mined area for reclamation. Federal regulations (30 CFR 816.97[b]) require that noise associated with blasting may not exceed 129 to 133 decibels (depending on the type monitoring equipment used to measure noise levels). These standards have been set to protect public health and safety and were not intended to preserve the highest levels of aesthetic qualities in an area. Under Federal regulation, blasting will occur only between sunrise and sunset. The blasting plan for the proposed operation indicates that blasts will occur no more than twice in a given day, with no more than 6 blasts in any given week. As such, blasting noise will occur infrequently (once or twice per day), will last only for a very brief period (i.e., a few seconds), and will occur only during daylight hours. As indicated in the BA, blasting will be conducted during the October 15 – March 31 time period (i.e., when bats are not present in the action area) to the greatest extent feasible.

2.2.6 Excavation and Coal Removal

Mined coal will be temporarily stockpiled at various locations on the proposed permit area prior to being loaded onto trucks and hauled away. These coal stockpiles will be located on or near the mine pit active at the time and within areas providing drainage control. Coal will then be removed by truck, using the internal mine roads and proceeding via Claiborne County roads and Tennessee and Kentucky State routes.

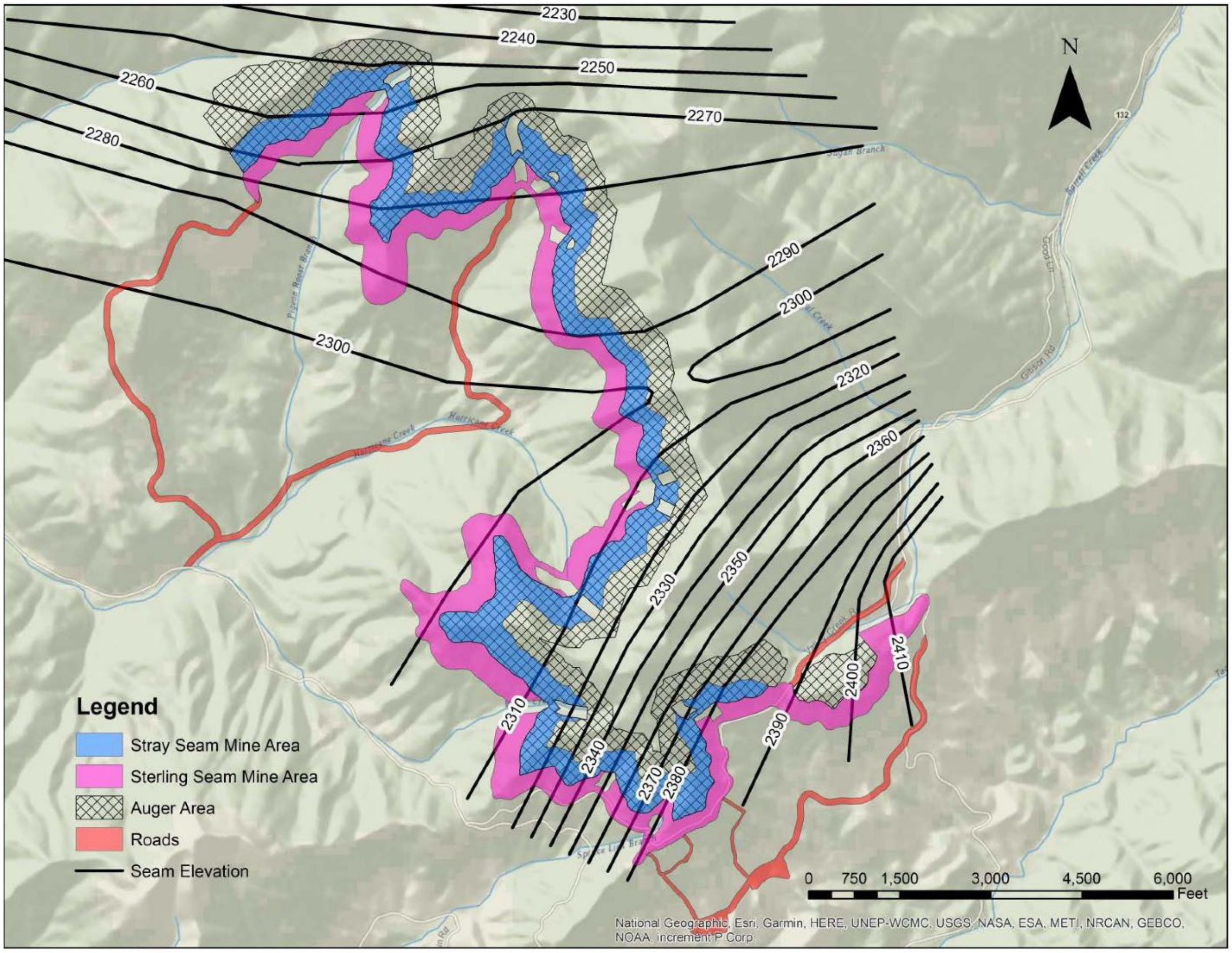

Figure 2-5. Coal seam elevation lines and roads.

This BO includes consideration of stream impacts that result from trucking coal via Claiborne County and Tennessee state routes. However, the scope of this BO does not include transport via Kentucky state routes and processing at a facility in Bell County, Kentucky.

2.2.7 Reclamation Methods

Approximately 346 acres of the mine permit area includes abandoned pre-SMCRA surface mines and associated un-reclaimed highwalls that would be re-mined. Any topsoil present on these acres prior to the previous mining on these areas was likely pushed downslope and then buried by the overburden that was left behind when coal was mined. Since little or no native topsoil is available in these areas, the material on the existing highwall benches will serve as alternate topsoil material. This material has been sampled and found to be suitable for plant growth. "Contemporaneous reclamation" methods will be used; in this case, a 1,500-ft mined segment will be reclaimed prior to advancement of mining into the next 1,500-ft segment. All available native topsoil, alternate topsoil material, and the unconsolidated soil material directly below the native topsoil will be segregated from the overburden material and used as growth media.

Stockpiles for growth media will be clearly marked, located on stable areas within the permit area, and graded to ensure positive drainage. Diversion swales, windbreaks, and/or other measures will be used to protect the stockpiles from wind and water erosion. These stockpiles will be seeded and mulched if storage is to exceed 30 days.

While the mine plan specifies that approximately 500 acres will be planted with trees, approximately 454 acres, not to be permanently altered by roads or other land uses, will be reclaimed with tree plantings in accordance with the Forestry Reclamation Approach (FRA). The FRA, a five-step reclamation approach based on forestry research used to reclaim coal mine lands (U. S. Department of Interior 2015), includes placement of at least four to six feet of loosely graded growth medium over the backfilled slopes. However, in areas where potentially toxic-forming materials have been identified, the loose compaction component of the FRA will not be utilized. In those areas, backfill and growth media will be compacted per normal backfilling and grading practices. Highwalls will be backfilled to the greatest extent feasible with the material available. Auger/highwall mining openings will be covered in the process to address human safety concerns and minimize the movement of groundwater to surface waters. This will also minimize lethal effects to bats.

Within thirty days after distributing growth media as described above, these areas will be planted with a mixture of grasses and legumes to accelerate establishment of vegetative cover and minimize erosion. Once grasses are sown, trees will be planted on the majority of the reclaimed mine site to facilitate the establishment of wildlife habitat. As specified in attachment 60.B of the permit application (Bat Protection and Enhancement Plan, PEP), a minimum of six tree species will be used for long-term habitat replacement, to include four exfoliating bark species. Proposed trees will include at least four of these species: shagbark hickory, white oak, black locust, red mulberry, white pine, and redbud; and a minimum success standard of sixty percent of 400 trees per acre (to include volunteer species) will be required for final bond release.

2.3 Expected Future Conditions

No additional development within the permit boundary is intended, with exception of retaining the existing road system; and the postmining land use within the permit boundary is expected to be undeveloped forest to facilitate restoration of fish and wildlife habitat. The Nature Conservancy holds title to the surface rights for the permit area, and reclamation methods are being coordinated with the owner and Tennessee Wildlife Resources Agency to facilitate benefits to fish and wildlife. A variety of native shrubs, trees, and herbaceous ground covers will be planted. However, for several years after mining, the ground cover species will provide the principal component of the postmining habitats. The northern long-eared bat PEP included as SMCRA Permit #3341 conditions, specifies tree species composition, density, and other planting requirements intended to establish eventual forest habitats appropriate for use by these and other bats. However, until the planted trees and other naturally invading trees become established and the forest canopy shades the ground cover, the reclaimed areas will be dominated by herbaceous species and woody shrubs. As a result, it may take 15 to 30 years to establish terrestrial habitats similar to pre-mine habitats present within the mine permit boundary, and 50 to 75 years or more following reclamation, before mature forests are established on the reclaimed mine site.

Mining and reclamation will alter the existing vegetative communities present on approximately 500 ac of the permit area. Vegetation on an estimated 41 ac within the permit boundary was previously eliminated to construct existing haul roads for the mining, logging, and oil and gas extraction that previously occurred within the permit boundary.

2.4 Conservation Measures

Highlights of the best management practices as specified in the BA are as follows, in general chronological order of operation.

Hydrologic sampling will be conducted in accordance with requirements of the Clean Water Act section 404 and State Aquatic Resource Alteration Permit. Additionally, a Fish and Wildlife Service-approved monitoring plan for blackside dace is currently being implemented.

Best management practices, including a system of diversion ditches and sediment ponds, will be implemented to confine wastewater and manage it within the boundary of the permit area. De-watering of on-bench wetlands will be achieved through pumping into sediment ponds to ensure containment of sediment within the permitted area.

Access Road construction would be comprised almost entirely of the opening and improving of existing roads. Road improvements are expected to provide an overall benefit relative to downstream water quality. Bottomless culverts would be installed at stream crossing sites as necessary to benefit fish. Estimates of 14 or fewer vehicles will operate on the project area. Best management practices for dust abatement (i.e., watering the roads as necessary) and water quality will be maintained. Federal / state regulations and best management practices will be implemented to manage fueling, containment of spills, and any necessary cleanup within fueling areas and outside of these areas.

The Fish and Wildlife Service and Office of Surface Mining would be contacted if removal of trees outside of the designated season becomes necessary, and a survey could occur to facilitate removal of select trees.

Portable lighting will be used only when necessary for safety purposes. Lights should be shielded downward to minimize extraneous illumination.

All machinery / motorized equipment will be removed from the site when mining is complete.

The use of temporary structures (e.g., a trailer that would act as temporary office space or other shelter) is possible, but retention of permanent structures at the mine site is not anticipated.

Stream restoration will not occur, as it will be unnecessary due to maintenance of 50-foot buffers along each side of all ephemeral, intermittent, and perennial streams, and maintenance of 100-foot buffers along larger streams as specified above. Restoration of wetlands is directed under the Aquatic Resource Alteration Permit from Tennessee Department of Environment and Conservation.

2.4.1 Sediment Control

Sediment ponds

Sediment ponds are dugout structures whose engineering and placement is specifically designed to control runoff and collect sediment throughout the mine permit boundary. Sediment ponds associated with mining permits in Tennessee are designed with higher storage capacity than many other states in the Appalachian region (OSMRE unpublished data). This storage capacity reduces the need for frequent sediment removal from the ponds, actions which can also result in temporary sediment releases. Where possible, these sediment pond structures are located in areas that will discharge into natural drainageways.

Twenty-eight sediment ponds and a network of drainage ditches are included in the Hurricane Creek Mine #2 mining plan (see Figure 2-4). Two of the ponds currently exist in the pavement (i.e., along the lowest level) of the Mason coal seam, and the remaining 26 ponds will be constructed in the pavement of the lowest coal seam to be mined.

Temporary sediment control measures consisting of two rows of straw bales and silt fences will be placed downstream of ponds or ditches during construction when drainageways are flowing. Topsoil and other material (rocks, gravel, boulders, sand, etc.) excavated during this construction will be stockpiled nearby for later use in reclamation. Disturbance to vegetated areas around pond locations will be minimized as much as possible during construction. Sediment ponds and diversion ditches will be lined with claylike material, if available, or synthetic liners if clays are not present. Diversion ditches used to direct runoff to these sediment ponds may include sumps and/or rock check dams to provide additional sediment storage volume.

When ponds reach approximately 50 percent of designed storage volume, accumulated sediment will be removed; water in the structure will be sampled and treated if necessary (according to the National Pollutant Discharge Elimination System, NPDES, permit requirements for maintaining pH values of 6 to 9 for protection of fish and aquatic life) prior to de-watering of the pond by pumping or siphoning. Non-acidic/non-toxic sediment will be transported to an area identified for such storage, allowed to dry, and later used as spoil or topsoil material, as appropriate. Any acidic/toxic sediment will be disposed of according to the approved permit acid/toxic materials handling plan and covered with a minimum of four feet of clean non-toxic material (more detail regarding this topic is provided below).

Existing ponds have been regularly inspected for structural weakness, design failure, compliance with permit discharge requirements, erosion, and other hazardous conditions. OSMRE is required (mandated) to inspect the permit four times per quarter, and these inspections must include at least one complete inspection and three partial inspections. All ponds are evaluated during complete inspections, but they can also be checked during partial inspections. In addition, the SMCRA permit requires basin annual certifications for each pond, and the TDEC NPDES permit associated with the Hurricane Creek Mine #2 also requires quarterly monitoring. Additional reporting is also required after significant rain events.

Stream crossings

Standard buffer zones included in SMCRA regulations are 50 ft on each side of a stream, and this specification will be applied for all streams involved in the Hurricane Creek Mine #2 application package (Office of Surface Mining Reclamation and Enforcement 2024a). However, a 100-ft buffer zone will be applied for each side of jurisdictional streams. No streams will be mined through, and existing stream crossings will be utilized and upgraded as necessary. After completion of mining, the crossings will be removed and reclaimed in accordance with TDEC's ARAP specifications.

2.4.2 Toxic Material Handling Plan / Waste Disposal

In accordance with the approved Hydrologic Reclamation Plan and the Toxic Material Handling Plan (Moran, 2024), if strata that might produce acid or toxic drainage are encountered during mining, measures to avoid adverse impacts from acid or toxic runoff include:

- Removing the rider seam,
- Selective handling of toxic material, or
- Blending the thin and discontinuous potentially acid producing strata with alkaline materials.

In addition, the Hydrologic Reclamation Plan and the Toxic Material Handling Plan includes the following commitments:

- Six existing wetland areas will be de-watered prior to mining. Each of the wetland areas has a discharging channel/spillway that will be lowered in a slow, staged manner to allow ponded water to be removed. Should sediment discharge be observed, silt fencing and/or straw bales will be used at the outlet and downstream to trap sediment and reduce effects of erosion. Should water show signs of an acidic or toxic nature, it will be tested prior to release. If found toxic or acidic, it will be treated chemically, re-tested, and then released upon finding of compliance.
- Special handling techniques will be employed for the auger development waste, coal cleanings, and sediment cleanings. These special handling techniques consist of final placement of the potential toxic material within the backfill for the Sterling coal seam in a high and dry manner. This material will be placed a minimum of 10 ft from the base of the Buckeye Springs coal seam, at least 10 ft from the highwall, 20 ft from the out-slope, and covered with at least 4 ft of clean non- toxic material.
- The auger development waste, coal cleanings, and sediment cleanings will be tested prior to final disposal in the above described high and dry manner. This testing will determine the amount of lime required to effectively neutralize the acid content of this material. Lime will be broadcast onto the toxic material after final placement, and prior to covering with a minimum of 4 ft of clean non-toxic material; the remaining backfill material will then be placed.

- Five feet of strata above and below each Strays coal seam, at approximately the 2,486-foot elevation, will be segregated and stored in toxic material storage pods (TMSP).

Potential selenium-producing strata identified in the shale material located directly above or below the Strays or Sterling seams often corresponds to the potentially acid-forming materials occurring in these same horizons. The southeastern portion of the permit exhibits a more consistent occurrence of selenium-bearing strata, and acid-bearing zones are highly variable and discontinuous in the northwestern portion of the permit area. Potential selenium-producing strata have been identified in drill holes adjacent to coal seams. Most of this material is found in shale materials located directly above or below the Strays seam and often corresponds to potentially acid-forming materials occurring in these horizons. Selenium is highly variable between drill holes, and the greatest concentration was in boreholes AF-485, 486, and 488 between the eastern fork of Hurricane Creek and Big Coal Gap.

Because of variability in occurrence of selenium, material encapsulated in TMSPs within backfill upon reclamation will be located well above the pit floor and final highwalls and a minimum of four ft below the surface. This will be done in order to minimize contact with ground water and to minimize oxidation that could result in release of toxic forms of these materials into the environment. Any bottom strata below a coal seam that is not disturbed will remain in place rather than being removed and stored elsewhere. Pit cleanings from the coal or auger/highwall wastes will be assumed to be potentially acid-forming and will also be segregated and placed high in the backfill to prevent contact with ground water. Other waste materials, such as those from road sump, drainage ditch, and sediment pond cleanings will also be tested for toxicity; and if found to be toxic or potentially acid forming, these materials will also be segregated and placed high in the backfill away from anticipated ground water levels and covered by at least four ft of non-acid and non-toxic spoil or soil material. Other thin and discontinuous acid-forming zones, which randomly occur throughout the proposed permit area and not directly associated with a coal seam, will be neutralized by mixing with alkaline materials during mining and backfilling.

2.4.3 Protection and Enhancement Measures for Northern Long-eared and Tricolored Bats

Hurricane Creek Mining incorporated a northern long-eared bat and Indiana bat protection plan into the Fish and Wildlife PEP that is a component of the mine permit application required by SMCRA. The PEP and additional measures specified as conditions of the permit include:

- Avoidance of Caves and Underground Mines – According to information provided by the applicant in the SMCRA permit application (Office of Surface Mining Reclamation and Enforcement 2024a), a winter habitat assessment of the permit boundary was performed; and no open caves or underground mines were found. Any adjacent auger holes had been covered prior to applying for this permit, and they were covered when the OSMRE application was received.
- Tree Clearing Restrictions – The mine project boundary is not within a five-mile radius of known hibernacula for northern long-eared bat or tricolored bat; nor is

any winter habitat for these species present within the permit boundary (see bullet above). Therefore, the permit boundary contains only potential summer roosting bat habitat for northern long-eared bat or tricolored bat. All trees within the permit boundary, including potential northern long-eared bat or tricolored bat maternity/roosting trees, or male summer roosting trees, will be removed. In accordance with the *Range-wide Indiana Bat Protection and Enhancement Plan Guidelines for Surface Coal-Mining Operations* (U. S. Fish and Wildlife Service 2013), tree removal will take place between October 15 and March 31 when bats would be hibernating and not present on the forest landscape.

