Electronically Filed

Rye Development

100 South Olive Ave., West Palm Beach, Florida 33401

June 13, 2025

VIA E-FILING

Debbie-Anne A. Reese, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: Lewis Ridge Pumped Storage Project, FERC Project No. 15249
Final Application for License for a Major Unconstructed Project

Dear Secretary Reese:

Lewis Ridge Pumped Storage, LLC (Applicant or LRPS) is pleased to file with the Federal Energy Regulatory Commission (FERC or Commission) the enclosed Final License Application (FLA) for an original license for the Lewis Ridge Pumped Storage Project, FERC No. 15249 (Lewis Ridge Project). The Lewis Ridge Project is a proposed pumped storage project in Bell County, Kentucky, with an anticipated total guaranteed power output capacity of 266 megawatts (MW) for a duration of 8 hours. LRPS has prepared this FLA in accordance with 18 CFR Subchapter B, Part 4 of FERC's regulations. The FLA conforms with the content requirements of 18 CFR § 4.41 and 18 CFR § 4.32 and includes the following:

Initial Statement
Exhibit A: Project Description
Exhibit B: Project Operation and Resource Utilization
Exhibit C: Proposed Construction Schedule
Exhibit D: Statement of Estimated Costs and Financing
Exhibit E: Environmental Report
Exhibit F: General Design Drawings and Preliminary Supporting Design Report (Critical Energy/Electric Infrastructure Information [CEII])
Exhibit G: Project Boundary Map

Sensitive information is being filed as Privileged in accordance with the Commission's regulations at 18 CFR §4.32(b)(3)(ii). Privileged files include rare species and cultural resources information.

In accordance with the Commission's Order No. 630 (68 FR 9857), Exhibit F contains CEII and is being filed under separate cover for the Commission's non-public file. Members of the public requesting CEII for the Lewis Ridge Project must comply with the Commission's procedures for obtaining access to CEII as required under CFR §388.113. All public requests for CEII should be made to the Commission's CEII Coordinator.

LRPS requested review and comment on the Draft License Application that was distributed on September 30, 2024, in accordance with the Commission's regulations at 18 CFR §4.38(d)(1). Comments on the Draft License Application were due by December 29, 2024. Comments were received by FERC, U.S. Environmental Protection Agency (USEPA), Kentucky Department of Environmental Protection (Kentucky DEP), and Kentucky State Historic Preservation Office (Kentucky SHPO). Comments were addressed as appropriate in the FLA, and Exhibit E includes a summary of responses to comments.

If you have any questions, please contact me by phone at 503-341-1425 or email at sandy@ryedevelopment.com.

Sincerely,

Sandra J Slayton

Sandy Slayton
Vice President
Rye Development

Attachments: *Distribution List*
Final Application for License for the Lewis Ridge Pumped Storage Project, FERC Project No. 15249

Lewis Ridge Pumped Storage Project (P-15249)
Distribution List

Elected Officials

Office of Senator Mitch McConnell
Lexington Office
771 Corporate Drive, Suite 108
Lexington, Kentucky 40503

Office of Senator Rand Paul
Main State Office
1029 State Street
Bowling Green, Kentucky 42101

Office of Representative Harold “Hal” Rogers
Somerset Office
551 Clifty Street
Somerset, Kentucky 42503

Scott Madon
Kentucky State Senator (29th District)
702 Capital Ave., Annex Room 215
Frankfort, Kentucky 40601

Adam Bowling
Kentucky House of Representatives (87th District)
P.O. Box 2928
Middlesboro, Kentucky 40965

Federal Agencies

Bryan Mercier, Director
MS-4660-MIB
Bureau of Indian Affairs
U.S. Department of the Interior
1849 C Street N.W.
Washington, DC 20240

Kim Amendola
Deputy Regional Administrator
National Oceanic and Atmospheric Admin.
National Marine Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-01930

Commanding Officer
United States Coast Guard
95 Peyton Street
Barboursville, West Virginia 25504

MSU Paducah
United States Coast Guard
225 Tully Street
Paducah, Kentucky 42003-0170

U.S. Army Corps of Engineers
Great Lakes and Ohio River Division
Nashville District
3701 Bell Road
Nashville, TN 37214-2660

Casey Ehorn
Deputy Chief, Regulatory Division
U.S. Army Corps of Engineers
3701 Bell Road
Nashville, Tennessee 37214-2660

Cara Beverly
U.S. Army Corps of Engineers
3701 Bell Road
Nashville, Tennessee 37214-2660

Dee Polk
Award Administrator
Office of Clean Energy Demonstrations
U.S. Department of Energy
1000 Independence Ave SW
Washington, DC 20585

Rodney Feazell
Program Manager
Office of Clean Energy Demonstrations
U.S. Department of Energy
1000 Independence Ave SW
Washington, DC 20585

Andrew L. Raddant
Regional Environmental Officer
U.S. Department of the Interior
Office of Environmental Policy and Compliance
15th State Street, 8th Floor
Boston, Massachusetts 02109

Maria R. Clark
NEPA Section – Region IV
U.S. Environmental Protection Agency
61 Forsyth Street SW
Atlanta, Georgia 30303

Mike Oetker
Regional Director, Southeast Region
U.S. Fish and Wildlife Service
Ecological Services
1875 Century Boulevard
Atlanta, Georgia 30345

John Faustini
Regional Hydrologist and FERC Hydropower Coordinator, Southeast Region
U.S. Fish and Wildlife Service
Ecological Services
1875 Century Boulevard
Atlanta, Georgia 30345

Lee Andrews
Field Supervisor
U.S. Fish and Wildlife Service
Kentucky Field Office
Interior Region 2 – South Atlantic-Gulf
330 West Broadway, Room 265
Frankfort, Kentucky 40601

Michael Floyd
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
JC Watts Federal Building
330 West Broadway, Room 265
Frankfort, Kentucky

Karah Jaffe
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
JC Watts Federal Building
330 West Broadway, Room 265
Frankfort, Kentucky

Jeff Duncan
Regional Hydropower Coordinator
U.S. National Park Service
Southeast Region
100 Alabama Street SW, 1924 Building
Atlanta, Georgia 30303

Tribes

Chuck Hoskin, Jr.
Principal Chief
Cherokee Nation
P.O. Box 948
Tahlequah, Oklahoma 74465

Elizabeth Toombs
Tribal Historic Preservation Officer
Cherokee Nation
P.O. Box 948
Tahlequah, Oklahoma 74465

Deborah Dotson
President
Delaware Nation
P.O. Box 825
Anadarko, Oklahoma 73005

Michell Hicks
Principal Chief
Eastern Band of Cherokee Indians
Qualla Boundary
P.O. Box 455
Cherokee, North Carolina 28719

Russell Townsend
Tribal Historic Preservation Officer
Eastern Band of Cherokee Indians
P.O. Box 455
Cherokee, North Carolina 28719

Douglas Lankford, Chief
Miami Tribe of Oklahoma
P.O. Box 1326
Miami, Oklahoma 74355-1326

David Hill
Principal Chief
Muscogee (Creek) Nation
P.O. Box 580
Okmulgee, Oklahoma 74447

Savannah Waters
Tribal Historic Preservation Officer
Muscogee (Creek) Nation
P.O. Box 580
Okmulgee, Oklahoma 74447

Craig Harper
Chief
Peoria Tribe of Indians of Oklahoma
118 South Eight Tribes Trail
Miami, Oklahoma 74355

Doug Mountain Spirit
Chief
Southern Cherokee Nation of Kentucky
scnkregistrar@gmail.com

Jeffrey Wacoche
Chief
United Keetoowah Band of Cherokee
Indians in Oklahoma
P.O. Box 746
Tahlequah, Oklahoma 74464

Roger Cain
Tribal Historic Preservation Officer
United Keetoowah Band of Cherokee
Indians in Oklahoma
P.O. Box 1425
Tahlequah, Oklahoma 74465

State Agencies

Louanna Aldrige
Office of Commissioner
Kentucky Department for Environmental
Protection
300 Fair Oaks Lane
Frankfort, Kentucky 40601

Shawn Hokanson
Kentucky Department of Environmental
Protection
Division of Water
300 Sower Boulevard
Frankfort, Kentucky 40601

Samantha Vogeler
Kentucky Department of Environmental
Protection
Division of Water
300 Sower Boulevard
Frankfort, Kentucky 40601

Joanna Ashford
Kentucky Department of Environmental
Protection
Division of Water
300 Sower Boulevard
Frankfort, Kentucky 40601

Beth Trent
Kentucky Department for Environmental Protection
Division of Water
London Regional Office
875 South Main Street
London, Kentucky 40741

Glen Alexander
Kentucky Department for Environmental Protection
Division of Water
300 Sower Boulevard
Frankfort, Kentucky 40601

Allan Shingleton
Kentucky Department of Environmental Protection
Division of Water
300 Sower Boulevard
Frankfort, Kentucky 40601

Gordon R. Slone, Commissioner
Kentucky Department for Natural Resources
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

Jay Cunningham
Environmental Scientist Consultant, Senior
Kentucky Department for Natural Resources
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

Barry Butcher
Environmental Scientist
Kentucky Department of Natural Resources
Division of Abandoned Mine Lands
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

Lonis Morgan
Environmental Control Manager
Kentucky Division of Mine Reclamation and Enforcement
1804 E. Cumberland Avenue
Middlesboro, Kentucky 40965

Thomas Barbour
Environmental Scientist Consultant
Kentucky Division of Mine Permits
300 Sower Boulevard
Frankfort, Kentucky 40601

Matthew Catron, Regional Biologist
Kentucky Department of Fish & Wildlife Resources
#1 Sportsman's Lane
Frankfort, Kentucky 40601

John Hast
Bear and Elk Program Coordinator
Kentucky Department of Fish & Wildlife Resources
#1 Sportsman's Lane
Frankfort, Kentucky 40601

Craig Potts, Executive Director and
State Historic Preservation Officer
Kentucky Heritage Council
The Barstow House
410 High Street
Frankfort, Kentucky 40601

Patricia Hutchins
Archaeology Review Coordinator
Kentucky Heritage Council
410 High Street
Frankfort, Kentucky 40601

Mona Juett
Office of the Secretary
Kentucky Tourism, Arts, and Heritage Cabinet
500 Mero Street, Fifth Floor
Frankfort, Kentucky 40601

Kenya Stump
Executive Director
Kentucky Office of Energy Policy
300 Sower Boulevard
Frankfort, Kentucky 40601

Kentucky Chamber of Commerce
464 Chenault Road
Frankfort, Kentucky 40601

Kentucky Coal & Marketing & Export Council
Cabinet for Economic Development
300 West Broadway
Frankfort, Kentucky 40601

Linda Bridwell
Executive Director
Kentucky Public Service Commission
211 Sower Boulevard
P.O. Box 615
Frankfort, Kentucky 40602

Patrick Morrisey
Attorney General
West Virginia Office of Attorney General
Building 1, Room E-26
State Capitol Complex
1900 Kanawha Boulevard E
Charleston, West Virginia 25305

Russell Coleman
Attorney General
Office of the Attorney General
700 Capital Avenue, Suite 118
Frankfort, Kentucky 40601-3449

Local Governments

Debbie Gambrel
County Clerk
Bell County
101 Courthouse Square
P.O. Box 157
Pineville, Kentucky 40977

Albey Brock
Judge/Executive
Bell County
101 Courthouse Square
P.O. Box 339
Pineville, Kentucky 40977

Bell County Conservation District
10581 US Highway 25E
P.O. Box 822
Pineville, Kentucky 40977

Sandra Wilson
City Clerk
City of Middlesboro
City Hall
221 N. 21st Street
Middlesboro, Kentucky 40965

Shawn Fugate II
Mayor
City of Pineville
300 Virginia Avenue
Pineville, Kentucky 40977

Non-Governmental Organizations

Ashley Wilmes, Director
Kentucky Resource Council
P.O. Box 1070
Frankfort, Kentucky 40602

Tom Fitzgerald
Kentucky Resource Council
P.O. Box 1070
Frankfort, Kentucky 40602

Catherine Clement
Kentuckians for the Commonwealth
P.O. Box 1450
London, Kentucky 40743

Josh Bills
Mountain Association
420 Main Street
Hazard, Kentucky 41701

Landowners

Rebecca Kelemen Blackburn
General Manager
Asher Land and Mineral, LLLP
204 Virginia Avenue
P.O. Box 463
Pineville, Kentucky 40977

Kentucky Natural Lands Trust, Inc
433 Chestnut Street
Berea, Kentucky 40403

Jack McCann Jr
c/o Ethel McCann
4003 E Fulton St.
Columbus, Ohio 43227

Tommy Lee McCann
817 Cooley Bridge Rd.
Pelzer, South Carolina 29669

Sarah Jane Buchanon
c/o Faye Partin
110 Sheckleford Lane
Tazewell, Tennessee 37879

Boyd Arnett[1]
Hulen, Kentucky 40845

Cordia and Vernon Templeton
P.O. Box 113
Ingram, Kentucky 40955

Ray and Wanda Franks
P.O. Box 113
Calvin, Kentucky 40813

AB Hoskins III and Judy Hoskins
c/o Albert Hoskins
5200 Boulder Court
Louisville, Kentucky 40207

David Victor Jr. and Susan L. Victor
127 Victor Way
Morehead, Kentucky 40351

RT Calloway
c/o Muriel Harbin
42 Mink Lane
Pineville, Kentucky 40977

David W. Victor Jr. (Trustee)
Audrey Victor Trust
127 Victor Way
Morehead, Kentucky 40351

---

[1] A complete mailing address has not been identified, so notification was not provided. LRPS will continue efforts to locate contact information and notify the individual once available.

Cheek R A Heirs
c/o Lucy Jackson
352 Gray Jackson Road
Pineville, Kentucky 40977

Jackson Larkin c/o Robert Brown
3782 Lake Oakland Shores Drive
Waterford, Michigan 48329

David Jackson & Joyce A. Jackson
22 D J Lane
Pineville, Kentucky 40977

David P. Jackson & Debra L. Jackson
1766 Balkan Road
Pineville, Kentucky 40977

Georgia C. & Phyllis Bowen
201 Willow Lane
Sharps Chapel, Tennessee 37866

Shirley Wilder
1829 Balkan Road
Pineville, Kentucky 40977

Leon & Connie Wilson
2068 Balkan Road
Pineville, Kentucky 40977

Jesse Wilder & Joyce Jackson
22 D J Lane
Pineville, Kentucky 40977

Todd Brock Jr.
c/o Michelle Baker
10476 US Highway 119
Pineville, Kentucky 40977

Tommy Lee McCann
817 Cooley Bridge Road
Pelzer, South Carolina 29669

Beverly M. Jones & Tommie Lee McCann
4003 Fulton Street
Columbus, Ohio 43227

George H. & Rosemarie Davenport
12989 Highway 119
Hulen, Kentucky 40845

Applicant

Sandy Slayton
Vice President
Rye Development
1455 SW Broadway Street, Suite 290
Portland, Oregon 97201

Erik Steimle
Chief Development Officer
Rye Development
1455 SW Broadway Street, Suite 290
Portland, Oregon 97201

Lesley Brotkowski
Senior Regulatory Advisor
Kleinschmidt Associates
233403 Stettin Ridge Court
Wausau, Wisconsin 54401

LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

INITIAL STATEMENT

BEFORE THE
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Lewis Ridge Pumped Storage Project **FERC Project No. 15249**

APPLICATION FOR LICENSE FOR MAJOR UNCONSTRUCTED PROJECT

INITIAL STATEMENT

(Pursuant to 18 CFR § 4.41(a))

1. Lewis Ridge Pumped Storage, LLC (Applicant or LRPS) applies to the Federal Energy Regulatory Commission (FERC or Commission) for an original license for the Lewis Ridge Pumped Storage Project, FERC No. 15249 (Lewis Ridge Project) as described in the attached exhibits. Pursuant to Section 6 of the Federal Power Act, as well as the Commission's Policy Statement on Establishing License Terms for Hydroelectric Projects,[1] the Applicant respectfully requests that the Commission issue a license for a term of 50 years for the Lewis Ridge Project.

2. The location of the Lewis Ridge Project is:

State:	Kentucky
County:	Bell County
Township or nearby town:	Blackmont, Tejay, Balkan, and Callaway
Stream or body of water:	Pumped storage; initial fill and recharge water from the Cumberland River and Tom Fork

3. The exact name and business address of the Applicant are:

   Lewis Ridge Pumped Storage, LLC
   100 South Olive Avenue
   West Palm Beach, Florida 33401

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[1] "As guidance, we note that the Commission has found that measures including the construction of pumped storage facilities . . . warranted longer license terms." 161 FERC ¶ 61,078, at P 16 (2017).

The Applicant requests that all correspondence and service of documents related to this notification and subsequent proceedings be addressed to:

Sandy Slayton
Vice President
Rye Development
1455 SW Broadway Street, Suite 290
Portland, Oregon 97201
Phone: 503-341-1425
Email: sandy@ryedevelopment.com

4. The Applicant is a limited liability company organized and existing pursuant to the laws of the Commonwealth of Kentucky and is not claiming preference under Section 7(a) of the Federal Power Act. Applicant is claiming preference as the holder of the preliminary permit under Section 5(a) of the Federal Power Act and the Commission's implementing regulations.

5. (i) The statutory or regulatory requirements of the Commonwealth of Kentucky in which the Lewis Ridge Project would be located that affect the project as proposed, with respect to bed and banks, and to the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power, and in any other business necessary to accomplish the purposes of the license under the Federal Power Act are:

    a. Lewis Ridge Pumped Storage, LLC is a limited liability company organized under the laws of the Commonwealth of Kentucky, and, as such, can engage in the activities set forth in its organizational documents, which include the generation, transmission, and distribution of electricity from the Lewis Ridge Project.

    b. Section 401 (a)(1) of the Clean Water Act requires that an applicant for a federal license or permit to conduct an activity that will or may result in discharge into waters of the United States (as defined in the Clean Water Act) must present the federal authority with either a Water Quality Certification (WQC) that the discharge would not violate water quality standards from the applicable state, or evidence of waiver thereof. In Kentucky, the 401 WQC is administered by the Kentucky Department for Environmental Protection (Kentucky DEP) Division of Water.[2]

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[2] The Kentucky DEP is under the Kentucky Energy and Environment Cabinet.

c. Under the revised Commonwealth of Kentucky statutes, including KRS Chapter 151, KRS Chapter 224A, and Kentucky Administrative Regulation (KAR) 401 KAR 4:010, a Water Withdrawal Permit is required for any withdrawal of 10,000 gallons per day or more from public waters of the Commonwealth of Kentucky, including streams, lakes, and groundwater. The Kentucky DEP Division of Water administers this program.

d. Under the revised Commonwealth of Kentucky statutes, including KRS Chapter 151.250 and 401 KAR 4:060, a Stream Construction/Floodplain Permit is required for any development in, along, or across a stream or within a designated floodplain. This includes construction, excavation, filling, or placement of structures or materials. The Kentucky DEP Division of Water administers this permit program to ensure that floodplain development does not increase flood risks or adversely impact water resources.

(ii) The steps the Applicant has taken or plans to take to comply with each of the laws cited above are:

a. The Applicant has complied with the requirements of the laws of the Commonwealth of Kentucky with respect to the right to engage in the business of developing and transmitting power.

b. The Applicant will file an application for a 401 WQC to Kentucky DEP Division of Water within 60 days following FERC’s notification of its acceptance of the license application being ready for environmental analysis.

c. The Applicant will consult with the Kentucky DEP Division of Water and will apply for and obtain a Water Withdrawal Permit as required.

d. The Applicant will consult with the Kentucky DEP Division of Water and will apply for and obtain a Stream Construction/Floodplain Permit as required. It is anticipated that an individual permit will be required.

INFORMATION REQUIRED BY 18 CFR § 4.32

1. *Identify every person, citizen, association of citizens, domestic corporation, municipality, or state that has or intends to obtain and will maintain any proprietary right necessary to construct, operate, or maintain the project:*

    Lewis Ridge Pumped Storage, LLC
    100 South Olive Avenue
    West Palm Beach, Florida 33401

2. *Identify (providing names and mailing addresses):*

    (i) Every county in which any part of the project, and any Federal facilities that would be used by the project, would be located;

    Bell County Clerk
    101 Courthouse Square
    P.O. Box 157
    Pineville, Kentucky 40977

    There are no federal facilities proposed to be used by the Lewis Ridge Project.

    (ii) Every city, town, or similar local political subdivision:

    (A) In which any part of the project, and any Federal facilities that would be used by the project, would be located; or

    No part of the Lewis Ridge Project is located in a city, town, or similar local political subdivision. The nearest communities to the proposed Lewis Ridge Project site are Blackmont, Tejay, Balkan, and Callaway, which are all unincorporated communities with no mailing address.

    (B) That has a population of 5,000 or more people and is located within 15 miles of the project dam;

    City of Middlesboro
    City Hall
    221 N. 21st Street
    Middlesboro, Kentucky 40965

(iii) Every irrigation district, drainage district, or similar special purpose political subdivision:

(A) In which any part of the project, and any Federal facilities that would be used by the project, would be located; or

Bell County Conservation District
10581 US Highway 25E
P.O. Box 822
Pineville, Kentucky 40977

(B) That owns, operates, maintains, or uses any project facilities that would be used by the project;

There are no known irrigation districts, drainage districts, or other special purpose political subdivisions that own, operate, maintain, or use any project facilities or any federal facilities that would be used by the Lewis Ridge Project.

(iv) Every other political subdivision in the general area of the project that there is reason to believe would likely be interested in, or affected by, the application; and

City of Pineville
300 Virginia Avenue
Pineville, Kentucky 40977

(v) All Indian tribes that may be affected by the project.

The Applicant is not aware that the proposed project would affect any Native American tribes. The following Native American tribes may have some level of interest in the surrounding area and have been included in the distribution list for the Lewis Ridge Project.

Cherokee Nation
P.O. Box 948
Tahlequah, Oklahoma 74465

Delaware Nation
P.O. Box 825
Anadarko, Oklahoma 73005

Eastern Band of Cherokee Indians
P.O. Box 455
Cherokee, North Carolina 28719

Miami Tribe of Oklahoma
P.O. Box 1326
Miami, Oklahoma 74355-1326

Muscogee (Creek) Nation
P.O. Box 580
Okmulgee, Oklahoma 74447

Peoria Tribe of Indians of Oklahoma
118 South Eight Tribes Trail
Miami, Oklahoma 74355

Southern Cherokee Nation of Kentucky
Mailing address no longer active; correspondence sent via email to scnkregistrar@gmail.com.

United Keetoowah Band of Cherokee Indians in Oklahoma
P.O. Box 746
Tahlequah, Oklahoma 74465

3. *(i) For a license (other than a license under section 15 of the Federal Power Act) state that the applicant has made, either at the time of or before filing the application, a good faith effort to give notification by certified mail of the filing of the application to:*

   (A) Every property owner of record of any interest in the property within the bounds of the project, or in the case of the project without a specific boundary, each such owner of property which would underlie or be adjacent to any project works including any impoundments:

   Property owners[3] that lie within the Study Area, or within or adjacent to the proposed Project Boundary, are included on the Distribution List and

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[3] The Applicant has been unable to locate one landowner mailing address, thus notification to this individual was not provided. LRPS will continue efforts to locate contact information and notify the individual once available. See Distribution List for available landowner information.

are being notified by certified mail concurrent with the Final License Application filing.

(B) *The entities identified in paragraph 2 of this section, as well as any other Federal, state, municipal or other local government agencies that there is reason to believe would likely be interested in or affected by such application.*

A list of these entities will be attached to the transmittal letter for the Final License Application.

(C) *Such notification must contain the name, business address, and telephone number of the applicant and a copy of the Exhibit G contained in the application, and must state that a license application is being filed with the Commission.*

The notification will contain the name, business address, and telephone number of the Applicant. The notification will also include a copy of Lewis Ridge Project Boundary depicted on Exhibit G and a statement that the license application is being filed with the Commission.

4. *(i) As to any facts alleged in the application or other materials filed, be subscribed and verified under oath in the form set forth in paragraph (a)(3)(B) of this section by the person filing, an officer thereof, or other person having knowledge of the matters set forth. If the subscription and verification is by anyone other than the person filing or an officer thereof, it must include a statement of the reasons therefor.*

   The subscription for this application is signed by a person authorized to act as agent for the Applicant.

5. *Contain the information and documents prescribed in the following Sections of this chapter, except as provided in paragraph (b) of this Section, according to the type of application.*

   The application is for an original license for a major unconstructed project and contains the following information per 18 CFR § 4.41:

   Initial Statement
   Exhibit A: Project Description
   Exhibit B: Project Operation and Resource Utilization
   Exhibit C: Proposed Construction Schedule
   Exhibit D: Statement of Estimated Costs and Financing
   Exhibit E: Environmental Report

Exhibit F:	General Design Drawings and Preliminary Supporting Design Report (Critical Energy/Electric Infrastructure Information [CEII])
Exhibit G:	Project Boundary Map

6. The Applicant does not intend to exercise its rights under Section 210(e) of the Public Utility Regulatory Policies Act of 1978 (PURPA). The Applicant reserves the right to exercise any additional rights available to it under PURPA in the future.

SUBSCRIPTION

This Application for an original License for the Lewis Ridge Pumped Storage Project, FERC Project No. 15249, is executed in the State of OREGON, County of MULTNOMAH, by Signee of Lewis Ridge Pumped Storage, LLC (100 South Olive Avenue West Palm Beach, Florida 33401) being duly sworn, deposes and says that the contents of this application are true to the best of their knowledge or belief. The undersigned has signed the application this 12 day of JUNE, 2025.

Lewis Ridge Pumped Storage, LLC

By: Sandra J Slayton
Name: SANDRA J SLAYTON
Title: AUTHORIZED REPRESENTATIVE
(VP, RYE DEVELOPMENT)

VERIFICATION

Subscribed and sworn to before me, a Notary Public of the State of Oregon, this 12th day of June, 2025.

(Notary Public)

(My Commission Expires 8/15/2026)/seal

OFFICIAL STAMP
KAYLA SANDERS
NOTARY PUBLIC - OREGON
COMMISSION NO. 1026708
MY COMMISSION EXPIRES AUGUST 15, 2026

LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

EXHIBIT A
PROJECT DESCRIPTION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DEFINITIONS OF TERMS, ACRONYMS, AND ABBREVIATIONS

AC	asphalt concrete
AIS	air insulated
Applicant	Lewis Ridge Pumped Storage, LLC
CFR	Code of Federal Regulations
cfs	cubic feet per second
Commission	Federal Energy Regulatory Commission
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
GSU	generator step-up
GWh	gigawatt-hour
h	height
HDPE	high-density polyethylene
kV	kilovolt
LG&E/KU	Louisville Gas & Electric Company/Kentucky Utilities Company
LRPS	Lewis Ridge Pumped Storage, LLC
Lewis Ridge Project	Lewis Ridge Pumped Storage Project, FERC P-15249
MVA	megavolt-ampere
MW	megawatt
NAVD 88	North American Vertical Datum of 1988
PMF	probable maximum flood
PMP	probable maximum precipitation
POI	point of interconnection
TLP	Traditional Licensing Process
VFD	variable frequency drive
w	width

1.0 GENERAL PROJECT DESCRIPTION

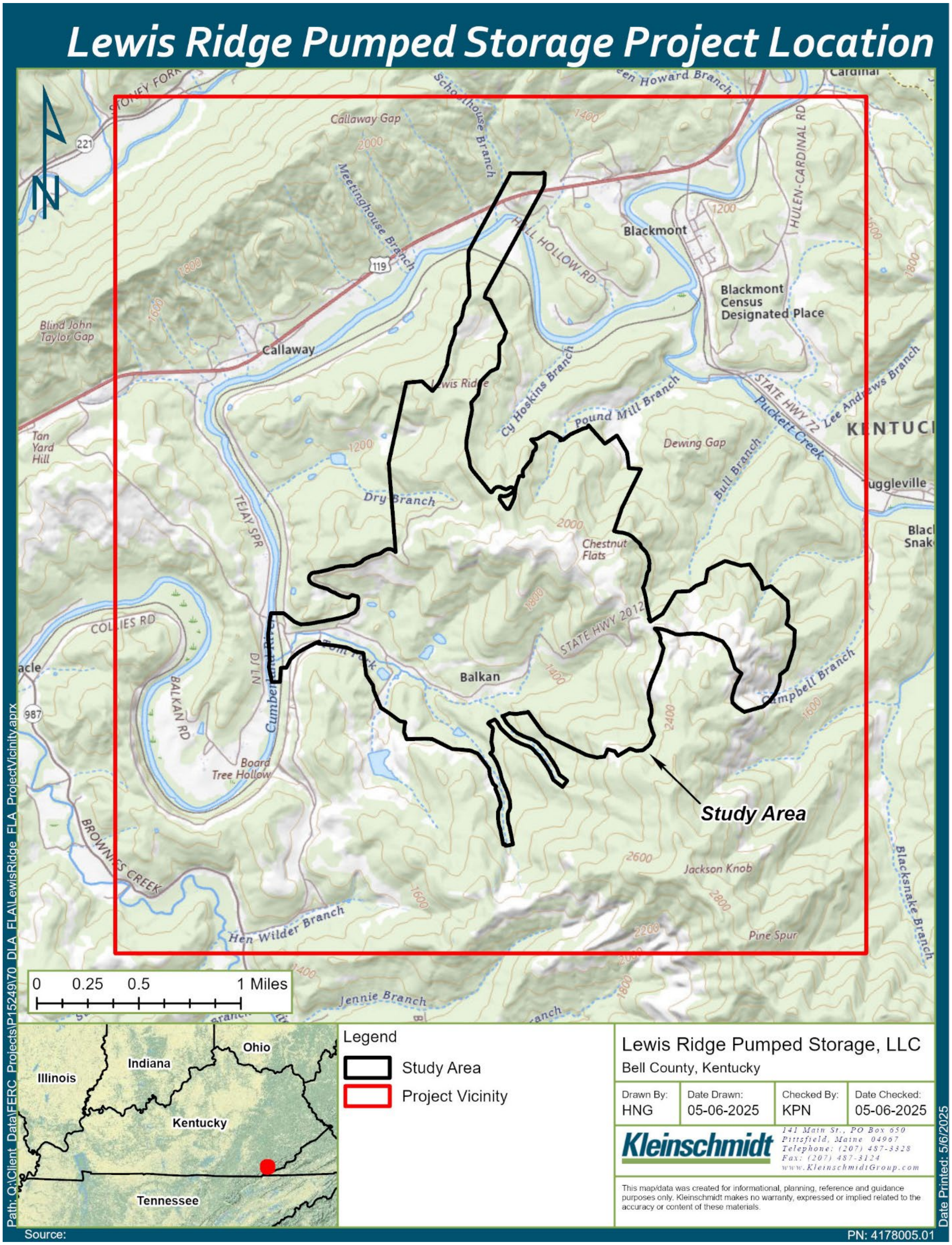
Lewis Ridge Pumped Storage, LLC (Applicant or LRPS) is filing with the Federal Energy Regulatory Commission (FERC or Commission) its Final License Application (FLA) for the Lewis Ridge Pumped Storage Project (FERC No. 15249) (Lewis Ridge Project). LRPS is using FERC's Traditional Licensing Process (TLP) as established in FERC regulations, Title 18 of the U.S. Code of Federal Regulations (CFR), Part 4. This Project Description (Exhibit A) has been prepared in accordance with 18 CFR § 4.41, contents for an Application for License for Major Unconstructed Project.