- In order to minimize temporal loss of summer habitat and optimize the opportunities for bats returning to forested landscapes to find other suitable habitats elsewhere, timber removal activities will take place one season before mining operations begin.
- Tree Planting - During reclamation, the permit area will be planted with species of trees that will, when mature, provide potential summer roost habitat for forest-dwelling bats.
- Tree Girdling – Girdling trees along the permit area perimeter, on the undisturbed berm within the permitted area, or along the perimeter of roadways within the permitted limits of roads will create roosting habitat for forest-dwelling bats. In these areas, one tree that is at least nine in DBH will be girdled approximately every 500 feet. The trees species selected for girdling will include those with exfoliating bark. Trees with smooth, tight bark will not be girdled.
- Minimization of Stream/Wetland Impacts - Stream sediment control measures will minimize impact of sediment runoff to stream habitats used by bats for water supply and foraging. To minimize the loss of existing wetlands that will be drained and eliminated from the project site, sediment ponds will be retained to function as low water depressions for foraging bats following completion of mining.
- Buffer Zones – Restricting all coal extraction activities at areas where permanent or temporary roads cross streams will preserve riparian habitat that could be used by bats for water and foraging, avoid direct impact to stream channel habitats, and minimize sediment deposition in stream habitats used by aquatic insects that could be preyed on by bats.
- Blasting – Although no hibernacula are known within a five-mile radius of the permit boundary, the blasting plan is intended to limit the amount of ground vibration that could disturb hibernating bats (in unknown hibernacula nearby), and also to prevent blasted rock being thrown that could destroy bat habitat or harm bats in adjacent areas beyond the permit boundary where bats may be roosting and/or foraging.
- During reclamation, shallow water depressions will be retained on the regraded area at the rate of at least two per linear mile, providing water sources for bats that could forage on the area after mining has been completed.
- As soon as possible after coal has been removed and backfilling and grading operations are completed, the mine site will be revegetated with a seed mixture selected for rapid establishment of herbaceous ground cover tolerant of post-mining soil conditions. The herbaceous ground cover will be compatible with

tree growth and provide benefits to wildlife. With the exception of permanent roads, ponds, and other existing structures, all disturbed areas will be planted in plots of trees and shrubs when mining has been completed. In order to satisfy the criteria for final bond release, the required tree stocking success rate is set at a minimum of 400 stems per acre (including volunteer colonizers).

Forested acres suitable for bat roosting and foraging habitat are located adjacent to the permit area. If large open areas are present within the permit area after the site is reclaimed and trees are planted, travel corridors linking roosting and foraging habitats will be planted. These travel corridors will be composed of at least four rows of trees and will be at least 50 ft in width (Per SMCRA Permit Item No. 59 - Revegetation Plan and Item No. 60 - Fish and Wildlife Protection and Enhancement Plan).

In summary, the post-mining land-use includes wildlife habitat that will consist of clumps of trees and shrubs being planted in strips along the backfill area. These activities will result in the reforestation of at least 70 percent forest (approximately 528 ac) of the project area and could be suitable for bat use within 40 to 80 years of planting, depending upon the success in tree growth and specific habitat (tree size) required by each bat species.

2.4.4 Protection and Enhancement Measures for Blackside Dace

OSMRE required Hurricane Creek Mining to incorporate a blackside dace protection plan into its Fish and Wildlife PEP. That PEP and additional measures include:

- Actions that would avoid impacts to blackside dace and their habitats;
- Actions that would minimize impacts, including construction and maintenance Best Management Practices (BMPs);
- Actions that enhance or improve habitats for blackside dace; and
- Physical, chemical, and biological monitoring programs, accompanied by adaptive management plans to address monitoring results suggesting mine-related problems that might need addressing. These actions are described in more detail below.

Avoidance

- A plan for handling and disposal of toxic materials will be developed using existing information that identifies areas where rock or soils that would expose acid or other toxic materials could be exposed during mining. Carefully implementing that plan as needed when acid or toxic materials are encountered during mining would avoid ground and surface water contamination.
- One-hundred-foot stream buffer zones will be maintained along each side of jurisdictional streams, as specified in the permit application.

Minimization

- The potential for erosion that could degrade stream habitats in watersheds receiving runoff from the mine would be minimized by incorporating and effectively installing and implementing BMPs and proper engineering techniques to prevent erosion to control sediment runoff at stream crossings and across the mine permit area.

- Erosion potential would also be minimized by placing engineered structures in locations where erosion is likely to occur or where a change in flow direction or force is anticipated.
- The potential for hazardous substances to contaminate downstream portions of the mined watersheds in stormwater runoff from the mine site would be minimized by installing and maintaining berm buffers around facilities where hazardous substances may be present.
- Water quality and habitat degradation to streams receiving drainage from mined areas would be minimized by surfacing haul roads with durable material and constructing sediment sumps to collect run-off from roads not located in areas where drainage would be collected in sediment ponds.
- Water quality and habitat degradation to streams receiving drainage from mined areas would be minimized by maintaining the required sediment clean-out level and pond storage capacity.
- Water quality and habitat degradation to streams receiving drainage from mined areas would be minimized by maintaining discharges from the mine site within the National Pollutant Discharge Elimination System (NPDES) effluent limitations for total settleable solids (TSS) to ensure compliance with a Total Maximum Daily Load (TMDL). (See OSMRE's Cumulative Hydrologic Impact Assessment No. 144 (2024) for the TDEC NPDES permit for Hurricane Creek Mine #2 (TN0070716), and additional information about the limits and requirements of the Clear Fork Cumberland River TMDL addressing TSS in this watershed). This would be accomplished by constructing sediment basins designed so that effluent from the site will not exceed 0.5 milliliters per liter peak settleable solids during a 10 year/24-hour precipitation event.
- Properly lining all drainage structures with either grass or rock and splash pads would control erosion and minimize impacts to water quality and habitat in streams receiving drainage from mined areas. Alternate sediment control in the form of hay bale dikes or silt fencing would be utilized during basin construction and removal to minimize the increase in solids in both the receiving streams and groundwater.
- Increases in suspended and settleable solids in streams draining the mine site would be minimized by promptly seeding and mulching road, ditch, and embankment out-slopes after construction has been completed.
- Disturbances to streams would be minimized by restricting impacts to crossings of existing roads where existing culverts will be upgraded or replaced.
- Quarterly sedimentation monitoring and annual stream macroinvertebrate surveys will be conducted in order to evaluate the ongoing level of success of best management practices.

2.4.5 Monitoring and Adaptive Management

In order to identify conditions that would require specific management actions to correct a problem, OSMRE analyzed pre-mine biological and water quality survey data. These analyses identified baseline water quality conditions and described the biological community in watersheds receiving drainage from mined areas. In addition, the predictive modeling (using Johnson et al. 2010) described anticipated changes that might occur during and following completing of mining (see *Hydrologic Impact*, Section 2 in the BA, Office of Surface Mining Reclamation and Enforcement 2024a). These data also include conductivity measurements from the continuously recording conductivity meters deployed as part of the multi-agency sampling plan for this and other mine permits (U. S. Fish and Wildlife Service 2015), that will be useful in identifying daily and seasonal fluctuations and trends for specific conductance at streams affected by the mining included in this permit. If increases in sediment or specific conductance (or other parameters of concern) above the levels predicted by these analyses are encountered or reported, OSMRE and the Service will investigate the likely source(s) with appropriate sampling and analysis; and measures to ameliorate adverse water quality trends will be implemented as appropriate. At a minimum, fish, invertebrate, and water quality monitoring survey data will be analyzed during the permit mid-term review (after mining has been ongoing for 2.5 years), at any time the permittee (Hurricane Creek Mining, LLC) requests revision of the existing permit, and at the time of permit renewal. In addition, invertebrate surveys will be conducted annually within Tackett Creek. Any unexpected trends that are associated with the mining occurring under this permit could result in an action plan to address the problem(s).

The Blackside Dace Protection and Enhancement Plan (PEP) for the Hurricane Creek Mine #2 permit includes:

- Analysis of potential water quality impacts to receiving watersheds, using the method presented by Johnson et al. (2010) was conducted to predict parameters (e.g., specific conductance) known to be important predictors of blackside dace occurrence and viability. This analysis is presented in the *Hydrologic Impacts* portion (Section 2) of OSMRE's BA (Office of Surface Mining Reclamation and Enforcement 2024a).
- Participating in a multi-agency study of blackside dace health and viability (U.S. Fish and Wildlife Service 2015). The baseline surveys for this study took place in 2022 and 2023, and OSMRE participated. In addition, OSMRE deployed continuously recording conductivity meters in May 2015 at eight localities associated with this study. Since deployment, data from meters at these localities have been downloaded on an approximate monthly basis and promptly shared with the Service.

3 STATUS OF SPECIES

This section summarizes best available data about the biology and current condition of northern long-eared bat, tricolored bat, and blackside dace throughout their ranges that are relevant to formulation of an opinion about the Action.

The blackside dace (*Chrosomus cumberlandensis*) was listed as a threatened species on June 12, 1987 (52 FR 22580-22585). A recovery plan addressing the blackside dace was approved on August 17, 1988 (U. S. Fish and Wildlife Service 1988). Critical habitat has not been designated for this species.

The northern long-eared bat was listed as threatened on April 2, 2015 (80 FR 17973–18033) and uplisted as endangered on March 31, 2023 (88 FR 4908-4910). On April 27, 2016, the Service determined that designation of critical habitat for the species was not prudent (81 FR 24707–24714).

The Service proposed a rule to list the tricolored bat as endangered under the ESA on September 14, 2022 (87 FR 56381–56393) and anticipates the species will be listed in the near future. Critical habitat has not been proposed for this species. The tricolored bat has undergone taxonomic revision, and most of the literature is published under the name *Pipistrellus subflavus*. Hoofer et al. (2006) revised the generic status to *Perimyotis*. The common name “tricolored bat” has been used as an alternative to the technically inappropriate classification of eastern pipistrelle.

The Service’s Environmental Conservation Online System (ECOS) can be accessed for additional information regarding listing status and availability of recovery plans and other documents pertaining to these species, hereby incorporated by reference at the following link: https://ecos.fws.gov/ecp/.

3.1 Tree-roosting Bats

Northern long-eared and tricolored bats are tree-roosting, insectivorous bats that exhibit biological similarities. This section provides general biological information about these bat species that is applicable to each. This information, in combination with the species-specific information that follows, provides the background for analyses in later sections of this BO.

Life Histories and Habitat
The bats addressed in this consultation have similar life histories. These bats are migratory and hibernate in mines and caves in the winter and spend summers in primarily in forested areas, although each species depends upon forested areas to varying degrees. Their key annual life cycle stages and timing of these stages are listed in Table 3-1. One notable difference in roosting behavior is the propensity for tricolored bats to roost in leaf clusters while northern long-eared bats tend to use loose bark or crevices.

Table 3-1. Key Life Cycle Stages of Tree-Roosting Bats Covered Under this Opinion.

Hibernation	Staging and Migration	Summer Occupancy	Pup Season	Fall Migration and Swarming
Nov 16-Mar 31	Apr 1–May 14	Apr 1-Sept 30	May 15-July 31	Aug 16-Nov 15

Summer forest habitats are used to give birth and rear pups; and each species forms maternity colonies of varying sizes, although tricolored bats may use buildings and other structures for maternity colonies to some degree. Males may or may not be sympatric with female maternity colonies depending upon the species. Both sexes roost primarily in trees and will migrate to their same summer areas (with the exception of males) with high site fidelity to establish seasonal residency within a distinct home range.

Home range includes roosting, foraging, and drinking areas and travel pathways between those habitats for a duration of several months. The minimum roosting and foraging areas or areas of relatively more concentrated movements have been identified via species scientific studies, and they vary greatly among studies. First, home range does not have a specific, comprehensive definition and may be estimated using various distance measurements. Home range size varies by time of year. For example, lactating females with non-volant (i.e., not yet flying) pups will have a much smaller home range than at other times of year. Home range size is also likely to vary by landscape availability of essential habitats, by sex, and many other factors will influence home range size.

3.1.1 Northern Long-eared Bat

The northern long-eared bat is an insectivorous migratory species that hibernates in caves and mines during winter and forages at night in wooded areas during summer. The species' longevity is up to 18.5 years (Hall et al. 1957). Prior to the arrival of WNS, Caceres and Pybus (1997) attributed the highest age-specific annual mortality rates for the northern long-eared bat to the juvenile stage. Northern long-eared bat sex ratios at the population level are not reported in the literature, but as a species similar to the Indiana bat in many other respects, we assume a 1:1 ratio is likely.

The northern long-eared bat spring migration period typically runs from mid-March to mid-May (Whitaker and Mumford 2009). Females depart shortly after emerging from hibernation and are pregnant when reaching their areas of summer occupancy. Young are born between mid-May and early-June, with nursing continuing until weaning, which is shortly after young become volant in mid- to late-July. Fall migration likely occurs between mid-August and mid-October.

Northern long-eared bats are not considered to be long-distance migrants (typically 64 to 80 km [40 to 50 mi]). Migration is an energetically demanding behavior for the species, particularly in the spring when their fat reserves and food supplies are low and females are pregnant. Males and non-reproductive females may spend summer near hibernacula or migrate to summer habitat some distance from their hibernacula. Males tend to roost singly, and females form maternity colonies in cavities of trees (Broders and Forbes 2004, Foster and Kurta 1999).

Young are typically born in late May or early June, and females give birth to a single offspring. Lactation then lasts three to five weeks, with pups becoming volant between early July and early August.

3.1.1.1 Summer Habitat and Ecology

Suitable summer habitat for northern long-eared bats consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats. This includes forests and woodlots containing potential roosts, as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable degrees of canopy closure.

While some studies have documented the northern long-eared bat in association with upland forests and mature upland forests (Caceres and Pybus 1997), a study on the Cherokee National Forest (CNF) in eastern Tennessee (Rojas et al. 2018) suggests that the species is more likely to occupy less rugged sites at lower elevations. The CNF study found that sites with a high probability of occupancy (> 0.90) were in forests ranging from 26 to 120 years in age (mean = 80 years), with the highest occupancy rates occurring in stands with a mix of hardwoods and pines (Pinus spp.) - oaks (Quercus spp.), hickory (Carya spp.), yellow poplar (*Liriodendron tulipifera*), and white pine (*Pinus strobus*).

Male and non-reproductive female summer roost sites may also include cooler locations, including caves and mines (Barbour and Davis 1969; Amelon and Burhans 2006). It is uncertain if the sex ratio of females to sympatric males in summer habitat is usually equal; however, an overlap of 90.4 percent in northern long-eared bat adult male home range and maternity colony home range was observed in Kentucky (Service 2018).

3.1.1.2 Maternity Colonies and Roosts

Following a variable-length period of foraging near hibernacula in spring, females seek suitable habitat for maternity colonies, which appears essential for reproductive success. Males are also occasionally found with females in northern long-eared bat maternity colonies (Service 2022). Based on an analysis of the post-WNS summer adult populations of northern long-eared bats in 30 states, the size of northern long-eared bat maternity colonies varies from 20 to 45 females (Service 2016). Because the Action Area for this BO lies entirely within Tennessee, we use 20 adult northern long-eared bat females per maternity colony as the number identified for purposes of this BO. We further assume that the local population is comprised of 20 adult females, 20 sympatric adult males, and 20 juveniles following parturition.

Female northern long-eared bats show inter-annual fidelity to roost trees and/or maternity areas. They use networks of roost trees often centered around one or more central-node roost trees with members of a colony exhibiting fission-fusion behavior (Garroway and Broders 2007), where members frequently coalesce to form a group (fusion), but composition of the group is in flux, with individuals frequently departing to act solitarily or to form smaller groups (fission) before returning to the main unit (Barclay and Kurta 2007). As part of this behavior, northern long-eared bats switch tree roosts often, typically every two to three days (Foster and Kurta 1999; Carter and Feldhamer 2005; Timpone et al. 2010). These bat roost networks also include multiple, alternate roost trees. The minimum summer roost area (area encompassing all roost locations) for known individual female northern long-eared bats ranges between 13 and 65 ac, with most studies finding the summer roost area to tend toward the smaller acreage of that range (Broders et al. 2006; Badin 2014). Bats using familiar foraging and roosting areas are thought to benefit from decreased susceptibility to predators, increased foraging efficiency, and the ability to switch roosts in case of emergencies or alterations surrounding the original roost (Gumbert et al. 2002).

Northern long-eared bats roost in cavities, underneath bark, crevices, or hollows of both live and dead trees or snags (typically ≥ 3 in DBH). They are known to use a wider variety of roost types than Indiana bats, using tree species based on presence of cavities, crevices, or peeling bark. Northern long-eared bats have also been found roosting in structures such as barns, sheds, and bridges (Benedict and Howell 2008; Krochmal and Sparks 2007; Timpone et al. 2010).

3.1.1.3 Home Range

Studies of northern long-eared bat home ranges are highly variable, and it is unclear whether male northern long-eared bat summer home range size is larger or smaller than that of females. Compared with Indiana bats studied at the same site, northern long-eared bats moved greater distances between roosts but varied between 6 and 2,000 m (Foster and Kurta 1999). Timpone et al. (2010) found the mean distance between capture sites and roosts was 1,700 m. Fill et al. (2021) recorded a male distance between capture site and roost at 2,700 m and a female up to 300 m. Another study found foraging areas to be larger for females than males (Broders et al. 2006). Broders et al. (2006) estimated that males traveled 500 m for foraging and roosting, and females traveled 2000 m; but these distances centered around roosting and foraging areas.

From data reported by Broders et al. (2006), we estimate home ranges of males to be approximately 14 ha (35 ac) and 54 ha (134 ac) for females. Henderson and Broders (2008) estimated movement distance for foraging females at 1,100 m, whereas total roost area was 31 ha (77 ac). Gorman et al. (2022) estimated a minimum roosting area for a maternity colony at 88.4 ha (218 ac). The Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities from Take Prohibitions (Service 2016) indicates 1,000 ac as the average area a northern long-eared bat colony uses. The Service assumed a 131 ha (325 ac) home range for northern long-eared bat, based on the average from reported studies (Service 2024); however, the Service did not provide the sources of its information. For the purposes of this BO, we assume there is no meaningful difference between male and female home range size, and we average the above-reported home range sizes for an estimate of 113 ha (279 ac) for sympatric males and females.

While the literature suggests differences in summer home range sizes between male and female northern long-eared bats, they may share a large fraction of their foraging habitat within the occupied forested landscape. We have found no information about the degree of spatial overlap between northern long-eared bat maternity colonies. However, an analysis of mist net survey data in Kentucky indicates that there is substantial overlap in the summer home range of reproductive females and that of males and non-reproductive females (Service 2016). Of 909 capture locations for male and non-reproductive female bats of the species, only 87 (9.57 percent) did not have reproductively active females and were more than 3 mi from captures of reproductive females (Service 2018). This data suggests a 100 – 9.57 = 90.43 percent overlap between the home range of individuals belonging to maternity colonies and other individuals (as previously mentioned under Summer Habitat and Ecology), which we adopt for use in this BO.

3.1.1.4 Population Dynamics/Status and Distribution

The range of the northern long-eared bat extends across much of the eastern and north central U.S. (37 states), and eight Canadian provinces west to the southern Yukon Territory and eastern British Columbia (Figure 3.2). Most historical records of northern long-eared bats are from winter hibernacula surveys (Caceres and Pybus 1997). Before the onset of WNS, the species was most frequently observed in the northeastern U.S. and the Canadian Provinces of Quebec and Ontario, and surveys of many hibernacula detected only a few individuals (Whitaker and Hamilton 1998). Prior to the introduction of WNS, the northern long-eared bat was considered common in the northern portion of its range, relatively uncommon in parts of the South, and rare in the West (Amelon and Burhans 2006). However, the species was commonly caught during netting surveys in Tennessee. The northern long-eared bat still occurs across much of its historical range, but with many gaps where the species is apparently extirpated or sparse due to WNS. The species has only been recently discovered in coastal North Carolina (within the Middle Atlantic Coastal Plain ecoregion) (Jordan 2020).

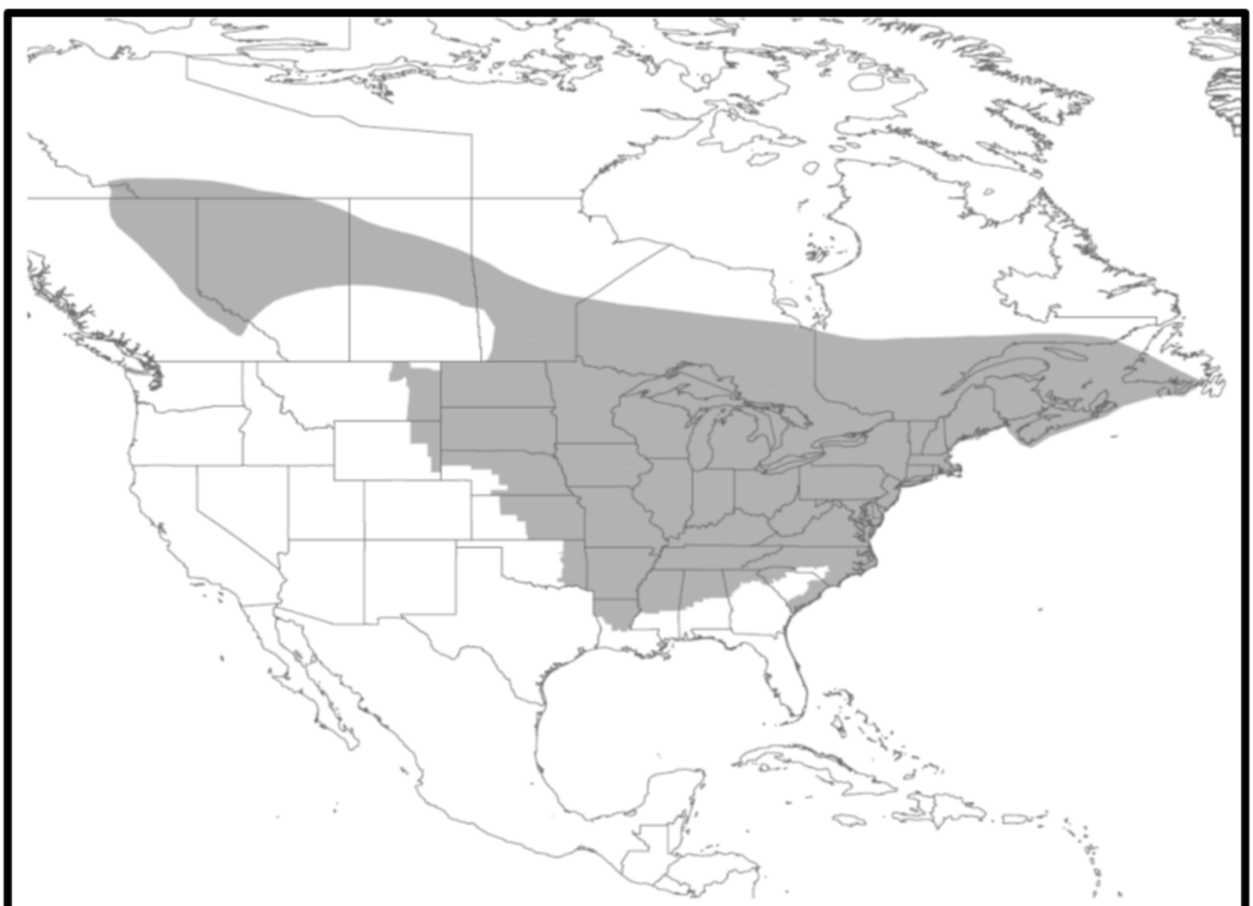

Figure 3.1. Range of the Northern Long-eared Bat (source: Service 2022, Figure 2-2)**.**

According to the recently completed SSA for the species (Service 2022), available evidence indicates that northern long-eared bat abundance has and will continue to decline substantially over the next 10 years under current conditions. Evidence of the past decline is demonstrated in available data in both winter and summer. For example, historical range-wide winter abundance declined by 49% by 2020, and the number of historically extant winter colonies (populations) declined by 81% by 2020. There has also been a noticeable shift toward smaller colony sizes, with a 96–100% decline in the number of large hibernacula (≥100 individuals). Although the declines are widespread, the magnitudes of the winter declines vary spatially. In the Eastern Hardwoods Representation Unit (RPU), the core of the northern long-eared bat range, abundance declined by 56% and the number of sites by 88%. Abundance and the number of sites also declined in the remaining four RPUs (87% and 82% - East Coast RPU; 90% and 44% - Midwest RPU; 24% and 70% - Southeast RPU; and 0% and 40% - Subarctic RPU, respectively). The winter colony sizes were also reduced, with the number of large hibernacula (≥100 bats) declining from 53 in 2000 to 20 in 2020.

Declining trends in abundance and occurrence are also evident across much of the northern long-eared bat summer range (Service 2022). Based on derived range-wide summaries from Stratton and Irvine (2022), range-wide occupancy declined by 80 percent from 2010 to 2019. Although these declines attenuated westward, the probability of occupancy declined in all RPUs. Similarly, Whitby et al. (2022), using data collected from mobile acoustic transects, found a 79% decline in range-wide relative abundance from 2009 to 2019. Measurable declines were also found in the Midwest RU (91%) followed by the Eastern Hardwoods (85%), East Coast (71%), and Southeast (57%) RPUs; data were not analyzed in the Subarctic RPU due to a lack of observations (Service 2022). Finally, Deeley and Ford (2022) observed a significant decrease in mean capture rate post-WNS arrival. Estimates derived from their results indicated a 43–77% decline in summer mist net captures when comparing pre-WNS and post-WNS information. Collectively, these data indicate that the northern long-eared bat has declined, and given the declining trajectories, will continue to decline (Service 2022).

Given the dramatic declines across its range and low current numbers, we do not have reasonable certainty that northern long-eared bat is present within suitable habitat or pre-WNS, historically documented occurrence areas. Therefore, the Service has established post-WNS years ranging from 2013 to 2022 for individual states, depending upon when population bottlenecks occurred as a result of WNS in each state. These post-WNS years represent the year after the population bottleneck and areas with historically documented occurrences that have a reasonable certainty of continued northern long-eared bat presence from the date of the bottleneck to present. The Service has determined 2015 to be the post-WNS year for Tennessee based on state-wide winter survey data (TWRA 2022).

3.1.2 Tricolored Bat

The tricolored bat is an insectivorous, migratory species that hibernates in caves and mines during winter and forages at night during summer. It is one of the smallest bats in eastern North America and is distinguished by its unique tricolored fur that appears dark at the base, lighter in the middle, and dark at the tip (Barbour and Davis 1969).

The typical lifespan of a tricolored bat is thought to be four to eight years in the wild (Fujita and Kunz 1984; Nowak 1991), with higher probability of survival for males and relatively high juvenile mortality (Davis 1966). A male holds the maximum reported longevity record of at least 14.8 years (a male recaptured after it was originally banded) (Walley and Jarvis 1971).

Between mid-August and mid-October, tricolored bats migrate to hibernation sites from summer roosting areas where they converge at cave and mine entrances to swarm and mate (Service 2021). However, mating has also been observed in late winter and in spring (Vincent and Whitaker 2007; Dodd and Johnson 2012). Adult females store sperm in their uterus during the winter, and fertilization occurs soon after spring emergence from hibernation (Guthrie 1933).

Tricolored bats hibernate from November to mid-March in more caves and abandoned mines than any other cave-hibernating bat species in eastern North America (Service 2021). Tricolored bats disperse from winter hibernacula and migrate to summer roosting habitat from mid-March to mid-May. Reported migration distances to summer habitats vary from 44 km (27 mi) to a maximum straight-line distance of 243 km (151 mi) for a female that migrated from her winter hibernaculum in southern Tennessee to a summer roost in Georgia (Samoray et al. 2019).

Little is known about the natural mortalities of this species. Most predation is presumably by chance. The chief cause of natural mortality is probably due to newborn individuals falling from the maternity roost (Service 2017). There are two records of tricolored bats being attacked by hoary bats (Whitaker and Hamilton 1998).

3.1.2.1 Summer Habitat and Ecology

Tricolored bats prefer landscapes with greater forest area, forest aggregation, and tree corridors and are less abundant among urban development (Duchamp and Swihart 2009; Farrow and Broders 2011). They typically forage on small, flying insects (Service 2021) within a 5-mi radius of their roosting site (Kath 2022) at treetop level or higher and often over waterbodies (Davis and Mumford 1962; Barbour and Davis 1969; Schmidly 1991).

Summer roosts are often located in mature forests within riparian corridors (Perry and Thill 2007; O'Keefe 2009) and far from roads (Perry et al. 2008). The species tends to roost among clusters of live and dead leaves on live or recently dead deciduous hardwood trees (Veilleux et al. 2003; Thames 2020), among pine needles (Perry and Thill 2007), and in eastern red cedar (*Juniperus virginiana*) (Thames 2020). Tricolored bats also roost in Spanish moss (*Tillandsia usneoides*) and bony beard lichen (*Usnea trichodea*) in the southern and northern portions of their range (Davis and Mumford 1962; Poissant 2009; Poissant et al. 2010) and in buildings, under bridges and other man-made structures; but they rarely roost within caves (Fujita and Kunz 1984; Veilleux et al. 2003; Service 2021).

Limited research suggests that the minimum summer roost area (not including foraging area) for individual adult female tricolored bat ranges between 0.1 and 2.2 ha (0.25 and 5.4 ac) (Veilleux and Veilleux 2004). A study conducted by Schaefer (2017) in western Kentucky and Tennessee demonstrated that tricolored bats used roost trees within relatively small geographic areas, with 482 m (1,581 ft) being the maximum distance moved between successive roosts and 86 m (282 ft) being the average distance moved; bats remained within 2.5 km (1.6 mi) of their original capture site.

Female tricolored bats exhibit high site fidelity, returning every year to the same summer roosting locations (Allen 1921; Veilleux and Veilleux 2004), and switch roost trees regularly (e.g., between 1.2 days and 7 days) (Veilleux and Veilleux 2004; Quinn and Broders 2007; Poissant et al. 2010), while males roost singly (Perry and Thill 2007; Poissant et al. 2010).

3.1.2.2 Maternity Colonies and Roosts

Tricolored bat maternity colonies are generally small, with groupings sometimes consisting of a single female and her two pups. In Indiana, maternity colonies averaged 4.4 ± 2.4 bats (range: 1–8) (Veilleux and Veilleux 2004). In Arkansas, maternity colonies (adults and pups) averaged 6.9 ±1.5 (range: 3–13). In Wisconsin, maternity colonies averaged 7.25 bats (range: 1–15 bats) (Wisconsin DNR 2022). In Nova Scotia, maternity colonies averaged 10 bats (range: 1–18) (Poissant 2009). As the maternity season progresses, colony sizes begin to fluctuate, females begin to disband soon after young became volant, and post-lactating females roost singly for the remainder of the summer (Veilleux and Veilleux 2004). In this BO, we used the mean of the above averages and estimate maternity colony size at six, 3 females and 6 pups - because females typically give birth to two pups between May and July (Allen 1921; Barbour and Davis 1969; Cope and Humphrey 1972).

Males are solitary and do not form colonies (Hofmann 2008; Fraser et al. 2012). Young bats begin to fly at three weeks of age and achieve flight and foraging ability at four weeks (Lane 1946; Whitaker 1998). Adults often abandon maternity roosts soon after weaning, but young remain longer (Whitaker 1998).

3.1.2.3 Home Range

While little is known about tricolored bat home range and daily movement and more research is needed (Wisconsin DNR 2022), a few studies have been carried out to identify home range sizes that included primary foraging locations for the species. A summer foraging range and diurnal roost selection study of tricolored bats in Franklin County, Tennessee (Thames 2020) found the mean foraging area for seven adult male tricolored bats was 2,350 ha (5,807 ac), ranging from 234 to 9,655 ha (578 to 23,858 ac) and 364 ha (900 ac) for a single, non-reproductive female (Thames 2020). The home range (roosting and foraging area) for a single male tricolored bat in central Indiana was 1,349 acres (546 hectares) (Helms 2010). It is likely that home ranges for male tricolored bats can be much larger than reproductive females; however, with additional studies, it is also likely that there is not a significant difference, similar to Indiana and northern long-eared bats.

In Wisconsin, home ranges for two lactating female tricolored bats roosting in trees were 420 acres (170 hectares) and 642 acres (260 hectares) (Wisconsin DNR 2018). The mean home range for pregnant (n=4), lactating (n=5), or post-lactating (n=1) female tricolored bats in a significantly forest fragmented landscape in central Indiana was 765 acres (range: 168–1,515 acres) (309 hectares; range: 68–613 hectares) (Helms 2010). Compared to females roosting in trees, home ranges for 4 pregnant or lactating female tricolored bats roosting in structures (i.e., barn, bridge) in Wisconsin were smaller (mean: 103 acres; range: 40–163 acres [42 hectares; 16–66 hectares]) (Wisconsin DNR 2017). The Service assumed a 237-ha (585 ac) home range for tricolored bats based on the average from reported studies (Service 2024); however, the Service did not provide the sources of its information. For the purposes of this BO, we use these female home range estimates (420 ac, 642 ac, 765 ac, 103 ac, and 585 ac) for a female tricolored bat average home range size of 503 ac.

During summer, male tricolored bats typically roost alone but utilize similar summer roosting habitat as females. A literature review found evidence of highly skewed sex ratios, indicating that males and females separate during pup-rearing season (McCoshum et al. 2023). For the purposes of this BO, we assume that males and females use similar summer habitat but are not sympatric.

3.1.2.4 Population Dynamics/Status and Distribution

The range of the tricolored bat encompasses 39 states in the eastern U.S. and, in recent decades, has expanded westward and into the Great Lakes basin, four Canadian provinces, Guatemala, Honduras, Belize, Nicaragua, and Mexico. This expansion is due to increases in suitable summer habitat (e.g., forested areas) and suitable winter roosting sites (e.g., abandoned mines and other human-made structures (Benedict et al. 2000; Geluso et al. 2005; Slider and Kurta 2011). A detailed description of the current range, including the species' three RPUs (Northern, Eastern, and Southern), and population dynamics is available in the SSA (Service 2021) and is hereby incorporated by reference.

Prior to 2006 (i.e., before WNS was first documented), tricolored bat was highly abundant and widespread, with over 140,000 bats observed during internal winter hibernacula surveys in 1,951 known hibernacula across over 405 million ha (one billion acres) in 34 states and one Canadian province (Service 2021). Tricolored bat numbers vary temporally and spatially, but abundance and occurrence on the landscape were generally stable (Cheng et al. 2022; Wiens et al. 2022).

Available evidence indicates that tricolored bat abundance has and will continue to decline substantially over the next ten years under current conditions (Service 2021). Range-wide winter abundance has declined by 52%, and the number of extant winter colonies (populations) is down 29% since 2000, with a noticeable shift toward smaller colony sizes. The magnitude of winter declines, although widespread, varies spatially. Abundance has declined 89%, 57%, and 24% in the Eastern RPU, Northern RPU, and Southern RPU, respectively. Whereas the number of winter colonies (i.e., occupied hibernacula) has also decreased 46% in the Eastern, 24% in the Northern, and 34% in the Southern RPUs. Lastly, across all RPUs, the potential for population growth is currently undetectable (Service 2021).

Declining trends in tricolored bat occurrence and abundance is also evident from summer data (Service 2021). Based on derived range-wide summaries from Stratton and Irvine (2022), summer range-wide occupancy declined by 28% from 2010 to 2019. Similarly, Whitby et al. (2022), using data collected from mobile acoustic transects, found a 53% decline in range-wide relative abundance from 2009 to 2019; they found measurable declines in the Northern RPU

(86%), Southern RPU (65%), and Eastern RPU (38%). Deeley and Ford (2022) observed a significant decline in mean capture rates from 1999 to 2019 across the range; estimates derived from their results correspond to a 12% decline in range-wide mist-net capture rates compared to pre-WNS capture rates. They found that capture rates decreased 19%, 16%, and 12%, in the Eastern RPU, Northern RPU, and Southern RPU, respectively.

3.1.3 Threats to Tree-roosting Bats

Conservation needs and threats to northern long-eared bat and tricolored bat are discussed in their listing notices and SSAs. Due to similarities in biology and geography, the tree-roosting bat species addressed in this BO face similar threats to their survival. Common threats are addressed and summarized below.

White-nose Syndrome (WNS)
In recent years, no other threat is more severe and immediate for the northern long-eared bat and tricolored bat than WNS. Since first observed in New York in 2006 (Meteyer et al. 2009), WNS has spread rapidly in bat populations from the Northeast U.S. to the Midwest and to the Southeast and Interior West, and more recently to the Pacific Northwest. As of February 2024, WNS has been confirmed in 40 states and eight Canadian provinces, and there is evidence that the causative fungus of WNS, *Pseudogymnoascus destructans* (Pd), is present in three additional states and two additional Canadian provinces; currently, 12 bat species in North America have been confirmed with WNS (White-Nose Syndrome Response Team 2024).

The range-wide Indiana bat population has decreased by 19.2% since arrival of WNS in New York State from 2007 to 2019 (Service 2019). While this decrease has contributed to downturns in Indiana bat numbers in some RUs, it has not afflicted them range-wide in the manner that WNS has affected northern long-eared bat and tricolored bat. It is unlikely that northern long-eared bat populations would be declining so dramatically without the impact of WNS. Cheng et al. (2021) concluded that WNS caused 97 to 99% population declines in northern long-eared bat populations in the eastern United States (across 79% of the species range), and that 36% of the little brown bat's range and 59% of the tricolored bat's range are being threatened by the presence of WNS. It appears that WNS will continue to spread throughout the ranges of the northern long-eared and tricolored bats.

Studies have found that there are additional energetic demands for Indiana bats in areas where WNS is present. For example, WNS-affected bats have lower fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012; Warnecke et al. 2012) and have wing damage (Meteyer et al. 2009; Reichard and Kunz 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, maintaining enough energy to heal, and successfully undergoing pregnancies and rearing pups.

Other stressors that had no discernable population-level impacts previously, combined with the impact of the disease, could become factors influencing northern long-eared and tricolored bat probabilities of persistence in particular areas or regions. In general, smaller populations are more vulnerable to extirpation resulting from direct impacts or adverse habitat changes than larger populations, especially those that rely on colonial behaviors for critical life history functions. For example, a single bat maternity colony reduced in size by WNS-related mortality and with the remaining individuals weakened by the disease, would be less likely to adapt to the loss or reduction of suitable roosting trees and foraging habitat in its traditional home range than a larger and healthier colony. Repeating this scenario with multiple colonies across a landscape could accelerate the population-level declines caused by WNS alone.