The Lewis Ridge Project is an unconstructed, pumped storage hydroelectric project that is anticipated to have a guaranteed power output capacity of 266 megawatts (MW) for a duration of 8 hours. The rated capacity will be 308 MW at the generator terminals. The Lewis Ridge Project will be located on land that has been used for underground and surface coal mining and will involve the construction of new water storage, water conveyance, and electric generation facilities. The Lewis Ridge Project will use electricity to store potential energy by moving water between a lower and upper reservoir, connected by a conveyance system (steel penstock, drop shaft, high-pressure tunnels, low-pressure draft tube tunnels, and intake/outlets) and powerhouse that contains two reversible pump-turbines. During periods of peak electricity demand, the Lewis Ridge Project will release stored water in the upper reservoir to the lower reservoir, generating power, and delivering that power to the grid. The Lewis Ridge Project will require an initial fill of the reservoirs with recharge water required on a periodic basis.

1.1 Lewis Ridge Project Location

The proposed site for the Lewis Ridge Project is in Bell County, Kentucky, near the borders of Tennessee and Virginia. The proposed site is located near the communities of Blackmont, Tejay, Balkan, and Callaway (Figure 1-1).

Figure 1-1: Lewis Ridge Project Location



2.0 PROPOSED PROJECT STRUCTURES (18 CFR SECTION 4.41(B)(1)-(B)(5))

The Lewis Ridge Project specifications described herein may change for reasons such as engineering and geotechnical feasibility, environmental concerns, or site agreements and contracts.

The proposed Lewis Ridge Project will consist of the following: (1) an 8,241-foot-long, 50-foot-high rocky earthfill dam for the upper reservoir with an integrated overflow emergency spillway; (2) an upper reservoir with a surface area of 48.2 acres and an active storage capacity of approximately 2,600 acre-feet; (3) a 4,174-foot-long conveyance system that includes a 16-foot-diameter high pressure surface penstock, a vertical shaft, and bifurcation manifold connecting two high-pressure tunnels to the spherical valve, from the bonneted gate two 12-foot-diameter low-pressure draft tube tunnels, and intake/outlets; (4) a 131-foot-diameter circular shaft powerhouse located 267 feet below the ground containing two 154 MW reversible pump-turbines, with a total rated capacity of 308 MW; (5) an 1,120-foot-long, 138-foot-high earthfill embankment dam at the lower reservoir with an integrated overflow emergency spillway; (6) a 51.6 acre lower reservoir with an active storage capacity of approximately 2,602 acre-feet; (7) a 2.5-mile-long, 161 kilovolt (kV) overhead interconnection line; (8) a low-profile intake, pump station, and three parallel 4,742-foot-long initial fill and recharge water supply pipelines to the lower reservoir; and (9) ancillary equipment.

A summary of proposed specifications for the Lewis Ridge Project is provided in Table 2-1. The proposed Lewis Ridge Project features are shown on Figure 2-1. Figure 2-2 shows renderings of key features of the Lewis Ridge Project. Additional details on Lewis Ridge Project features are provided under the corresponding subheadings below.

Table 2-1: Proposed Lewis Ridge Project Specifications

Lewis Ridge Project Description	Specification[1]
General Information	
FERC Number	P-15249
Operation Type	Pumped Storage Project
Location	Bell County, Kentucky
Active Storage Capacity	Approximately 2,600 acre-feet
Gross Storage Capacity	2,877 acre-feet upper reservoir, 3,486 acre-feet lower reservoir
Storage Time	8 hours (at 266 MW)
Maximum Gross Head	1,016 feet elevation
Minimum Gross Head	842 feet elevation
Rated Head	929 feet elevation
Generation	
Rated Capacity	308 MW (total for 2 units at the rated head as measured at the generator terminals)
Average Annual Generation[2]	717 gigawatt-hours (GWh)
Average Monthly Generation[2]	60 GWh
Upper Reservoir	
Structure Type	Rocky earthfill embankment dam (2H:1V upstream and downstream slopes)
Location	36.768800 Latitude, -83.538000 Longitude
Minimum Water Surface Elevation and Surface Area	Approximately 2,076 feet, 22.8 acres
Maximum Water Surface Elevation and Surface Area	Approximately 2,150 feet, 48.2 acres
Dam Height	50 feet (crest at 2,160 feet elevation)
Dam Length	8,241 feet
Dam Crest Width	20 feet
Overflow Spillway	Integrated overflow emergency spillway

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[1] Elevations are based on the North American Vertical Datum of 1988 (NAVD 88).

[2] Based on guaranteed power output and including scheduled and unscheduled outages.

Lewis Ridge Project Description	**Specification**[1]
Outlet	Low-level outlet for emergency drawdown requirements
Conveyance System	
Number of penstocks	1 penstock (bifurcates to two penstocks before entering powerhouse)
Diameter of penstocks	16 feet and 12 feet, respectively
Length of penstock	4,174 feet
Lower Reservoir	
Structure Type	Earthfill embankment dam (3H:1V upstream and downstream slopes)
Location	36.760000 Latitude, -83.550860 Longitude
Minimum Water Surface Elevation and Surface Area	Approximately 1,134 feet, 9.3 acres
Maximum Water Surface Elevation and Surface Area	Approximately 1,234 feet, 51.6 acres
Dam Height	138 feet (crest at 1,252 feet elevation)
Dam Length	1,120 feet
Dam Crest Width	20 feet
Overflow Spillway	Integrated overflow emergency spillway, concrete chute spillway located in the right abutment, sized for probable maximum precipitation event with lower reservoir at the maximum water surface level
Outlet	Low-level outlet for emergency drawdown requirements
Powerhouse	
Location	Northern end of lower reservoir
Configuration	Approximately 131 feet in diameter, shaft-style powerhouse 267 feet below ground level
Pump-Turbines	Two 154 MW reversible pump-turbine units
Motor-Generator	Two 171MVA motor-generator units
Hydraulic Capacity[3]	4,544 cubic feet per second (cfs) total station flow

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[3] The hydraulic capacity is defined as the maximum flow that the project has been designed for.

Lewis Ridge Project Description	**Specification**[1]
Composition and Dimensions of Above Ground Powerhouse Building	Assumed to be a 276 ft long x 137 ft wide x 84 ft high steel-framed building clad in insulated metal panel, which will be evaluated as the design progresses.
Transformers and Interconnection Lines	
Number of Interconnection Lines	1
Length of Interconnection Line	2.5 miles
Interconnection Line Voltage	161 kV
Number of Transformers	2 primary and 1 spare
Water Supply for Initial Fill and Recharge Water	
Type	Low-profile intake screen from Cumberland River, temporary mobile pumps, connected to three permanent initial fill and recharge water supply pipelines discharging into the lower reservoir.
Access Roads	
Permanent Access Roads	7.1 miles long, 28 feet wide
Temporary Access Roads	4 miles long, 28 feet wide

Figure 2-1: Proposed Project Features

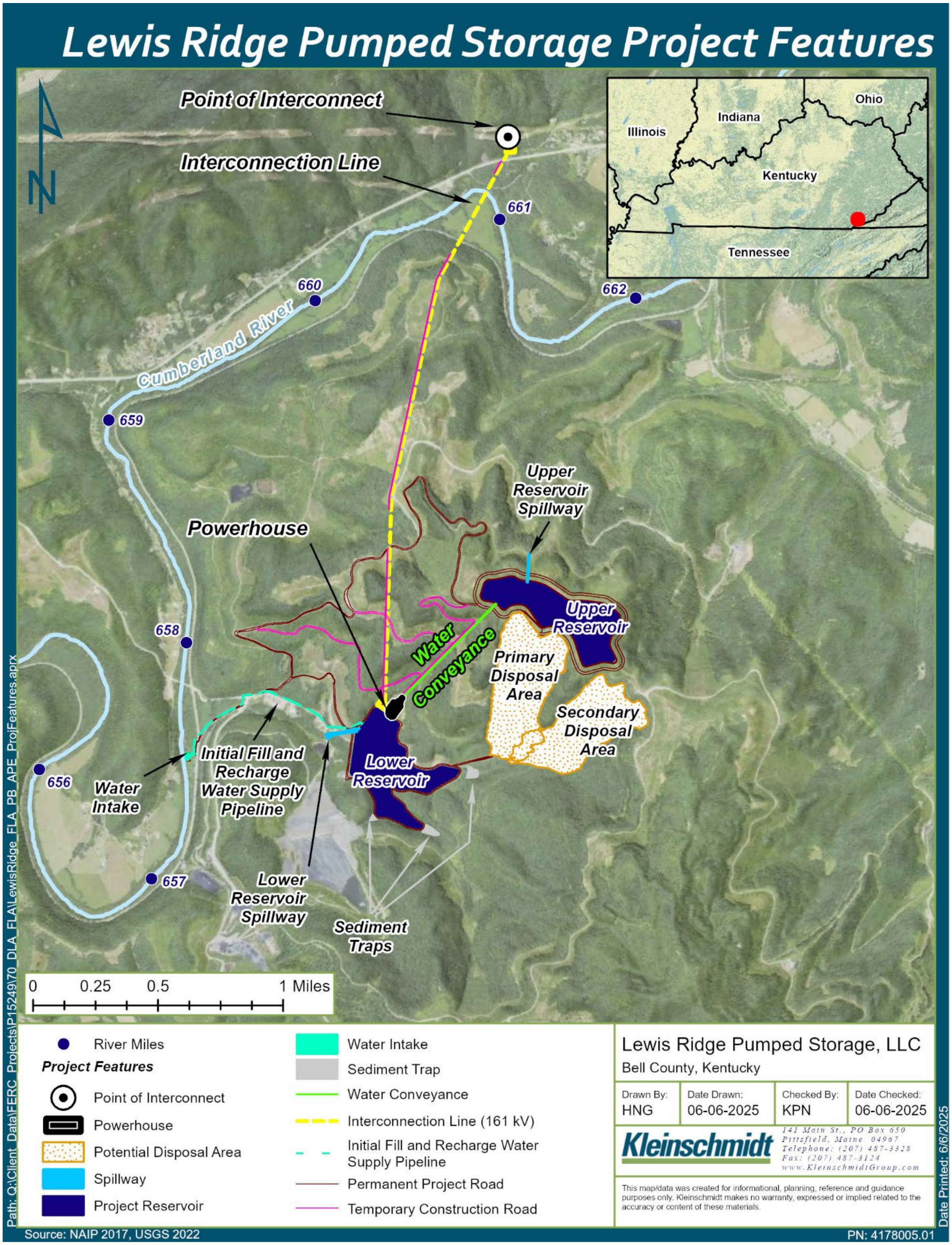
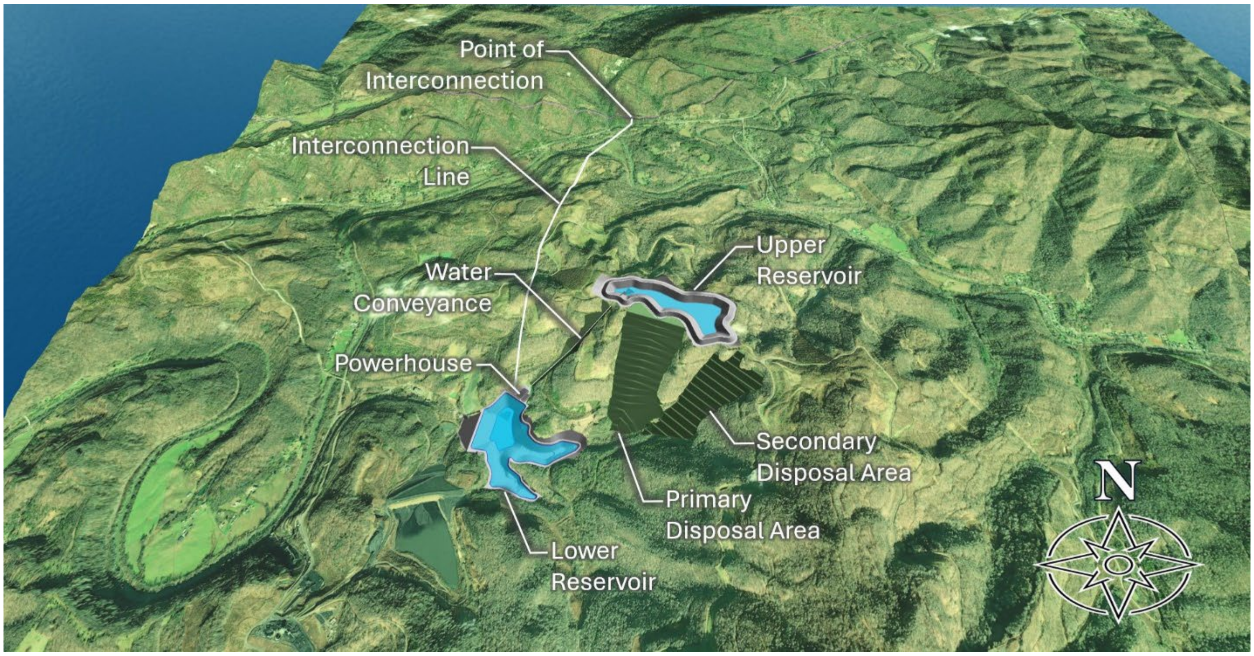


Figure 2-2: Rendering of Proposed Lewis Ridge Project Key Features



2.1 Upper Reservoir and Dam

The upper reservoir will be located on top of a ridge. The upper reservoir will have a surface area of 48.2 acres at the normal maximum water surface elevation of 2,150 feet and a surface area of 22.8 acres at the normal minimum water surface elevation of 2,076 feet. The upper reservoir will have a gross storage capacity of 2,877 acre-feet[4] at the spillway crest elevation and an active storage capacity of approximately 2,602 acre-feet[5] at the normal maximum water surface elevation. The change in water surface elevation in the upper reservoir during normal operations is anticipated to be 74 feet.

The upper reservoir dam will be an 8,241-foot-long, 50-foot-high ring dike rocky earthfill dam with an integrated overflow emergency spillway. The upper reservoir dam will have upstream and downstream slopes of 2H:1V and a 20-foot-wide dam crest. The upper reservoir dam will include low-level outlet works, teeing off the penstock above the

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[4] Gross storage in the upper reservoir includes dead storage, active storage, and additional capacity to accommodate direct runoff from a probable maximum precipitation (PMP) event over the reservoir surface.

[5] Active storage capacity is equal to the volume at the normal maximum water surface elevation minus the volume at the normal minimum water surface elevation.

powerhouse, with an outlet into the lower reservoir for use in emergency drawdown situations.[6]

The upper reservoir will store the probable maximum precipitation (PMP) within the freeboard zone between the normal maximum water surface and the spillway crest. In an over-pumping event, the upper reservoir will store the active volume and dead storage volume of the lower reservoir below the spillway elevation. The embankment dam will have an ogee spillway and will be set within the crest of the dam as a redundant safety feature. The reservoir will have water level sensors and alarms to send an alert in the event of an over pumping event or spillway activation. The spillway will discharge into a flexible articulated concrete block mat-lined chute on the downstream face of the dam; a riprap-lined channel downstream of the spillway is included for safe discharge away from the dam. A prefabricated bridge will span over the spillway. In the unlikely situation of a PMP and over-pumping event simultaneously occurring, water discharged from the spillway channel would flow though the Pound Mill Branch and into Puckett Creek approximately 1,000 feet upstream of the confluence with the Cumberland River.

The upper reservoir will be lined up to the dam crest elevation with an asphalt concrete (AC) lining system to limit seepage and erosion issues. The liner construction detail will include 3.5 inches of dense AC over 3.5 inches of an asphalt binder layer, placed on a subgrade/sub-base of a firm, stable, graded crushed rock (Zone 2). The drainage system below the AC liner and the Zone 2 layer will consist of a finger drain system within the reservoir floor and at the upstream toes of the embankment and reservoir slopes. The drain system will include 12-inch high-density polyethylene (HDPE) drainpipes embedded in drain gravel wrapped in filter fabric placed in trenches excavated into the subgrade. The drainpipes will include access for cleanout of sediment and inspection by remotely operated vehicles.

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[6] In an emergency situation, the powerhouse units may not be available for upper reservoir drawdown. Therefore, the reservoirs will require dedicated bottom outlets to release water via gravity drainage without requiring the power generation pumping system to provide for safety of the upper dam.

2.2 Conveyance System

The water conveyance system between the two reservoirs will consist of the following: intake/outlet facilities at both reservoirs, a surface penstock from the upper reservoir to a drop shaft, the drop shaft, a high-pressure tunnel and manifold connecting the drop shaft to the pumping-generating units, and low-pressure draft tube tunnels connecting the pumping-generating units to the lower reservoir. The total length of the water conveyance system is 4,174 feet.

The upper reservoir intake/outlet structure will be located immediately upstream of the upper reservoir dam on the west end of the reservoir facing the powerhouse. The water intake structure is anticipated to have gradually increasing flow velocities throughout the structure from the reservoir to the penstock entrance.

The upper reservoir water intake/outlet will have a length of 104 feet from the trash rack to the penstock entrance. The 16-foot-diameter-high-pressure steel penstock will span 3,134 feet before entering a 237-foot vertical drop shaft. From the drop shaft, there will be a tunnel and bifurcation manifold that extends 340 feet to the spherical valve flange inside the powerhouse. The mean slope of the high-pressure penstock will be 30.6 percent. The penstock will include four vertical bends and no horizontal bends, as the number of bends has been minimized to reduce local head losses.

The setting of the pump-turbine units, as well as the centerline of the penstocks from the bifurcation, will be 120 feet lower than the lower reservoir minimum operating water level.

Downstream of the powerhouse, each pump-turbine unit will have its own 12-foot-diameter low-pressure steel draft tube connected to the lower reservoir water intake/outlet structure. The length of each low-pressure draft tube will be 249 feet, and the length of the water intake/outlet will be 110 feet.

The lower reservoir water intake will be located at the bottom of the lower reservoir. Water intake/outlet structures, steel penstock, bifurcation manifold, and other parts of the conveyance system are dimensioned so that flow velocities will be close to the target flow velocity range as presented in Table 2-2. The conveyance system dimensions are presented in Table 2-3.

Table 2-2: Design Characteristics of Conveyance System

Component	Target Flow Velocity Range (feet per second)
Water intake/outlet trash rack	0.5 to 3.0
Water intake/outlet structure	Transition from trash racks to conveyance system entrance
Steel penstock (high-pressure)	Up to 20
Draft Tubes (low-pressure)	Up to 20
Bifurcation manifold	Up to 20
Turbine inlet valve	Up to 23

Table 2-3: Dimensions of Conveyance System

Component	Shape	Dimensions (feet)
Upper Reservoir Intake Trash Rack (inclined)	Rectangular (w x h)	30 x 37
Upper Reservoir Intake Gate	Square (w x h)	16 x 16
High Pressure Penstock	Circular (Dia.)	16
High Pressure Manifold Entrance	Circular (Dia.)	16
High Pressure Manifold Exit	Circular (Dia.)	12
Turbine Inlet Valve	Circular (Dia.)	10
Low Pressure Draft Tubes (2)	Circular (Dia.)	12
Lower Reservoir Intake Gate (set of 2)	Square (w x h)	12 x 12
Lower Reservoir Intake Trash Rack (set of 2)	Rectangular (w x h)	22 x 26

2.3 Lower Reservoir and Dam

The lower reservoir will be located within a valley that contains Tom Fork, a tributary to the Cumberland River. The lower reservoir will have a surface area of 51.6 acres at the normal maximum water surface elevation of 1,234 feet and a surface area of 9.3 acres at the normal minimum water surface elevation of 1,134 feet. The lower reservoir will have a gross storage capacity of 3,486 acre-feet[7] at the probable maximum flood elevation and

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[7] The gross storage capacity of the lower reservoir consists of dead storage, active storage, flood storage for a probable maximum flood (PMF) event, and the volume of water contained in the conveyance system, which may return to the reservoir during non-operational periods.

an active storage capacity of approximately 2,602 acre-feet at the normal maximum water surface elevation. The change in water surface elevation in the lower reservoir during normal operations is anticipated to be 100 feet.

The lower reservoir dam will be a 1,120-foot-long, 138-foot-high earthfill embankment dam with an integrated overflow emergency spillway located in the right abutment. The lower reservoir dam will have 3H:1V upstream and downstream slopes and a 20-foot-wide dam crest.

The lower reservoir dam will include low-level outlet works for use related to emergency drawdown requirements and discharging base flows from Tom Fork. The low-level outlet will be located beneath the dam in the lowest part of the valley and will include a 36-inch-diameter steel pipe encased in reinforced concrete, inlet structure, outlet dissipation structure, and valves for operation. Sediment traps will be located upstream of the reservoir along Tom Fork. Water from Tom Fork will enter the sediment traps, allowing time for sediment to settle before discharging into the lower reservoir through the sediment trap's principal spillway culvert outlet. A flow gauge will be installed at this outlet to monitor flows. This culvert will be installed beneath the lower reservoir perimeter road, above the lower reservoir's maximum water surface elevation, and will flow by gravity into the AC-lined reservoir basin. Water discharged from the lower reservoir through the low-level outlet works and into Tom Fork will be regulated to match the inflows measured by the flow gauges, thereby maintaining base flows for Tom Fork.

To limit seepage, the entire lower reservoir footprint will have an AC liner system extending to the dam crest elevation. The liner system will be the same as described for the upper reservoir.

The lower reservoir will include a concrete-lined integrated overflow emergency spillway in the right abutment of the dam designed to pass the probable maximum flood (PMF) flow. The spillway will have an approach channel leading to an ogee crest. A concrete chute will convey flow from the ogee to the stilling basin. A riprap lined discharge channel will connect to Tom Fork. The chute will be anchored to the foundation and will include keys and underdrains to control uplift pressures.

2.4 Initial Fill and Recharge Water

For initial fill and recharge operations, the system will use portable, trailer, or skid-mounted self-priming pumps. Power sources for pumps will use local power supply with variable frequency drives (VFDs). Temporary pumps offer flexibility to move out of the floodway during large storm events, allowing for adaptive management, reducing risk of damage to and displacement of equipment, and minimizing permanent disturbance.

The permanent intake installation will feature low-profile screens to maintain intake velocities below 0.5 feet per second, minimizing aquatic life entrainment. Six half-cylinder screens, each estimated at 30-inch diameter by 15 feet long, will be installed on three concrete pads on the riverbed, each measuring 3 feet wide by 31 feet long. Intake components will use corrosion-resistant materials like stainless steel and HDPE, with mechanical components located outside the waterway. Cleaning involves air surges and mechanical scrubbing, with no cleaning agents allowed. Heat generated by the system will be dissipated through indirect methods, preventing localized warming of the river and avoiding the formation of thermal plumes that could alter natural water temperatures.

The initial fill and recharge water supply pipelines will be comprised of three parallel 24-inch HDPE pipes, buried with 3.5 feet of ground cover, adjacent to site access roads. A permanent manifold at the start of the pipelines will include isolation, throttling, backflow prevention, metering, and vacuum/air release provisions. The initial fill and recharge water supply pipelines will cross the CSX Transportation Railroad using the jack and bore method, each housed within a 36-inch steel casing pipe. The pipelines will be installed using open cut and cover through Tom Fork. The pipelines will discharge into a stilling basin north of the lower reservoir spillway, positioned 2 feet above the maximum operating water surface elevation to dissipate energy before flowing into the reservoir.

The duration of the initial fill will depend on water availability, project operations, and a detailed fill plan. A detailed and comprehensive initial fill plan will be developed in accordance with FERC Dam Safety and Kentucky Dam Safety guidelines.

2.5 Powerhouse and Generating Equipment

The powerhouse will be located at the northern end of the lower reservoir and will be a shaft-style powerhouse. The approximate 131-foot-diameter circular shaft powerhouse will be located 267 feet below the ground surface, allowing for the pump-turbine units runner elevation setting to have adequate submergence below the minimum operating level in the lower reservoir.

The powerhouse will contain two identical 154 MW fixed speed reversible Francis pump-turbines with a total rated capacity of 308 MW. The pump-turbine units will be in a vertical shaft arrangement. The pump-turbine units will have an overall cycle efficiency for pumping and generating of approximately 78 percent.

The Lewis Ridge Project will consider the potential use of variable speed pump-turbine units as the design progresses. The generator will be either a synchronous or asynchronous machine based on the decision of fixed speed versus variable speed turbine. The generators will be totally enclosed, vertical salient-pole type.

Three 13.8-to-161 kV, 150 megavolt-ampere (MVA) iso-phase bus to air-bushings generator step-up (GSU) transformers (two primary and one spare) will be located adjacent to the powerhouse at the ground level. Each GSU transformer will be connected on its high voltage side to a 161 kV air insulated (AIS) SF6 circuit breaker, tied to a single bus. A single 161 kV AIS main circuit breaker will be connected to the interconnection line.

2.6 Transmission Facilities

The transmission facilities include a 2.5-mile, 161 kV primary transmission interconnection line and two switching stations, one outside of the powerhouse and the other at the point of interconnection (POI).

The size of the switching station just outside of the powerhouse will be approximately 270 feet by 135 feet. This switching station will have two incoming 161 kV short slack span lines from the powerhouse. Each incoming line will connect to a circuit breaker located within the switching station and then be routed through a rigid overhead 161 kV bus with bus support structures and through a circuit breaker on the outgoing line. The bus height will be about 20 feet above grade. The static lines will be about 60 feet above grade at the dead ends. The phase conductors will be about 48 feet above grade at the dead ends.

The dimensions of the switching station at the 161 kV POI will be approximately 320 feet by 200 feet. It will have one 161 kV incoming line from the powerhouse switching station that will connect with a 161 kV ring bus configuration consisting of three circuit breakers before connecting to the existing Pineville-Harlan #1 line that will be separated at the switching station.

At both switching stations, each circuit breaker will have isolation switches on each side of the circuit breaker. The complete footprint of the switching stations will have a ground grid for the safety of personnel and be enclosed with a security fence. The POI switching station will have a small protection and control building. The switching station near the powerhouse will house protection and control equipment within the powerhouse control room. The POI interconnect switching station is anticipated to be jointly managed by the project company and the connecting utility. The switching stations and POI will be within the proposed Project Boundary.

Other features that will be included in the at-grade switchyard include disconnect switches, surge arresters, instrument transformer, control house with protective relaying, and a dead-end structure for connecting the interconnection line.

The new 161 kV overhead interconnection line will consist of a single circuit running approximately 2.5 miles from the new switching station located outside the powerhouse near the lower reservoir to the switching station at the 161 kV POI, where it will interconnect to the existing 161 kV Pineville-Harlan #1 line. The interconnection line will be within the proposed Project Boundary and is estimated to have a right-of-way width of 200 feet. The majority of the interconnection line structures will be steel monopoles either directly embedded or placed on reinforced concrete foundations. Lattice tower structures will be incorporated at locations where the span length needs to be increased to cross the Cumberland River and to provide adequate clearances over existing overhead lines per the latest standards.

2.7 Ancillary Equipment

Ancillary equipment is described below and includes main inlet valves, governor system, main hoisting devices, and instrumentation and monitoring devices.

2.7.1 Main Inlet Valves

The turbine inlet will be equipped with a spherical valve acting as a main inlet valve. The main inlet valve will allow the turbines to be dewatered and the penstock flow to be shut off in case of an emergency. The spherical valves will be equipped with maintenance and service seals. The spherical valves may be controlled in local mode, but the control will normally be incorporated in the turbine automatic control sequence. Each spherical valve will be equipped with a bypass line for the purpose of filling and/or equalizing the water pressure in the turbine and manifold before opening the spherical valve.

2.7.2 Governor System

The pump-turbine equipment will be equipped with a governor system composed of a digital governor, governor actuator, common pressure oil system for the turbine, and the spherical valves and associated control instruments.

2.7.3 Main Hoisting Devices

Two electrically operated overhead traveling cranes of equal capacity will be installed in the powerhouse, each equipped with main and auxiliary hoists. The crane’s main hoists will be designed to lift the heaviest part of the generator including the lifting beam. The crane will be capable of lifting and lowering the main inlet valves and other accessories of the pump-turbine during installation.

2.7.4 Instrumentation and Monitoring Devices

Instrumentation will be included in the dam embankments and foundations, below the dams, and within the reservoirs. Instrumentation will include reservoir level sensors, flow gauges, survey monuments, piezometers, water level standpipes, settlement sensors, accelerographs, seepage monitoring weirs, and fiberoptic cables for seepage monitoring.

3.0 LANDS OF THE UNITED STATES (18 CFR SECTION 4.41(B)(6))

The Lewis Ridge Project will be located on private land, and there is no associated federal or Tribal land.

4.0 REFERENCES

U.S. Geological Survey, National Geospatial Program. 2022, April 19. USGS National Hydrography Dataset Best Resolution (NHD) – Kentucky [Vector digital data]. U.S. Geological Survey. Reston, VA. Retrieved from https://prd-tnm.s3.amazonaws.com/StagedProducts/Hydrography/NHD/State/GDB/NHD_H_Kentucky_State_GDB.zip

LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

EXHIBIT B
PROJECT OPERATION AND RESOURCE UTILIZATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DEFINITIONS OF TERMS, ACRONYMS, AND ABBREVIATIONS

ABL	aggregate base layer
AC	asphalt concrete
Applicant	Lewis Ridge Pumped Storage, LLC
CFR	Code of Federal Regulations
cm	centimeter
Commission	Federal Energy Regulatory Commission
DLA	Draft License Application
EDDI	Evaporative Demand Drought Index
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
fps	feet per second
gpm	gallon per minute
GWh	gigawatt-hours
HAC	Hydraulic Asphalt Concrete
HDPE	high-density polyethylene
in	inch
k	permeability
KY	Kentucky
Lewis Ridge Project	Lewis Ridge Pumped Storage Project, FERC P-15249
LG&E/KU	Louisville Gas & Electricity Company and Kentucky Utilities Company
LRPS	Lewis Ridge Pumped Storage, LLC
MIV	Main Inlet Valve
mm	millimeter
MW	megawatt
MWh	megawatt-hours
NAVD 88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PAD	Pre-Application Document
PMF	probable maximum flood
PMP	probable maximum precipitation

PPA	preliminary permit application
s	second
SAP	superabsorbent polymer
TLP	Traditional Licensing Process
USGS	United States Geological Survey
VFD	variable frequency drives

1.0 PROJECT ALTERNATIVES CONSIDERED (18 CFR SECTION 4.41(C)(1) AND 4.41(C)(2))

1.1 Project Site Alternatives

The proposed Lewis Ridge Pumped Storage Project (Lewis Ridge Project) site is located in Bell County, Kentucky, near the borders of Tennessee and Virginia. The proposed site is located near the communities of Blackmont, Tejay, Balkan, and Callaway and near river mile 657.5 of the Cumberland River.

Site selection for a pumped storage project involves identifying locations with suitable topography, typically areas with significant elevation differences between an upper and lower reservoir. Lewis Ridge Pumped Storage, LLC (Applicant or LRPS) also considers factors including accessibility for infrastructure development, proximity for connection to the electrical grid, regional need for power, land availability, proximity to existing water sources, and potential for minimization of environmental impacts. The selected proposed site for the Lewis Ridge Project features topography and existing conditions beneficial to a pumped storage system and provides a unique opportunity to repurpose a site historically used for mining.

1.2 Project Design Alternatives

Throughout the engineering design process, from the initial conceptual design to the proposed preliminary engineering design in this license application, multiple design alternatives were evaluated. These alternatives were assessed based on engineering and geotechnical feasibility, cost considerations, and environmental impact. Previous design alternatives presented in the 2021 Preliminary Permit Application (PPA)[1] and the 2022 Pre-Application Document (PAD)[2], which were developed using only early-stage engineering concepts, were described in prior Federal Energy Regulatory Commission (FERC) filings and are not addressed in this Final License Application (FLA). The design alternative outlined previously in the Draft License Application (DLA)[3] is described below. Following further refinement, the alternative proposed in the FLA was identified as the

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[1] FERC Accession Number: 20211122-5269

[2] FERC Accession Number: 20221021-5166

[3] FERC Accession Number: 20240930-5296

preferred option, selected based on its advantages in environmental sustainability, feasibility, and cost-effectiveness.

In the DLA, the Lewis Ridge Project was proposed to consist of the following: (1) a 5,450-foot-long, 135-foot-high hardfill dam for the upper reservoir with an integrated overflow emergency spillway; (2) an upper reservoir with a surface area of 39.7 acres and an active storage capacity of approximately 2,600 acre-feet; (3) a 4,757-foot-long steel penstock with a 16-foot-diameter upper section and a lower extent bifurcating into two 12-foot-diameter steel sections; (4) a 150-foot-diameter circular shaft powerhouse located 250 feet below the ground containing two 143.5-megawatt (MW) reversible pump-turbines with a total installed capacity of 287 MW; (5) an 908-foot-long, 120-foot-high earthfill embankment dam at the lower reservoir with an integrated overflow emergency spillway; (6) a 48.3-acre lower reservoir with an active storage capacity of approximately 2,600 acre-feet; and (7) a 3.6-mile-long, 161 kilovolt overhead interconnection line. The Lewis Ridge Project features as described in the DLA are depicted on Figure 1-2.

The 2024 Study Area, as depicted in the DLA (and shown in Figure 1-2), covered a broad and comprehensive geographic region to accommodate further refinements in engineering design. This area included buffers surrounding preliminary locations for facilities, potential fill areas, construction laydown and parking zones, as well as both permanent and temporary access roads. The 2024 Study Area served as the basis for licensing studies conducted in support of the DLA.

Figure 1-1: Lewis Ridge Project Study Area as Depicted in 2024 Draft License Application

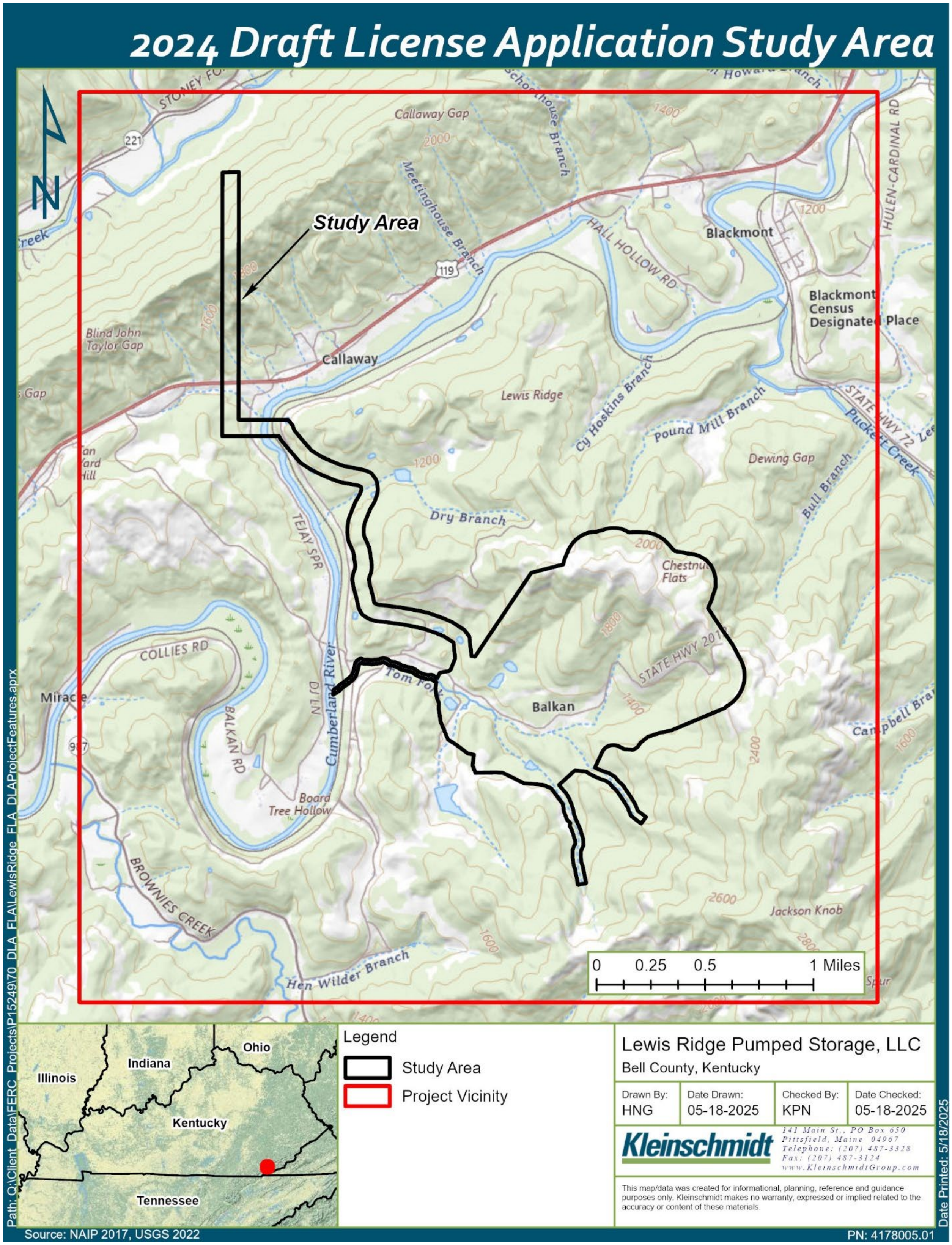
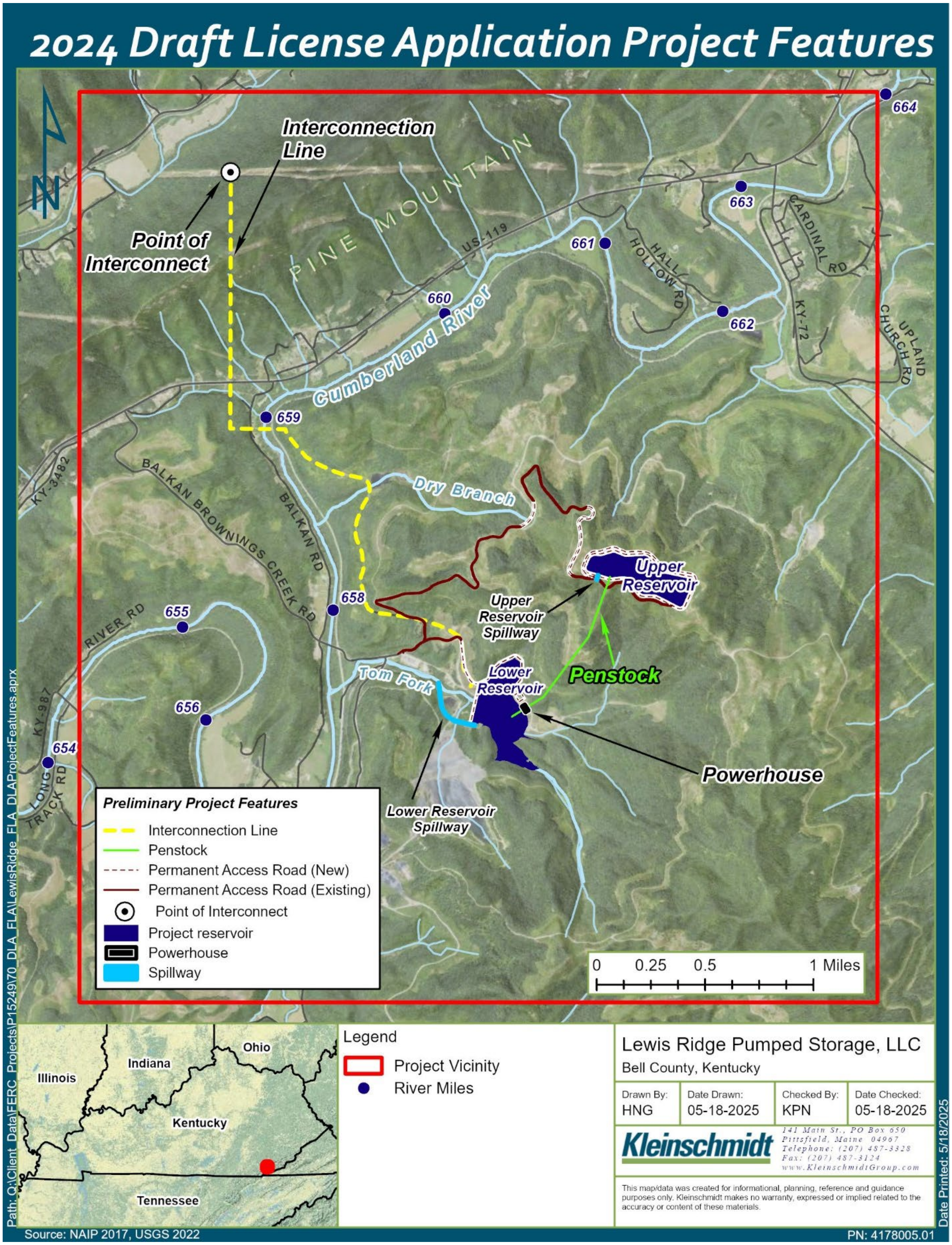


Figure 1-2: Lewis Ridge Project Features as Depicted in 2024 Draft License Application



1.3 Proposed Project Alternative

The proposed specifications of the Lewis Ridge Project are presented in Exhibit A. The proposed Lewis Ridge Project features are depicted on Figure 1-3.

The engineering design of the Lewis Ridge Project advanced between the DLA and FLA, incorporating refinements for feasibility and project efficiency, while prioritizing public and dam safety and minimization of potential environmental impact. These advancements were informed by comprehensive reviews of site information, technical studies, and consultation with regulatory agencies. Additional details of these modifications are provided herein.

The 2025 Study Area is a slightly modified version of the 2024 Study Area, updated to reflect minor adjustments in project design and to ensure the geographic scope remained comprehensive. These refinements include slight shifts in the locations of proposed facilities and infrastructure, as well as adjustments to buffer zones to better align with the evolving engineering layout. The updated area continues to encompass all relevant components, such as project features, fill areas, construction laydown areas, and access roads, ensuring that the region remains suitable for ongoing environmental and engineering evaluations in support of the FLA. The 2025 Study Area served as the basis for licensing studies conducted in support of the FLA. The 2025 Study Area is shown on Figure 1-4.

Figure 1-3: Proposed Lewis Ridge Project Features

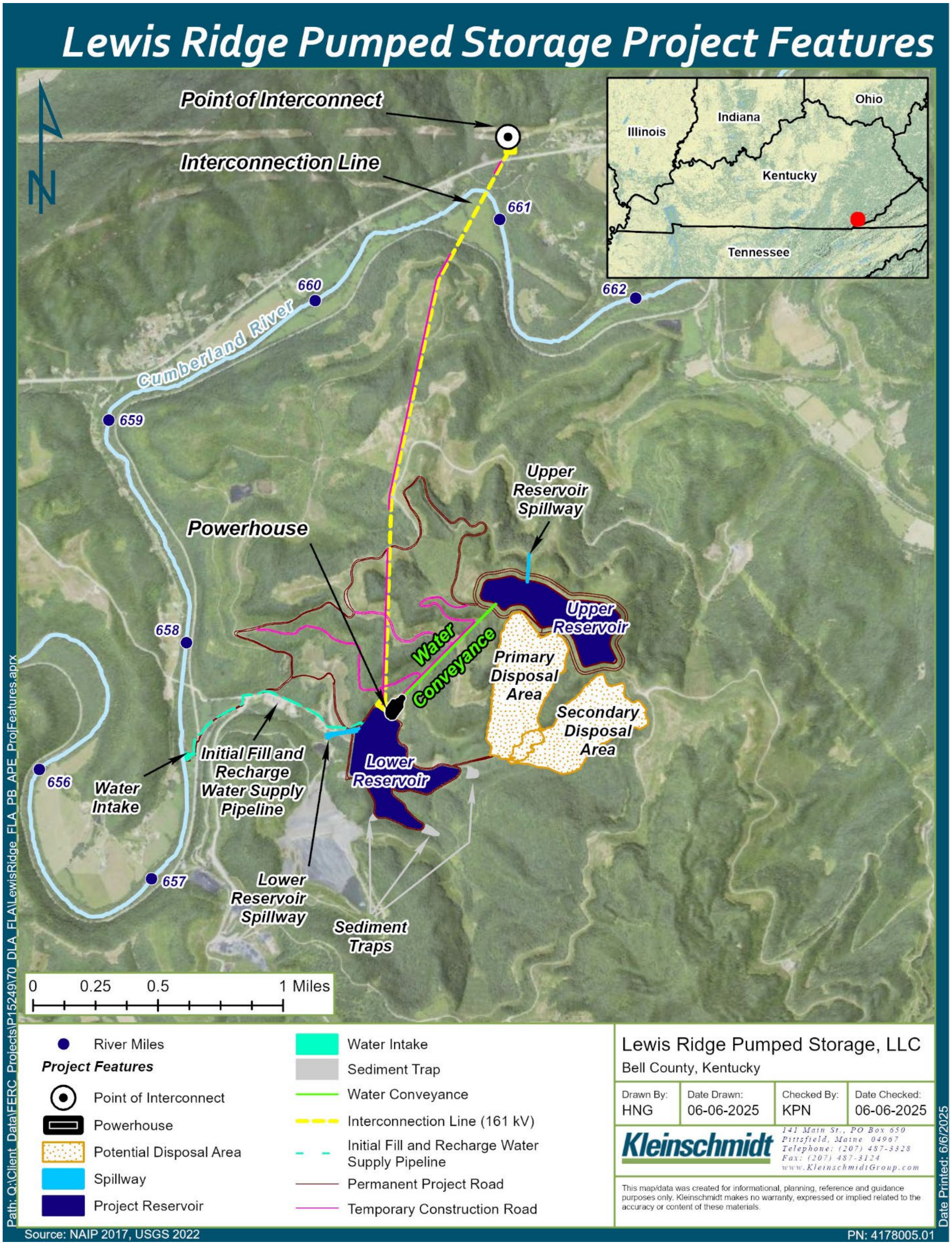
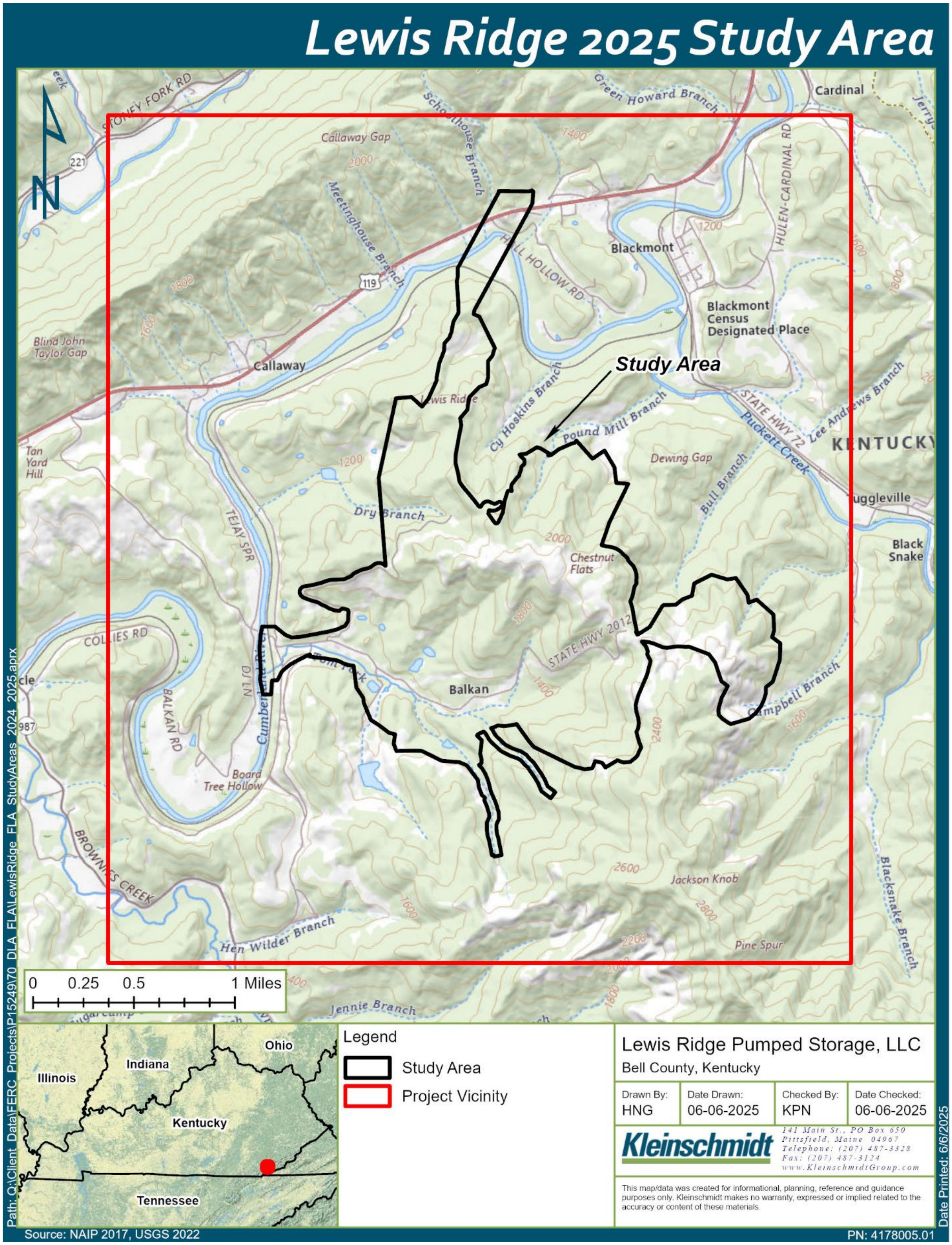


Figure 1-4: Lewis Ridge Project 2025 Study Area



Upper Reservoir

The dam type was changed from a hardfill dam to a rocky earthfill embankment dam. This modification allows the project to utilize materials excavated from within the reservoir basin to construct the embankment. Consequently, all component elevations were revised, and the maximum dam height was reduced from 130 feet to 50 feet. The rocky earthfill embankment slopes will be 2H:1V with a crest width of 20 feet.

Lower Reservoir

Coal extraction methods left mine spoils up to 80 feet thick within the lower reservoir footprint, primarily on the northern and eastern sides. These spoils will be removed to prepare the subgrade for the asphalt concrete (AC) liner. At the eastern end of the reservoir, partial removal and re-compaction may be needed to form the reservoir slope. The layout of the lower reservoir was adjusted to remove most of the mine spoils beneath the reservoir lining system. Additionally, minor excavation for clearing and grubbing in the south finger is now included, showing the limit of disturbance for the lower reservoir. The earth embankment dam crest was raised from an elevation of 1,244 feet[4] to 1,252 feet to accommodate the probable maximum flood (PMF) and wave run-up. The maximum dam height is 138 feet.

Water Conveyance

The water conveyance alignment was revised, reducing the overall length by approximately 20 percent. Additionally, horizontal and vertical bends were minimized to make the conveyance system more hydraulically efficient. The water conveyance was revised from subsurface to an above-ground configuration to enhance accessibility for inspection and maintenance. An above-ground water conveyance simplifies repairs and replacements, leading to improved operational efficiency and reduced long-term maintenance costs. This modification also enhances visibility and facilitates monitoring, improving safety by providing easier access for routine maintenance while reducing the need for extensive excavation.

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[4] Elevations are based on the North American Vertical Datum of 1988 (NAVD 88).

Powerhouse

The powerhouse was relocated from the eastern lower reservoir edge to the northern lower reservoir edge, reducing the length of the water conveyance system.

Water Supply

The water supply for the Lewis Ridge Project was updated to include a river intake system at the Cumberland River, a temporary pump station, and three parallel pipelines for initial fill and recharge water. The proposed initial fill and recharge water are discussed in Section 2.1 and Section 2.2, below. This modification was implemented to minimize ecological impacts on Tom Fork, a smaller water source with limited flow. Sourcing water from the Cumberland River enables a faster reservoir fill rate, improving project efficiency and reducing overall costs associated with an extended filling period. While recharge water will primarily be sourced from Tom Fork storm events, the greater flow capacity of the Cumberland River provides flexibility for occasional supplemental water withdrawals, thereby ensuring adequate water availability in Tom Fork to support aquatic habitat.

Interconnection Line

The interconnection line alignment has been revised, resulting in a reduction in overall length, yielding cost savings and reduced habitat disturbance. The revised route eliminates the need to cross Pine Mountain, which would have required vegetation clearing in an undisturbed area with steep slopes.

Borrow Areas

It is currently assumed that most of the material needed to construct the dams and liner subbase will be sourced from within the footprint of each reservoir. An ongoing geotechnical investigation will provide subsurface information to determine if the materials present are suitable. A potential borrow area has been identified in the case that additional material is required for the construction of the upper reservoir's rocky earthfill dam and liner subbase.

Disposal Sites

Excavation of the upper and lower reservoirs, water conveyance system, and other site features will result in excess soil and rock material. Two disposal sites have been identified for this excess material. The exact amount of excavation is not yet determined, so the use of both disposal sites may not be required. If possible, excavation and fill activities will be optimized to result in the construction of a single disposal site. Geotechnical investigations will inform foundation characteristics and help determine the limits and footprint of the sites. As the project advances through the design phases, the earthwork quantities will be updated, and the disposal sites will be sized accordingly. Disposal sites will follow standard practices for mining and mass excavation in the Appalachian region, filling existing hollows (narrow drainages). Design and construction will comply with state and federal regulations (Kentucky Regulations 405 KAR 16:130 and Reclamation Advisory Memorandum 141, and Federal Regulation 30 CFR § 715.15). After the establishment of the disposal sites, they will be seeded and vegetated to promote ecological restoration and long-term erosion protection and to support wildlife.

2.0 PROJECT OPERATION (18 CFR SECTION 4.41(C)(3))

The Lewis Ridge Project will operate as a pumped storage facility, using water stored in the upper reservoir to generate electricity by releasing it through pump-turbine units into the lower reservoir. Water will then be pumped back from the lower reservoir to the upper reservoir to replenish the storage. There are no inflows to the proposed upper reservoir other than pumping flows during normal Lewis Ridge Project operations and rainfall. The proposed lower reservoir is located within a valley that contains Tom Fork, a tributary to the Cumberland River. The lower reservoir is subject to natural inflows of Tom Fork generated by rainfall. Water for the initial fill and annual recharge will be pumped into the lower reservoir from a screened pump intake on the Cumberland River. Natural inflows from Tom Fork will also contribute to the initial fill and annual recharge.

The powerhouse will be operated automatically using a control system. In a 24-hour operating cycle, the Lewis Ridge Project will have the capacity to generate energy for 8 hours a day at a guaranteed power output[5] of 266 MW at the generator terminals and pump water back from the lower reservoir to the upper reservoir for approximately 8.8 hours to accomplish the upper reservoir refill. The pump flow will vary from 4,210 cubic feet per second (cfs) at the beginning of the pump cycle to 2,862 cfs at the end of the pump cycle. During a 24-hour operating cycle, the upper reservoir may fluctuate up to 74 feet, from the normal maximum water surface elevation of 2,150 feet to the normal minimum water surface elevation of 2,076 feet, and the lower reservoir may fluctuate up to 100 feet, from the normal maximum water surface elevation of 1,234 feet to the normal minimum water surface elevation of 1,134 feet.