White-nose Syndrome in Tennessee

WNS is greatly impacting winter bats in Tennessee, especially northern long-eared bat, little brown bat, and tricolored bat. Some bat researchers and biologists believe WNS has caused and is leading to extirpation of species from sites (TWRA 2022). WNS and Pd were first documented in Tennessee during the winter of 2009-2010 (Lamb and Wyckoff 2010), when the fungus was found on the three species indicated above in six caves within six different counties. Currently, WNS and Pd are found in 57 of the 77 counties containing caves in Tennessee (74%), and the disease is considered widespread in the state (TWRA 2022).

According to TWRA (2022), winter populations of northern long-eared bat in Tennessee have declined precipitously since 2013. Although, historically, observations of northern long-eared bats in hibernacula in Tennessee have been low, there have only been 36 northern long-eared bats observed in Tennessee during annual winter colony counts since 2015 (Figure 3-2) (TWRA 2022). No observations were made during the 2020-2021 cave survey period. This 100% decline in total observations likely do not indicate complete extirpation, as many of the sites surveyed had not been previously surveyed and not all caves in the state were surveyed. However, such a drastic decline in the number of observations across multiple winters indicates WNS is having detrimental impacts to northern long-eared bats, and therefore, is a high cause of concern for the species in Tennessee.

Summer declines in northern long-eared bats appear to have followed the same trends as winter populations in Tennessee (TWRA 2022). Once commonly captured throughout much of the state, captures for this species during the summer have declined significantly. To demonstrate these declines, the following capture summary has been provided in the *Tennessee Bat Population and White-nose Syndrome Monitoring Report for 2020-2021* (TWRA 2022). Pre-WNS, northern long-eared bats were captured every 4.56 mist net hours or every 2.21 mist net

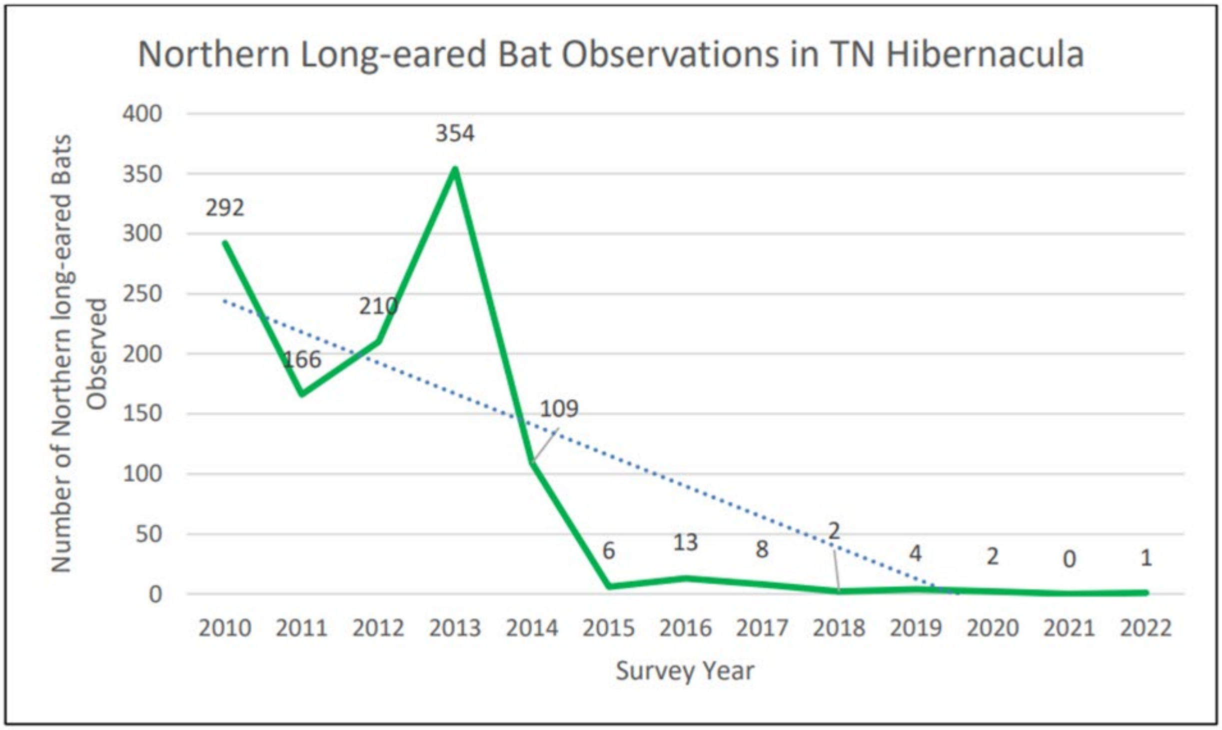

Figure 3.2. Northern long-eared bat observations from winter colony surveys in Tennessee since the introduction of white-nose syndrome (TWRA 2022).

nights, and 100 net hours would produce approximately 21 captures of the species. Post-WNS, captures have significantly declined for the northern long-eared bat. They have been captured every 76.92 mist net hours or every 13.89 mist net nights, and 100 net hours have produced approximately 1.3 captures of the species. Therefore, based on net hours necessary to capture the species, captures during the summer have declined 93.8%, post-WNS, similar to declines observed in winter populations.

The following summaries of winter observations and summer captures for the little brown bat and tricolored bat are included from the Tennessee Bat Population and White-nose Syndrome Monitoring Report for 2020-2021 (TWRA 2022). Tricolored bat constituted over 48% of the 2020-2021 observations, and this species was observed in 64.5% of all caves surveyed. Despite being commonly observed, the species continues to decline throughout the state. As with other species, its documented numbers peaked in 2013 but have since declined at an alarming rate. Winter observations continued to decrease 5.51% between the 2019-2020 (1,161 individuals) and 2020-2021 (1,097 individuals) winter field seasons and as of 2020-2021, have declined 49.19% since the 2009-2010 winter survey period. Along with the decrease in total observations, the number of tricolored bats observed per cave survey has declined significantly since 2009-2010. During 2009-2010, the average number of tricolored bats observed per cave was 59.97; however, the average number of individuals observed per cave during 2020-2021 was 9.97.

A similar pattern has emerged for tricolored bat in Tennessee when assessing summer captures. Pre-WNS summer surveys (2005–2009) resulted in 100 mist net hours producing approximately 14 tricolored bat captures. Post-WNS captures (2009-2020) of tricolored bats have declined significantly, with 100 mist net hours now producing approximately two tricolored bat captures. Tricolored bat captures during the summer have declined 85.7% when comparing captures per net hour (7.09 pre-WNS mist net hours versus 43.48 post-WNS mist net hours) and are almost twice that of declines observed during winter surveys.

WNS was first reported in Tennessee by TWRA in 2010 when the agency began monitoring winter observations of bats. The annual survey data presents clear evidence that populations of the species susceptible to WNS bottlenecked by 2015 (TWRA 2022). Therefore, the Service's Tennessee Ecological Service's Field Office (TNFO) categorizes data up to the year 2014 as "pre-WNS" and data from 2015 to present as "post-WNS."

Forest Fragmentation and Habitat Modifications

Forests used by foraging and roosting bats during spring, summer, and fall have changed dramatically from pre-settlement conditions, and loss of deciduous forest landcover has decreased bat habitats that influence survival and reproduction of bat colonies across their ranges (Service 1999, 2021). The U.S. Department of Agriculture (USDA), U.S. Forest Service (USFS) summary of forest trends (USDA, USFS 2014) reported a decline in forest acreage from 1850 to the early 1900s, when forests were converted to other land cover types or native plant communities were altered. Over the next century, other land cover types (mostly cropland) were converted to forest through tree planting or pioneer-field succession. From 2001 to 2006, the U.S. lost 1.2% of its total forest acreage, mostly in the Southeast and West. Interior forests (40-ac parcels comprised of at least 90% forest cover) experienced a net loss of 4.3%. Although it is difficult to quantify the resultant impacts that forest fragmentation has caused to bat habitats, especially summer habitats, it is suspected in contributing to the decline in numbers of tree-roosting bat species (Service 1999, 2022). These changes in landcover may be associated with losses of suitable roosting or foraging habitats, longer flights between suitable roosting and foraging habitats due to habitat fragmentation, fragmentation of maternity colony networks, and direct injury or mortality (Service 2022).

Summer habitat can include extensive forests or small woodlots connected by hedgerows. The removal of such habitats is occurring rapidly in some portions of the Indiana and northern long-eared bats' ranges due to residential and commercial development, mining, oil and gas development, and infrastructure development, including roadways and utility corridors. Even in areas of relatively abundant habitat, permanent and temporary impacts to forest habitat pose mortality risks to Indiana bats and northern long-eared bats during tree felling activities. Impacts from forest habitat removal may range from minor (e.g., removal of a small portion of foraging habitat in an unfragmented forested area with a robust bat population) to significant (e.g., removal of roosting habitat in a highly fragmented landscape with a small, disconnected population). Adverse impacts are more likely in areas with little forest or highly fragmented forests, as there is a higher probability of removing roosts or causing loss of connectivity between roosting and foraging habitats (Service 2022). Furthermore, the ongoing, permanent loss of forests and woodlots may have a significant cumulative effect on bats as habitat is lost, fragmented and/or degraded, and as maternity colonies are displaced from habitat to which they exhibit fidelity (Service 2012).

According to the SSA for the tricolored bat (Service 2021), while temporary or permanent habitat loss may occur throughout the species' range, impacts to the tricolored bat and its habitat typically occur at a more local scale (i.e., individuals and potentially colonies), with impacts from loss of habitat varying dependent upon the timing, location, and extent of the removal and may range from minor to significant. Adverse impacts are more likely in areas with less forest or highly fragmented forests (e.g., western U.S. and central Midwestern states), where there is a higher probability of removing roosts or causing loss of connectivity between roosting and foraging habitat.

Wind Turbines
Mortality by wind turbine collision has been recorded for 24 of North America's 47 bat species (American Wind Wildlife Institute 2018). Bats are vulnerable to mortality and injury associated with the rotating turbine blades, either by collision or barotrauma (pressure-change injury). Compared to many passerine birds, wind turbines may have a more pronounced negative impact on migratory tree-roosting bats. At the majority of U.S. wind facilities that have been examined, bat mortality has been estimated to be higher than bird mortality (Schuster et al. 2015; Allison, et al. 2019), with estimates of annual bat fatalities in North America totaling between 600,000 to 949,000.

There are many ongoing efforts to improve our understanding of bat interactions with wind turbines and to explore additional strategies for reducing bat mortality at wind facilities. To date, operational strategies, such as "feathering" turbine blades (i.e., pitching turbine blades parallel with the prevailing wind direction to slow rotation speeds at low wind speeds when bats are most likely to be active) (Hein and Straw 2021) are the only broadly proven and accepted measures to reduce the severity of impacts.

Climate Change
The capacity of climate change to result in changes in the range and distribution of wildlife species is recognized, but detailed assessments of how climate change may affect specific species, including bats, are limited. Bats are sensitive to changes in temperature, humidity, and precipitation (Adams and Hayes 2008). For example, only a small proportion of caves provide the right conditions for hibernating Indiana bats because of the species' very specific temperature and humidity requirements.

Climate change may affect bats through changes in food availability, timing of hibernation and reproductive cycles, frequency and duration of torpor, rates of energy expenditure, and rates of juvenile bat development (Sherwin et al. 2013). Surface temperature is directly related to cave temperature, so climate change that involves increased surface temperatures may affect the suitability of hibernacula. Therefore, climate change may result in shifting of bats from southern to northern hibernacula (Clawson 2002).

Observed climate-related impacts for some species of insectivorous species, such as little brown bat, include reduced reproduction due to drought conditions with decreased availability of drinking water (Adams 2010) and reduced adult survival during drought years in the Northeast (Frick et al. 2010). While sufficient moisture is important, too much precipitation during the spring can also result in negative consequences to insectivorous bats. During anticipated heavier precipitation events, there may be decreased insect availability and reduced echolocation ability (Geipel et al. 2019), resulting in decreased foraging success. Precipitation also dampens bat fur, reducing its insulating value (Webb and King 1984; Burles et al. 2009) and increases a bat's metabolic rate (Voigt et al. 2011). Bats are likely to reduce their foraging bouts during heavy rain events, and reduced reproduction has been observed during cooler, wetter springs in the Northwest (Grindal et al. 1992; Burles et al. 2009). Responses will vary throughout bats' ranges based on the extent of annual temperature rise in the future.

The Service currently has no evidence demonstrating population-level climate change impacts to bats. The rapid spread of WNS across their ranges likely masks any effects of climate change on their status.

Wiens et al. (2022) used available data from hibernacula surveys to estimate the annual impacts of WNS relative to the year of arrival of Pd; their analysis predicted that Pd is present at 99 to 100 percent of documented northern long-eared bat hibernacula. Although variation exists among sites, an overwhelming majority of hibernating northern long-eared bat colonies have developed WNS and experienced serious impacts within two to three years after the arrival of Pd (Cheng et al. 2021; Wiens et al. 2022). The vast majority of northern long-eared bat colonies exposed to Pd have developed WNS and will continue to experience impacts from the disease (Cheng et al. 2021; Wiens et al. 2022).

The coastal plain of North Carolina is a possible refuge from the WNS epidemic for the northern long-eared bat. The species has been found to be active year-round on the southern coastal plain, where there are no known traditional hibernacula (i.e., caves or mines) and no symptoms of WNS (Grider et al. 2016; Jordan 2020). Torpor for northern long-eared bats on the coastal plain was observed, but time spent in torpor was very short with the longest torpor bout (i.e., hibernation period) for each bat averaging only 6.8 days (Jordan 2020).

WNS was predicted to reach 100 percent of the tricolored bat's range in the U.S. by 2025 (Wiens et al. 2022). WNS is estimated to be impacting 85 to 100 percent of hibernacula for both the tricolored bat and little brown bat (Wiens et al. 2022) and has resulted in most winter colonies experiencing dramatic declines in abundance compared to historical conditions (Cheng et al. 2021).

3.2 Blackside Dace

As previously stated, critical habitat has not been designated for the blackside dace. At the time of its listing, the Service determined that designation of critical habitat was not prudent for the species (52 FR 22580- 22585). The Service believed that the designation and publication of critical habitat areas would increase the species' vulnerability to illegal taking and/or vandalism, further threaten the species survival, and increase law enforcement problems. The Service decided that protection of the species' habitat could best be accomplished by providing suitable habitat locations to all appropriate local, state and Federal agencies, and that additional protection of the species' habitat would be addressed through Federal recovery and consultation processes.

3.2.1 Blackside Dace Life History

The biology of blackside dace is only partially understood. Feeding habits and reproductive characteristics were investigated by Starnes and Starnes (1981), who reported schools of 5 to 20 fish grazing on rocks and sandy substrates. Gut analyses revealed that sand comprised the largest portion of the species' gut (36 percent). The remaining portions of the gut were composed of unidentified organisms (32 percent), algae and diatoms (12 percent) and macroinvertebrates (4.5 percent). However, during the winter, macroinvertebrates (mostly aquatic insect larvae) composed the entire diet (Starnes and Starnes 1981).

The spawning period for the species extends from April until July (Starnes and Starnes 1981), but spawning individuals have been observed in late March in the Rock Creek basin, a tributary of Jellico Creek in southeastern McCreary County, Kentucky. Eggs are typically deposited in fine gravel, primarily in nests constructed by other species such as creek chubs (*Semotilus atromaculatus*) (Cicerello and Laudermilk 1996) and central stonerollers (*Campostoma anomalum*) (Starnes and Starnes 1981). Creek chub nests appear to be used more often than stoneroller nests, as suggested by Cicerello and Laudermilk (1996). Interestingly, Lewis and Cashner (2015) reported that creek chubs will defend their nest mounds, but they tolerate nest associates that exhibit bright red hues when they are spawning, including blackside dace.

In a study of blackside dace reproductive behavior, Mattingly and Black (2007) provided evidence that blackside dace rely heavily on creek chubs as a nest-building spawning associate, perhaps in an obligatory fashion. Mattingly and Black (2007) observed 25 spawning events, and all of these events took place over creek chub nests; there was no evidence that blackside dace spawned independently. It is suspected that the species takes advantage of other species' nests because these habitats provide the most abundant silt-free substrates in much of the species' current range and possibly afford the eggs some protection from predators by guarding these nests. Rakes et al. (2013) were successful in enticing captive blackside dace to spawn without any cues from other nest building fish species, but they did construct a rock mound similar to the nest constructed by creek chubs. However, it remains unknown whether the species will construct nests independent of other species in natural streams if suitable substrates are available (Mattingly, personal communication).

Scherer & Santangelo (2013) studied a large, healthy, stable population of blackside dace in Big Lick Branch in the Daniel Boone National Forest (DBNF) in Kentucky, to quantify physical stream characteristics associated with spawning habitat. They found 16 active nests during their surveys between early May and mid-June. Nests found were all shallow, but well-defined gravel pits, often located at the downstream ends of pools. More than half the nests observed by Scherer and Santangelo (2013) were at depths of 10-15 centimeter (cm), with flows between 0.06 and 0.14 meters per second (m/sec); 75% of the nests they observed were placed one third to halfway from stream bank, closer to the center of the stream channel than the bank. They observed at least five and up to 20 or more males over these nests during their observations.

While they were seen in the stream, but not observed constructing nests, Scherer and Santangelo (2013) assumed creek chub (*Semotilus atromaculatus*) was the nest-building associate in Big Lick Branch. These authors suggested that blackside dace benefit from nest selection choices made by other species, but they also commented that several inactive nests were observed, indicating that the dace may also discriminate between nests and choose ones that they consider to be better.

Starnes (1981) observed spawning in May at water temperatures of approximately 64 degrees Fahrenheit (ºF). Females deposited eggs on fine gravel at the edge of an existing stoneroller nest located in a run area. Adults are capable of spawning at age one (I) and have a lifespan of three to four years (Starnes and Starnes 1981); females appear to have greater survivorship (Starnes and Starnes 1981). Starnes and Starnes (1981) reported the sex ratio in September as 21 males to 29 females and in April as 11 males to 11 females. Based on length-frequency and scale data, growth rates were similar for males and females (age 0, 20 to 24 millimeters [mm] [approximately 0.8 to 1-in] standard length [SL]; age I, 39 to 57 mm [approximately 1.5 to 2.2 in] SL; and age II, 62 to 64 mm [approximately 2.4 to 2.5 in] SL). The fastest growth occurred during the first year and then gradually declined during the second and third years (Starnes and Starnes 1981).