2.1 Initial Fill

Withdrawal from the Cumberland River will serve as the primary fill water source. The initial fill volume includes the total dead storage of both reservoirs, the active storage, and the volume within the conveyance conduits. The estimated initial fill volume is approximately 2,808 acre-feet, as shown in Table 2-1.

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[5] Guaranteed Power Output is the minimum total output of the units, considering the hydraulic losses and unit efficiency. The guaranteed power output is available throughout the head range.

Table 2-1: Initial Fill Volume

Storage	Initial Fill Volume (acre-feet)
Dead Storage for Lower Reservoir	78
Dead Storage for Upper Reservoir	110
System Active Storage	2,602
Conveyance Volume	18
Total	**2,808**

The project's initial fill and recharge operations are designed to align with construction timelines while adapting to variable hydrologic conditions. The strategy utilizes both Cumberland River withdrawals as the primary water source and stormwater capture from Tom Fork, employing a flexible, flow-responsive approach to optimize water availability and minimize environmental impact.

Water withdrawals from the Cumberland River will follow a flow-based framework:

- At Mean Monthly Flow[6] (MMF) shown in Table 2-2: Up to 10 percent of MMF may be withdrawn.
- Above MMF: Additional withdrawals may occur that will include all or a portion of the surplus above the MMF.
- Below MMF: Withdrawals will be reduced proportionally, not exceeding 10 percent of available flow[7].

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[6] Mean monthly flow: Derived from USGS gage data at Cumberland River near Harlan, KY (03401000; 1981–2023) and at Pine Street Bridge, Pineville, KY (03402900; 1991–2005). Flow values were interpolated based on drainage area to estimate conditions at the confluence with Tom Fork.

[7] Available flow is defined as the interpolated flow between upstream and downstream USGS gages 03401000 (Cumberland River near Harlan, KY) and 03402900 (Cumberland River at Pine Street Bridge, Pineville, KY). Both gages are real-time monitoring stations operated by the USGS.

Table 2-2: Mean Monthly Flow for the Cumberland River at Tom Fork

Month	Cumberland River Near Harlan, KY – 03401000 (cfs)	Cumberland River at Pine St Br at Pineville, KY – 03402900 (cfs)	Cumberland River at the Confluence with Tom Fork (cfs)
January	1,060	2,180	1,337
February	1,450	2,550	1,722
March	1,360	2,930	1,749
April	1,120	2,450	1,449
May	827	1,500	994
June	430	913	550
July	308	441	341
August	277	426	314
September	198	383	244
October	230	237	232
November	471	885	573
December	956	1,910	1,192

Any flow below or equal to the estimated mean annual flow of 2.8 cfs[8] from Tom Fork and the lower reservoir's drainage area will be routed through the lower reservoir low-level outlet works to maintain flows in Tom Fork downstream of the dam. During a storm event, the lower reservoir will use flow in excess of 2.8 cfs to supplement initial fill and recharge of the reservoir. This opportunistic capture strategy enhances reservoir storage during high-flow events and contributes downstream flood management benefits.

The duration of the initial fill will depend on water availability, project operations, and a detailed initial fill plan. A detailed and comprehensive initial fill plan will be developed during the final design in accordance with FERC Dam Safety and Kentucky Dam Safety guidelines.

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[8] The estimated mean annual flow for Tom Fork at the location of the lower dam, obtained from the U.S. Geological Survey (USGS) StreamStats program (USGS 2019). Monthly Tom Fork flows were estimated by scaling the mean annual flow rate by monthly precipitation data.

2.2 Recharge Water

During operation, the Lewis Ridge Project will experience water losses due to both evaporation and seepage. Annually, evaporation accounts for approximately 128 acre-feet, while leakage is estimated to be 20.5 acre-feet, resulting in an estimated total annual loss of 149 acre-feet.

Table 2-3 shows the estimated volume of water from precipitation that would fall on the surface areas of the Upper and Lower Reservoirs from the average of the driest years on record for the Baxter, KY and Harlan KSP Post 10 rain gages. This volume of water is 319 acre-feet, which exceeds the estimated annual loss of water of 149 acre-feet by 114 percent.

Table 2-3: Estimated Precipitation Volume of Water on Surface Areas of Upper and Lower Reservoirs During Average Driest Year on Record

	Value
Upper Reservoir Surface Area	48.2 acres
Lower Reservoir Surface Area	51.6 acres
Total Reservoir Surface Area	99.8 acres
Annual Precipitation during Average Driest Year on Record	38.4 inches
Total Estimated Volume of Precipitation on Reservoir Surface Areas during Average Driest Year on Record	319 acre-feet

Annual refill, when needed, may be sourced from retaining a percentage of runoff from storm events in the Tom Fork basin when flow exceeds the annual mean of 2.8 cfs and supplemented by pumping from the Cumberland River.

2.2.1 Evaporation Data

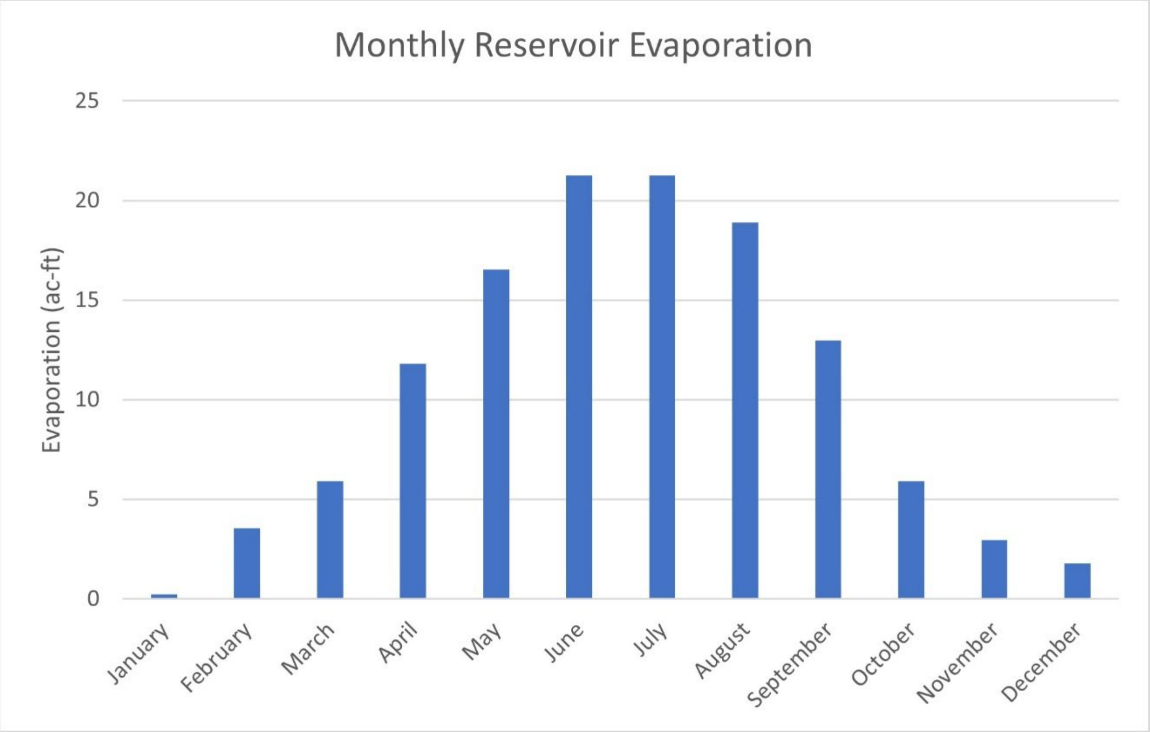
Monthly average evaporation rate data, from 1991 to 2020, were downloaded and reviewed from the National Weather Service (NWS) Climate Predication Center (NWS 2025). Evaporation data are estimated using Evaporative Demand Drought Index (EDDI) calculations and pan evaporation. EDDI uses temperature, humidity, wind speed, and solar radiation to estimate the atmospheric evaporative demand. Precipitation is measured and cleared from the pan to obtain accurate evaporation data, and the nearest pan evaporation data station is located 60 miles from the project site in Greenville, Tennessee. These data are summarized in Table 2-2 and shown in Figure 2-1. Evaporation was estimated based on both reservoirs being half full (average between the minimum and maximum operating levels). The estimated annual evaporation is 128 acre-feet.

Table 2-4: Monthly Average Evaporation Totals

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Average Evaporation Total (mm)	1	15	25	50	70	90	90	80	55	25	12.5	7.5	521
Average Evaporation Total (in)	0.04	0.59	0.98	1.97	2.76	3.54	3.54	3.15	2.17	0.98	0.49	0.30	20.51

Source: NWS 2025

Figure 2-1: Estimated Monthly Reservoir Evaporation



2.2.2 Seepage Losses

An AC lining system is included in the design to limit seepage losses from the lower and upper reservoirs. Using Darcy's law for seepage through the AC liner, the calculated leakage rates for the upper and lower reservoirs are as follows:

Upper Reservoir:

- At maximum water surface elevation 2,150 feet: the estimated leakage is 8.6 gallons per minute (gpm).
- At minimum water surface elevation 2,076 feet: the estimated leakage is 0.3 gpm.

Lower Reservoir:

- At maximum water surface elevation of 1,234 feet: the estimated leakage is 12.4 gpm.
- At minimum water surface elevation of 1,134 feet: the estimated leakage is 0.2 gpm.

The following assumptions were used for this analysis: The permeability (k) is 1E-09 centimeter (cm)/second (s), based on lab testing of a 3.5-inch-thick AC liner for similar projects; no holes in the liner were included; steady-state conditions; and all head is lost through the 3.5-inch AC liner, which is underlain by an aggregate base layer (ABL) functioning as a drain. The estimated leakage loss through both reservoirs is 20.5 acre-feet per year.

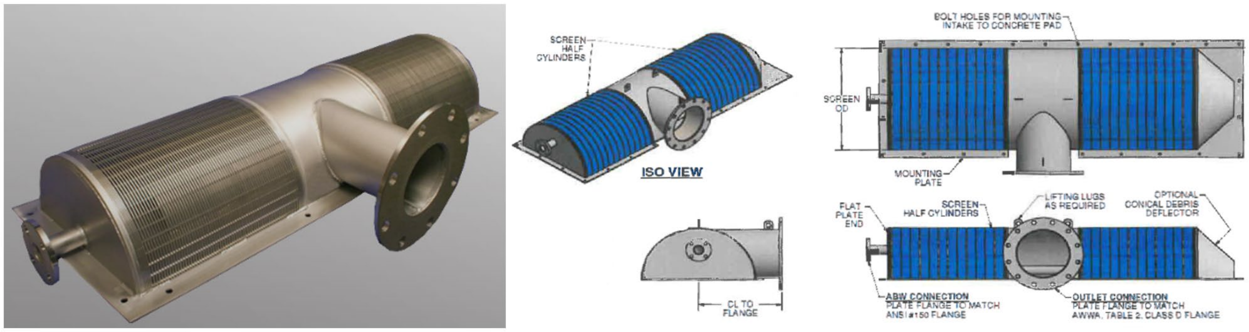
2.3 Water Supply System

For the initial fill and recharge operations, the system will utilize portable trailer or skid-mounted self-priming pumps. It is assumed that six pumps will be required, with one additional standby in the event of equipment malfunction during the initial fill operation. A permanent manifold at the beginning of the pipeline will be installed and will include provisions for isolation, throttling, backflow prevention, metering, and vacuum/air release (anti-siphoning). The power source for the pumps will use skid-mounted variable frequency drives connected to the local power supply. For recharge operations, up to six pumps will be used without the need for a standby.

The plan to use temporary pumps allows for flexibility to quickly move the pumps out of the floodway in the event of a significant storm event. Additionally, a temporary pump installation minimizes permanent disturbance within the floodway.

The permanent intake installation will feature low-profile screens sized to maintain intake velocities below 0.5 feet per second (fps) for aquatic resource protection, minimizing entrainment and impingement of aquatic life. An example of the screen is shown in Figure 2-2. Six pumps will be supported by six screens, with each screen measuring 15 feet in length and 30 inches in diameter. Each pump will have its own dedicated screen to minimize suction friction loss and to provide for balanced flow. Two screens will be installed on each concrete pad, with each pad measuring 31 feet by 3 feet. A total of three concrete pads will be placed on the riverbed, with buoyancy and anchor calculations performed during a future phase of design. The intake installation will also be outfitted with debris deflectors to protect the screens from floating/suspended materials and displaced river rock.

Figure 2-2: Johnson Screens Passive Half Intake Screen



To maintain the intake screens, which are likely to be wedge wire screens, a temporary air compressor will be used for air bursting (backflushing). Air lines will be installed with the intake suction lines to facilitate periodic cleaning without entering the waterway.

Intake components within the waterway will typically include piping and fittings made from materials less susceptible to corrosion, such as stainless steel and high-density polyethylene (HDPE), and concrete for anchoring and weighting. All mechanical components that require fuel, lubricating oils, and coolants (e.g., pumps, motors, generators, compressors) will be located outside the waterway within a stabilized and contained area. Cleaning of the screens will typically involve a surge of air from outside the waterway and, if necessary, mechanical scrubbing within the waterway. No cleaning agents (solvents, oxidizers, disinfectants) will be allowed within the waterway. If a screen becomes compromised or fouled and air or mechanical scrubbing does not suffice, the screen will be removed from the waterway for additional cleaning, repair, or replacement as required.

The water supply pipelines from the river intake pump system will consist of three 24-inch-diameter HDPE pipes, extending approximately 4,742 linear feet. The pipelines will be buried with a minimum ground cover of 3.5 feet and will be placed adjacent to existing site access roads where feasible. The pipelines will include isolation and air release valves. The pipelines will discharge north of the lower reservoir spillway into a stilling basin, positioned 2 feet above the maximum operating water surface elevation. This approach will help dissipate energy before the water flows by gravity into the lower reservoir.

2.4 Project Operational Control

The Lewis Ridge Project will be staffed with onsite operations staff 24 hours a day, 7 days a week. The Lewis Ridge Project will include features to perform emergency shutdown of the equipment. These emergency shutdown features will include the following:

a. Closure of the wicket gates to stop flow and allow the units to shut down.
b. Closure of the Main Inlet Valve (MIV) to stop flow and allow the units to shut down.

2.5 Annual Plant Factor

Plant factor is defined as the average production for a given time divided by the total maximum production at rated capacity. The Lewis Ridge Project is designed to generate up to 266 MW for 8 hours each day, based on the guaranteed power output. Although the rated capacity of the facility is 308 MW, operational constraints related to water volume and head conditions limit generation duration at full output, and actual generation will be dependent on market demand. Accounting for scheduled and unscheduled outages, the annual generation is estimated at 717.3 gigawatt-hours (GWh), resulting in a plant factor of approximately 26.6 percent based on the rated capacity.

2.6 Project Operation During Adverse, Mean, and High-Water Years

The Lewis Ridge Project is designed to maintain stable operations across a wide range of hydrologic conditions, including adverse (low flow), mean, and high-water years. Its pumped storage configuration and limited local drainage to the lower reservoir reduce reliance on inflows for day-to-day power generation, allowing the project to buffer against hydrologic variability.

2.6.1 Water Supply

While natural inflows from Tom Fork are modest under mean annual flow conditions, the project's water supply strategy prioritizes stormwater capture from Tom Fork as the primary recharge source, with pumping from the Cumberland River serving as a supplemental supply during drier periods or when additional volume is needed. As described in Sections 2.1 and 2.2, this dual-source approach provides flexibility to support both initial fill and ongoing operations, even during prolonged dry conditions.

Key design and operational elements that support low-flow and drought resilience include the following:

- Reservoir Storage Capacity: The project includes 2,600 acre-feet of active storage capacity for pumped storage operations, while the lower reservoir has a gross storage capacity of approximately 3,486 acre-feet. This additional storage volume provides operational flexibility and creates capacity to opportunistically capture stormwater inflows from Tom Fork during high-flow events.
- Flow-Responsive Intake Strategy: Water withdrawals from the Cumberland River are implemented using a dynamic, flow-based framework (see Section 2.1) that scales with river availability and prioritizes ecological protection during low-flow conditions. Withdrawals are limited to a fraction of available flow and reduced when river conditions fall below seasonal averages.
- Stormwater Capture as Primary Recharge: When flows in Tom Fork exceed the mean annual flow of 2.8 cfs, the Lewis Ridge Project will opportunistically store stormwater runoff to replenish reservoir storage. This approach not only supports operations during wetter periods but also provides downstream flood attenuation benefits.
- Low-Flow Monitoring and Discharge Matching: Inflows from Tom Fork will be continuously monitored via gages at the sediment traps. During low-flow periods, these inflows will be passed through the low-level outlet works to maintain mean

annual flows in Tom Fork, preserving downstream hydrologic continuity and minimizing ecological impacts.

- Operational Flexibility: The Lewis Ridge Project is not dependent on continuous inflow for normal operation. Recharge may be deferred or reduced during periods of prolonged drought without compromising system integrity or generation capacity, due to the availability of stored water and flexible intake options.
- Operations Plan: A detailed operations plan will be developed during final design to align seasonal inflow trends, project water needs, and environmental flow requirements. The plan will incorporate real-time monitoring data and forecast tools to proactively manage low-flow periods and ensure continuity of both project operations and aquatic habitat support.

These design features and operational safeguards ensure the Lewis Ridge Project can operate reliably and responsibly during droughts and other adverse hydrologic conditions, without requiring a standalone drought management plan.

2.6.2 Reservoir Emergency Spillways

The upper reservoir will store the probable maximum precipitation (PMP) within the freeboard zone between the normal maximum water surface and the spillway crest. The embankment dam will have an overflow spillway, with crest elevation at 2,154 feet (above the PMP water surface). The spillway will be set within the crest of the dam as a redundant safety feature. The spillway will discharge into a flexible articulated concrete block mat-lined chute on the downstream face of the dam; a riprap-lined channel downstream of the spillway is included for safe discharge away from the dam. A prefabricated bridge will span over the spillway. In the unlikely situation of a PMP and over-pumping event simultaneously occurring, water discharged from the spillway channel would flow through the Pound Mill Branch and into Puckett Creek approximately 1,000 feet upstream of the confluence with the Cumberland River.

During periods of high inflow or flood conditions, the lower reservoir will manage excess water through an integrated system of emergency spillways designed to safely convey flow downstream. Each sediment trap includes an emergency spillway that releases water into the lower reservoir. From there, water is discharged through a concrete-lined overflow emergency spillway located in the dam’s right abutment, which is designed to safely accommodate the PMF event.

The emergency spillway system includes an approach channel leading to a 50-foot-wide ogee crest at an elevation of 1,234 feet. Flow passing over the crest will be directed through a concrete chute into a stilling basin and then conveyed via a riprap-lined discharge channel into Tom Fork.

2.7 Maintenance

2.7.1 Pump Turbines and Generator-Motor Equipment

The powerhouse operates with two pump-turbine units. Each unit will be subject to scheduled maintenance to maintain optimal performance and reliability. Over the course of a year, it is estimated that the powerhouse will achieve 313.8 days of full generation with both units operational. However, to accommodate maintenance needs, each unit is scheduled for an outage amounting to 6.5 percent of the year. This results in approximately 47.5 days where only one unit is generating power. During these periods, the remaining unit continues to operate, ensuring that power generation is sustained, albeit at a reduced capacity.

2.7.2 Asphalt Concrete Liner

Maintenance for AC liners will require the drawdown of the reservoir to a level needed for maintenance. The majority of maintenance work will involve treating and sealing cracks and local patching of damaged AC. Local patching of damaged AC includes removing the damaged asphalt using air tools or milling machines, cleaning and drying the repair area, applying a tack coat of bituminous emulsion, placing and compacting AC, and treating the joints around the edges of the patch.

Full rehabilitations typically occur after 40 to 50 years of service, depending on site conditions including ultraviolet degradation, weather, and oxidation. Full rehabilitations typically are only needed in areas that are exposed and not consistently submerged below the minimum operating water level; the reservoir liners will be exposed daily during drawdown and refill cycles. Reservoir drawdown for maintenance and repair will be limited to exposing only the areas requiring rehabilitation; full dewatering of the reservoir is not anticipated. A full rehabilitation consists of removing the damaged AC liner with a milling machine and repaving with new AC over the existing liner. During a full rehabilitation, the entire area to be resurfaced is inspected for defects, and cracks are locally repaired or reinforced. Rehabilitated liners are expected to have a similar lifespan to a new liner.

During the drawdown, sediment deposits will be removed, stabilized, and transported to the disposal site.

The drainage system below the AC liner and the Zone 2 layer will consist of a finger drain system grid within the reservoir floor and at the upstream toes of the embankment and reservoir slopes. The drain system will include 12-inch HDPE drainpipes placed within drain gravel that will be embedded in filter sand. The drainpipes will include access for cleanout of sediment and inspection by remotely operated vehicles.

2.7.3 Intake/Outlet Structure Trash Racks

Minimal debris accumulation is expected at the lower reservoir intake/outlet structure due to the inclusion of sediment traps that manage inflow. At the upper reservoir, debris is not anticipated due to the absence of a contributing drainage area. Trash rack cleaning will occur on an as-needed basis, depending on conditions observed during operation. Cleaning activities will be scheduled to coincide with routine reservoir drawdowns associated with the pumping cycle, rather than requiring a dedicated reservoir lowering event.

To clean the trash racks at the conveyance intake/outlet structures, the reservoir is lowered to its minimum operating water level, and access to the water intake is gained from the bank, through the constructed access path. A boom truck is used to rake the trash rack, and if necessary, the trash rack can also be cleaned underwater using appropriate equipment. Natural debris (e.g., sticks and logs) will be placed on-site, while any non-natural debris will be removed from the site and properly disposed of in accordance with local solid waste regulations.

2.7.4 Sediment Traps

Based on the estimated sediment yield and trap sizing, the sediment traps will require cleanout approximately every 24 years. The Kentucky Energy and Environment Cabinet specifies that the sediment traps will need to be inspected after every precipitation event exceeding 0.5 inch, and sediment removal is required before it fills half of the trap volume.

3.0 ESTIMATED ENERGY PRODUCTIONS AND DEPENDABLE CAPACITY (18 CFR SECTION 4.41(C)(4))

Pumped storage projects are designed to provide dependable capacity to the regional electric grid and are specifically configured based upon these anticipated grid requirements. It is projected that the annual dependable capacity electrical energy production will be 717.3 GWh based on the calculations outlined below.

3.1 Project Flow Data

3.1.1 Tom Fork

Tom Fork is an ungaged stream. LRPS initiated flow monitoring in Tom Fork in 2025 to collect baseline flow information that will be used in developing a comprehensive initial fill plan during the final design. Stream flow data for Tom Fork at the location of the proposed lower dam will be collected for a minimum duration of 12 months. The collected flow and rainfall data will support the hydrologic and hydraulic modeling of the current and anticipated flows from Tom Fork. The estimated mean annual flow for Tom Fork at the location of the lower dam is 2.8 cfs, obtained from the U.S. Geological Survey (USGS) StreamStats program (USGS 2019). Monthly Tom Fork flows were estimated by scaling the mean annual flow rate by monthly precipitation data and are summarized in Figure 3-1. The median, “Wet,” and “Dry” flows were derived using the percentile method. The 25th percentile of the Tom Fork flow data is classified as “Dry,” the 50th percentile is classified as the median flow, and the 75th percentile is classified as “Wet.” Flow from Tom Fork and the lower reservoir’s drainage area will be routed through the lower reservoir’s low-level outlet works to maintain pre-project flows downstream, with the exception of recharge water retained in the reservoir after storm events. The flow duration curve was estimated similarly by scaling the mean annual flow rate from historical precipitation data and is presented on Figure 3-2 and Figure 3-3.

Figure 3-1: Estimated Monthly Median Tom Fork Flows

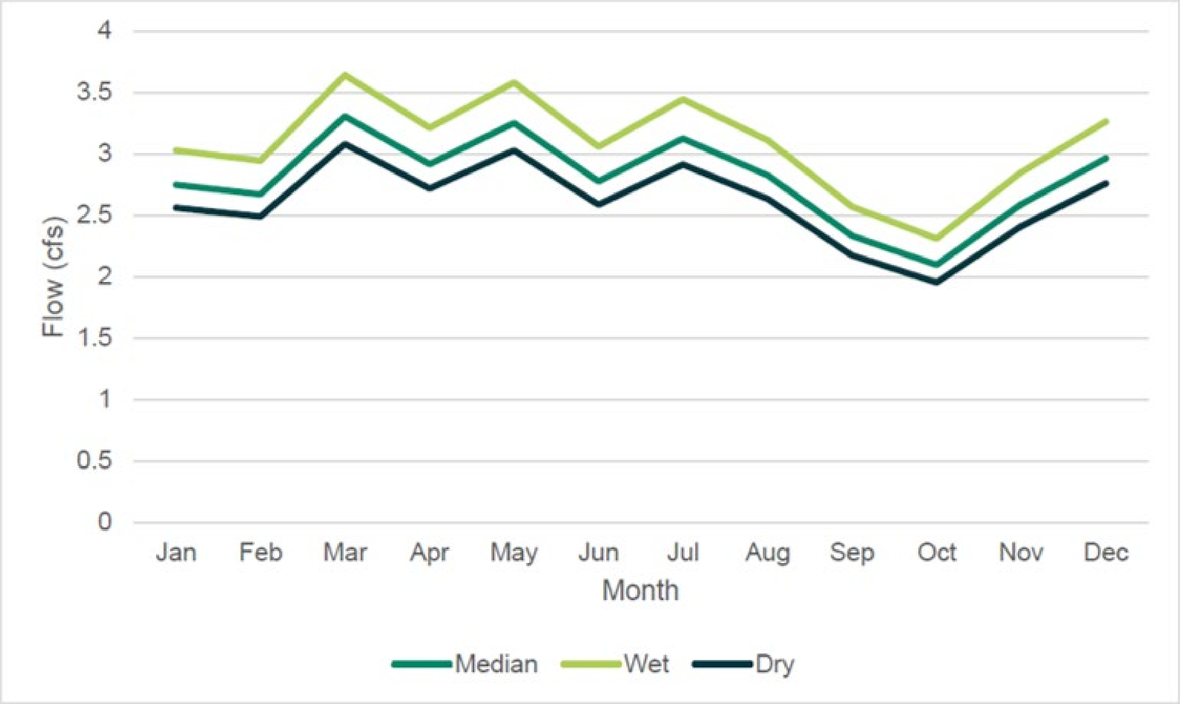


Figure 3-2: Annual Flow Duration Curve - Tom Fork

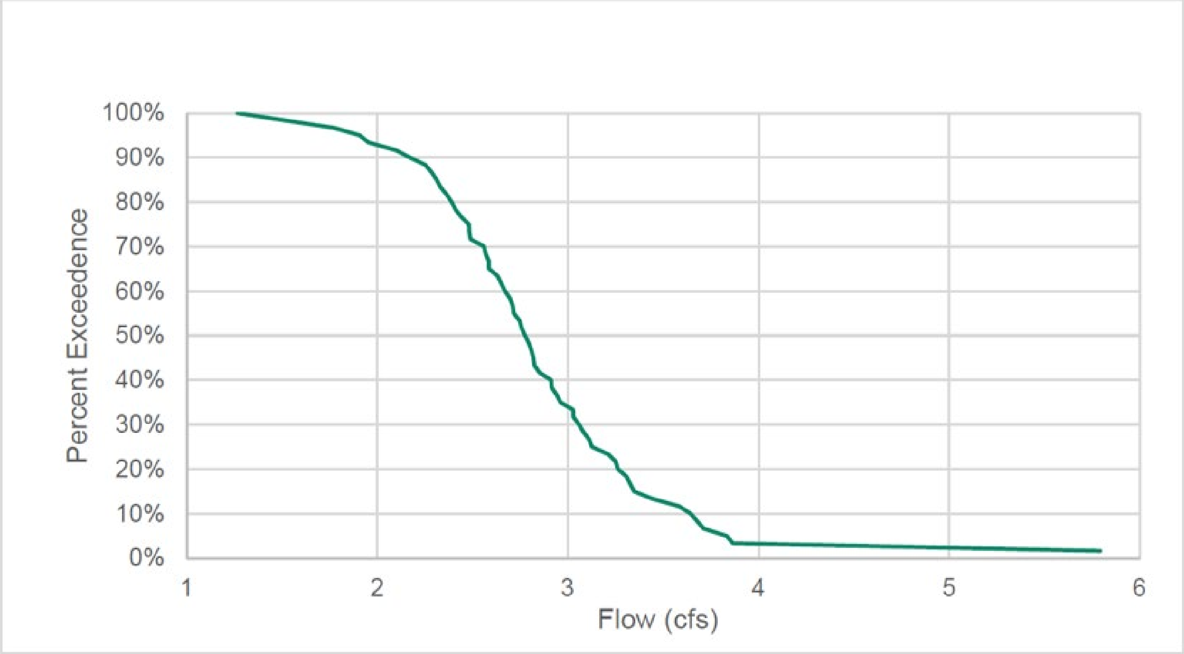
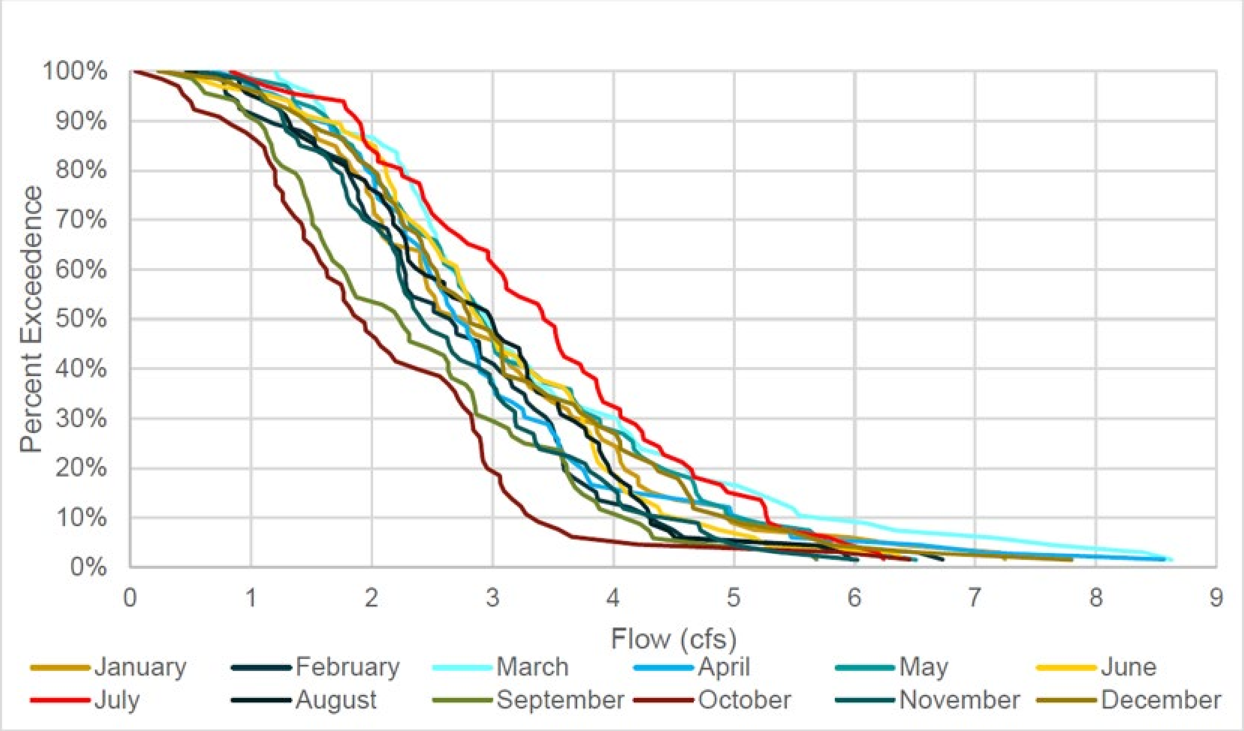


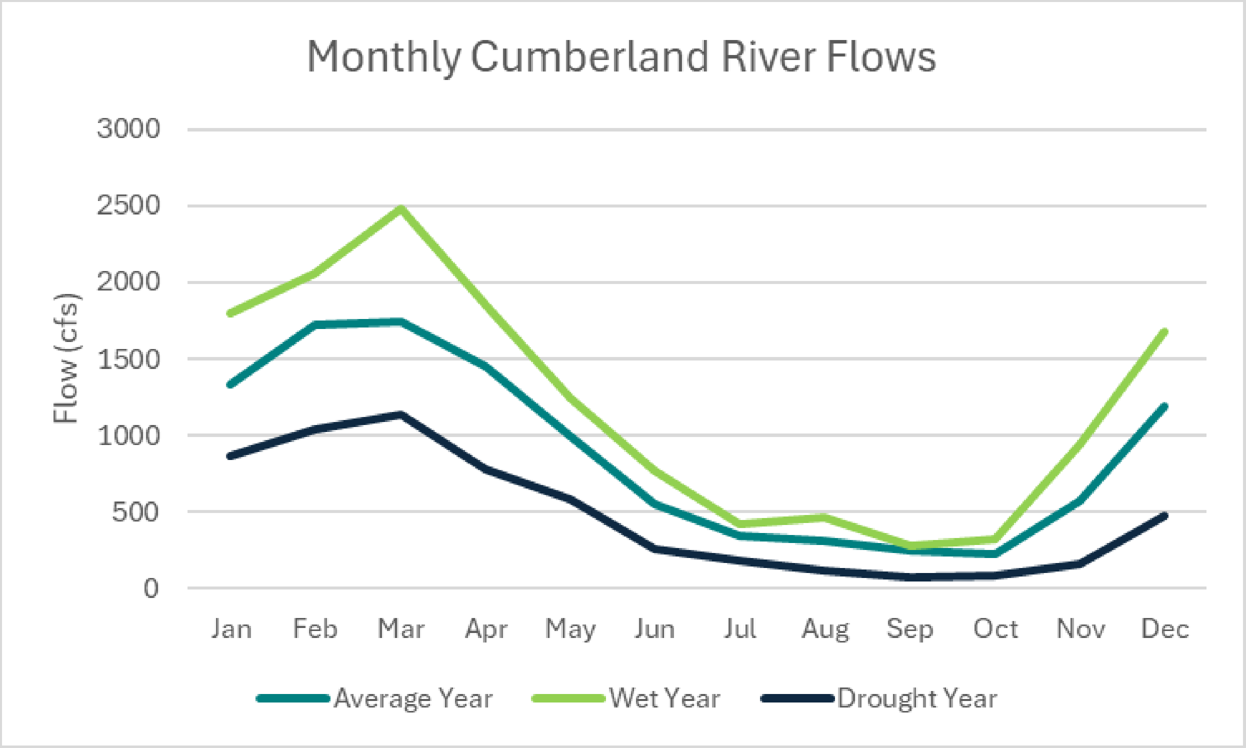
Figure 3-3: Mean Monthly Flow Duration Curves – Tom Fork



3.1.2 Cumberland River

The monthly average flows of the Cumberland River are lowest during the summer and early fall, as shown in Figure 3-4.

Figure 3-4: Monthly Cumberland River Flows at Confluence with Tom Fork(1)



[1] Linearly interpolated based on flows and drainage areas from USGS Gage Nos. 03401000 and 03402900. To identify "Dry" and "Wet" years, the 25th percentile classified drought years and the 75th percentile classified wet years of the annual monthly river flow were used (USGS 2025a, 2025b).

Flow data were obtained from the USGS StreamStats program at the Cumberland River at Harlan gage (USGS Gage No. 03401000) and the Cumberland River at Pine Street gage (USGS Gage No. 03402900). The flow-duration data from both gages were linearly interpolated, based on drainage areas, to estimate the flow-duration curve of the Cumberland River at the confluence with Tom Fork (Figure 3-5 and Figure 3-6). The flow-duration curve was calculated using historical data from each gage’s years of record.

Figure 3-5: Annual Flow-Duration Curve - Cumberland River at Confluence with Tom Fork

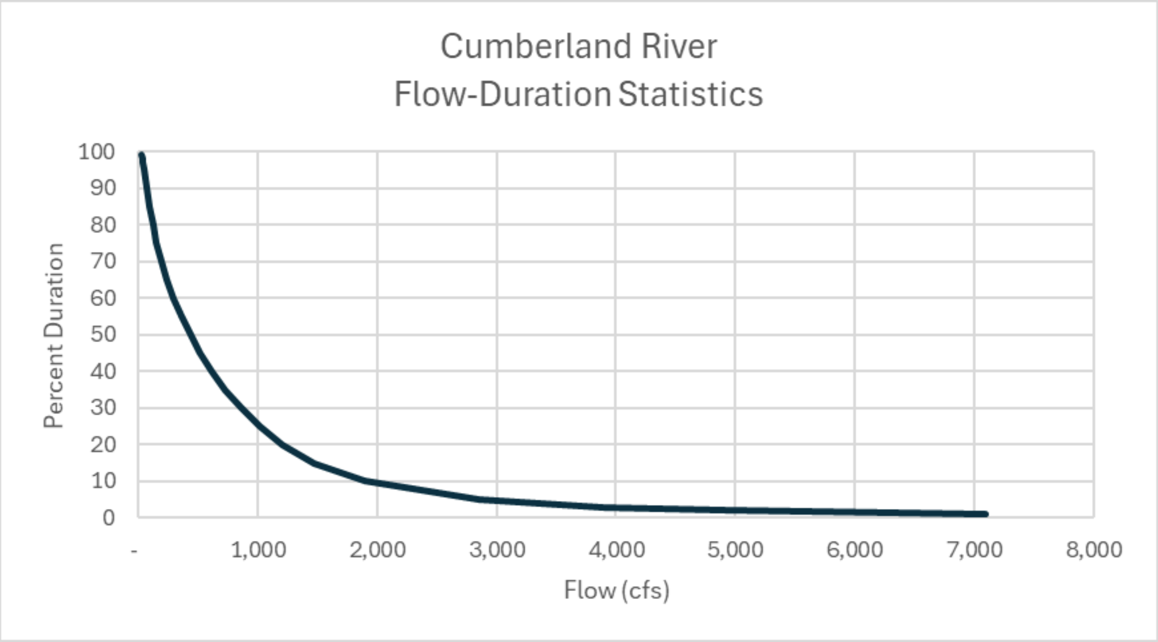
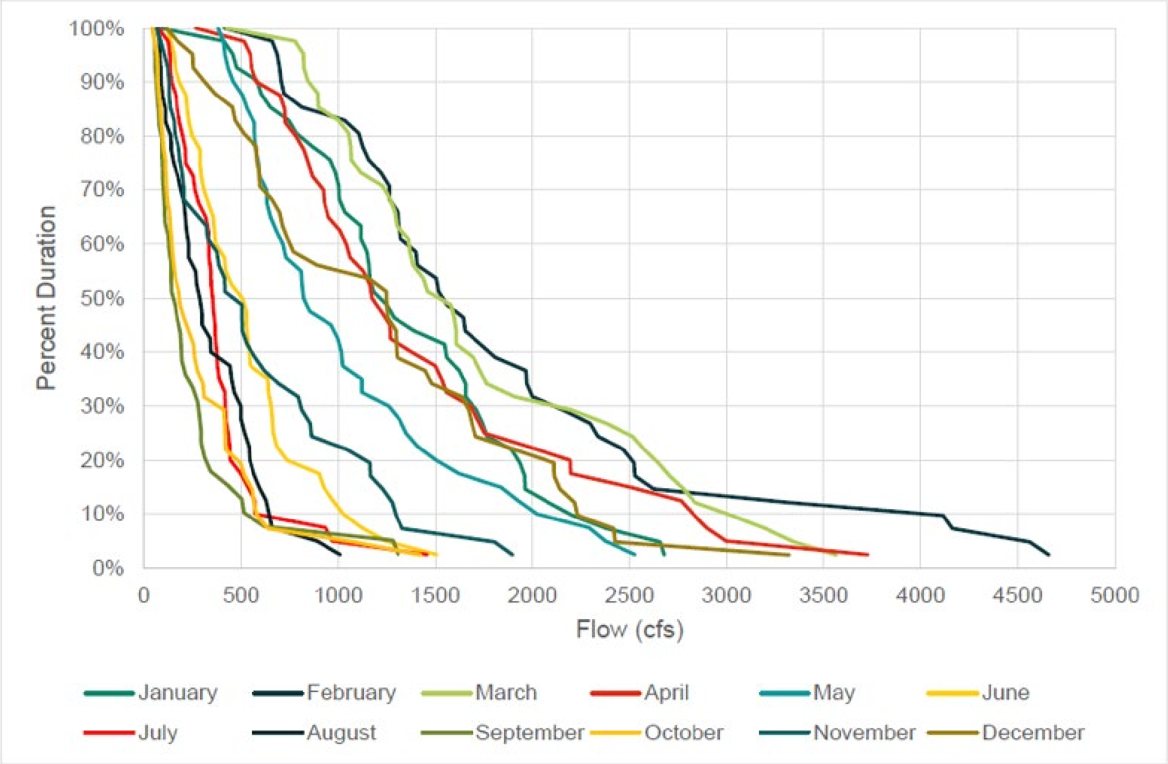


Figure 3-6: Mean Monthly Flow-Duration Curve - Cumberland River at Confluence with Tom Fork



3.2 Area-Capacity Curves

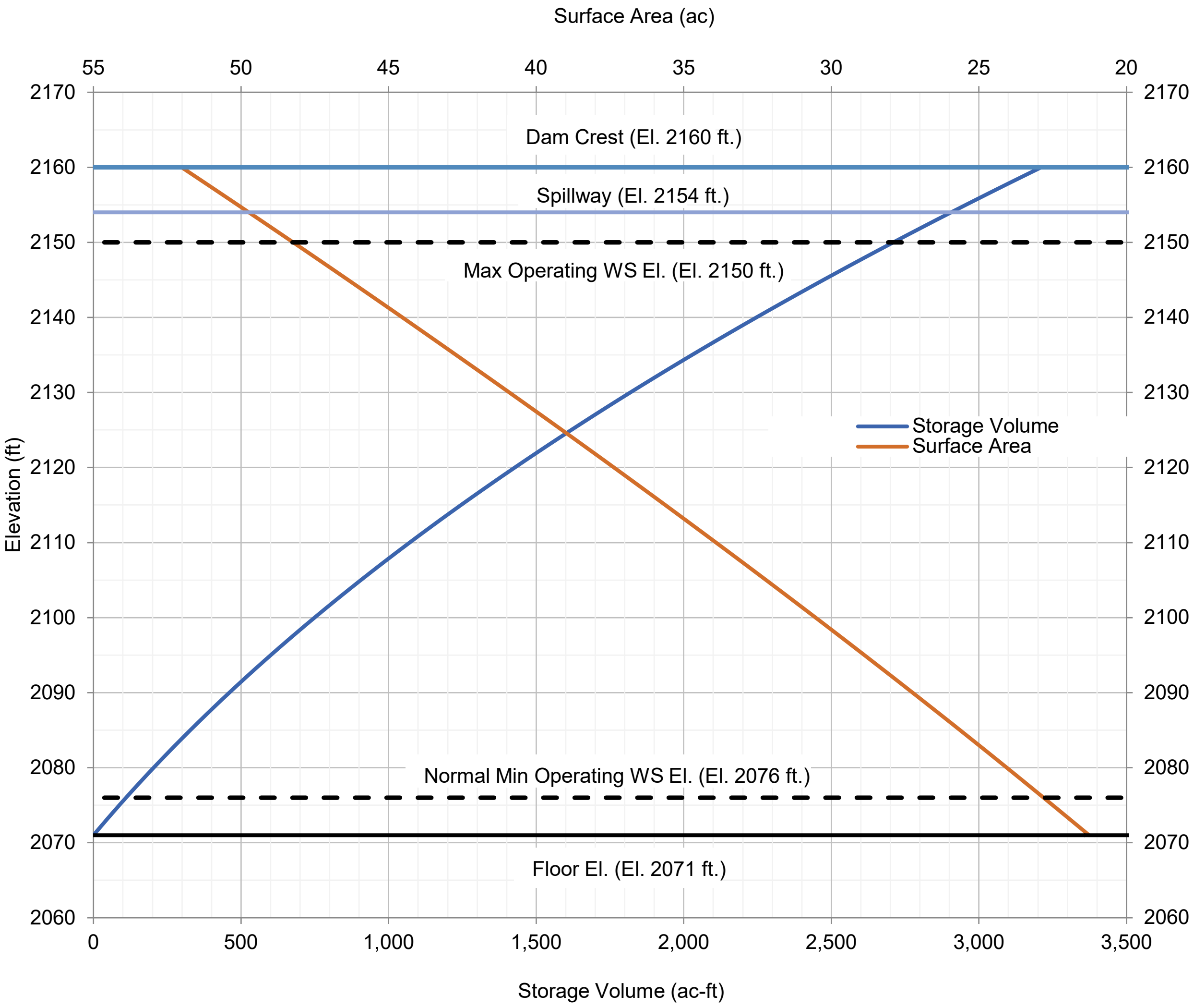
During generation mode, water stored in the upper reservoir will be released through the upper reservoir intake/outlet through the water conveyance system, pass through the pump-turbines, and discharge into the lower reservoir. The upper reservoir water surface elevation will decrease as the lower reservoir water surface elevation increases. During pumping mode, this process is reversed. The generating and pumping times will be dependent on market demand; however, during a full 8-hour generating cycle, the upper reservoir will be at its normal minimum water surface elevation after 8 hours, and the lower reservoir will be at its normal maximum water surface elevation. The pumping cycle, which refills the upper reservoir, takes approximately 8.8 hours. Lewis Ridge Project operation can alternate between pumping and generating modes quickly and for different lengths of time to respond to market demand. The following sections describe the area-capacity curves for the upper and lower reservoirs.

3.2.1 Upper Reservoir

At its normal maximum operating water surface elevation, the upper reservoir has a surface area of 2,101,053 square feet, or 48.2 acres. The active storage volume is approximately 2,600 acre-feet.

A preliminary area-capacity curve for the upper reservoir is shown in Figure 3-7. The normal minimum water surface elevation of 2,076 feet in the upper reservoir will be maintained such that the intake/outlet structure is submerged by 5 feet to prevent vortices from entering the intake during power generation.

Figure 3-7: Upper Reservoir Area-Capacity Curve

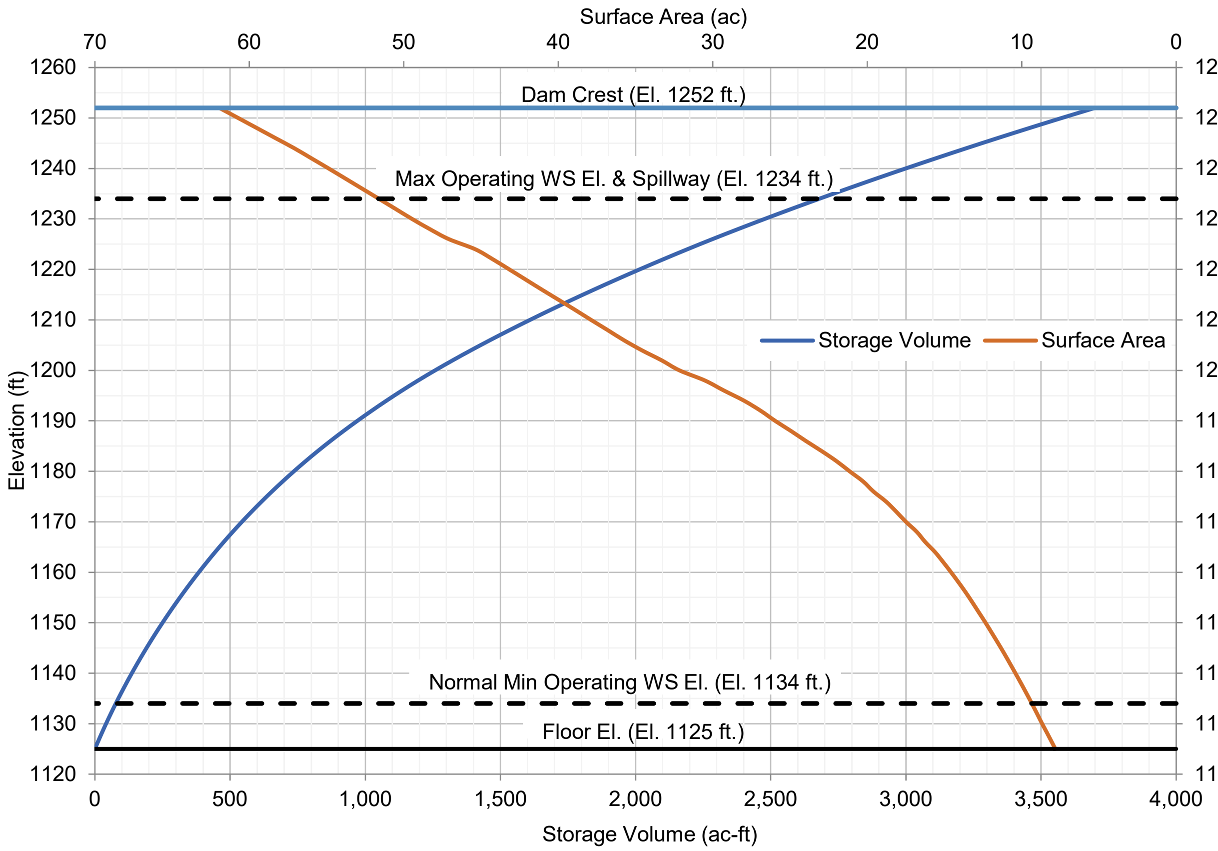


3.2.2 Lower Reservoir

The lower reservoir at its normal maximum operating water surface elevation has a surface area of 2,248,452 square feet, or 51.6 acres. The active storage volume is approximately 2,602 acre-feet.

A preliminary area-capacity curve for the lower reservoir is shown in Figure 3-8. The normal minimum water surface elevation of 1,134 feet in the lower reservoir will be maintained such that the intake/outlet is always submerged to prevent an intake vortex from forming during pumping mode of operation.

Figure 3-8: Lower Reservoir Area-Capacity Curve



3.3 Estimated Hydraulic Capacity

Table 3-1 provides the estimated hydraulic capacity data during generating mode for the Lewis Ridge Project.

Table 3-1: Estimated Hydraulic Capacity

Characteristic	Flow (cfs)	Turbine Efficiency (%)	Motor-Generator Efficiency (%)	Plant Output (at Generator Terminals) (MW)
Minimum Hydraulic Capacity	1,136	85	98.5	75
Maximum Hydraulic Capacity	4,544	90	98.5	308

3.4 Tailwater Rating Curves

The lower reservoir is considered the Lewis Ridge Project tailwater. The tailwater rating curve is equivalent to the lower reservoir area-capacity curve outlined in Figure 3-8 above. The lower reservoir elevation increases during the generating cycle as flow is discharged through the powerhouse into the lower reservoir.

3.5 Power Plant Capability versus Head

The following sections describe the plant capability versus head in the generating and pumping cycle. Typically, generating cycles are started at the maximum gross head while pumping cycles are started at the minimum gross head. Maximum, average, and minimum gross heads for the Lewis Ridge Project are summarized in Table 3-2.

Table 3-2: Maximum, Average, and Minimum Gross Head

Operating Level	Upper Reservoir Water Level (feet)	Lower Reservoir Water Level (feet)	Gross Head (feet)
Maximum	2,150	1,234	1,016
Average	2,113	1,184	929
Minimum	2,076	1,134	842

3.5.1 Generating Cycle

Table 3-3 provides the power outputs during the generating cycle.

Figure 3-9 depicts the variation of water surface elevations for both reservoirs during the generation cycle. Figure 3-10 depicts the total power output at the generator terminals, the total energy produced during 8 hours of generation, and the total turbine flow. For a complete generating cycle, the total energy produced at the generator terminals is 2,125 MWh.

The total annual dependable capacity energy production calculated at the generator terminals (including scheduled and unscheduled outages) is 717.3 GWh (Table 3-4).

Table 3-3: Power Outputs

Operating Level	Gross Head (feet)	Discharge (cfs)	Turbine Output (MW)	Plant Output (at Generator Terminals) (MW)
Maximum Head	1,016	4,400	332	326
Rated (Average) Head	929	4,544	312	308
Minimum Head	842	4,326	270	266

Figure 3-9: Water Level Variations in Upper and Lower Reservoirs

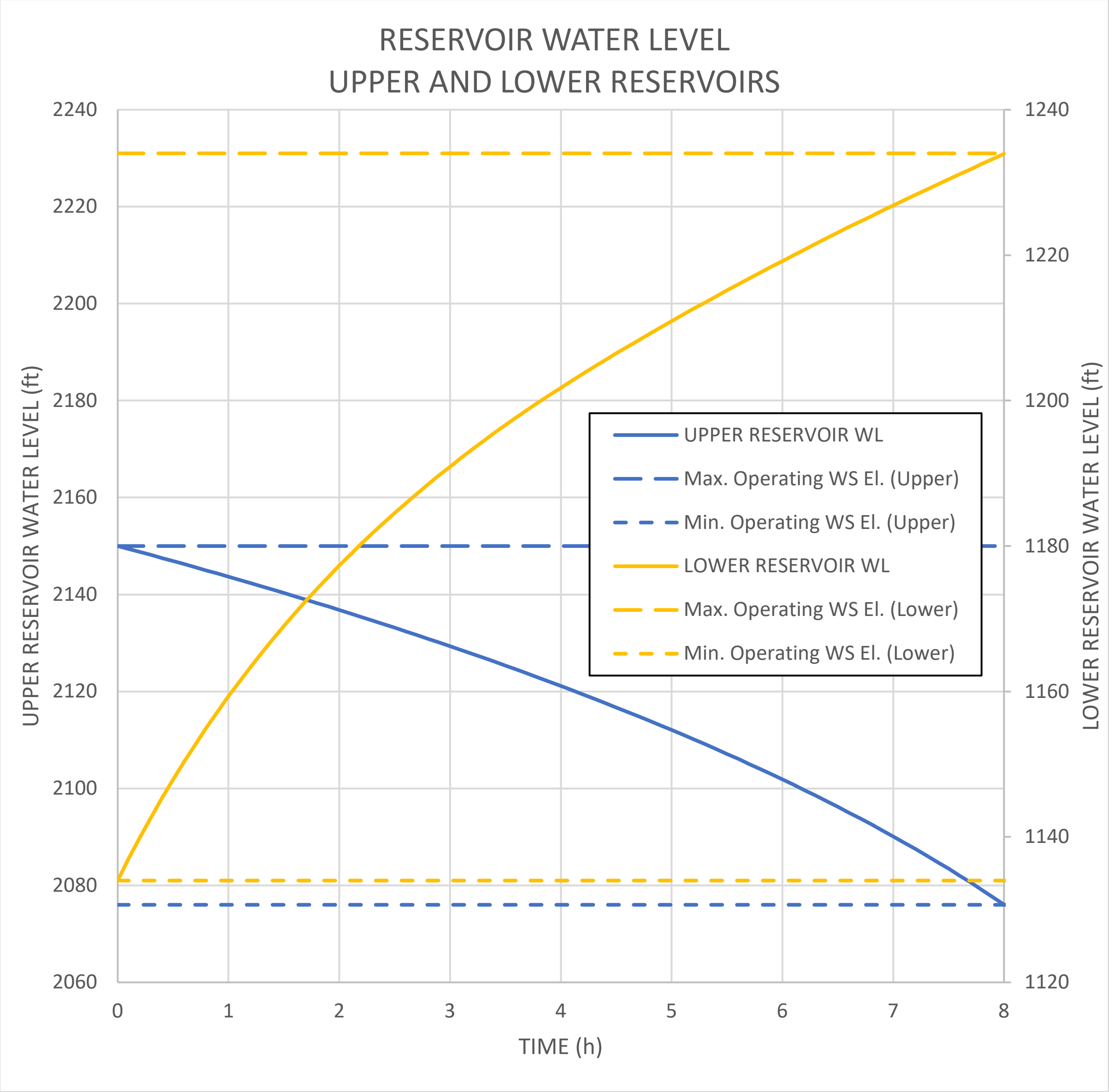


Figure 3-10: Gross Head, Turbine Flow, Power Output, and Energy Generation

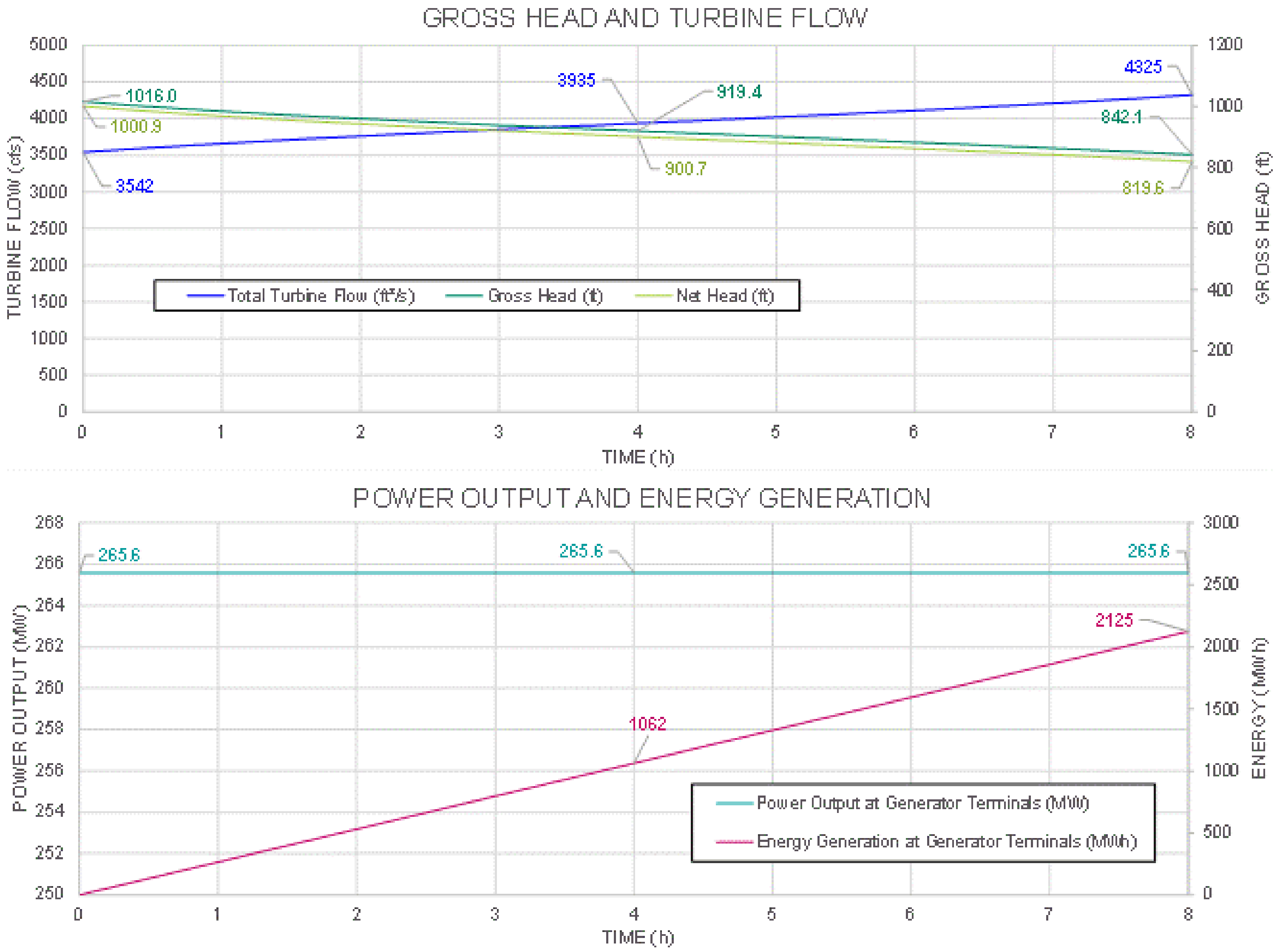


Table 3-4: Annual Dependable Capacity Calculations at Generator Terminals

Generation Scenario	Gigawatt-hours (GWh)
313.8 days of full generation	666.8
47.5 days of generation with only 1 unit (6.5% scheduled outage each unit)	50.5
3.7 days without generation (1% unscheduled outage)	0
Total	**717.3**

3.5.2 Pumping Cycle

Table 3-5 and Figure 3-11 depict estimates for gross head, pump flow, power input, and energy consumption for the pumping cycle. The required power input is estimated to vary from 340 MW at the start of the cycle (lowest head) to 274 MW at the end of the cycle (highest head). It is estimated that it will take approximately 8.8 hours to pump the complete active storage volume of approximately 2,600 acre-feet from the lower reservoir to the upper reservoir. The total pump flow varies from 4,210 cfs at the beginning of the pump cycle to 2,862 cfs at the end of the pump cycle. The total energy required at the motor terminals for each full pumping cycle is 2,738 MWh. Table 3-6 provides the assumed efficiencies for the pumping cycle.