Fish species commonly found in association with blackside dace include the creek chub, central stoneroller, white sucker (*Catastomus commersoni*), northern hogsucker (*Hypentelium nigricans*), green sunfish (*Lepomis cyanellus*), stripetail darter (*Etheostoma kennicotti*), arrow darter (*E. sagitta sagitta*) and rainbow darter (*E. caeruleum*) (Starnes and Starnes 1978, O'Bara 1990, Mattingly et al. 2005). Additional species that may occur along with blackside dace include the bluntnose minnow (*Pimephales notatus*), silverjaw minnow (*Notropis buccata*), striped shiner (*Luxilus chrysocephalus*), longear sunfish (*Lepomis megalotis*), and redbreast sunfish (*Lepomis auritus*).

Mattingly et al. (2005) and Detar and Mattingly (2013) studied movement patterns (frequency, spatial extent, directionality and environmental correlates) of the species by tagging 653 blackside dace from Big Lick Branch (Pulaski County, Kentucky) and Rock Creek (McCreary County, Kentucky) with visible implant elastomer injections. Dace were re-captured from February 2003 through March 2004 using baited minnow traps. The majority of tagged dace (81% in Big Lick Branch and 58% in Rock Creek) were recaptured within the 200-meter (m) (approximately 656 ft) stream reach where tagging had occurred. However, several individuals moved considerable distances from the original tagging site, including the first documented inter-tributary movement for the species. Mean distances of upstream movement in these two systems (148 ± 138 m [486 ± 453 ft] in Big Lick Branch; 733 ± 1,259 m [2,405 ± 4,131 ft] in Rock Creek) were not statistically different from mean distances of downstream movement (77 ± 29 m [253 ± 95 ft] in Big Lick Branch; 314 ± 617 m [1,030 ± 6,640 ft] in Rock Creek). However, the mean overall distance moved was statistically greater in Rock Creek, a longer stream, than in Big Lick Branch; maximum distances moved in Big Lick Branch and Rock Creek were 1 kilometer (km) (0.6-mile [mi]) and 4 km (2.5 mi), respectively. These results were similar to those of other fish movement studies, suggesting that some stream fish populations are comprised of a relatively large sedentary group and a small mobile group (Freeman 1995, Smithson and Johnston 1999, Rodriguez 2002).

3.2.2 Blackside Dace Habitat Characteristics and Use

Habitat for blackside dace consists of small (generally 4 to 15 ft wide), cool (rarely exceeding 80 ºF), upland streams with moderate flows and generally, silt-free substrates (Starnes and Starnes 1978, 1981, O'Bara 1985, 1990, U. S. Fish and Wildlife Service 1988, 2015, Mattingly et al. 2005, Black et al. 2013a, b, Mattingly and Black 2013b). Streams inhabited by the species are generally those with good riparian vegetation that provide at least 70 percent canopy cover and numerous submerged root wads, undercut banks and large rocks (U. S. Fish and Wildlife Service 1988). Blackside dace rarely have been found in low-gradient streams or high-gradient tributaries (O'Bara 1985, U. S. Fish and Wildlife Service 1988, 2015a, Black et al. 2013a). A riffle to pool ratio less than 60:40 and elevations ranging from 300 to 500 m (984 to 1,640 ft) above mean sea level (msl) appear to be preferred by the species (Starnes and Starnes 1981, O'Bara 1990). Streams with higher riffle to pool ratios (above 60:40) harbor fewer populations of blackside dace and tend to be dominated by blacknose dace (*Rhinichthys atratulus*) and creek chubs.

These descriptions are also supported by the results of a blackside dace survey in a stream located partially on the DBNF in Kentucky reported by Leftwich et al. (1995). They surveyed all available habitat units in the stream and found blackside densities increased from downstream to upstream reaches, with most blackside dace (75 percent or more) found in pools, and the remainder in riffles. The stream contained a total of 11 species of fish, including non-native rainbow trout.

Also, Hitt et al. (2016) used range-wide collections of blackside dace to construct a model that identified the species' persistence in relation to important landscape and other variables. The model included conductivity, stream temperature, slope, and watershed area (mean watershed areas of 20 km^2) as the four most important variables, explained 75.7 percent of the total variance in the data they analyzed. Blackside dace occurrence probability decreased as conductivity values increased from the 13 microsiemens per centimeter (µS/cm) minimum observation to approximately 400 µS/cm, and in watersheds smaller than approximately 20 km^2, above both levels which the species' occurrence probability was diminished. Stream temperature was nearly as important (less than 20°C) as conductivity.

3.2.3 Blackside Dace Population Dynamics / Status and Distribution

The species' distributional area includes the Cumberland River upstream of Cumberland Falls and tributaries to the Cumberland River downstream of Cumberland Falls, upper Kentucky River system, and the upper Tennessee River system (U. S. Fish and Wildlife Service 2015a and see Figure 8).

Range-wide surveys completed during the periods of 1982−1994, 2003−2006, and 2010−2012 demonstrate that the species has likely been extirpated from 31 streams (Laudermilk and Cicerello 1998, Black et al. 2013b, Compton et al. 2013, U. S. Fish and Wildlife Service 2015a). Populations of the blackside dace continue to persist in 125 streams, including: (1) the upper Cumberland River drainage in eight Kentucky counties (Bell, Harlan, Knox, Laurel, Letcher, McCreary, Pulaski and Whitley) and three Tennessee counties (Scott, Campbell and Claiborne)

(Burr and Warren 1986, Mattingly et al. 2005, Black et al. 2013b, Skelton 2013), (2) the upper Kentucky River drainage in one Kentucky county (Perry County in the Maces Creek watershed) (U. S. Fish and Wildlife Service 2015a), and (3) the Powell and Clinch River drainages in two Virginia counties (Lee and Scott) (U. S. Fish and Wildlife Service 1988, Laudermilk and Cicerello 1998, Skelton 2007, Black et al. 2013b, U. S. Fish and Wildlife Service 2015a). Blackside dace were captured at 52 of 72 sites (25 of 28 streams) in the upper Cumberland River basin using single-pass electrofishing. The majority of sites (58 percent) had catch rates of ten or fewer dace per 200-m site, and 70 or more dace were captured in only 7 of the 72 sites.

Strange and Burr (1995) investigated the genetic variation and meta-population structure of the species. Their research revealed the presence of three or four meta-population units: one centered in the upper Poor Fork through Straight Creek stream systems (Group A), another unit comprised the stream systems from Stinking Creek to Youngs Creek (Group B), a third centered around Marsh and Jellico creeks (Group C), and a potential fourth comprised of streams below Cumberland Falls. A cladistic analysis of gene-flow indicated that Group B was the center of dispersal for blackside dace mitochondrial-DNA haplotypes. In order to preserve blackside dace genetic diversity, Strange and Burr (1995) recommended that recovery plans treat the meta-populations as management units, employing carefully planned re-introductions and habitat protection.

3.2.4 Threats to Blackside Dace

The recovery plan attributed the loss of many blackside dace populations to impacts associated with the extraction of coal and timber resources in Kentucky and Tennessee (U. S. Fish Wildlife Service 1988). Coal mining-related problems were identified as the primary threat to the species, followed in order of importance by logging, road construction, agriculture, human development and naturally low stream flows (U. S. Fish Wildlife Service 1988). All of these threats remain, but the overall decline of blackside dace can be attributed to a variety of human-related activities in the upper Cumberland River drainage. Resource extraction (e.g., surface coal mining, logging, oil/gas well exploration), land development, rural residential land use, road construction and agricultural practices have all contributed to the degradation of streams within the species' range (Mattingly et al. 2005, Kentucky Division of Water 2010, 2011, 2013, Tennessee Department of Environment and Conservation 2014).

These land use activities have led to chemical and physical changes to stream habitats that have adversely affected the blackside dace and other fishes. Specific stressors have included inputs of dissolved solids and elevation of instream conductivity, inputs of nutrients and organic enrichment, sedimentation/siltation of stream substrates (excess sediments suspended or deposited in a stream), the removal of riparian vegetation, and the relocation or straightening of stream channels (Kentucky Division of Water 2011, 2013). Some of the most recently identified stream reaches where water or habitat quality is potentially affecting blackside dace populations include listings by the Kentucky Division of Water (2013) and the Tennessee Department of Environment and Conservation (2014), which identified portions of 27 streams in Kentucky and seven streams in Tennessee as impaired on their respective 303(d) lists.

Black et al. (2013a) developed a model to predict occurrence of blackside dace. They found that specific conductivity (below 240 microsiemens per centimeter, µS/cm, during summer) was a good predictor of blackside dace presence and persistence. However, the mechanism of effect for impacts of elevated conductivity to blackside dace remains unknown. While streams with high levels of conductivity may drain areas affected by various land uses (natural gas extraction, silviculture and urbanization), surface coal mining can also increase the conductivity of receiving streams (McAbee et al. 2008, 2013).

Blackside dace are consumed by natural predators; however, there is no evidence that predation is a significant threat to the species. The species has evolved with various predators over thousands of years and has continued to persist. Disease is not known to be a threat to the species. Mattingly and Floyd (2013) summarized the status of blackside dace and listed a variety of natural and anthropogenic impacts affecting the species, alteration of habitat by beaver impoundment, including natural resource extraction, stream channelization, bridge or culvert construction that might prevent barriers to movement, and loss of, and alteration of, riparian vegetation. Eisenhour and Floyd (2013) described culvert barriers to blackside dace movement.

Climate change is expected to affect water quality, quantity in both inland and coastal areas, and alter the seasonal changes in stream flow. Specifically, precipitation is expected to occur more frequently via high-intensity rainfall events, causing increased runoff and erosion. More sediments and chemical runoff will, therefore, be transported into streams and groundwater systems, impairing water quality. Water quality may be further impaired if decreases in water supply cause nutrients and contaminants to become more concentrated. Rising air and water temperatures will also impact water quality by increasing primary production, organic matter decomposition and nutrient cycling rates in lakes and streams, resulting in lower dissolved oxygen levels. This suite of water quality effects will increase the number of water bodies in violation of today's water quality standards, worsen the quality of water bodies that are currently in violation, and ultimately increase the cost of meeting current water quality goals for both consumptive and environmental purposes (Adams and Peck 2008).

4 ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the northern long-eared bat, tricolored bat, and blackside dace, their habitats, and ecosystems within the Action Area. The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation/conference and does not include the effects of the Action under review.

The entire 925-ac project area of Hurricane Creek Mine #2 is located in Claiborne County, Tennessee, approximately five miles southeast of the junction of Tennessee State Highway 90 (TN SR 90) and Valley Creek Road (Figure 2-1). Much of the area within the permit boundary was mined in the 1950's, 1960's, early 1970's, and 2000's. Although little or no reclamation has occurred on these areas, they have largely undergone natural succession to secondary forests. In addition, logging has periodically occurred during the same timeframe, and oil and gas exploration with their associated disturbances are common in this area. Roadbeds remaining from these historic land uses in the area crisscross the ridges (Office of Surface Mining Reclamation and Enforcement 2024).

The current land use within the proposed permit area is best defined as undeveloped forest that functions as fish and wildlife habitat. Roads left in place since completion of previous mining activities will provide most of the needed access between the mine site and public roads, and ponds remaining on previous mine sites will provide the foundation for some sediment control basins to be used in conjunction with the proposed mining (Office of Surface Mining Reclamation and Enforcement 2024).

Precipitation and runoff from the proposed mine site drains to the Clear Fork and Yellow Creek watersheds - drained locally by Valley Creek and Tackett Creek in the Clear Fork system, Bennett's Fork in the Yellow Creek system, and various unnamed tributaries of these streams.

4.1 Numbers, Reproduction, and Distribution of Bats within the Action Area

Biological Systems Consultants, Inc. conducted acoustic and mist net surveys in the proposed project area in 2013 (Biological Systems Consultants, Inc. 2013d); four northern long-eared bats, three adult females (two post-lactating and one non-reproductive) and one adult male, were captured during these surveys over 20 net nights. Acoustical monitoring was also performed, resulting in identification of calls of the northern long-eared bat and tricolored bat. Because presence of the northern long-eared bat and tricolored bat in the action area has been verified, OSMRE has assumed their presence near the mine permit site during the non-hibernating season (April 1 – September 30). It is important to note that WNS has decimated northern long-eared bat populations since 2013, and no northern long-eared bats have been captured in summer mist-net surveys across the state of Tennessee since 2017. Although tricolored bats have also declined significantly due to WNS, they are still captured regularly in summer mist-net surveys across the state. Suitable summer habitat for each species (maternity roost trees and foraging habitat) occurs throughout portions of the Bat Action Area. The "Action Area" for this consultation includes the 925-ac project footprint and a Bat Action Area of 1,148 ac (see Section 2.1.1).

4.2 Numbers, Reproduction, and Distribution of Blackside Dace within the Action Area

According to OSMRE data, blackside dace were identified in the 1994 and 1995 surveys of Little Tackett Creek (one individual in 1994 and five in 1995), the 2000 survey of Bennetts Fork (one individual), and the 2013 survey of Spruce Lick Branch (one individual), which is a tributary to Tackett Creek. While Little Tackett Creek would not receive any drainage from the mining or associated activities (e.g., coal transport off the mine site), Spruce Lick Branch and Bennetts Fork will both receive drainage from the Action Area. Six total specimens have been collected from Little Tackett Creek (1994 and 1995). A single Spruce Lick Branch specimen was observed in 2013, and recent (2015 and 2016) surveys in the mainstem of Tackett Creek upstream of Spruce Lick Branch resulted in the collection of a few blackside dace individuals (Biological Systems Consultants 2016). The extent and status of the Tackett Creek population remains largely unknown (U. S. Fish and Wildlife Service 2015d). However, recent surveys in the Valley Creek watershed have not identified the presence of blackside dace.

Results of a multi-agency blackside dace survey (U. S. Fish and Wildlife Service 2015) and surveys by Biological Systems Consultants, Inc. (2011, 2012, and 2013) demonstrated that, at least through 2015, water quality and habitat conditions were good in upper Tackett Creek, although Carter (personal communication 2016) indicated a considerable amount of sediment deposition there. Beaver presence in the system has resulted in some impoundments and siltation. However, in spite of these impacts, Cumberland arrow darters (*Etheostoma sagitta*) were abundant in the surveyed reach in addition to the blackside dace individuals observed there (U. S. Fish and Wildlife Service, unpublished data). Cumberland arrow darter is an at-risk fish species found in Kentucky and Tennessee (80 FR 60834). Tackett Creek surveys downstream of the Spruce Lick Branch confluence noted that water quality and habitat were poor, with high conductivity, siltation, and embedded substrates (U. S. Fish and Wildlife Service, unpublished data 2016).

The observation of a few individual blackside dace in Spruce Lick Branch (Eisenhour (2013) and the mainstem of upper Tackett Creek (U. S. Fish and Wildlife Service 2015, Biological Systems Consultants Inc. 2016) where there have been numerous previous and subsequent negative surveys (U. S. Fish and Wildlife Service 2015, Biological Systems Consulting, Inc. 2014, Office of Surface Mining Reclamation and Enforcement 2016) suggest that undiscovered blackside dace population(s) may exist in other Tackett Creek tributaries in the vicinity. These inconsistent blackside dace tributary observations also support the idea that the larger streams in this system (Tackett Creek and Valley Creek, for example) may be occasionally used as dispersal corridors, providing a route by which blackside dace individuals travel between populations or attempt to colonize new areas.

Two blackside dace were documented during electroshocking surveys within the upper portion of Tackett Creek in 2023 (Biological Systems Consultants 2023). Sampling of Spruce Lick Branch, a stream in which the species had previously been found, did not yield any blackside dace. Dr. Michael Floyd (pers. comm. 2025) indicated that, on average, electroshocking sampling methodology results in documentation of approximately 30 percent of existing blackside dace population numbers. Therefore, we estimate that approximately six individuals are present within the area of concern for this project, including Tackett Creek, Burrell Creek, and their tributaries.

The Blackside Dace Action Area for the project addressed by this BO involves 461 ac, which includes 200-ft buffers (100 ft on each side of streams) along 9.8 miles of stream (2.5 mi of Spruce Lick Branch, 3.1 mi Tackett Creek, and 4.2 mi of tributaries).

4.3 Action Area Conservation Needs and Threats

Approximately one-third (346 ac) of the total proposed project area (925 ac) was previously mined for coal from the 1950s through the early 1970s, and an additional 25 percent of the mine permit area was mined and reclaimed post-SMCRA (Office of Surface Mining Reclamation and Enforcement 2016). OSMRE’s BA (Office of Surface Mining Reclamation and Enforcement 2024) indicated that approximately 6.5 mi of un-reclaimed highwall and the existing haul roads that will be used for the proposed mining remain from those previous mining activities. These roads have undergone continuing use at various times throughout the years for transporting coal and timber from the proposed project area and adjacent areas and to provide general access to the area. Spoil ridges and orphan pits, remaining after previous pre-SMCRA mining activities, have diverted surface water transport within the action area. Surface runoff is detained in the orphan pits and is introduced into streams via road culverts, eroded windows, and/or gullies. Gullies through abandoned spoil banks are often created naturally by erosion, and "windows" have been cut occasionally through spoil banks by people in order to facilitate water drainage. Surface runoff from above mined areas undergoes sheet flow across backfilled slopes into drainage ditches, which flow directly to streams. Valley Creek and portions of the Tackett Creek watershed currently receive the drainage from previous surface and underground mining activities, resulting in water quality issues (primarily elevated sulfates and specific conductance levels).

Previous land-clearing activities have temporarily or permanently reduced the amount of suitable summer habitat available to the northern long-eared bat and tricolored bat. Much of the forestland has now gone through several successional stages and currently provides habitat for both bat species, but existing roads and other areas cleared for agriculture, residences, etc. remain and have contributed to habitat loss. In summary, historical coal mining activities and associated remnant disturbances, along with impacts caused by logging, agriculture, residential development, oil/gas disturbances (exploration and well development, maintenance and abandonment), and road building and maintenance activities have impacted aquatic and terrestrial habitats within the action area.

Threats to the two bat species within the Action Area for this project are the same as the range-wide threats described in Sections 3.1.3 (with the exception of wind turbines). Removal of forested habitat and ongoing disturbances (i.e., noise, vibrations, and lighting) are of greatest concern to bats in the Bat Action Area due to the nature of the proposed Action, and additional precautions should be taken to minimize pollution of the surface waters that bats use in conjunction with foraging.

Sediment deposition and introduction of other pollutants (i.e., dissolved solids, selenium, etc.) are the primary threats to blackside dace. Water quantity inputs to the upper Tackett Creek, Spruce Lick Branch, and Burrell Creek systems will also be important in recovery of the blackside dace in the local part of its distributional area. Mattingly and Floyd (2013) and U. S. Fish and Wildlife Service (2015a) summarized the threats that continue to affect blackside dace throughout its range in spite of state and federal regulatory mechanisms that could potentially protect the species. Human-induced land and water use changes were included in these discussions (i.e., improper stream riparian zones, stream channel alterations, and culvert and dam passage barriers). However, persistent effects of legacy and current surface coal mining activities continue to impact the habitat and water quality of streams in the Action Area that were historically occupied and continue to be occupied or transitionally used by blackside dace.