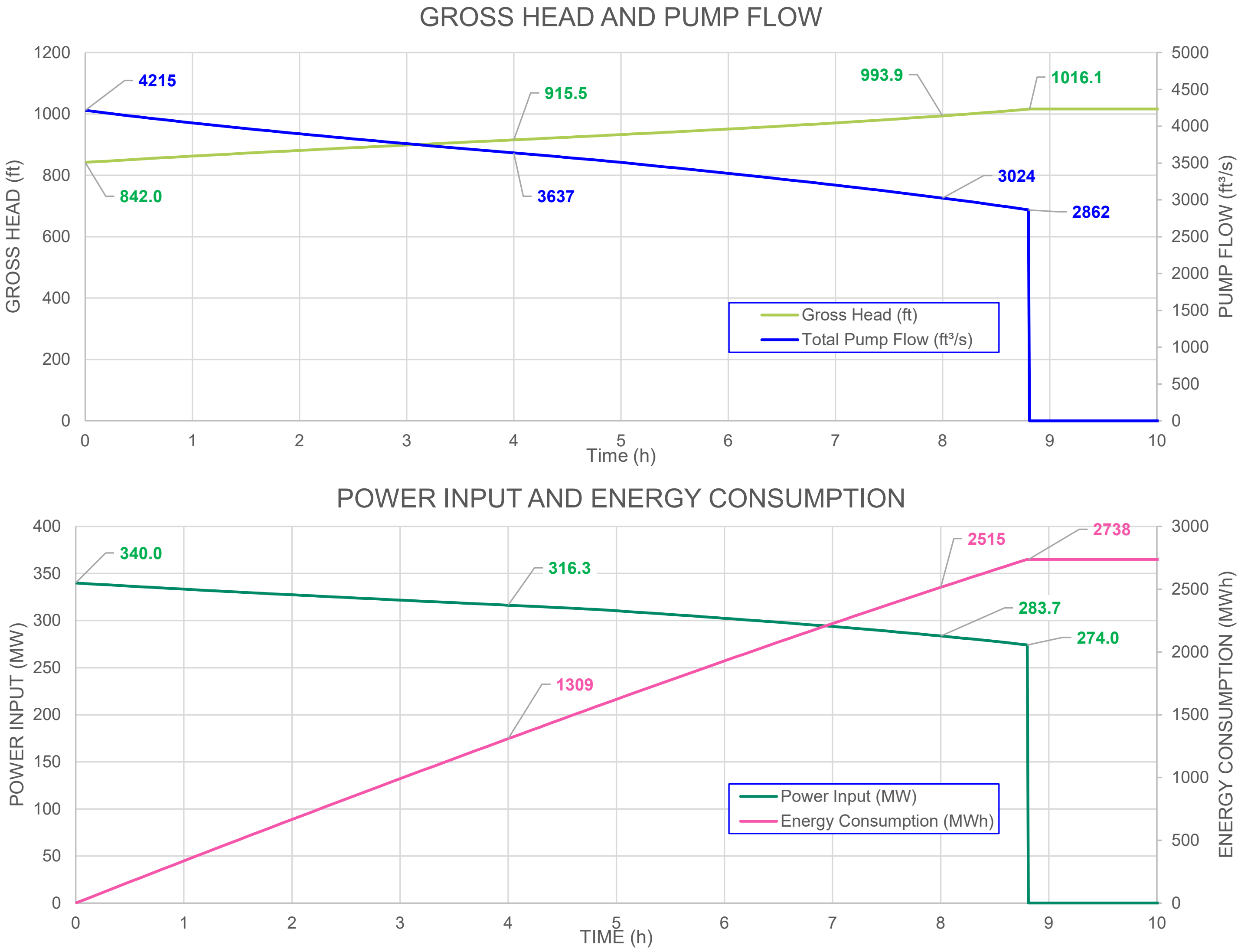
Table 3-5: Pump Cycle Power Inputs

Operating Level	Gross Head (feet)	Discharge (cfs)	Pump (MW)	Motor (MW)
Maximum Head	1,016	2,862	270	274
Rated (Average) Head	929	3,542	308	312
Minimum Head	842	4,210	334	340

Table 3-6: Pumping Cycle Efficiencies

Component	Efficiency (%)
Conveyance System	98.7
Pump	92.0
Motor	98.5

Figure 3-11: Gross Head, Pump Flow, Power Input, and Energy Consumption



4.0 UTILIZATION OF PROJECT POWER (18 CFR SECTION 4.41(C)(5))

The electrical energy produced at the Lewis Ridge Project will be marketed to electric utilities servicing this region. The electrical energy used on site will include basic utilities and the energy needed to pump the water to the upper reservoir. The project will produce 266 MW of guaranteed power output for the 8-hour generation cycle. The Lewis Ridge Project is estimated to have an approximately 8.8-hour pumping cycle, which will require 340 MW of power input at the start of the pumping cycle and 274 MW of power input at the end of the pumping cycle. The power absorbed and the power produced will be balanced to optimize the portfolio of the offtaker. All the power generated, up to 308 MW, will be provided to utility customers.

Kentucky and the broader region are facing unprecedented generation retirements, mostly in the form of aging fossil-based resources. The need for new capacity to continue the electrical grid's reliability is critical. The Lewis Ridge Project allows for local utilities to take advantage of excess power on the grid when available and deploy that energy when demand is high. The project also provides necessary resource diversification in times of extreme weather events.

The Applicant is an independent power producer building a single project for grid interconnection and is not responsible for system or regional planning needs.

5.0 PLANS FOR FUTURE DEVELOPMENT (18 CFR SECTION 4.41(C)(6))

The Applicant has no plans for future development of the Lewis Ridge Project or of any other existing or proposed waterpower at this site beyond what has been proposed in this application.

6.0 REFERENCES

AECOM Technical Services, Inc. 2025. Hydraulic Evaluation of Preliminary Layout. Lewis Ridge Pumped Storage Project. April 2025.

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LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

EXHIBIT C
PROPOSED CONSTRUCTION SCHEDULE

TABLE OF CONTENTS

LIST OF TABLES

1.0 CONSTRUCTION SCHEDULE (18 CFR SECTION 4.41(D)(1))

The estimated date of Notice to Proceed (NTP) for construction is December 1, 2027.

A Gantt chart schedule is provided below that illustrates the complete construction schedule with task relationships and duration. The final construction schedule will be dependent on a number of factors, including approvals for all required local, state, and federal permits, outcomes of agency and stakeholder consultation, Federal Energy Regulatory Commission (FERC) approval of construction implementation plans, project financial plans, and environmental factors.

2.0 COMMERCIAL OPERATION (18 CFR SECTION 4.41(D)(2))

The estimated commercial operation date of the Lewis Ridge Pumped Storage Project (Lewis Ridge Project) is December 31, 2031. Table 2-1 provides the estimated operation dates for the pump-turbine units at the Lewis Ridge Project.

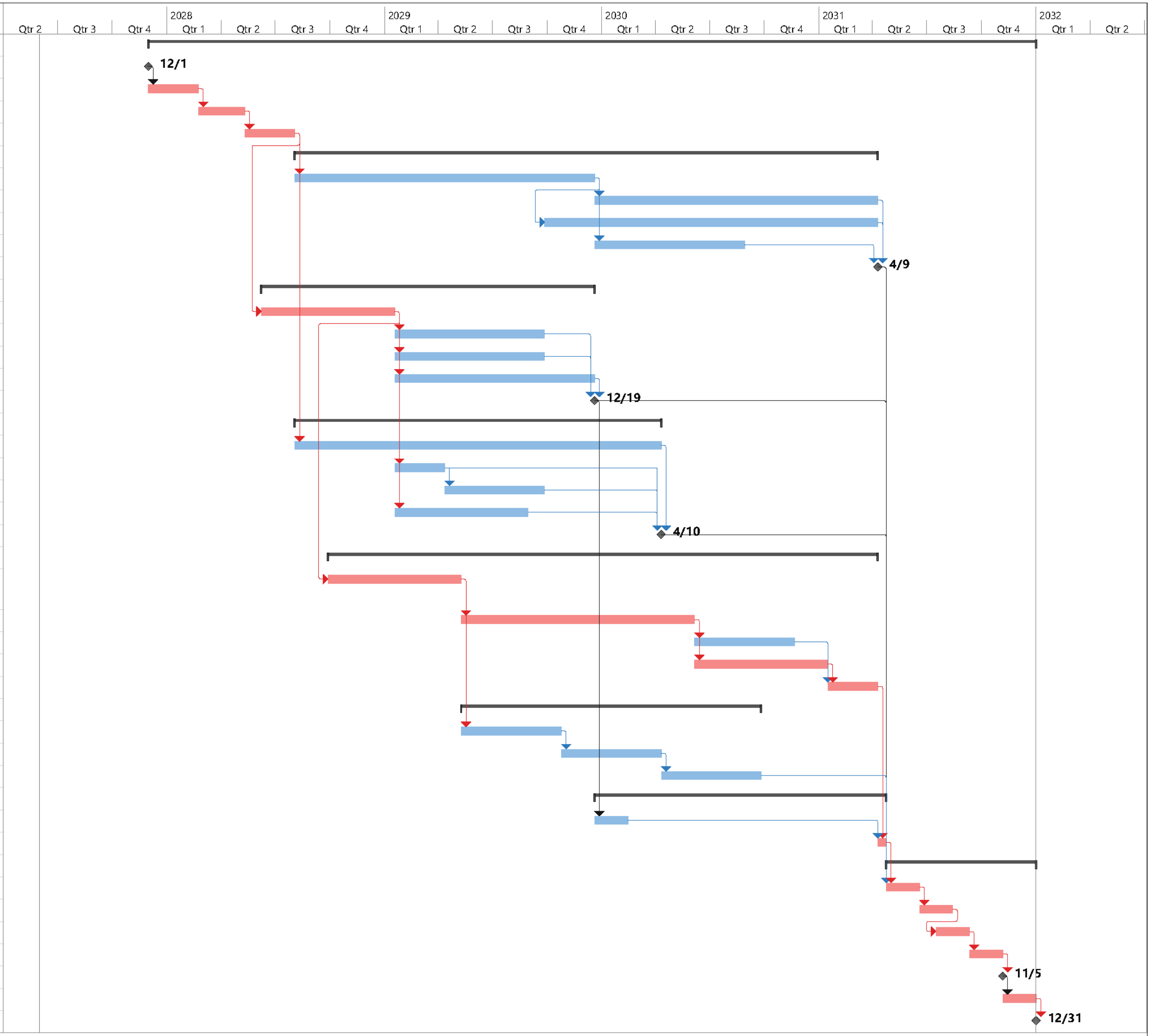
Table 2-1: Pump-Turbine Estimated Operation Dates

Unit No.	Operation Date
1	November 5, 2031
2	December 31, 2031

3.0 PREVIOUSLY CONSTRUCTED FACILITIES (18 CFR SECTION 4.41(D)(3))

There are no previously constructed facilities, unlicensed waterpower structures, or facilities at the Lewis Ridge Project site.

ID	ℹ	Task Mode	Task Name	Start	Finish
1			**Lewis Ridge Pumped Storage Project - Construction Schedule**	**Wed 12/1/27**	**Wed 12/31/31**
2			Construction NTP	Wed 12/1/27	Wed 12/1/27
3			Early Submittals and Approvals	Wed 12/1/27	Tue 2/22/28
4			Mobilization	Wed 2/23/28	Wed 5/10/28
5			Site Improvements, Roads, and Access	Thu 5/11/28	Wed 8/2/28
6			**Upper Reservoir**	**Thu 8/3/28**	**Wed 4/9/31**
7			Foundation Excavation and Prep	Thu 8/3/28	Wed 12/19/29
8			Inlet / Outlet Structure	Thu 12/20/29	Wed 4/9/31
9			Hardfill Embankment Placement	Thu 9/27/29	Wed 4/9/31
10			Reservoir Floor HAC Liner	Thu 12/20/29	Wed 8/28/30
11			Upper Reservoir Operational	Wed 4/9/31	Wed 4/9/31
12			**Lower Reservoir**	**Thu 6/8/28**	**Wed 12/19/29**
13			Foundation Excavation and Prep	Thu 6/8/28	Wed 1/17/29
14			Inlet / Outlet Structure	Thu 1/18/29	Wed 9/26/29
15			Earthfill Embankment Placement	Thu 1/18/29	Wed 9/26/29
16			HAC Liner	Thu 1/18/29	Wed 12/19/29
17			Lower Reservoir Operational	Wed 12/19/29	Wed 12/19/29
18			**Penstocks**	**Thu 8/3/28**	**Wed 4/10/30**
19			Trench Excavation, Penstock Installation, Welding, and Fill	Thu 8/3/28	Wed 4/10/30
20			Vertical Penstock Shaft	Thu 1/18/29	Wed 4/11/29
21			Penstock Manifold Tunnel	Thu 4/12/29	Wed 9/26/29
22			Tailrace Tunnels	Thu 1/18/29	Wed 8/29/29
23			Penstocks Operational	Wed 4/10/30	Wed 4/10/30
24			**Powerhouse**	**Thu 9/28/28**	**Wed 4/9/31**
25			Circular Shaft Excavation, Temporary Support, and Permanent Support	Thu 9/28/28	Wed 5/9/29
26			Interior Structural Construction	Thu 5/10/29	Wed 6/5/30
27			Pump-Turbine Unit Installation	Thu 6/6/30	Wed 11/20/30
28			BOP Electrical and Mechanical Installation	Thu 6/6/30	Wed 1/15/31
29			Draft Tube Gates and Turbine Inlet Valve Installation	Thu 1/16/31	Wed 4/9/31
30			**Transmission and Interconnection**	**Thu 5/10/29**	**Wed 9/25/30**
31			161 kV Switching Station	Thu 5/10/29	Wed 10/24/29
32			3.2 Mile 161kV Overhead Line	Thu 10/25/29	Wed 4/10/30
33			161kV Transmission Interception Switching Station	Thu 4/11/30	Wed 9/25/30
34			**Initial Fill**	**Thu 12/20/29**	**Wed 4/23/31**
35			Lower Reservoir Initial Fill	Thu 12/20/29	Wed 2/13/30
36			Conveyance System and UR Dead Pool Initial Fill	Thu 4/10/31	Wed 4/23/31
37			**Startup and Commissioning**	**Thu 4/24/31**	**Wed 12/31/31**
38			Commissioning of Auxiliary Equipment	Thu 4/24/31	Wed 6/18/31
39			Dry Commissioning of Unit 1	Thu 6/19/31	Wed 8/13/31
40			Dry Commissioning of Unit 2	Thu 7/17/31	Wed 9/10/31
41			Wet Commissioning of Unit 1	Thu 9/11/31	Wed 11/5/31
42			Commercial Operation of Unit 1	Wed 11/5/31	Wed 11/5/31
43			Wet Commissioning of Unit 2	Thu 11/6/31	Wed 12/31/31
44			Commercial Operation of Unit 2	Wed 12/31/31	Wed 12/31/31



Project: Lewis Ridge Constructio
Date: Fri 5/30/25

Task	▬	Summary	▬	Inactive Milestone	◇	Duration-only	▬	Start-only	[	External Milestone	◆
Split	┄	Project Summary	▬	Inactive Summary	▬	Manual Summary Rollup	▬	Finish-only	]	Deadline	⬇
Milestone	◆	Inactive Task	▭	Manual Task	▬	Manual Summary	▬	External Tasks	▬	Critical	▬
										Critical Split	┄
										Progress	─
										Manual Progress	─

Page 1

LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

EXHIBIT D
STATEMENT OF ESTIMATED COSTS AND FINANCING

TABLE OF CONTENTS

LIST OF TABLES

DEFINITIONS OF TERMS, ACRONYMS, AND ABBREVIATIONS

AACE	Advancement of Cost Engineering
Applicant	Lewis Ridge Pumped Storage, LLC
CFR	Code of Federal Regulations
Commission	Federal Energy Regulatory Commission
FERC	Federal Energy Regulatory Commission
Kentucky DEP	Kentucky Department for Environmental Protection
KPDES	Kentucky Pollutant Discharge Elimination System
Lewis Ridge Project	Lewis Ridge Pumped Storage Project, FERC P-15249
LRPS	Lewis Ridge Pumped Storage, LLC
PM&E	protection, mitigation, and enhancement
SMCRA	Surface Mining Control and Reclamation Act of 1977
SOFR	Secured Overnight Financing Rate
SWPPP	Stormwater Pollution Prevention Plan
USACE	U.S. Army Corps of Engineers
USD	U.S. Dollar

1.0 ESTIMATED COSTS OF ANY CONSTRUCTION, MODIFICATION OR REPAIR (18 CFR SECTION 4.41(E)(1))

1.1 Land and Water Rights

1.2 Land Rights

Lewis Ridge Pumped Storage, LLC (Applicant or LRPS) has entered into a Land Option Agreement with Asher Land and Mineral, LLLP, the primary landowner of the Lewis Ridge Pumped Storage Project (Lewis Ridge Project) site. The Applicant will purchase Asher Land and Mineral, LLLP, lands within the Federal Energy Regulatory Commission (FERC) Project Boundary for fair market value. The Applicant will also negotiate purchase or long-term lease with other landowners within the FERC Project Boundary.

1.3 Water Rights

The initial fill and recharge water will be sourced from the Cumberland River and Tom Fork. Details regarding water withdrawal are provided in Exhibit B, Section 2.0, and Exhibit E, Section 5.2. The Applicant will consult with the Kentucky Department for Environmental Protection (Kentucky DEP) and the U.S. Army Corps of Engineers (USACE) and obtain required permits associated with the water resources. Any fees associated with water withdrawal will be determined through the permitting process, as required.

1.4 Total Costs of All Major Project Works

The total construction costs for the Lewis Ridge Project have been estimated at a Class 4 level as defined by the Association for the Advancement of Cost Engineering (AACE). Costs are provided in 2025 U.S. Dollars (USD). Table 1-1 provides a summary of the estimated construction costs for the Lewis Ridge Project. The construction costs include direct costs, indirect costs, contractor bonds and insurance, contractor overhead and profit, and contingencies.

Table 1-1: Estimated Lewis Ridge Project Construction Costs

Component	Project Cost (USD)
General Conditions, Mobilization	$80,000,000
Site General Improvements	$10,000,000
Reservoirs and Dams	$215,000,000
Shaft, Tunnels, and Penstocks	$130,000,000
Electrical, Mechanical, and Balance of Plant	$120,000,000
Powerhouse and Inlet/Outlet	$120,000,000
Subtotal Direct Construction Costs	**$675,000,000**
Indirect Construction Costs – Contractor (15.0%)	$101,300,000
Contractor Bonds and Insurance (4.0%)	$27,000,000
Subtotal Contractors Direct and Indirect Costs	**$803,300,000**
Contractor Overhead and Profit (15.0%)	$120,500,000
Contingency (25.0%)	$230,900,000
Construction Design and Other Miscellaneous Costs	$36,300,000
Total Project Construction Costs	**$1,191,000,000**

1.5 Indirect Construction Costs

The indirect construction costs are estimated at approximately 15 percent of the direct construction costs. Indirect construction costs include site supervision, facilities, safety, consultation and permitting, and other project support costs. Indirect costs, including project salaried supervision, are estimated based on the understanding of the work and the level of supervisory effort anticipated.

The Applicant will consult with the permitting agencies, including Kentucky DEP and USACE, regarding the permits required for the Lewis Ridge Project and will obtain them as required. The following permits may be required: Clean Water Act Section 401 Water Quality Certification; Clean Water Act Section 402 Kentucky Pollutant Discharge Elimination System (KPDES) General Stormwater Permit; Rivers and Harbors Appropriation Act Section 404 and Section 408 permits; Kentucky Water Withdrawal Permit, Kentucky Dam Construction Permit, and Kentucky Stream Construction/Floodplain Permit.

Additionally, the Applicant will consult with the Kentucky Department for Natural Resources regarding existing Surface Mining Control and Reclamation Act of 1977 (SMCRA) permits and verify compliance with SMCRA. Certifications for the interconnection line, powerhouse, and related Lewis Ridge Project facilities will likely be required from the Kentucky State Board on Electric Generation and Transmission Siting.

1.6 Interest During Construction

Interest during construction is estimated based on a calculation of the Secured Overnight Financing Rate (SOFR) plus a risk margin in the context of current market conditions. The interest during construction is estimated to be $110 million.

1.7 Overhead, Construction, Legal Expenses, and Contingencies

Overhead, construction, legal expenses, and contingencies are included in construction costs in Table 1-1.

2.0 PREVIOUSLY CONSTRUCTED FACILITIES (18 CFR SECTION 4.41(E)(2))

This section is not applicable. The Lewis Ridge Project is unconstructed and does not include any previously constructed waterpower structures or facilities.

3.0 ESTIMATED AMOUNT PAYABLE UPON TAKEOVER PURSUANT TO SECTION 14 OF THE FEDERAL POWER ACT (18 CFR SECTION 4.41(E)(3))

This section is not applicable. The Lewis Ridge Project is unconstructed, and the Applicant is filing for an original license.

4.0 ESTIMATED AVERAGE ANNUAL COST OF THE PROJECT, AS PROPOSED (18 CFR SECTION 4.41(E)(4))

Pursuant to Section 6 of the Federal Power Act, the Applicant respectfully requests that the Commission issue a license for a term of 50 years for the Lewis Ridge Project. This request is in accordance with the Commission's Policy Statement on Establishing License Terms for Hydroelectric Projects, published in the Federal Register on October 26, 2017 (82 FR 49501). This Final License Application assumes a 4-year construction period, followed by 46-year operational period. Operational costs shown are a 46-year average annual cost proxy, including an assumption of cost escalation of 2.5 percent after the first year for all annual costs.

4.1 Capital Costs

The Lewis Ridge Project has access to a blended cost of capital (equity and debt) of approximately 10 percent. The capital cost is subject to market forces between now and completion of Lewis Ridge Project construction that may raise or lower this value.

4.2 Taxes

The Lewis Ridge Project will contribute to tax revenues in local and state jurisdictions. Property taxes will increase in Bell County, sales/use taxes[1] will increase in Kentucky, and income taxes will increase in Kentucky. This analysis does not estimate the impact on property taxes, vehicle license fees, or business license fees that may be paid by Lewis Ridge Project employees or businesses supplying inputs to the Lewis Ridge Project, as it is likely that there would be only a small increase in these taxes associated with economic activity supported by the Lewis Ridge Project (i.e., it is likely that these taxes would be paid by state residents and businesses at similar values without the Lewis Ridge Project). Taxes paid by LRPS, its suppliers, and its employees are challenging to estimate for a number of reasons, including the size of the Lewis Ridge Project, uncertainty regarding

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[1] Use tax is a tax on the use of goods and services in Kentucky for which sales tax has not been paid. Use tax would be applicable for Lewis Ridge Project goods/services that are purchased from another state that does not have a sales tax or that has a sales tax lower than Kentucky's (in which case, the use tax would equal the difference between the Kentucky State sales tax and the sales tax in the other state). In the case of goods/services purchased from Tennessee, there would be no use tax because the sales tax rate in Tennessee is higher. The general sales tax rate in Tennessee is 7 percent.

material sourcing and expenditures, and uncertainty regarding potential property tax abatement agreements. That said, this section provides an overview of some of the key taxes that would apply to the Lewis Ridge Project and the potential magnitude of associated tax revenues to state and local jurisdictions.

Bell County property taxes are assessed at $1.32 per $100 of assessed value (Compton 2024). According to the Bell County assessor, for energy facilities, property taxes are assessed on the full construction value the first year after construction and then are assessed based on the net profit of the facility. As such, the first year after Lewis Ridge Project construction, property taxes paid to Bell County by LRPS may be approximately $16.5 million. Thereafter, the value would fluctuate based on the net profitability of the Lewis Ridge Project. These property taxes will support local jurisdictions and county services in Bell County. Further, other sub-county taxing districts may also levy property taxes on the facility if the facility falls within their tax district boundaries.

Sales and use taxes in unincorporated portions of Bell County total 6.0 percent, all of which goes to the state (Kentucky Department of Revenue 2024). Based on historical data on sales and use taxes paid by the power and communications construction sector in Kentucky (as estimated by IMPLAN), total sales and use taxes paid by the Lewis Ridge Project may be approximately $22.9 million during construction.

Kentucky residents pay a flat 4-percent income tax; after deductions and exemptions, the effective tax rate may be approximately 3.8 percent.[2] All income earned in the state is taxed, typically including income paid to out-of-state residents working in Kentucky (unless their home state has a reciprocal agreement with the state of Kentucky, which only applies to residents of Illinois, Indiana, Michigan, Ohio, Virginia, West Virginia, and Wisconsin) (Kentucky Department of Revenue 2025). Based on the Lewis Ridge Project's Economic and Fiscal Impacts Analysis (Exhibit E, Appendix P), during construction an estimated $534 million may be paid to construction workers and proprietors. Assuming 3.8 percent of these wages would be paid in Kentucky state income tax, this would equate

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[2] This is calculated based on the estimated average annual wage of construction workers of $123,000 and the standard annual household deduction of $6,540 in Kentucky for a married couple. Kentucky does not have personal exemptions, only the standard deduction. Applying a 4 percent tax rate to taxable income of $116,460 yields tax of $4,658. Dividing $4,658 by $123,000 equates to an approximately 3.8 percent effective tax rate.

to approximately $20 million in state income taxes, or approximately $5 million in income tax annually in each of the 4 years during construction.

Thus, during construction, state level tax revenues may increase by a total of approximately $60 million in Kentucky, or approximately $15 million annually over the 4 years of construction. During operations, tax revenues would increase by a smaller amount.

4.3 Depreciation

The estimated average annual depreciation is estimated at 2 percent.

4.4 Operation and Maintenance Expenses

The estimated annual operation and maintenance expense, including insurance, administrative and general expenses, and contingencies, for the Lewis Ridge Project is approximately $10 million (in 2025 USD) starting in the first year of operation.

4.5 Proposed Environmental Measures

The estimated costs of proposed environmental measures for the Lewis Ridge Project are depicted in Table 4-1. Total annual costs of proposed environmental measures are estimated to be $1,830,000. Initial costs are estimated to be $735,000, followed by variable incremental costs for environmental measure implementation. Average cost over the requested license term of 50 years is $36,600 per year. Costs for environmental measures are subject to change based on additional comments and consultation during the FERC licensing process.

Table 4-1: Estimated Costs of Proposed Environmental Measures at the Lewis Ridge Project Over License Term

Resource Area	PM&E* Measure Category	Task Description	Initial Cost	Incremental Cost	Frequency (Years)	Total Cost
Water Resources	Water Quality Monitoring Plan	Develop and implement plan	$30,000	$10,000	46	$490,000
Water Resources	Stream Mitigation	Stream mitigation for Tom Fork (in reservoir habitat loss) and the Cumberland River (concrete pads on bed of waterway) impacts; coordinated with the USACE and Kentucky DEP Division of Water	$500,000	-	-	$500,000
Water Resources	Stormwater Pollution Prevention Plan (SWPPP)	Develop and implement plan	$20,000	$10,000	4	$60,000
Water Resources	Hazardous Substances Spill Prevention and Cleanup Plan	Develop and implement plan	$20,000	$5,000	50	$270,000
Water Resources	Groundwater Protection Plan	Develop and implement plan	$10,000	$5,000	4	$30,000
Fish and Aquatic Resources	Fish Exclusion Measures	Install and maintain fish exclusion bar racks at the lower reservoir intake/outlet to minimize fish entrainment; install fish screens on water pumps to minimize the intake of larval and juvenile fish	Included in Construction and Operations Costs			
	Mussel Relocation	Relocation of mussels, if found, in the area of the pump intake pads	Included in Construction Costs			
Wildlife Resources	Wildlife Management Plan	Develop and implement plan	$20,000			$20,000
Botanical Resources	Vegetation Management Plan	Develop and implement plan	$20,000			$20,000
		Vegetation establishment during and after construction	Included in Construction Costs			
		Vegetation monitoring	$15,000	10,000	5	$65,000
		Invasive species management	$40,000	$6,000	46	$316,000
Historic and Archaeological Resources	Historic Properties Management Plan	Develop and implement plan	$30,000	To be determined	-	$30,000
Geological and Soil Resources	Erosion and Sediment Control Plan	Develop plan	$30,000	-	-	$30,000

* PM&E = protection, mitigation, and enhancement.

5.0 ESTIMATED ANNUAL VALUE OF PROJECT POWER (18 CFR SECTION 4.41(E)(5))

Based on the Lewis Ridge Project economics, the Applicant is expecting to sell capacity on long-term contracts to utilities in the region between $25 per kilowatt month to $30 per kilowatt month. The Applicant's expected annual revenues are based on the value of the Lewis Ridge Project power contract at value per kilowatt month, multiplied by months times kilowatts.

6.0 ENERGY ALTERNATIVES (18 CFR SECTION 4.41(E)(6))

Other energy alternatives include fossil-based generation, nuclear power, renewable resources (including solar, wind, and conventional hydropower), other pumped storage projects, and other energy storage technologies. Renewable energy projects such as wind and solar are not a good comparison to the Lewis Ridge Project, as these types of renewable projects are non-dispatchable and are unable to provide capacity and ancillary services to the market. Pumped storage provides large-scale, cost-effective dispatchable energy storage capacity and a range of essential grid reliability services that differentiate it from other energy generation sources.

7.0 CONSEQUENCES OF LICENSE APPLICATION DENIAL (18 CFR SECTION 4.41(E)(7))

If the license application is denied and the Lewis Ridge Project is not constructed as a result, the following value creations of the Lewis Ridge Project would be lost:

- Creation of low carbon and low-cost energy during peak use periods;
- Provision of ancillary services to respond to immediate needs of ramping and load following;
- Provision of regulation to manage grid stability, in particular with relation to renewable generation;
- Ability to absorb surplus energy when there is surplus generation;
- A marked reduction in carbon dioxide from fossil fuel generators;
- Diversification of dispatchable grid resources to create reliability during extreme weather events; and
- Generation of tax revenue over the life of the Lewis Ridge Project, along with thousands of employment job-years in construction and operation and associated indirect income and spending and additional community benefits.

8.0 SOURCES AND EXTENT OF FINANCING (18 CFR SECTION 4.41 (E)(8))

The Lewis Ridge Project is assumed to be financed with a combination of investments and debt financing raised from the private markets.

9.0 COST TO DEVELOP THE LICENSE APPLICATION (18 CFR SECTION 4.41(E)(9))

The estimated cost to develop the license application is approximately $15 million.

10.0 ON-PEAK AND OFF-PEAK VALUES OF PROJECT POWER (18 CFR SECTION 4.41(E)(10)

The future value of revenues and costs associated with operating the Lewis Ridge Project is based on market comparisons and expected value of power at peak capacity. The costs are presented in Section 4.0, and the market prices and revenues are presented in Section 5.0.

11.0 REFERENCES

Compton, J. 2024. Fiscal Court keeps same tax rate as last year. Middlesboro News, pp. https://middlesboronews.com/2024/09/12/fiscal-court-keeps-same-tax-rate-as-last-year/.

Kentucky Department of Revenue. 2024. Sales & Use Tax. Retrieved from Kentucky Department of Revenue: https://revenue.ky.gov/Business/Sales-Use-Tax/pages/default.aspx.

Kentucky Department of Revenue. 2025. Personal Income Tax. Retrieved from https://revenue.ky.gov/Individual/Individual-Income-Tax/Pages/default.aspx.

LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

EXHIBIT E
ENVIRONMENTAL REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

DEFINITIONS OF TERMS, ACRONYMS, AND ABBREVIATIONS

AC	asphalt concrete
ACHP	Advisory Council on Historic Preservation
Applicant	Lewis Ridge Pumped Storage, LLC
APE	Area of Potential Effects
AWF	Appalachian Wildlife Foundation
BMP	best management practices
°C	degrees Celsius
CCD	Census County Divisions
CEII	Critical Energy Infrastructure Information
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
CPUE	catch per unit effort
Commission	Federal Energy Regulatory Commission
CRAI	Cultural Resource Analysts, Inc.
CZMA	Coastal Zone Management Act
DLA	Draft License Application
DO	dissolved oxygen
EFH	Essential Fish Habitat
EJ	environmental justice
ESA	Endangered Species Act
ETSZ	Eastern Tennessee Seismic Zone
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
FPA	Federal Power Act
gpm	gallons per minute
HAMF	Historic Average Monthly Flow
IPaC	Information for Planning and Consultation
Kentucky DEP	Kentucky Department for Environmental Protection
Kentucky DFWR	Kentucky Department of Fish and Wildlife Resources

Kentucky DNR	Kentucky Department for Natural Resources
Kentucky EEC	Kentucky Energy and Environment Cabinet
KGS	Kentucky Geologic Survey
Kentucky SHPO	Kentucky State Historic Preservation Office
KPDES	Kentucky Pollutant Discharge Elimination System
KRS	Kentucky Revised Statutes
KSS	Kentucky Speleological Survey
KY-BAT	Kentucky Biological Assessment Tool
L	liter
Lewis Ridge Project	Lewis Ridge Pumped Storage Project, FERC No. 15249
LRPS	Lewis Ridge Pumped Storage, LLC
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MASW	multichannel analysis of surface waves
MBI	Macroinvertebrate Bioassessment Index
mg	milligrams
mg/L	milligrams per liter
ml	milliliter
mm	millimeter
MLRA	Major Land Resource Area
MTR	mountain top removal
MW	megawatt
MWh	megawatt hours
NAVD 88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NPS	National Park Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRI	Nationwide Rivers Inventory
NWI	National Wetlands Inventory
NRCS	Natural Resources Conservation Service

NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
OKNP	Office of Kentucky Nature Preserves
OSMRE	Office of Surface Mining Reclamation and Enforcement
PAD	Pre-Application Document
PEZ	Paleozoic Extended Crust Seismotectonic Zone
PM&E	protection, mitigation, and enhancement
Project Vicinity	The general geographic area in which the proposed Lewis Ridge Project will be located, as indicated on the Project Vicinity figures.
RPW	Relatively Permanent Water
SCORP	Statewide Comprehensive Outdoor Recreation Plan
Siting Board	Kentucky State Board on Electric Generation and Transmission Siting
SMCRA	Surface Mining Control and Reclamation Act of 1977
SOAR	Shaping Our Appalachian Region
Study Area	The Study Area was used as the geographic area for licensing studies conducted in 2025 and includes appropriate buffers around the proposed facilities to account for further refinement of the Lewis Ridge Project.
SWPPP	Stormwater Pollution Prevention Plan
TLP	Traditional Licensing Process
TMDL	total maximum daily load
TNS	terrestrial nuisance species
µS	microsiemens
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VisitLex	Lexington Visitors Center
WQC	Water Quality Certification

1.0 INTRODUCTION

1.1 Overview

Lewis Ridge Pumped Storage, LLC (Applicant or LRPS) is filing with the Federal Energy Regulatory Commission (FERC or Commission) its Final License Application (FLA) for the Lewis Ridge Pumped Storage Project (FERC No. 15249) (Lewis Ridge Project). The Lewis Ridge Project is a proposed, unconstructed pumped storage hydroelectric generating facility located in Bell County, Kentucky, on land that has been used for both underground and surface coal mining. The Lewis Ridge Project will involve the construction of new water storage, water conveyance, and electric generation facilities. The grid-connected project will use electricity to store potential energy by moving water between a lower and upper reservoir, connected by a penstock and powerhouse that contains two reversible pump hydroelectric turbines. During periods of peak electricity demand, this same water will be released, generating power and delivering it to the grid. The Lewis Ridge Project will require an initial fill of the reservoirs with minimal recharge water required.

1.2 FERC Process and Consultation Summary

On November 19, 2021, LRPS submitted an application for preliminary permit for the Lewis Ridge Project.[1] On December 16, 2021, FERC issued Notice of Preliminary Permit Application Accepted for Filing and Soliciting Comments, Motions to Intervene, and Competing Applications.[2] FERC issued a preliminary permit for the Lewis Ridge Project on March 3, 2022.[3] LRPS is using FERC's Traditional Licensing Process (TLP) as established in FERC regulations, Title 18 of the U.S. Code of Federal Regulations (CFR), Part 4. Documentation of agency and stakeholder consultation is provided in Appendix A and summarized by resource area in Section 5.0.

In July of 2022, LRPS initiated consultation with resource agencies and stakeholders to introduce the Lewis Ridge Project. In August 2022, LRPS sent outreach emails to 20 entities providing an information sheet on the Lewis Ridge Project and requested meetings to learn about available resource information and discuss potential resource concerns, information gaps, and proposed studies. LRPS conducted meetings with the USFWS and

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[1] Accession No. 20211122-5269
[2] Accession No. 20211216-3054
[3] Accession No. 20220303-3084

the Kentucky Cabinet for Economic Development on September 9, 2022, and with the Kentucky Resource Council on September 13, 2022.

LRPS filed a Pre-Application Document (PAD) and Notice of Intent (NOI) to seek an original license for the Lewis Ridge Project on October 21, 2022.[4] LRPS held a Joint Agency and Public Meeting and site visit on January 25, 2023, to provide information about the project and licensing process, solicit information regarding existing environmental resources at the Lewis Ridge Project, and obtain agency and stakeholder opinions regarding the project and its potential effect on existing resources.

As the Applicant is utilizing the TLP, there was no requirement to prepare a formal study plan document, and therefore there was no subsequent study plan determination by FERC. Nonetheless, LRPS distributed a Draft Study Plan to FERC, resource agencies, Tribes, and stakeholders on June 13, 2024, for a 30-day review.[5] The Draft Study Plan included four proposed studies: (1) Wetland and Waterway Evaluation, (2) Blackside Dace Habitat Evaluation, (3) Bat Survey, and (4) Cultural Resources Evaluation. The Kentucky Department for Environmental Protection (Kentucky DEP)[6] and the Kentucky State Historic Preservation Office (Kentucky SHPO) provided comments on the Draft Study Plan. LRPS filed a Revised Study Plan with FERC on August 16, 2024.[7] LRPS filed its Draft License Application (DLA) on September 30, 2024.[8] The Environmental Report (Exhibit E) of the DLA included the study reports for the four proposed studies. The U.S. Environmental Protection Agency (USEPA), FERC, Kentucky DEP, and Kentucky SHPO provided comments on the DLA or accompanying study reports (Appendix A). LRPS conducted additional studies in 2025 to address DLA comments and an updated Study Area. Studies included a wetland and waterway evaluation, aquatic habitat evaluation of Tom Fork, bat portal survey, bat mist net and acoustic surveys, vegetation assessment, cultural historic survey, archaeological survey, and economic and fiscal impact analysis. Resource studies and evaluations appear in Appendix F through Appendix P. LRPS incorporated study results and addressed DLA comments in the FLA. A Summary Response Table to DLA Comments is provided in Appendix A.

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[4] Accession No. 20221021-5176

[5] Accession No. 20240614-5007

[6] The Kentucky DEP is part of the Kentucky Energy and Environment Cabinet (Kentucky EEC).

[7] Accession No. 20240816-5241

[8] Accession No. 20240930-5296

1.3 Purpose and Organization of Exhibit E

This Exhibit E has been prepared in accordance with 18 CFR § 4.41, contents for an Application for License for Major Unconstructed Project. In addition, LRPS has included elements of 18 CFR § 5.18 to assist in the Commission staff's National Environmental Policy Act (NEPA) analysis. The purpose of the Exhibit E is to describe the existing resources at the proposed Lewis Ridge Project, describe how the proposed facilities or operations may affect those resources, and include measures for protection, mitigation, and enhancement (PM&E) with respect to each resource affected. The Report on Resources in this Exhibit E (Section 5.0) presents information on the existing environment, potential impacts of the Lewis Ridge Project, agency consultation, and the expected benefits of proposed PM&E measures by resource. This report is based on available information and on the results of studies conducted during the licensing process.

2.0 STATUTORY AND REGULATORY REQUIREMENTS (18 CFR § 5.18 (B)(3))

2.1 Clean Water Act

Under Section 401(a)(1) of the Clean Water Act (CWA), a license applicant must obtain certification from the appropriate state pollution control agency verifying compliance with the CWA. As part of the TLP, LRPS consulted with the Kentucky DEP throughout the licensing process (Appendix A) and discussed the requirement to obtain CWA Section 401 WQC from the Kentucky DEP Division of Water. Pursuant to Section 401 of the CWA and 18 CFR § 4.34(b)(5). The Applicant will file an application for a 401 WQC to Kentucky DEP Division of Water within 60 days following FERC's notification of its acceptance of the license application being ready for environmental analysis. In addition, LRPS will obtain a CWA Section 402 Kentucky Pollutant Discharge Elimination System (KPDES) General Stormwater Permit from Kentucky DEP Division of Water.

LRPS will be required to obtain a Section 404 permit from the U.S. Army Corps of Engineers (USACE) for any work within jurisdictional streams or wetlands. In addition, LRPS will request a Section 408 permit review from USACE for use of the Cumberland River for initial fill and recharge water. Initial fill and recharge water is proposed to be sourced from the Cumberland River and Tom Fork. Additional information related to water and wetland resources is provided in Section 5.2.

2.2 Endangered Species Act

Section 7(a)(2) of the Endangered Species Act (ESA) requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of federally listed threatened and endangered species or result in the destruction or adverse modification of their designated critical habitat. On October 21, 2022, LRPS requested to be designated as the Commission's non-federal representative for the purposes of consultation under Section 7 of the ESA. FERC designated LRPS as the Commission's non-federal representative for carrying out informal consultation in its December 21, 2022 NOI to File License Application, Filing of PAD, and Approving Use of the TLP. LRPS conducted a blackside dace habitat assessment and bat portal and mist net surveys to evaluate potential presence of rare, threatened, and endangered species. Additional information related to rare, threatened, and endangered species is provided in Sections 5.3 and 5.4.

2.3 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires federal agencies to consult with the National Oceanic Atmospheric Administration (NOAA) Fisheries on all actions that may adversely affect Essential Fish Habitat (EFH). There is no EFH at the Lewis Ridge Project, and therefore EFH consultation pursuant to Section 305(b) of the Magnuson-Stevens Act is not required (NOAA 2025).

2.4 Coastal Zone Management Act

Pursuant to Section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA), 16 United States Code (U.S.C.) Section 1456(3)(A), FERC cannot issue a license for a project within or affecting a state's coastal zone unless the state CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA program, or the agency's concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification. The Commonwealth of Kentucky does not have a coastal zone and therefore does not have a CZMA agency. As such, there is no requirement for a federal consistency certification or concurrence from the state CZMA agency for the Lewis Ridge Project.

2.5 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, requires that every federal agency "take into account" how each of its undertakings could affect historic properties. Historic properties include districts, sites, buildings, structures, traditional cultural properties, and objects significant in American history, architecture, engineering, and culture that are listed in or eligible for inclusion in the National Register of Historic Places (NRHP). FERC designated LRPS as the Commission's non-federal representative for carrying out informal consultation pursuant to Section 106 of the NHPA in its notice dated December 21, 2022. Information related to cultural resources is provided in Section 5.6 and associated attachments.

2.6 Wild and Scenic Rivers and Wilderness Acts

The Wild and Scenic Rivers Act was created by Congress in 1968 (Public Law 90-542; 16 U.S.C. 1271 et seq.) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. The Wilderness Act of 1964 (Public Law 88-577; 16 U.S.C. 23 et seq.) created the National Wilderness Preservation System. It defines wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain" and "an area of undeveloped federal land retaining its primeval character and influence without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions."

There are no rivers that have been designated for inclusion in the National Wild and Scenic River System (National Park Service [NPS] 2025a), no lands included in the National Trails System, or lands designated as, or under study for inclusion as, a Wilderness Area (NPS 2025b, Southern Appalachian Wilderness Stewards 2025) at the Lewis Ridge Project.

2.7 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act was originally enacted in 1940 (16 U.S.C 668-668d) to protect eagles from human-induced alterations and human interactions. As defined in 50 CFR, Part 22, permits are required for the "taking" (meaning to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb), possession, and transportation within the United States of bald eagles and golden eagles and their parts, nests, and eggs. Bald eagles are discussed in Section 5.4 of this Exhibit E.

2.8 Surface Mining Control and Reclamation Act of 1977

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) governs mining and reclamation of surface coal mines in the United States. Prior to 1977, mining activities throughout the United States were not federally regulated. The SMCRA includes federal guidelines intended to regulate (permit) mining activities, by setting enforceable standards, and created the Office of Surface Mining Reclamation and Enforcement as the agency to oversee the program. The Kentucky Department for Natural Resources (Kentucky DNR)[9] is responsible for implementing the SMCRA through the Kentucky Revised Statutes (KRS) 350.020. The Division of Mine Reclamation and Enforcement (DMRE) is one of three agencies within the Kentucky DNR responsible for administering Kentucky's mining, reclamation, and abandoned mine land laws. The DMRE is responsible for inspecting all surface and underground coal mining permits in the state to assure compliance with the SMCRA. The DMRE is also responsible for regulating and enforcing

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[9] The Kentucky DNR is under the Kentucky EEC.

the surface mining reclamation laws for non-coal mining sites in the state, including limestone, sand, gravel, shale, and the surface effects of dredging river sand and gravel. The DMRE works closely with the Division of Mine Permits and the Division of Abandoned Mine Lands to ensure that established standards of operation are addressed and that the public and the environment are protected. (Kentucky Energy and Environment Cabinet [Kentucky EEC] 2024).

There are current permits issued to Nally & Hamilton Enterprises, Inc. in the proposed location of the Lewis Ridge Project that are under Kentucky DNR jurisdiction. The current permits related to the site are further discussed in Sections 5.8.1 and 5.11.1.

2.9 References

Kentucky Energy and Environment Cabinet (Kentucky EEC). 2024. Mine Reclamation and Enforcement. Available online: https://eec.ky.gov/Natural-Resources/Mining/Reclamation-Enforcement/Pages/default.aspx. Accessed: June 2024.

National Park Service (NPS). 2025a. National Wild and Scenic Rivers System. Available online: https://www.rivers.gov/kentucky.php Accessed: August 2025.

NPS. 2025b. National Trails System. Available online: https://www.nps.gov/subjects/nationaltrailssystem/national-scenic-trails.htm Accessed: August 2024.

National Oceanic and Atmospheric Administration (NOAA). 2025. Essential Fish Habitat Mapper. Available online: https://www.habitat.noaa.gov/apps/efhmapper/?page=page_3. Accessed: April 2025.

Southern Appalachian Wilderness Stewards. 2025. Available online: https://www.wildernessstewards.org/kentucky Accessed: April 2025.

3.0 PROPOSED ACTION AND ALTERNATIVES (18 CFR § 5.18 (B)(5))

3.1 No-Action Alternative

Under the no-action alternative, an original FERC license for the Lewis Ridge Project would not be granted and the project would not be constructed. Consequently, the expected generation of reliable, dispatchable energy and its associated benefits would not be realized. Additionally, the potential impacts of the Lewis Ridge Project on natural and cultural resources would not occur and PM&E measures would not be implemented. While this may initially seem beneficial in terms of avoiding disruption to local ecosystems, it is important to consider that the Lewis Ridge Project has been specifically designed to maximize energy benefits while minimizing environmental disruption. Furthermore, the proposed site is a mined industrial site in various stages of reclamation, and the project's cancellation would result in the loss of an opportunity to repurpose this area for beneficial use. The no-action alternative is used to establish baseline environmental conditions for comparison with other alternatives.

3.2 Applicant's Proposed Action

LRPS proposes to seek an original FERC license and subsequently construct, operate, and maintain the Lewis Ridge Project. Additional information on the Applicant's proposal (specifically the proposed project location, facilities, and operations) is provided below.

3.2.1 Proposed Project Location

The proposed Lewis Ridge Project site is located in Bell County in southeastern Kentucky, near the borders of Tennessee and Virginia. The proposed site is located near the communities of Blackmont, Tejay, Balkan, and Callaway and near River Mile 657.5 of the Cumberland River.[10] The location of the proposed facilities and FERC Project Boundary are depicted on Figure 3-1. This proposed Project Boundary depicts the geographic extent that LRPS anticipates to encompass land necessary to operate the Lewis Ridge Project once construction is completed. A larger "Study Area"[11] was used as the geographic area for licensing studies conducted in 2025 and includes buffers around the proposed

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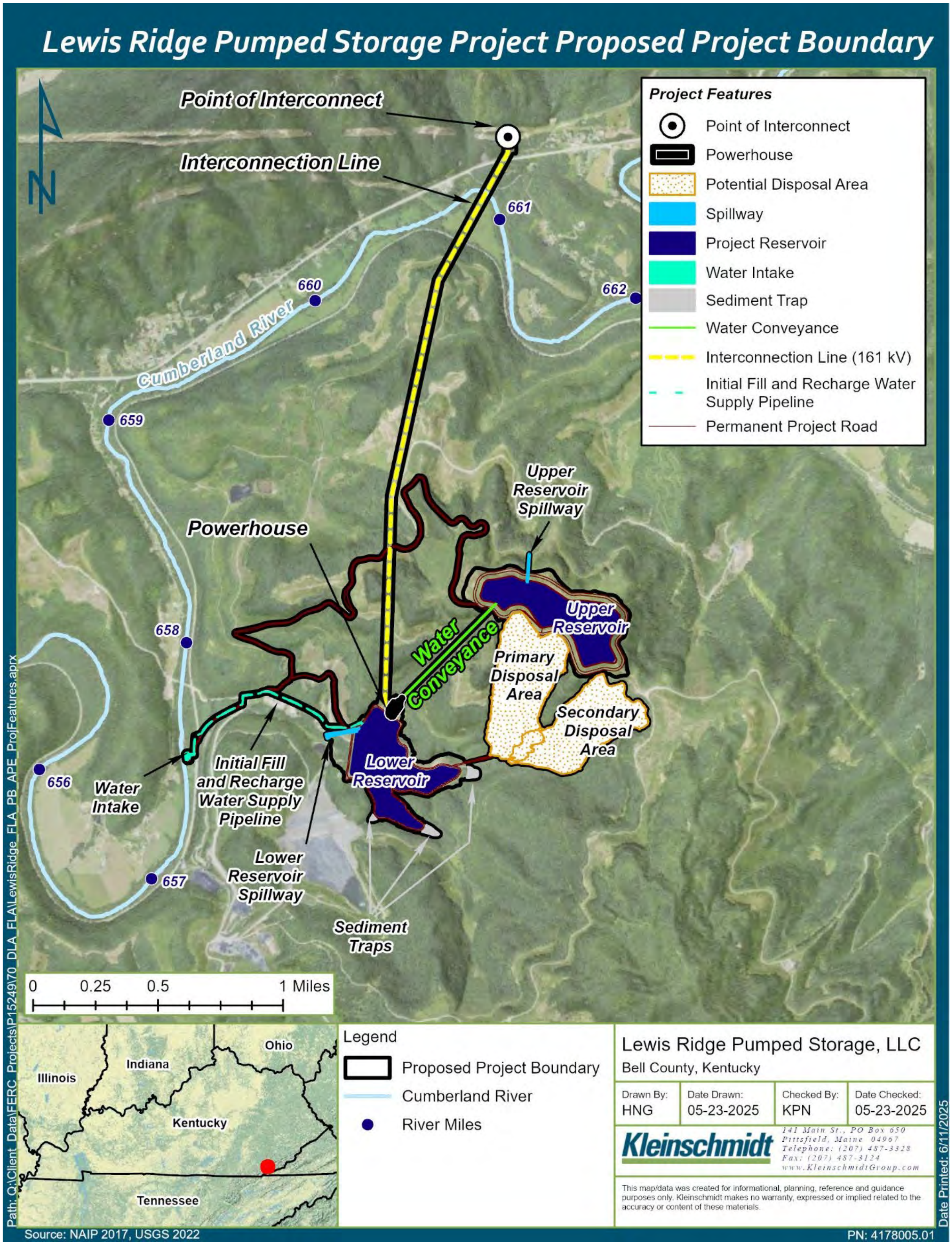
[10] River miles were produced using the National Hydrography Dataset (NHD) (USGS 2022).

[11] The Study Area is outlined on figures within individual resource sections of this Exhibit (Sections 5.2 through 5.12).

facilities to account for further refinement of the project and construction activities. The proposed Lewis Ridge Project is located entirely on private land. There are no lands of the United States in the Project Boundary. Figure 3-1 shows the delineated "Project Vicinity" for the purpose of this license application. In accordance with 18 CFR 4.41, where applicable, environmental resources were described for the area within the Project Vicinity to allow for a broader geographic context as compared to the immediate area surrounding the proposed project.