5 EFFECTS OF THE ACTION

This section analyzes the effects of the proposed federal Action on the northern long-eared bat, tricolored bat, and blackside dace including all consequences to these species that would be caused by the proposed Action over the next 40 years (i.e., the approximate timeframe during which significant use of trees as roosts by bats will not likely occur). A consequence is caused by the proposed Action if it would not occur but for the proposed Action and it is reasonably certain to occur. Effects of the Action may occur later in time and may include consequences occurring outside the immediate area involved in the Action (50 CFR §402.02).

Components of the Action are expected to result in stressors to the northern long-eared bat, tricolored bat, and blackside dace; and they require this BO for ESA compliance purposes. The following sections review the best available data about the stressors associated with each Action component and the responses of bats and fish to these stressors. However, in the following paragraphs in this section, we first dismiss from further analysis any potential stressors that are not likely to have measurable or detectable effects on bat numbers, reproduction, or distribution, or on the availability of roost tree or prey resources for any bat colonies that may occupy the Action Area.

Upgrading the existing roads, rather than installing new public roads with high traffic volume, is not likely to result in collisions or affect the blackside dace.

5.1 Stressor: Tree Removal

Tree-roosting bats use networks of multiple roost trees within their home ranges and show fidelity to roosts used in previous years (see Section 3.1). However, trees are an ephemeral resource, especially the trees preferred for roosting, which are typically dead or dying, with cavities, crevices, exfoliating bark, and other characteristics of decay or senescence. Despite the observed use of the same roosts between years, these species must seek new roosts as necessary when traditional roost trees inevitably fall. Potential bat responses to roost loss, caused by natural factors or felling by humans, depends on when the loss occurs during the annual life cycle: (a) when non-volant pups (or adults in torpor) are present in the tree; (b) other times during the active season; or (c) during the inactive (winter hibernation) season. Removal of an occupied roost tree during the spring, summer, or fall has direct and immediate effects. Removal of an unoccupied roost tree has indirect (later in time) effects (Service 2022).

Silvis et al. (2014) modeled the effects of roost loss on northern long-eared bats, and Silvis et al. (2015) removed known roosts during the winter to investigate the effects. Overall location and spatial size of colonies was similar pre- and post-treatment. Patterns of roost use before and after removal treatments were also similar. Roost height, DBH, percent canopy openness, and roost species composition were similar pre- and post-treatment. However, once removals exceeded 20–30% of documented roosts (ample similar roosts remained), a single maternity colony network started showing patterns of break-up. Sociality is believed to increase reproductive success (Silvis et al. 2014), and smaller colonies could experience reduced reproductive success, providing less thermoregulatory benefits for adults in cool spring temperatures and/or for non-volant pups. Fitness benefits of colonial roosting include minimizing the physiological stress of lactation, creation of more favorable thermal conditions, and cooperative rearing of newborn pups (Olivera-Hyde et al. 2019).

Bennett and Braun (2004) indicated that noise associated with tree cutting on a National Forest, regardless of the felling method used, can cause an Indiana bat to flush, which could result in the bat altering its normal behavior pattern and possibly make it more susceptible to various predators during daylight hours (Mikula *et al*. 2016).

Effects Pathway 1

Activities – Tree felling and loss of habitat value for 40-50 years or more.

Stressor –Relatively long-term (approximately 40-80 years) loss of roosting habitat.

Exposure (time) – Inactive season for tree clearing October 15-March 31.

Exposure (space) – 391 ac (496 maximum) of summer habitat.

Resource Affected – Adult females and males returning to summer roosting areas.

Individual Response – Loss of unoccupied roosts, expenditure of energy to locate new roosts, colony fragmentation decreasing thermoregulatory efficiency.

Effect –Indirect harm related to significant habitat modification and alterations of essential behaviors.

Conservation and Minimization Measures – Removal of trees during the inactive season of October 15-March 31.

Interpretation – Removal of suitable roosting trees when bats are not present could result in non-lethal harm to bats as they re-establish maternity colonies and locate to new alternative roost sites. Foraging over the 391-496 ac of habitat would also be lost until the forest is reclaimed and matures over the next several decades. However, existing habitat located in the general proximity of the permit area is expected to be readily used by bats that may have occupied the Action Area and adjacent areas.

5.2 Stressor: Culvert Replacement and Maintenance

In addition to forested habitats, northern long-eared and tricolored bats are also known to roost in human-made structures during summer months. Tricolored bats roost in bridges and culverts, and occasionally in barns or the underside of open-sided shelters (e.g., porches, pavilions). Therefore, larger culverts and bridges should be considered potential summer habitat (Service 2023).

Tricolored bats use bridges as winter roosting structures in some states, including Louisiana and South Carolina (Newman et. al 2021). Concrete structures seem to be preferred for roosting due to their tendency to retain heat longer than other materials; however, metal and wood structures may also be used with less frequency (Service 2020). Day roosts are typically used by bats between sunrise and sunset and consist of sheltered areas that provide protection from adverse weather conditions and predators (Keeley and Tuttle 1999; Kiser et al. 2002).

Night roosts are generally used by bats between sunset and sunrise to rest, digest food between foraging bouts, conserve energy, and avoid inclement weather (Ormsbee et al. 2007). Bridges with a concrete deck and concrete or metal girders seem to be preferred as night roosts (Keeley and Tuttle 1999; Kiser et al. 2002). This bridge type retains heat into the night, and the chambers between the girders trap heat rising from under the bridge and provide protection from wind, weather, and predators. Night-roosting bats are typically found on the vertical surface of the girder at the intersection with the underside of the deck. Areas near the bridge abutments and over land seem to be preferred over the central portion of the bridge and areas spanning water. Bridges that lack crevices/expansion joints or girders are rarely used as day or night roosts (Adam and Hayes 2000; Feldhamer et al. 2003; Ormsbee et al. 2007); however, structures with cave-like areas or other unique features that provide suitable roosting locations can also provide suitable roosting habitat.

Rehabilitation and replacement of culverts can result in alteration and loss of potential roosting habitat for tricolored bats. Culvert dimensions are a factor in determining the use by bats. Based on review of the use of culverts by bats, the Service (2024) recommends minimum culverts sizes for surveys. A culvert that greater than or equal to three feet in diameter/height or 23 feet in length is considered suitable for bat occupancy (Service 2024). Tricolored bats have been documented in culverts as small as two feet in diameter as reported in Service (2022); however, documented instances of tricolored bat in culverts this small are rare. Culverts less than three feet in height/diameter, regardless of length, are generally not considered suitable for bat occupancy. While bat use of these structures may occur infrequently during this Action, the presence of northern long-eared bats and/or tricolored bats is expected to be very low and the likelihood of culvert use, and adverse effect from culvert work, is discountable.

5.3 Stressor: Burning of Tree Debris

The majority of research on effects of fire upon bats has focused on landscape-level prescribed fire. Forest-dwelling bats were presumably adapted to the fire-driven disturbance regime that preceded European settlement and fire suppression in many parts of the eastern United States. Dickinson *et al*. (2010) used a fire plume model, field measurements, and models of carbon monoxide and heat effects on mammals to explore the risk to tree-roosting bats during prescribed fires in mixed-oak forests of southeastern Ohio and eastern Kentucky. In his study, carbon monoxide levels did not reach critical thresholds that could harm bats in low intensity burns at typical roosting heights for Indiana bats (8.6 m). However, at this height, direct heat could cause injury to the thin tissue of bat ears. Such injury would occur at roughly the same height as tree foliage necrosis (death), or where temperatures reach 60 °C (140 °F). Burning of tree slash/debris piles would expectedly have less far-ranging effects than prescribed fire due to the nature of spatial containment of this activity, and we expect impacts due to this activity to be negligible.

Effects Pathway 2

Activities – Burning of tree debris during disposal activities.

Stressor – Smoke could displace bats roosting or foraging in the vicinity of burn sites.

Exposure (time) – Active season, adult bats are volant (able to fly) (April 1-September 30), but pups are non-volant (May 15-July 31). Burn events would be relatively short in duration.

Exposure (space) – Widely-spaced burn piles within a 500-ac area (635 ac maximum) of surface disturbance to be cleared of trees in preparation for mining.

Resource Affected – Individual roosting and foraging bats only.

Individual Response – Volant adults roosting immediately adjacent to burn piles could flush, and non-volant pups could be exposed to heat and/or smoke.

Effect – Direct and indirect harm as a result of significant alteration of foraging and roosting habitat for maternity colonies. Roosting and foraging bats could require increased effort to find new suitable habitat, expending extra energy with possible reduction in fitness and survival/reproductive success.

Conservation and Minimization Measures – Burning of trees/debris piles will be minimized in duration and conducted under standard protocols for minimizing impacts to adjacent forested habitat.

Interpretation – Direct harm to the two species of bats from smoke exposure is considered discountable due to expectedly short duration and number of burning events.

5.4 Stressor: Noise / Vibration and Lighting

Noise and Vibration

Bats have adapted to noise in some circumstances; however, noise and vibration may still adversely affect bats. Caltrans (2016) reports that bats have evolved to reduce noise levels and potential hearing damage from up to 110 decibels (dB) for echolocation calls - including behavioral avoidance, changing the shape and orientation of the pinnae (attenuates up to 20 dB), closing the cartilaginous fold in the outer ear canal (attenuates 20-40 dB), tympanic reflex (attenuates up to 23 dB), and resonance absorption.

However, bats may be disturbed by activities that cause noise/vibration, which may increase bat arousal during hibernation or reduced fitness during spring emergence. Garner and Gardner (1992) reported that loud noise (e.g., construction equipment, live-fire gun ranges, and aircraft noise) can disturb Indiana bat maternity colonies and suggested that loud activities around or near maternity colonies should be regulated when the species is using the roost. Callahan (1993) noted that an Indiana bat roost tree was abandoned after a bulldozer cleared brush in an area. If pregnant females are required to search for new roosting habitat due to disturbances, it is assumed that such effort would place additional stress on them at a time when fat reserves are low or depleted and when they are already stressed from the energy demands of migration (Service 2007).

There is anecdotal evidence that daytime noise and vibration can cause a bat to flush or abandon a maternity roost; although Garner and Gardener (1992) indicate that disturbance would have to be severe to cause roost abandonment. There is little scientific evidence of such an effect. Additionally, the likelihood of an unknown roost being exposed to intense daytime noise that would cause flushing the roost is low.

Other studies suggest that bats tend to avoid noisy areas. Noise effects on bat foraging and other behaviors will vary in relation to volume, proximity, and duration of noise. Effects from noise attenuate with distance; for example, two studies found no or insignificant effects of traffic noise to bats when they were more than 50 to 150 m (164-492 ft) from the noise source (Bonsen et al. 2015). Pallid bats' (*Antrozous pallidus*) foraging efficiency was reduced when exposed to "noise playbacks replicating acoustic conditions as far away as 640 m (3,000 ft) from a major road and 320 m (1,050 ft) from a natural gas compressor station bunk" (Bunkley and Barber 2015). In an experiment that exposed free-living bats to recorded traffic noise in England, Myotis species substantially decreased their activity in experimental areas where they were exposed to noise (Finch et al. 2020). They found no evidence of habituation across the approximately two to three-month duration of the two study periods in 2017 and 2018 (Finch et al. 2020). The lesser response to ultrasound compared to noise in the sonic spectrum indicated that the noise acted "through general deterrence and avoidance" as opposed to interfering with echolocation (Finch et al. 2020).

Finch et al. 2020 demonstrated noise effects on bats at least 20 m (65 ft) away from the source. Using an online noise attenuator calculator (https://www.calctool.org/waves/distance-attenuation) and assuming normal conditions, terrain, and traffic noise, the study found that a peak of 86 decibels (dB) at 3 m would attenuate over 20 m to 69.5 dB.

Siemers and Schaub (2011) exposed captive foraging bats to playbacks of different types of road noise (continuous and transient) and different amplitudes simulating noise levels with increasing distances from a highway (7.5–50 m). They found that foraging efficiency in the bats decreased proportionally with increasing proximity to the simulated highway. Search times increased by a factor of five in trials simulating noise conditions closest to the highway. The researchers estimated that effect of the highway noise on foraging efficiency was equivalent to a 25-fold decrease in available foraging area for the bats. This effect levels off with distance from the highway, and the authors extrapolated their results to estimate effects up to 60 m from the road. Levels of highway traffic noise typically range from 70 to 80 dBA (decibels adjusted to human hearing levels) at a distance of 15 m (50 ft) from the source (Federal Highway Administration [FHWA] 2003). Using the online distance attenuation calculator at 60 m away from an 80-dBA source (at 15 m), the noise would be 68.1 dBA.

Siemers and Schaub (2011) also determined that even near the highway, bats were still able to detect and localize prey by their rustling movement sounds in about 50 percent of the trials. These results demonstrate that bats may be impeded, but do not tend to be prevented, from foraging effectively next to highways. The studies suggest that bats' acute and highly directional sense of hearing allow them to differentiate and localize the high frequency components of click-like sounds of prey from lower frequency road noise.

The U.S. military has gathered some evidence demonstrating that habituation to noise and vibration does occur in bats and may be less impactful than might be assumed. Martin et al. (2004) evaluated acoustic bat call and thermal imaging video data of bat activity on Fort Knox, Kentucky. They found that preliminary data analysis generally indicated somewhat consistent bat activity in the vicinity of ranges throughout an evening of large and small caliber weapons firing. However, the data analyzed for Martin et al. (2004) only represented a small sample of the entire data set intended to eventually be processed and statistically compared. 3D/Environmental (1996) monitored the foraging behavior of nine tracked Indiana bats on Fort Leonard Wood, MO. Their research indicated that for a small sample size of five Indiana bats, military training activity and noise on specific ranges did not alter their selection of foraging locations on nights with training activities versus nights without training activities. BHE Environmental, Inc. (2002, as reported in U.S. Army Corps of Engineers Research and Development Center-Construction Engineering Research Laboratory (ERDC-CERL) (2005), captured and radio-tracked an adult male Indiana bat on Fort Campbell, KY in June 2002. The Indiana bat was observed foraging and night-roosting in approximately the same location near the impact area on three nights when heavy training activity (frequent, low-altitude helicopter flights and artillery firing) occurred, compared to nights with little or no training activity.

Gardner et al. (1991a, b) observed that Indiana bats continued to roost and forage in an area with active timber harvest. Hom et al. (2016) exposed big brown bats to 20-100 kilohertz (kHz) at 116 dB for one hour and reported little or no influence on echolocation behavior in individual bats. In Zurcher et.al (2010), the authors conclude noise level and lighting from highways was considered to have no effect on the behavior of the bats.

In conclusion, there is experimental evidence of effects to bat foraging above an estimated 68 dBA, but it is uncertain if these observations are biologically significant. For example, most construction sounds are in the 80-90 dBA range, presumably near the source, while jackhammers and other such loud equipment can generate noise up to 120 dBA (American National Standards Institute 2018). Federal regulations (30 CFR 816.97[b]) require that noise associated with blasting may not exceed 129 to 133 db. Construction without loud drilling equipment (80-90 dBA) would attenuate to 68 dBA in just 4 m; and in a forest, noise would travel even less distance. In these cases, noise and vibration up to 90 dB, produced by construction and vehicular traffic, would be localized and in the case of construction, temporary. However, if use of equipment generating noise up to 120 dBA is part of the proposed action, then noise would attenuate to 68 dBA around 120 m from the source. If blasting is part of the proposed action, then noise would attenuate to 68 dBA around 175 m from the source.

Only a significant disturbance close to a roost could cause a bat to flush or abandon a maternity colony; and where there are no known roosts, the chance of this exposure is unlikely. Reduced foraging efficiency or deterrence over a relatively small area compared to the amount of locally available habitat would not be significant enough to impair essential behaviors. We expect rare forest-dwelling bats to be minimally exposed to, or not impacted by this stressor, unless noise and/or vibration is expected to occur adjacent to a known occurrence area and encompass a significant portion of a species' home range. Therefore, for traffic and construction without drilling/blasting adjacent to forest areas outside of known bat occurrence buffers, we expect effects from this stressor to be insignificant - especially when vast amounts of forested foraging areas are available, which is the case in most areas of Tennessee. This may not be the case in some parts of Tennessee where forested habitat is more limited or where noise and vibration up to 120 or 133 dBA over a sizable area would reduce foraging efficiency over a significant portion of a known home range.

For this project, rock drilling and blasting may occur year-round; however, the project proponent will attempt to blast mostly during the October 15 to March 31 time frame when bats are not present in the Bat Action Area. A 175-m buffer (437 ac) has been applied to the project footprint area to account for blasting effects on bats.

Lighting
Numerous studies suggest that artificial light could reduce the suitability of an area for foraging and cause bats to avoid illuminated areas. Lighting negatively affected little brown bat foraging activity in Connecticut, resulting in decreased use of an illuminated wetland (Seewagen and Adams 2021). In England, activity of Myotis species declined significantly under orange, white, and green light; red light also negatively impacted the bats, but not as significantly (Zeale *et al*. 2018). Lighting in France had a substantial negative effect on Myotis species' activity, whether the lighting was on for entire or only partial nights (Azam et al. 2015). Bat activity in Italy declined at illuminated sites "mainly due to the response of the most abundant species, *Myotis daubentonii*" (Russo et al. 2019). Lighting intensity in France had mixed effects on bats, but the effect was significantly negative for Myotis species (Lacoeuilhe et al. 2014). The light-negative species included primarily aerial hawking and gleaning bats, the foraging behaviors used by northern long-eared bat; no gleaning bat species were among the light-tolerant species (Lacoeuilhe et al. 2014). Feeding of pond bats (*M. dasycneme*) in the Netherlands was reduced by 60 percent on nights when they were exposed to artificial light versus dark nights (Kuijper et al. 2008). Experimental exposure in England and Wales, even to low levels of light-emitting diode (LED) sources, reduced activity of Myotis species (Stone et al. 2012).

Myotid juveniles that typically use houses and buildings for roosts were found during a European study to be significantly smaller when occupying illuminated structures, and night emergence was significantly delayed for adults (Boldogh et al. 2007). A British study demonstrated reduced activity in association with LED streetlights for slower flying bats (including Myotis spp.) (Stone et al. 2012).

Schroer et al. (2020) stated that "The behavior of light-sensitive bats can be impaired within the radius of up to 50 m (164 ft) distance to the light source, even if the luminance level is as low as 1 lux" (lx). Azam et al. (2018) actually detected streetlight avoidance at values below 1 lux by Myotis species and Serotine bat (*Eptesicus serotinus*) at 50 m from a streetlight (Azam et al. 2018). The authors did not detect avoidance at 100 m (329 ft), and they recommended "separating streetlights from ecological corridors by at least 50 m and to limit vertical light trespass on vegetation to less than 0.1 lx to allow their effective use by light-sensitive bats" (Azam et al. 2018). Effects of lighting on forest-dwelling bats is localized and can be mitigated through use of cut-off lighting. We expect rare forest-dwelling bats to be minimally disturbed by this stressor unless lighting effects are unmitigated, expected to occur adjacent to a known roost site, and the 50-m buffer from light sources encompasses a significant portion of the species' home range. We expect any effects from this stressor to be insignificant for forest areas outside of known occurrence buffers, given the vast amount of forested foraging habitat available in most areas of Tennessee. This may not be the case in some parts of the state where forested habitat is more limited.

Effects Pathway 3

Activities – Noise/vibration and lighting associated with equipment operation, occasional blasting, and occasional use of artificial lights.

Stressor – New chronic and/or intense anthropogenic sources of lighting, vibrations, or noise above 68 dBA in known suitable summer habitat to the extent that significant portions of the home ranges for northern long-eared bat or tricolored bat would be affected.

Exposure (time) – Active season, adult bats are volant (i.e., able to fly) (April 1-September 30), but pups are non-volant (May 15-July 31).

Exposure (space) – 1,148 ac of summer habitat.

Resource Affected – Individual roosting and/or foraging northern long-eared and tricolored bats.

Individual Response – Flushing, deterrence, and/or avoidance of the affected area because of significant alteration of habitat used during roosting and foraging activities.

Effect – Direct and indirect harm as a result of disturbances or modification of habitat altering essential bat behaviors. Intense noise may cause a bat to flush from suitable roost trees adjacent to the project area, which could result in harm to the individual by altering its normal behavior patterns and making it more susceptible to various predators during daylight hours. Noise may also result in a bat abandoning a roost tree; if pregnant females are required to search for new roosting habitat due to disturbances, such effort could place additional stress on them at a time when fat reserves are low or depleted and they are already stressed from the energy demands of migration. Reduction of foraging efficiency over enough acres in known habitat that is would significantly alter available home range foraging area would harm individuals in a potential maternity colony by increasing energy expended for foraging and reducing reproductive success and/or fitness of individuals. Certain lighting types may attract bats to light sources, which results in increased risk of predation and/or deters their normal foraging activities. Significant alteration of known habitat would cause harm similar to the effects of noise on foraging efficiency.

Conservation and Minimization Measures – Noise and vibration minimization measures would be implemented to dampen potential adverse effects to bats in the Action Area. Use of explosives would be directed toward the bat hibernation season. Adverse effects of lighting to bats can be minimized through standard methods, as described in Section 9, Conservation Recommendations.

Interpretation – Noise, vibrations, and/or lighting effects would overlap 1,148 ac of known habitat. However, shifting of bats to adjacent areas with suitable habitat qualities is expected to be insignificant, given the low number of individuals in the environmental baseline.

5.5 Stressor: Pollutant Transport to Surface Waters

All receiving streams are covered by the NPDES permit to address water quality parameters for pollutants of concern. However, a water quality-based effluent limitation is incorporated into the NPDES permit for two water quality parameters. The applicant is required to meet in-stream water quality criteria at the discharges from each pond for selenium, and sediment is regulated in the sense that discharges from the project area "shall not constitute measurable degradation for sediment/siltation/TSS [total settleable solids]" associated with receiving streams associated with the NPDES permit for this project.

Vegetation would be removed in areas where roads are to be upgraded and maintained, and where active mining would occur to facilitate surface mining and to construct and provide access for monitoring and to perform necessary maintenance to sediment pond structures. Clearing vegetation to allow for road construction would be accomplished; however, because 15 of the roads required to achieve the proposed project are existing, minimal additional vegetation clearing would be required to upgrade the existing roadbeds to SMCRA standards (30-ft width). Installation of one or more culverts will be needed to facilitate the upgrades, minimizing sediment input to streams in areas where vehicles previously forded streams. Existing roads total approximately 107 ac of the mine permit area, with 71 ac of upgrades.

Active mining on an open surface mine consists of separating "stripping" the surface soil and rock, or overburden, from the top of the coal deposits. This is achieved through use of heavy equipment to remove and separate the coal from the overburden, and through use of blasting as needed. A series of narrow, flat benches, ledges, or steps are the result, when the surface spoil is removed, which allows access and removal of coal as it is encountered at different elevations. As indicated in the BA (Office of Surface Mining Reclamation and Enforcement 2024), the mine site contains an estimated 6.5 mi (346 ac) of pre-SMCRA mining benches that have never been reclaimed; the remining portion of this project would also include using these previously constructed benches to access remaining coal when possible.

Disturbance of 500 ac or more (635 ac maximum) of the 925 ac within the permit boundary would result in removal of vegetation and coal, including approximately 346 ac that had been mined prior to the initiation of SMCRA and not reclaimed, but has since been naturally revegetated. Therefore, the mining and reclamation would result in removal of as many pre-existing highwalls as feasible (Office of Surface Mining Reclamation and Enforcement 2024a), and reclamation of these areas would restore land contours across the permit boundary as close to the approximate original topography as possible. In addition, revegetation of the disturbed permit area would eventually result in restoration of forest to approximately 454 ac and conversion of the sediment ponds to wetlands as additional wildlife habitat in the post mining footprint (Office of Surface Mining Reclamation and Enforcement 2024a).

The mine plan's Indiana bat and northern long-eared bat PEP conservation measures identified appropriate tree species to be used for reclamation, and required 400 surviving stems per ac before restoration would be considered successful. In addition, the planting layout was intended to maximize use by roosting Indiana and northern long-eared bats (Office of Surface Mining Reclamation and Enforcement 2016). However, before trees would be planted herbaceous ground cover would be planted in order to control sediment from the mined areas. In areas where there were no soils or rocks that could contribute toxic components potentially affect ground or surface water quality, the FRA restoration method would be used (Office of Surface Mining Reclamation and Enforcement 2024a). Approximately 454 ac of the mining area to be replanted in trees will be reclaimed using the FRA.

When they would no longer be needed for sediment retention, ponds demonstrated to have sufficient water quality levels will be modified to shallow water depressions or wetlands by filling the pond such that the depression retains a depth of one to two ft, blending the topography with the surrounding area. A channel will be constructed through the pond to ensure that large volumes of water are not retained in the shallow depression remaining.

Sedimentation of streams from mining, roadways, and logging activities pose a threat to the hydrologic balance and biological integrity within the hydrologic unit. Altered habitat quality could result in a decrease in blackside dace fitness because of sediment deposition and associated pollutants, which could alter diversity and/or abundance of macroinvertebrate prey and periphyton. Altered habitat quality and/or quantity in portions of the affected streams used by blackside dace for spawning may reduce blackside dace population size because the amount of available spawning habitat and/or number of nest-building fish spawning associates (creek chubs) may be reduced. Also, opportunities for blackside dace expansion to other small streams in the watershed may be reduced, including reduction in availability of blackside dace refugia from poor conditions elsewhere in the watershed. Altered habitat quality in affected streams could reduce opportunities for individuals to travel through the watershed and contribute to gene flow that supported the long-term persistence of the metapopulation throughout the affected watershed. These effects could be more pronounced in reaches of the affected streams adjacent to and downstream of mining areas that release significant sediment loads.

Coal surface mining operations represent a significant source of heavy metal contamination in the environment. Coal surface mining exposes trace elements, such as selenium, that can concentrate in via bioaccumulation at levels that are toxic to organisms such as fish and bats. Selenium, in particular, has gained attention due to its narrow range between essential dietary requirements and toxic thresholds in wildlife. During coal extraction and processing, selenium can be released in multiple forms and transported via surface runoff and groundwater, eventually making its way into aquatic systems where it bioaccumulates through food webs (Presser et al., 2004; Jennings et al., 2008).

Bats are particularly vulnerable to heavy metal contamination from coal mining activities due to several unique biological and ecological characteristics. With lifespans reaching up to 40 years, they have extended periods for bioaccumulation of toxicants (Timofieieva et al., 2021). Their high metabolic rates and significant food consumption further increase their exposure risk (Zukal et al., 2015). The primary exposure pathway for insectivorous bats in mining-impacted areas is through dietary intake. Aquatic insects emerging from contaminated water bodies near coal mines can carry substantial heavy metal burdens (Kraus et al., 2014). Zocche et al. (2010) documented elevated heavy metal concentrations in insectivorous bats from coal mining areas in Brazil, demonstrating a direct link between mining operations and contamination in bat populations. Additionally, bats may be exposed through drinking contaminated water while foraging over mining-impacted water bodies.

A secondary exposure route unique to bats is their large wing membrane surface area, which can absorb airborne contaminants directly (Timofieieva et al., 2021). Coal processing and waste disposal generate particulate matter containing adsorbed heavy metals that may settle on bat wing membranes, creating an additional exposure pathway that is not present in other mammals. Studies have demonstrated that bats effectively bioaccumulate heavy metals, with different contaminants showing affinity for specific tissues. In a comprehensive review, Zukal et al. (2015) found that lead primarily accumulates in bones, liver, and kidneys; arsenic concentrates in liver, kidney, and brain tissue; cadmium accumulates predominantly in kidneys and liver; while mercury shows highest concentrations in fur and liver tissue.

Selenium, which is often elevated in mining-impacted watersheds, follows similar accumulation patterns to other metalloids. Jones and Cherian (1990) observed that selenium tends to accumulate in protein-rich tissues including kidneys, liver, and muscle. This pattern is concerning, given selenium's ability to substitute for sulfur in amino acids - potentially disrupting protein function at elevated concentrations. Selenium released from coal mining can bioaccumulate through the food chains to toxic levels (Orr et al., 2006). Insectivorous bats in mining-impacted areas are primarily exposed to heavy metals through dietary intake of contaminated aquatic insects and drinking affected water, with studies by Zocche et al. (2010) documenting direct links between mining operations and bat contamination.

The connection between mining activities and heavy metal burdens in bats was directly established by O'Shea et al. (2001), who found significantly elevated arsenic and mercury levels in guano collected from roosts of big brown bats (*Eptesicus fuscus*) near mine-impacted sites compared to reference areas. Similarly, Pedro et al. (2020) documented substantially higher selenium, arsenic, and lead concentrations in small mammals near coal mining operations compared to reference sites, suggesting similar patterns would likely exist in sympatric bat populations.

While studies specifically examining the effects of coal mining-derived heavy metals on bats remain somewhat limited, existing research on heavy metal toxicity in bats provides strong evidence for multiple adverse health impacts:

- DNA damage: Zocche et al. (2010) demonstrated that bats from coal mining regions in Brazil exhibited significantly elevated DNA damage in blood cells compared to bats from control areas, directly linking mining contaminant exposure to genotoxic effects.

- Kidney damage: Exposure to heavy metals, particularly cadmium and mercury, has been associated with renal inclusion bodies in bats (Zukal et al., 2015). This is especially relevant for coal mining areas where multiple heavy metals may act synergistically.

- Neurological impairment: Lead exposure, common near mining operations, has been linked to ascending paralysis in bats (Zukal et al., 2015), while mercury affects cholinergic functions (Nam et al., 2012). These neurological effects could significantly impact echolocation, foraging efficiency, and overall survival.

- Reproductive impacts: Laboratory studies have shown that cadmium exposure causes testicular necrosis in *Rhinopoma kinneari* (Dixit and Lohiya, 1974; Zukal et al., 2015), suggesting potential population-level implications through reduced reproductive success.

- Metabolic disruption: Selenium plays a role in energy metabolism in liver, adipose tissue, and muscle (Loscalzo, 2014). Excess selenium exposure can disrupt normal metabolic functions, which is particularly problematic for bats with their high energy demands and seasonal torpor behavior.

The potential for interaction between effects of heavy metal exposure in bats with other environmental stressors is particularly concerning in mining-impacted areas. Courtin et al. (2010) found potentially toxic levels of lead (13% of bats) and arsenic (4% of bats) in liver tissue of bats already effected by white-nose syndrome, suggesting that compounding stressors may overwhelm physiological coping mechanisms. The chronic, sub-lethal exposure to multiple contaminants from mining operations may be more ecologically significant than acute toxicity events. As noted by both Zukal et al. (2015) and Timofieieva et al. (2021), bats in mining landscapes are frequently exposed to multiple anthropogenic stressors simultaneously, including habitat fragmentation, noise pollution, and climate change impacts. The physiological stress of detoxifying heavy metals may compromise immune function and energy reserves, leaving bats more vulnerable to disease and other challenges.

Due to their endangered species status and federal regulations, there is limited direct research on lethal concentration thresholds specifically for bats. However, there is information gathered from relevant research and regulations that support the evidence that decline in water quality may result in harm to bats:

1. Total Dissolved Solids (TDS): SW-38 value of 1008.7 mg/L exceeds the EPA secondary drinking water standard of 500 mg/L.

2. Iron (Total): Seep 29 (4.16 mg/L) and some trend stations (up to 3.21 mg/L) exceed the EPA secondary drinking water standard of 0.3 mg/L.

3. Lead: The exceedance at CIA 10-09 trend station (0.0498 mg/L) is significantly above the EPA action level of 0.015 mg/L for drinking water. Lethal blood concentrations for most mammals range from 1.0-1.5 mg/L. Sublethal neurological effects in bats likely occur at much lower concentrations.

4. Mercury: 0.00057 mg/L exceeds the EPA's water quality criterion of 0.00077 mg/L for freshwater aquatic life (chronic exposure). Neurological effects in bats have been documented at fur concentrations of 10 mg/kg. These levels can impair foraging and survival.

5. Selenium: Seep 22 value (0.017 mg/L) exceeds the EPA's chronic freshwater criterion of 0.005 mg/L for aquatic life protection. Toxic effects in mammals begin at tissue concentrations of 3-5 mg/kg and reproductive impacts occur at dietary concentrations as low as 3-4mg/kg.

6. Barium: Concentrations of 36.2-36.8 mg/L far exceed the EPA drinking water standard of 2.0 mg/L.

7. Aluminum (Total): Maximum value of 1.8 mg/L exceeds the EPA's secondary drinking water standard of 0.05-0.2 mg/L. Toxic to aquatic life that forms bat prey when pH is below 6.0, potentially reducing prey availability.

The effects of selenium and other heavy metals from coal mining on bats likely vary significantly between sites due to differences in local geochemistry, mining practices, and bat species assemblages. Brix et al. (2005) noted that selenium bioaccumulation varies considerably between sites due to site-specific water and sediment chemistry, trophic relationships, and other environmental factors. This site-specificity presents challenges for establishing universal regulatory thresholds. Research on birds provides instructive parallels for understanding site-specific effects on bats. Skorupa (cited in Brix et al., 2005) derived an egg selenium threshold of 6 mg/kg dry weight for black-necked stilts based on field data relating selenium to clutch viability. In contrast, Fairbrother et al. (cited in Brix et al., 2005) argued for a higher threshold of 16 mg/kg dry weight based on laboratory data from mallards. The variability in these thresholds highlights the complexity of establishing universal standards and supports the case for site-specific approaches to regulation.

Effects Pathway 4

Activity – Soil disturbance and transport of metals and other toxicants to areas of bat occupation.

Stressor – Contaminants such as selenium, lead, cadmium, arsenic, and mercury, can be mobilized and released into surrounding ecosystems.

Exposure (time) – Active season (April 1- October 30), when adult bats are present in Action Area.

Exposure (space) – Sediment retention ponds and streams in the project Action Area and potential aerial exposure over the surface disturbance area.

Resource affected – Individuals (adults, juveniles).

Individual response – Although evidence of lethality in bats due to exposure to metals and other toxicants is limited, there is data to support the evidence that decline in water quality due to excessive amounts of dissolved solids, iron, lead, mercury, selenium, barium, and aluminum may harm bats.

Effect – Direct harm during active season.

Conservation and Minimization Measures – Conservation and minimization measures, as described in Section 2 (*Proposed Action*), will be implemented to address toxicity concerns. These include a system of diversion ditches to direct stormwater to sediment retention ponds, with pond cleanout to occur when sediment reaches a level of 50 percent of pond capacity. Portions of the area known to contain higher levels of selenium will be disposed of in a manner that maximizes sequestration of these materials.

Interpretation - The primary impact of selenium and heavy metals from surface coal mining activities on northern long-eared and/or tricolored bats is the degradation of water quality through acidification, sedimentation, and the accumulation of heavy metals. Additionally, the combined effects of multiple contaminants may result in synergistic toxicity effects at levels lower than individual thresholds. Given accumulation of heavy metals such as selenium in sediment retention ponds, exposure to this stressor could harm an indeterminable number of northern long-eared and/or tricolored bats within the Bat Action Area. However, measures for maintenance of sediment control structures are expected to address this concern to some degree, especially relative to long-term impacts.

Effects Pathway 5

Activities – Soil disturbance and transport of pollutants to stream segments occupied by blackside dace.

Stressor – Sediment transport with subsequent impairment of physical stream habitat.

Exposure (time) – Year-round.

Exposure (space) – 5.6 miles of potentially occupied stream habitat.

Resource Affected – Blackside dace individuals that may move downstream of an occupied reach of Tackett Creek (approximately 3.1 mi long, located roughly 600 m upstream of the northernmost drainage from the permit area) and individuals that may persist in Spruce Lick Branch (2.5 mi from south of the permit area to its confluence at Tackett Creek).

Individual Response – Blackside dace exposed to pollutants are more susceptible to diseases, feeding disruption, and lowered reproductive rates - leading to decreased fitness and survival.

Effect – Direct and indirect harm related to chronic stress or mortality, significant habitat modification, and alterations of essential behaviors – thereby reducing reproduction and population viability.

Conservation and Minimization Measures – Sediment control as described in Section 2 (*Proposed Action*), will be implemented to address sediment transport concerns. These measures include a system of diversion ditches to direct stormwater to sediment retention ponds, with pond cleanout to occur when sediment reaches a level of 50 percent of pond capacity. Maintenance of roads, appropriate soil replacement methods, and re-vegetation will also facilitate water quality control.

Interpretation – Although episodic increases in sediment transport are expected, relative effects to substrate composition is expected to be minimal – to the extent that measurable reaction by the species is not expected to be significant. Conservation measures are expected to be adequate in addressing this stressor, and the reclamation of re-mined areas should result in net long-term benefits to downstream aquatic habitats.

5.6 Stressor: Groundwater Quantity / Recharge Effects

Mine spoils and abandoned underground mine workings allow for greater infiltration and storage of ground water, which tends to increase and sustain surface stream flow. As a result, mined watersheds generally have higher base flows than similar unmined watersheds (USOSMRE 2024b).

The Hurricane Creek Mine No. 2 would be expected to increase baseflow by a maximum of 14 gallons per minute to the Valley Creek portion of the CIA 1 O0lA watershed. These maximum increases would not be expected to ever be achieved, as the entire 2,500 acres of hydrologic impact assessment area would not be disturbed at one time and revegetation occurs shortly after backfilling and grading. As a result, replacement of forest with a mixture of grasses will result in gradual forest succession throughout the permit area. Forest and predicted transpiration losses in the Tackett Creek watershed are even less significant with increases to baseflow estimated at only about 4 gallons per minute. None of these increases is expected to result in a noticeable impact to the use of water resources or increase potential for downstream flooding or channel alterations.

<u>Effects Pathway 6</u>

Activities – Augering and soil disturbance during site preparation, surface mining, and reclamation that may affect groundwater hydrology.

Stressor – Rainfall transmission through pre-SMCRA mine spoil material and ground water via post-project auger workings to downstream surface waters. Effects upon groundwater hydrology can impact surface water quantity and pollutant concentrations (e.g., dissolved solids/conductivity, selenium, and acidity) to blackside dace streams.

Exposure (time) – Year-round.

Exposure (space) – 5.6 miles of potentially occupied stream habitat.

Resource Affected – Blackside dace individuals that may move downstream of an occupied reach of Tackett Creek to a 3.1-mi reach of stream and dace that may persist in a 2.5-mi reach of Spruce Lick Branch.

Individual Response – Blackside dace that may be exposed to pollutants are likely more susceptible to diseases, feeding disruption, and decreased reproductive rates - leading to decreased fitness and survival.

Effect – Decreased streamflow that occurs in response to lower groundwater flow-through during seasons of low precipitation can result in lower availability of fish habitat and can also exacerbate high concentrations of toxicants. Direct and indirect harm to blackside dace can result in relation to chronic stress, alteration of essential behaviors, and/or mortality. Water quality impairment and impacts to individual blackside dace may impact the species' local population dynamics.

Conservation and Minimization Measures – Methods for soil replacement, re-vegetation, and backfill of highwalls will be applied to preclude adverse modification of groundwater hydrology and subsequent surface water effects.

Interpretation – Conservation measures (especially backfill of highwalls) are expected to be adequate in minimizing hydrologic modifications and are expected to result in a net improvement in hydrology as a result of reclamation of areas to be re-mined.

5.7 Summary of Effects

The proposed area of permitted surface mining for the Hurricane Creek Mine #2 project is 925 ac, the area of proposed underground mining is 290 ac, re-mining area is comprised of 346 ac, the area to be directly revegetated is 454 acres, and the area expected to be suitable as bat roosting habitat within 40-50 years is 454 acres (given that bats will utilize open areas within 1,000 feet of contiguous forest). Site preparation and operation of the mine will result in approximately 500 ac (635 ac maximum) of tree removal, the area of anticipated impacts to off-permit forested habitat due to noise and lighting will involve 437 ac, and the total area of potential impacts to bats will involve 1,148 ac (i.e., the Bat Action Area).

A variety of potential effects upon northern long-eared bats, tricolored bats, and blackside dace could potentially occur as a result of a number of activities associated with coal mining and reclamation (Table 5-2). Conservation measures will be utilized in minimizing effects to bats and blackside dace. Primary measures include seasonal tree clearing and blasting to avoid injury and harassment of bats (Effects Pathways 1 and 3), measures to minimize lighting's effects upon adjacent forested habitat (Effects Pathway 3), and implementation of a system of diversion ditches and sediment retention ponds to maintain downstream water quality relative to toxicants (Effects Pathway 4) and sediment transport (Effects Pathway 5). Other potential effects to the three species of concern for this project involve burning of debris (Effects Pathway 2) and groundwater hydrology (Effects Pathway 6).

In summary, the following direct and indirect effects to the two bats and blackside dace may occur as a result of site preparation, mining, and reclamation-related activities:

1. Harm of bats as a result of tree removal and subsequent loss of roosting habitat.
2. Harassment of bats as a result of burning tree debris with resulting smoke and heat.

3. Harassment of bats as a result of noise/vibrations and lighting.
4. Harm to bats and/or blackside dace as a result of soil disturbance and resulting pollutant transport to sediment ponds and streams.
5. Harm to blackside dace resulting from effects to groundwater quantity and recharge of surface waters.

6 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. Factors discussed in section 4.0 (*Environmental Baseline*), especially conductivity in downstream surface waters and temporal impacts to roosting habitat for bats, are expected to continue to affect the listed species considered in this BO into the future. 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 Act.

7 CONCLUSION

We summarize and interpret the findings of the previous sections for the northern long-eared bat, tricolored bat, and blackside dace (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA. The Service concludes that these species may be directly and/or indirectly affected by the project. Given the documented presence of the species in the Action Area, the Service anticipates that effects to each species may occur.

After reviewing the current status of northern long-eared bat, tricolored bat, and the environmental baseline for the project's Action Area, the Service confirms in this BO that the proposed Action in Claiborne County, Tennessee, is not likely to jeopardize the continued existence of the northern long-eared bat or tricolored bat because: (1) the adversely affected project area would be small relative to the species' ranges and existing level of threats, and therefore, include only a small fraction of their overall populations; (2) direct effects related to mining, reclamation, and associated activities would be limited to about 5 years of active mining; and (3) the number of individuals in the action area is very few.

Likewise, after review of the current status of the blackside dace and environmental baseline, the Service confirms that the proposed Action is not likely to jeopardize the continued existence of the species because the number of individuals in the action area is very small (i.e., estimated to be six) relative to population densities across the species' range and existing level of threats; and therefore, include only a small fraction of its overall population. Although dissolved solids levels and associated conductance within the Dace Action Area exceed the desired water quality necessary for recovery of the local species' population, the proposed action will contribute relatively little pollutant inputs to the stream reaches occupied by blackside dace. In fact, due to reclamation that would be conducted upon completion of re-mining, the Action is expected to result in long-term benefits to local aquatic resources.

8 INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) regulations prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term "take" in the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA §3). The Service chose to modify the definition of the term "harass" by restricting its application to acts or omissions that are done intentionally or negligently. Thus, harassment is a form of purposeful take that is not authorized as taking incidental to lawful activity. Instead, harm is the only form of incidental take that is authorized under section 7 of the ESA. In regulations at 50 CFR §17.3, the Service defines:

- "harm" as "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;" and

- "incidental take" as "any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered prohibited, provided that such taking is in compliance with the terms and conditions (T&Cs) of an incidental take statement (ITS). For the exemption in ESA §7(o)(2) to apply to the Action considered in a BO, OSMRE must undertake the non-discretionary measures described in this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action. OSMRE has a continuing duty to regulate the activities covered by this ITS.

The ITS provided for the tricolored bat does not become effective until the species is listed, and the CO is adopted as the BO 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 better reflect take. No take of the species or its critical habitat may occur between the listing of a species and the adoption of the CO through formal consultation, or the completion of a subsequent formal consultation. See Section 10 of this document for instructions on adopting the CO.

8.1 Amount or Extent of Take Anticipated

This section specifies the amount or extent of take of northern long-eared bats, tricolored bats, and blackside dace that the action is reasonably certain to cause, which is described in Section 5 (*Effects of the Action*) of this BO.

8.1.1 Estimating Take of Bats

The Service anticipates that incidental take of northern long-eared bat (and tricolored bat, should it be listed) will be difficult to detect for the following reasons:

1. Individual bats are small and occupy forested summer habitats or caves where they are difficult to find;
2. Tree-roosting bats form small, widely dispersed maternity colonies, some species occur under loose bark or in the cavities of trees; and males and non-reproductive females may roost individually, which results in difficulty in finding the species or occupied habitats;
3. Finding dead or injured specimens during or following project implementation is unlikely;
4. Tree-roosting bats are mostly nocturnal; and
5. Most incidental take will be non-lethal and undetectable (e.g., bats fleeing disturbances caused by blasting, lighting, and other activities, thereby resulting in increased likelihood of death or injury due to predation and reduced fitness).

Due to the difficulty of detecting take of northern long-eared and tricolored bats, OSMRE will monitor the extent of take using the surrogate of acreages of forested habitats altered or disturbed by the proposed Action. The amount of anticipated take depends upon the seasonal timing of these activities and the minimization and conservation measures that are implemented. Therefore, OSMRE will monitor post-mining habitat conditions and/or effects of the project to the bats within the adversely affected portion of the Action Area to ensure that take in the form of tree removal (with subsequent displacement to forested habitat adjacent to the permit area) is less than or equal to the 496 ac of suitable bat habitat as identified in Section 5 of this BO.

Additionally, bats within the forested acres of the adjacent suitable habitat, 341 ac, would undergo disturbance due to vibration, noise, and/or artificial lighting. Because documentation of specific levels of disturbance in this regard is difficult, we rely on the reasonable and prudent measures and their implementing terms and conditions to address this type of take; and monitoring of measures to protect the species will be conducted to ensure their proper implementation.

8.1.2 Estimating Take of Blackside Dace

Two blackside dace were documented during electroshocking surveys within the upper portion of Tackett Creek in 2023 (Biological Systems Consultants 2023). Dr. Michael Floyd (pers. comm. 2025) indicated that, on average, electroshocking sampling methodology results in documentation of approximately 30 percent of the blackside dace individuals occupying a specific area. Therefore, we estimate that approximately 6 or fewer individuals are present within the area of concern for this project, including Tackett Creek, Burrell Creek, Spruce Lick Branch, and their tributaries. This accounts for all individuals that reside within the streams or that may migrate through them seasonally (e.g., upstream movements in facilitation of spawning and downstream movements during dry seasons in search of pools). Because of the difficulty in estimating take of blackside dace, monitoring of measures to protect the species will be conducted to ensure appropriate protection of physical habitat and water quality.

8.1.3 Effect of the Take of Bats and Blackside Dace

As indicated in the literature review and effects analysis, the mechanism(s) of blackside dace impact (including toxicant effects) from elevated conductivity have not been identified. Therefore, the Service has concluded that this take would not be lethal but would instead be in the form of harm and/or harassment. Because of the spatial and temporal scope and form of the identified incidental take, it would be difficult to monitor. Observing/collecting and quantifying six or fewer blackside dace whose feeding, breeding, or sheltering behavior had been affected by the identified stressor over 9.8 miles of stream channels during the time period(s) when they might be present is impractical. Therefore, surrogate measures to monitor this take will include analyzing water quality and biological conditions in these receiving streams (identified in T&Cs 3 and 4) while mining takes place and during reclamation and comparing the identified parameters (e.g., conductivity) with those projected in OSMRE's BA and in this BO.

In this BO, we determined that the anticipated level of incidental take would not result in jeopardy to the continued existence of the northern long-eared bat, tricolored bat, or blackside dace (see Section 7, *Conclusion*). Previous BOs, completed for populations of northern long-eared bats within Tennessee and for blackside dace within Tennessee, which identified incidental take, have been included in Appendices B and C, respectively.

8.2 Reasonable and Prudent Measures

The measures described below are non-discretionary and must be undertaken by OSMRE so that they become binding conditions of any permits or contracts, as appropriate, for the exemption in section 7(o)(2) to apply. OSMRE has a continuing duty to regulate the activity covered by this Incidental Take Statement. If OSMRE (and ultimately the project proponent, Hurricane Creek Mining, LLC): (1) fails to assume and implement the T&Cs or (2) fails 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. In order to monitor the effect of incidental take, OSMRE must report the progress of the action and its effect on the species to the Service as specified in the Incidental Take Statement. (50 CFR § 402.14 [1][3]).

The Service believes the reasonable and prudent measures (RPM) below, in addition to the conservation measures in the action description that the OSMRE pledged to implement, are necessary and appropriate to minimize any anticipated taking of northern long-eared bat, tricolored bat (should it be listed), and blackside dace that may occur incidental to the action:

1. Hurricane Creek Mining will burn debris in a manner that minimizes smoke transmission to forested areas that may be occupied by bat pups during the period of May 15 – July 31, and burning during this period will be avoided to the greatest extent feasible.

2. OSMRE will promptly notify the Service and other appropriate partners of any substantial issues noted during routine inspections that could result in impacts to bats or blackside dace population viability.

3. OSMRE will continue to coordinate with the Service and other partners in communicating adequacy of the monitoring and water quality assurance measures to address the local blackside dace population viability.

8.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, OSMRE must comply with the following terms and conditions (T&Cs), which carry out the RPMs described above. These T&Cs are non-discretionary.

1. OSMRE will provide the Service with summary annual reports describing the following mining and reclamation activities taking place on the mine site during the previous year: a) acres or number of trees removed, b) acres or number of trees planted, c) tree survival rate, d) annual average of water quality measures at each pond, e) descriptions of major conservation measures implemented, and f) results of any biological investigations.

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 the level of incidental take of bats will not exceed that of a few individuals supported by 496 acres of habitat in the permitted mining area and 341 acres of adjacent area (to be indirectly affected through disturbances such as noise, vibrations, and lighting). The level of incidental take of blackside dace is not expected to exceed 6 individuals as they reside in and migrate through approximately 9.8 miles of stream channels (Section 5, Effects of the Action). 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 federal Action Agency must immediately describe the causes of the taking and review with the Service the need for possible modification of the RPMs.

The incidental take included in this BO is authorized for OSMRE until such time as OSMRE no longer maintains regulatory authority over this project (i.e., through Phase III Bond Release). If, during the course of the action, this level of incidental take were to be exceeded, as identified by evaluating the surrogate water quality and biological data, and identified in collaboration with the Service, such incidental take would represent new information requiring reinitiation of consultation and review of the RPMs provided. OSMRE must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the RPMs.

9 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat to help carry out recovery plans or to develop information. We offer the following conservation recommendations for consideration:

1. Hurricane Creek Mining and OSMRE should coordinate with staff of the Tennessee Wildlife Resources Agency and Wildlife Services in attempt to reduce the presence of beavers in Tackett Creek in order to provide for historic levels of habitat function in support of blackside dace resiliency and local recovery.
2. OSMRE should ensure that information regarding levels of selenium is provided to the U.S. Environmental Protection Agency.
3. OSMRE should provide support for future research efforts that focus on methods to mitigate legacy effects of past mining on stream water quality (e.g., conductivity), and to the affected aquatic biological communities within a landscape that includes historical and current mining.
4. OSMRE should conduct surveys to determine whether northern long-eared bats or tricolored bats use habitats in adjacent areas for roosting during the non-hibernating season and, if the species are found to occupy these areas, estimate the number and types of roosts found there.
5. OSMRE should convene workshops that include a variety of stakeholders, including mining companies and conservationists, to develop a conservation plan for blackside dace and other aquatic species potentially affected by surface coal mining in the southern Appalachian coal fields.
6. Hurricane Creek Mining should minimize artificial lighting's impact to bats by eliminating the use of UV lighting, installing only "warm" white lighting, using cut-off light shields at 45 degrees with bulbs installed deep inside fixtures, utilizing lighting controls such as sensors and timers, and minimizing column heights of mounted lights.

10 REINITIATION NOTICE

This concludes formal consultation on preparation for and operation/reclamation of Hurricane Creek Mine #2 in Claiborne County, Tennessee (the Action). As written in 50 CFR Section 402.16, reinitiation of formal consultation is required where discretionary OSMRE involvement or control over the Action have 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 Action that may affect listed species or critical habitat in a manner or to an extent not considered in this BO; (3) the Action is later modified in a manner that causes an effect to a listed species or critical habitat not considered in this BO; 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 CO as a BO issued through formal consultation if the tricolored bat is listed or critical habitat is designated at a later date. 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 CO as the BO for the Action; and no further section 7 consultation will be necessary.

After listing of the tricolored bat as endangered/threatened and/or designation of critical habitat and any subsequent adoption of this CO, 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 CO; (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 CO; or (4) a new species is listed or critical habitat designated that may be affected by the Action.

The Service appreciates the cooperation of OSMRE during this consultation. For further coordination please contact David Pelren with the Tennessee Ecological Services Field Office at 931/378-8938 or by email david_pelren@fws.gov.

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12 APPENDIX A

Summary and comparison of species-specific foraging and roosting requirements during the non-hibernation period for tree-roosting bats in the Action Area (Service 2022).

Activity	Northern long-eared bat	Tricolored bat
Roost Trees	Roost generalists: live or dead; cavity, crevices, and (under bark); small or large diameters, tree can have solar exposure but not required (i.e., often associated with relatively high canopy cover)	Live (or dead) trees; in dead (seldom live) leaf clusters among foliage; solar exposure seasonally variable; in South, cavities in live trees during winter.
Use of Man-made Roosts	Yes, but use less than trees: bat boxes, sometimes crevices in buildings (e.g., in walls or other tight spaces)	Yes, but less use than trees: open, lighted areas, e.g., under porch roofs. Culverts and bridges and other transportation structures (summer and winter use)
Roost Tree Species	Pine, oak, maple, ash (*Fraxinus spp.*), black locust (*Robinia pseudoacacia*) and suppressed understory trees (e.g., sassafras [*Sassafras albidum*], sourwood [*Oxydendrum arboreum*], dogwood [*Cornus spp.*], redbud [*Cercis canadensis*]) that develop cavities or loose bark	Primarily deciduous forest, especially in oaks; occasionally in pine-dominated stands and in pine.
Roost Tree Habitat	Upland forest; do not avoid managed stands (e.g., harvest, prescribed fire), and sometimes use trees within them	Upland or riparian, retention areas within or near partially harvested (i.e., more open) stands
Roost Area Fidelity	Yes, but with frequent roost switching within an area	Yes, especially compared to other foliage-roosting bats
Foraging Habitat	Cluttered forest conditions under forest canopy in uplands: paths, edges of harvest areas; forested ponds, streams, and cluttered riparian habitat (e.g., upland swamps)	Forested streams with open spaces, edge habitats, uplands & bottomlands, large reservoirs, and other water bodies
Foraging Strategy (see Faure et al. 1993)	Gleaner & aerial hawker	Aerial hawker

13 APPENDIX B

Post-WNS (2015 on) Incidental Take of Northern Long-eared Bats from Previous Consultations in Tennessee.

Biological Opinions Issued (Year)	Incidental Take Numbers
2015	Unspecified number of individuals within 32.5 ac of suitable swarming or roosting habitat in Van Buren and Bledsoe Counties
2015	Unspecified number of individuals within 15,925 ac of suitable summer habitat on Arnold Air Force Base
2016	Using habitat as a surrogate, incidental take of up to 10,000 ac
2018	Seven individuals annually and 50 individuals over 20 years within the seven-state Tennessee Valley Authority Region, including portions of Tennessee
2022	No more than three individuals in 139.2 ac of suitable summer habitat on Volunteer Training Site-Tullahoma/Arnold Air Force Base, Coffee and Franklin Counties
2023	Three individuals annually and 21 individuals over 15 years within the seven-state Tennessee Valley Authority Region, including portions of Tennessee
2023	Five individuals annually within 578 ac of post-WNS documented occurrence buffers on the Cherokee National Forest over 14 years
2023	84 ac of suitable summer habitat affected by the action equating to five individual bats on Arnold Air Force Base
2024	13 northern long-eared bats in 223 ac of suitable roosting and foraging habitat on Oak Ridge Reservation
2025	Loss of 144 ac of foraging and roosting habitat on Oak Ridge National Laboratory
2025	17 individuals within 3,554 ac of foraging and roosting habitat on Bridgestone-Firestone Wildlife Management Area

14 APPENDIX C

Incidental Take of Blackside Dace from Previous Consultations in Tennessee.

Opinions (Year)	Incidental Take Numbers
2016	Unquantifiable number of individuals in the Big South Fork Cumberland River watershed, Fentress, Scott, Pickett, and Morgan Counties.
2016	Unspecified number of individuals in 2,593 feet of Rose Creek, Campbell County.
2016	Up to 9 individuals per year traveling through 12.6 miles of Davis Creek watershed, Campbell, County.
2016	Up to 38 individuals per year traveling through 52 miles stream miles of Clear Fork system, Claiborne County.
2017	Up to 868 individuals per year – within the Capuchin Creek and Elk Fork Creek watersheds.
2017	80 individuals total estimated individuals taken from Buffalo Creek and Valley Creek watersheds.
2020	Up to 206 individuals in Hatfield Creek, Campbell County.