Figure 3-1: Proposed Project Features and Project Boundary



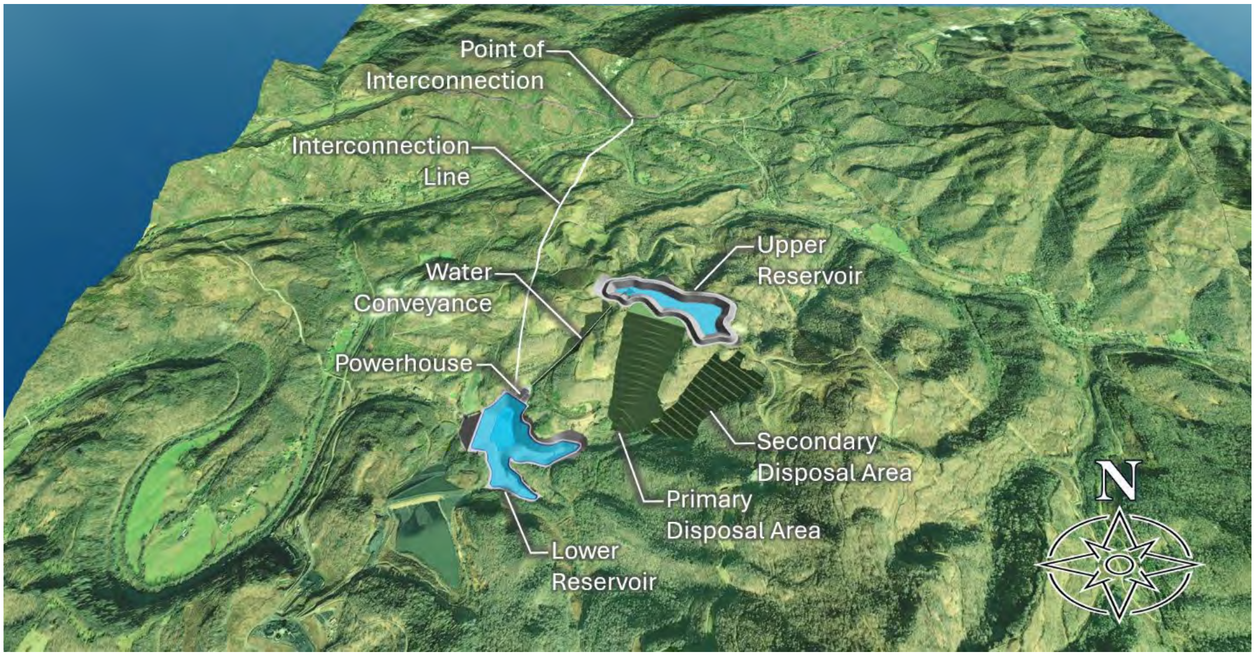
Source: NAIP 2017, USGS 2022

3.2.2 Proposed Project Facilities

The proposed Lewis Ridge Project will consist of the following: (1) an 8,241-foot-long, 50-foot-high rocky earthfill dam for the upper reservoir with an integrated overflow emergency spillway; (2) an upper reservoir with a surface area of 48.2 acres and an active storage capacity of approximately 2,600 acre-feet; (3) a 4,174-foot-long conveyance system that includes a 16-foot-diameter high pressure surface penstock, a vertical shaft, and bifurcation manifold connecting two high-pressure tunnels to the spherical valve, from the bonneted gate two 12-foot-diameter low-pressure draft tube tunnels, and intake/outlets; (4) a 131-foot-diameter circular shaft powerhouse located 267 feet below the ground containing two 154 MW reversible pump-turbines, with a total rated capacity of 308 MW; (5) an 1,120-foot-long, 138-foot-high earthfill embankment dam at the lower reservoir with an integrated overflow emergency spillway; (6) a 51.6 acre lower reservoir with an active storage capacity of approximately 2,602 acre-feet; (7) a 2.5-mile-long, 161 kilovolt (kV) overhead interconnection line; (8) a low-profile intake, pump station, and three parallel 4,742-foot-long initial fill and recharge water supply pipelines to the lower reservoir; and (9) ancillary equipment. Additional specifications of the proposed Lewis Ridge Project are provided in Exhibit A of the license application.

A rendering of the proposed Lewis Ridge Project is shown on Figure 3-2 and includes the upper reservoir, lower reservoir, water conveyance, fill sites, powerhouse, interconnection line, and point of interconnection.

Figure 3-2: Lewis Ridge Project Rendering



3.2.3 Proposed Project Operations

The proposed Lewis Ridge Project will use water stored in the upper reservoir to create energy by releasing that storage through the turbine-pump units to the lower reservoir. Water will then be pumped back from the lower reservoir to the upper reservoir to replenish the storage. There are no inflows to the proposed upper reservoir other than pumping flows during normal Lewis Ridge Project operations and rainfall. The proposed lower reservoir is located within a valley that contains Tom Fork, a tributary to the Cumberland River. The lower reservoir is subject to natural inflows of Tom Fork generated by rainfall. The primary source of the initial fill water will be the Cumberland River, with fill water supplemented by Tom Fork during storm events. Annual refill, when needed, may be sourced from retaining a percentage of runoff from storm events in the Tom Fork basin and supplemented by pumping from the Cumberland River.

In a 24-hour operating cycle, the Lewis Ridge Project will have the capacity to generate energy for 8 hours a day at full power output and pump water back from the lower reservoir to the upper reservoir for approximately 8.8 hours to accomplish the upper reservoir refill.

Additional information on proposed operations is provided in Exhibit B of the license application.

3.2.4 Proposed Protection, Mitigation, and Enhancement Measures

Table 3-1 provides a summary of the proposed PM&E measures. Proposed PM&E measures are further described in the individual resource sections of this Exhibit (Sections 5.2 through 5.12).

Table 3-1: Proposed PM&E Measures at the Lewis Ridge Project

No.	PM&E Measure
1	**Water Quality Monitoring Plan**. Additional details are provided in Section 5.2.3.2 and Appendix B.
2	**Stream Mitigation**. Additional details are provided in Section 5.2.3.2.
3	**Stormwater Pollution Prevention Plan (SWPPP)**. Additional details are provided in Section 5.2.3.2.
4	**Hazardous Substances Spill Prevention and Cleanup Plan**. Additional details are provided in Section 5.2.3.2.
5	**Groundwater Protection Plan**. Additional details are provided in Section 5.2.3.2.
6	**Fish Exclusion Measures**. Additional details are provided in Section 5.3.3.2.
7	**Mussel Relocation.** Additional details are provided in Section 5.3.3.2.
8	**Wildlife Management Plan**. Additional details are provided in Section 5.4.3.2 and Appendix C.
9	**Vegetation Management Plan**. Additional details are provided in Section 5.5.3.2 and Appendix D.
10	**Historic Properties Management Plan**. Additional details are provided in Section 5.6.3.2 and Appendix E.
11	**Erosion and Sediment Control Plan**. Additional details are provided in Section 5.8.3.2.
12	**Slope Stability Analysis.** Additional details are provided in Section 5.8.3.2.
13	**Subsidence Analysis**. Additional details are provided in Section 5.8.3.2.
14	**Breakthrough Analysis**. Additional details are provided in Section 5.8.3.2.

3.3 Alternatives Considered but Eliminated (18 CFR § 4.41 (F)(10))

3.3.1 Project Site Alternatives

Site selection for a pumped storage project involves identifying locations with suitable topography, typically areas with significant elevation differences to support an upper and lower reservoir. The Applicant also considers factors including accessibility for infrastructure development, connection to the electrical grid, regional need for power, land availability, proximity to existing water sources, and potential for minimization of environmental impacts. Alternative sites were considered but eliminated during the Applicant's initial review once the Lewis Ridge Project site was selected.

3.3.2 Project Design Alternatives

In addition to the design proposed in this FLA, LRPS has considered alternate designs, including as described in the DLA. The design alternatives appear in Exhibit B of this FLA.

4.0 GENERAL DESCRIPTION OF THE LOCALE (18 CFR § 4.41 (F)(1))

The Lewis Ridge Project is a proposed unconstructed pumped storage project that will be located in the Upper Cumberland River Basin, in southeast Kentucky near the borders of Tennessee and Virginia. The Cumberland River is the nearest major river and is located approximately 0.5 mile from the proposed lower reservoir. The proposed intake at the Cumberland River will be located at River Mile 657.5 and the interconnection line will cross the Cumberland River at River Mile 661.1. The Cumberland River flows in a western direction for approximately 688 miles from the Appalachian Mountains to the confluence with the Ohio River and the mouth of the Tennessee River (Olson 2021).

4.1 River Basin and Sub-Basins Description

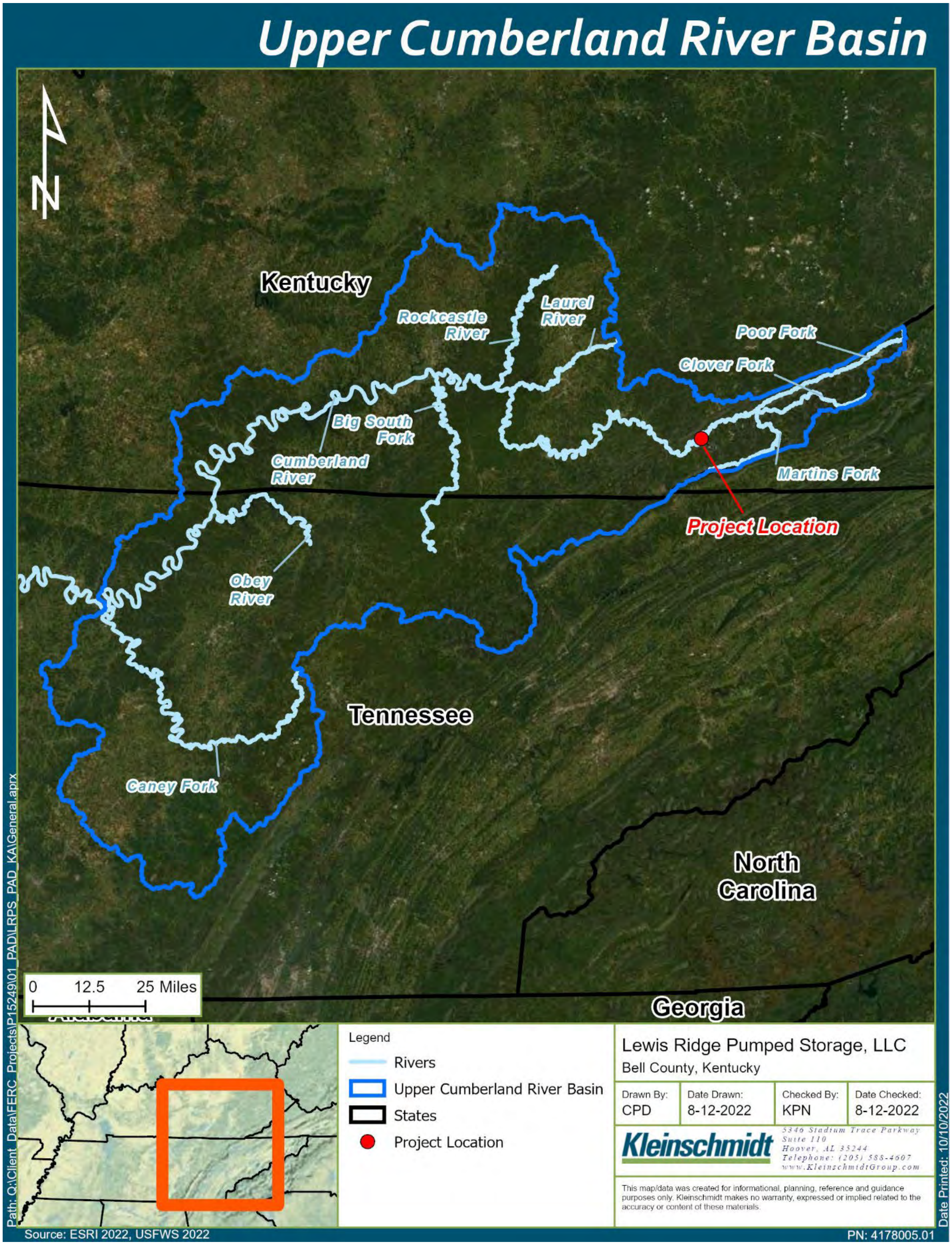
The Lewis Ridge Project is within the Upper Cumberland River Watershed (HUC8 05130101), which is part of the Upper Cumberland River Basin (HUC6 051301), which is part of the larger Cumberland River Basin (HUC4 0513) (U.S. Geological Survey [USGS] 2024). Figure 4-1 and Figure 4-2 show the river basins and sub-basins.

The drainage area of the Cumberland River Basin (HUC4 0513) is approximately 18,000 square miles (Olson 2021) and stretches across 70 Kentucky and Tennessee counties (Cumberland River Compact 2024a). The drainage area of the Upper Cumberland River Basin (HUC6 051301) is approximately 10,688 square miles. The drainage area of the Upper Cumberland River Watershed (HUC8 05130101) is 2,336 square miles. The Upper Cumberland River Watershed (HUC8 05130101) crosses Bell, Clay, Harlan, Knox, Laurel, Leslie, Letcher, McCreary, and Whitley counties in Kentucky, and Campbell, Claiborne, and Scott counties in Tennessee (Cumberland River Compact 2024b).

Figure 4-1: Cumberland River Basin and Sub-Basins

Source: ESRI 2022, USGS 2022

Figure 4-2: Upper Cumberland River Basin

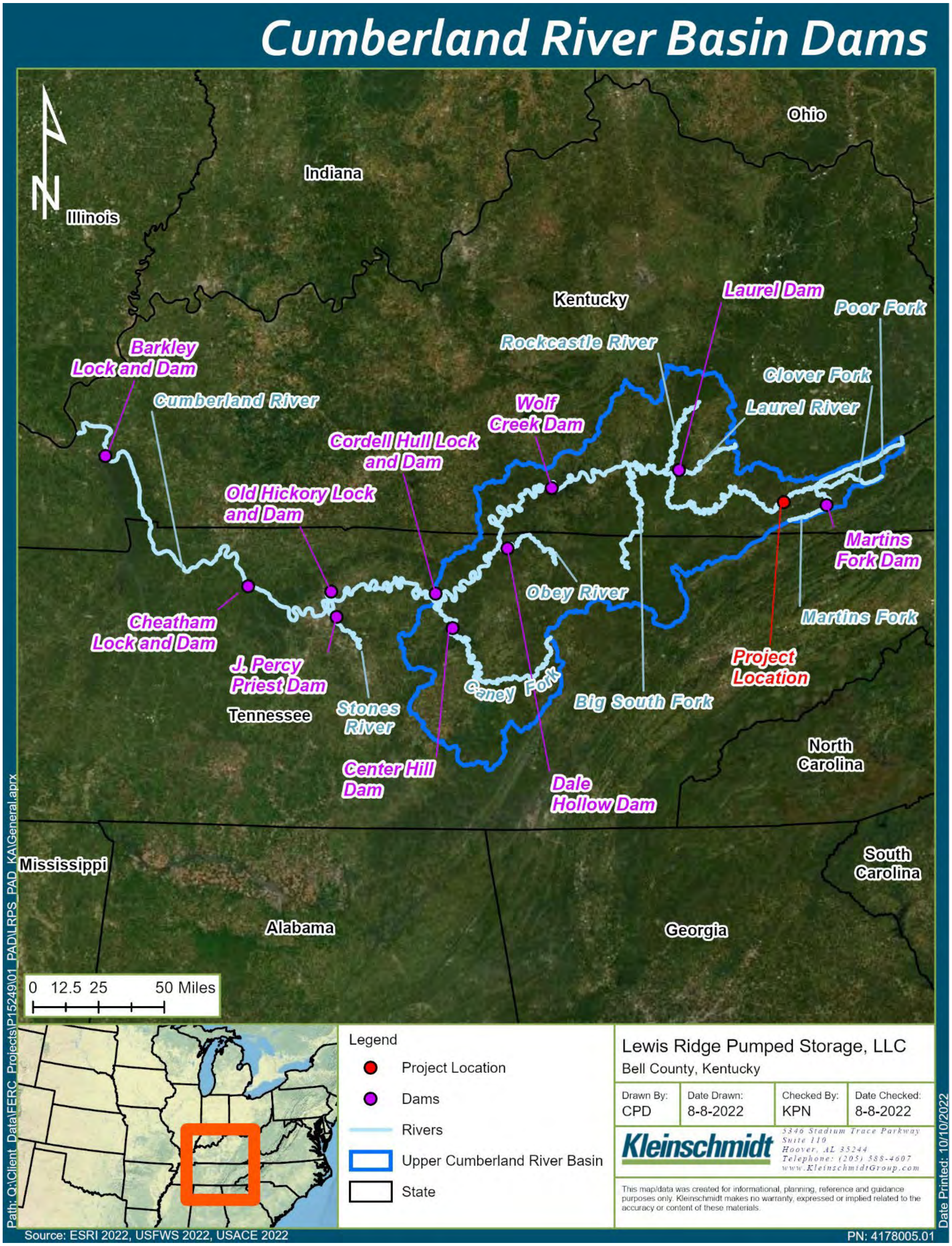


4.2 River Basin Tributaries and Dams

The Cumberland River Basin (HUC4 0513) includes over 22,000 miles of streams and rivers (Cumberland River Compact 2024a). The mainstem of the Cumberland River flows in a westerly direction, with its tributaries draining from the north or south (Kentucky EEC 1998). Clover Fork, Martins Fork, and Poor Fork form the headwaters of the Cumberland River in southeast Kentucky in the city of Harlan (Olson 2021). Between Harlan, Kentucky, and Celina, Tennessee, the Cumberland River flows 310 miles and drains 6,400 square miles from over 7,900 miles of tributaries and streams (Cumberland River Compact 2019). Along this stretch, the Cumberland River receives water from streams and creeks such as Rockcastle, Laurel, Big South Fork, Caney Fork, and Obey River (World Atlas 2024). The Cumberland River flows naturally for 135 miles before reaching Lake Cumberland (formed by Wolf Creek Dam). Near Celina, Tennessee, Caney Fork and Obey River join the Cumberland River and it continues through Nashville, Tennessee, where the river is dammed to form Old Hickory Lake and Cordell Hull Lake (World Atlas 2024).

USACE operates eight dams on the Cumberland River (Wolf Creek Dam, Dale Hollow Dam, Center Hill Dam, Cordell Hull Dam, Old Hickory Dam, J. Percy Priest Dam, Cheatham Dam, and Barkley Dam) and two dams on its tributaries (Martins Fork Dam and Laurel River Dam) (USACE 2022, Olson 2021). Figure 4-3 shows the locations of these dams. Major impoundments in the Upper Cumberland Watershed include Lake Cumberland on the mainstem of the Cumberland River, Laurel River Lake, Martins Fork Lake, Cranks Creek Reservoir, Wood Creek Lake, Lake Linville, and Cannon Creek Reservoir (Kentucky EEC 2000).

Figure 4-3: USACE Dams on the Cumberland River



4.3 Major Land Uses and Land Ownership

The proposed Lewis Ridge Project is in the Cumberland Plateau Major Land Resource Area (MLRA) 125. The area's general topography is characterized by long, steep side slopes between narrow ridgetops and narrow stream floodplains. Major land uses in the Cumberland Plateau MLRA include commercial timber production and farming (corn, hay, tobacco, and vegetable production). Extensive forested areas exist in national forests, wildlife management areas, state parks, and private tracts owned by coal and timber companies within the Cumberland Plateau MLRA (Natural Resources Conservation Service [NRCS] 2022).

The Lewis Ridge Project will be located on private land. No federal or Tribal lands will be associated with the Lewis Ridge Project. A majority of the Lewis Ridge Project features will be located at a site owned by Asher Land and Mineral, LLLP that has been used for coal mining. The northern portion of the interconnection line with associated switch yard and point of interconnect, a segment of the upper reservoir access road, and western extent of the water intake pipeline and associated intake are located on private lands outside Asher Land and Mineral, LLLP property.

4.4 Major Water Uses

Public supply, livestock, and irrigation are the major water uses within the Cumberland Plateau MLRA. Total withdrawals average 915 million gallons per day with 84 percent sourced by surface water (from precipitation and perennial streams). Reservoirs within the Cumberland Plateau MLRA provide water for municipal and industrial users, while springs provide for domestic use and livestock (NRCS 2022).

4.5 Climate

Average annual precipitation for the Cumberland Plateau MLRA is 45-60 inches and as high as 75 inches in higher elevations. Most of the rainfall occurs during summer thunderstorms with half of the annual precipitation occurring during the growing season. Annual temperatures average 50-60 degrees Fahrenheit (°F), and the freeze-free period averages 200 days (NRCS 2022).

4.6 References

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5.0 REPORT ON RESOURCES

This section provides the information required in 18 CFR § 4.41 (f)(2-9), including existing environmental conditions by resource and an analysis of potential effects of the proposed Lewis Ridge Project on each resource. Following NEPA regulations and guidelines, a project's potential effects can be categorized as direct, indirect, and cumulative. Cumulative effects are discussed in Section 5.1. Agency consultation and Applicant recommendations for potentially impacted resources are described in individual resource subsections of Section 5.0. Studies were conducted in 2024 and 2025 in support of this license application, with 2025 studies occurring in a revised Study Area to accommodate design changes. The studies completed are listed in Table 5-1. Additionally, LRPS has conducted and is continuing to conduct geotechnical evaluations, including test pits, geophysical seismic refraction surveys, and geophysical seismic multichannel analysis of surface waves (MASW) surveys, to inform engineering design of the Lewis Ridge Project. Geotechnical evaluations are included in the Exhibit F, Preliminary Supporting Design Report, filed as Critical Energy Infrastructure Information (CEII).

Table 5-1: Studies Conducted to Inform License Application

Study	Year	Topic	Appendix
Jurisdictional Streams and Wetlands Determinations	2024	Water Resources	DLA – Exhibit E Appendix B
Jurisdictional Streams and Wetlands Determinations Report	2025	Water Resources	FLA – Exhibit E Appendix F
Water Quality and Tom Fork Flow Evaluations	2025 - 2026	Water Resources	Ongoing – evaluations will be completed in 2026
Blackside Dace Habitat Assessment	2024	Fish and Aquatic Resources	FLA – Exhibit E Appendix G
Aquatic Baseline Assessment (Privileged)	2025	Fish and Aquatic Resources	FLA – Exhibit E Appendix H
Cumberland River Aquatic Resources Study	2025	Fish and Aquatic Resources	Ongoing – survey will be completed in 2025
2024 Listed Bat Presence/Probable Absence Survey (Mist Netting) (Privileged)	2024	Wildlife Resources	FLA – Exhibit E Appendix J
Listed Bat Presence/Probable Absence Portal Survey Report (Privileged)	2025	Wildlife Resources	FLA – Exhibit E Appendix K

Study	Year	Topic	Appendix
2025 Listed Bat Presence/Probable Absence Survey (Mist Netting) (Privileged)	2025	Wildlife Resources	FLA – Exhibit E Appendix L
Vegetation Assessment Report	2025	Botanical Resources	FLA – Exhibit E Appendix M
Archaeological Survey Report (Privileged)	2024	Cultural Resources	DLA – Exhibit E Appendix F
Cultural Historic Survey (Privileged)	2024	Cultural Resources	DLA – Exhibit E Appendix G
Cultural Historic Survey Report (Privileged)	2025	Cultural Resources	FLA – Exhibit E Appendix N
Archaeological Survey Report (Privileged)	2025	Cultural Resources	FLA – Exhibit E Appendix O
Archaeological Survey Report (Privileged)	2025 - 2026	Cultural Resources	Ongoing – pending private landowner access approval
Economic and Fiscal Impact Analysis	2025	Socioeconomic Resources	FLA – Exhibit E Appendix P

5.1 Cumulative Effects Analysis

A cumulative effect is the effect on the environment that results from the incremental effect of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over time, including hydropower and other land and water development activities. The Applicant identified water resources and geological and soil resources as being cumulatively affected by the prior impacts from mining activities and the proposed construction and operation of the Lewis Ridge Project. The Applicant has not identified any other resources that would be cumulatively affected by the construction and operation of the Lewis Ridge Project.

5.2 Water and Wetland Resources (18 CFR § 4.41 (f)(2))

5.2.1 Existing Environment

Overview

Mapped hydrologic features and waterbodies within the Study Area[12] and Project Vicinity according to the National Hydrography Dataset (NHD) are shown in Figure 5-1. Water bodies within the Study Area include the Cumberland River, Dry Branch, Tom Fork, and portions of several intermittent streams. Additional waterbodies within the Project Vicinity include several intermittent streams, a portion of Puckett Creek, and a portion of Brownies Creek (Figure 5-1).

The Cumberland River is mapped on the NHD as a stream/river. Approximately 9.1 river miles of the Cumberland River are within the Project Vicinity. The drainage area of the Cumberland River at the confluence with Tom Fork is approximately 472 square miles (AECOM 2025).

The proposed lower reservoir will be located within a valley that contains Tom Fork, an approximately 9,300-foot (1.8-mile) perennial stream. The Tom Fork drainage basin is within a narrow valley surrounded by elongated ridges (Schnabel Engineering [Schnabel] 2023). Tom Fork flows to the northwest and west to its confluence with the Cumberland River and has a drainage area of approximately 2.6 square miles (USGS 2024a).

Dry Branch is mapped as an intermittent stream (Figure 5-1). Dry Branch is approximately 1.1 miles long and flows from east to west to its confluence with the Cumberland River. Approximately 0.31 mile (1,650 feet) of Dry Branch is within the Study Area. The drainage area of Dry Branch is approximately 0.7 square mile (USGS 2024a). Additional intermittent streams are within the Study Area and include portions of Schoolhouse Branch, Pound Mill Branch, and Campbell Branch (Figure 5-1).

Betsie Branch is an intermittent stream that flows through the Betsie Branch coal refuse impoundment southwest of the Study Area to join Tom Fork (Figure 5-1); approximately

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[12] For purposes of this FLA, the Study Area is defined as the geographic area for licensing studies conducted in 2025 and includes buffers around the proposed facilities to account for the proposed limits of disturbance and areas that could be used following further advancement of the engineering design.

1,225 feet of Betsie Branch is within the Study Area. The Betsie Branch dam emergency spillway, if utilized, will flow into one of the sediment traps and then the lower reservoir.

The drainage area of the upper reservoir will be the size of the proposed reservoir, which is approximately 48.2 acres at the normal maximum water surface elevation of 2,150 feet.[13] The drainage area of the lower reservoir is approximately 2.1 square miles, which includes 1.8 square miles from the lower reservoir drainage basin and 0.3 square miles from the Betsie Branch Reservoir subbasin[14] (Figure 5-2).

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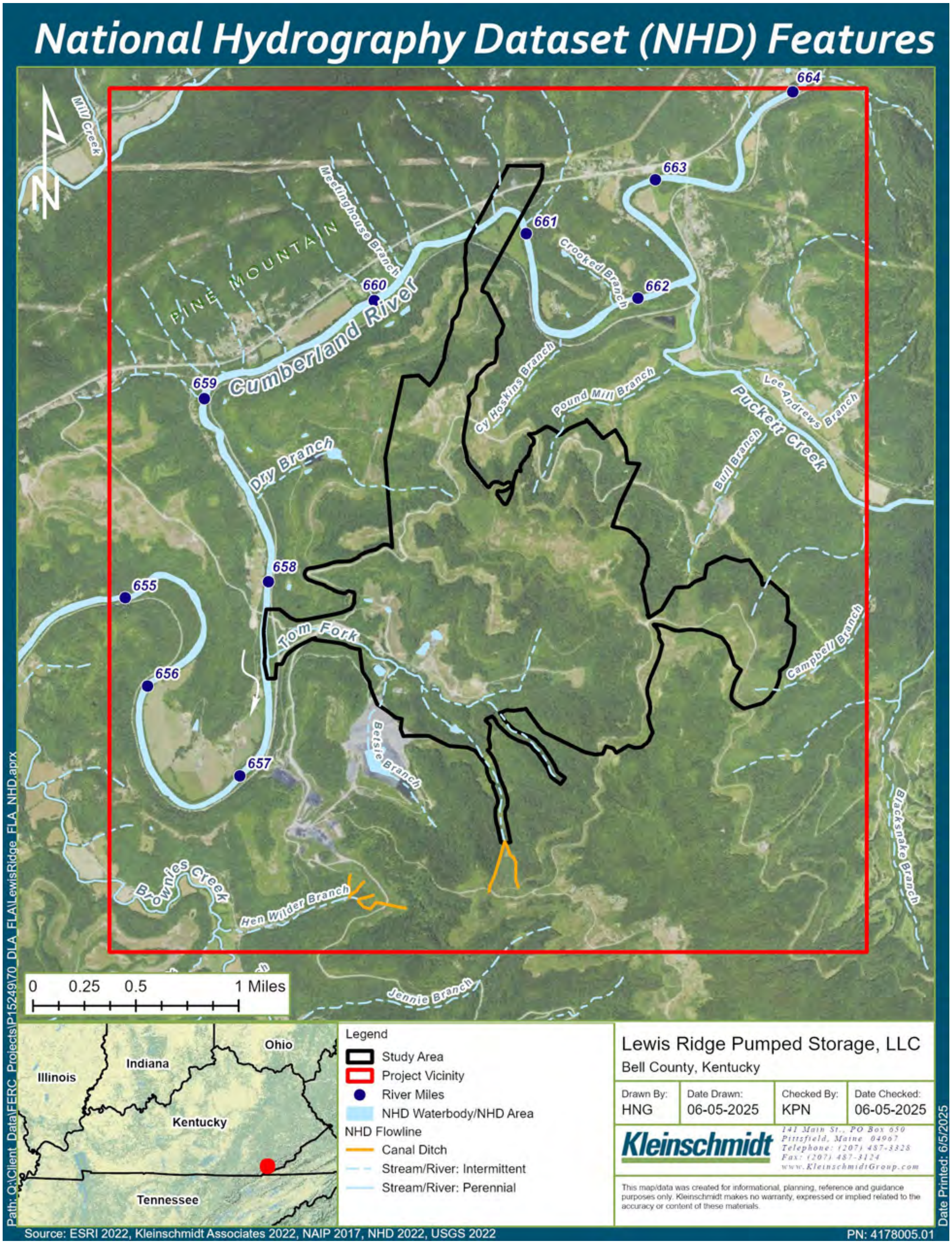
[13] Elevations are based on North American Vertical Datum of 1988 (NAVD 88).

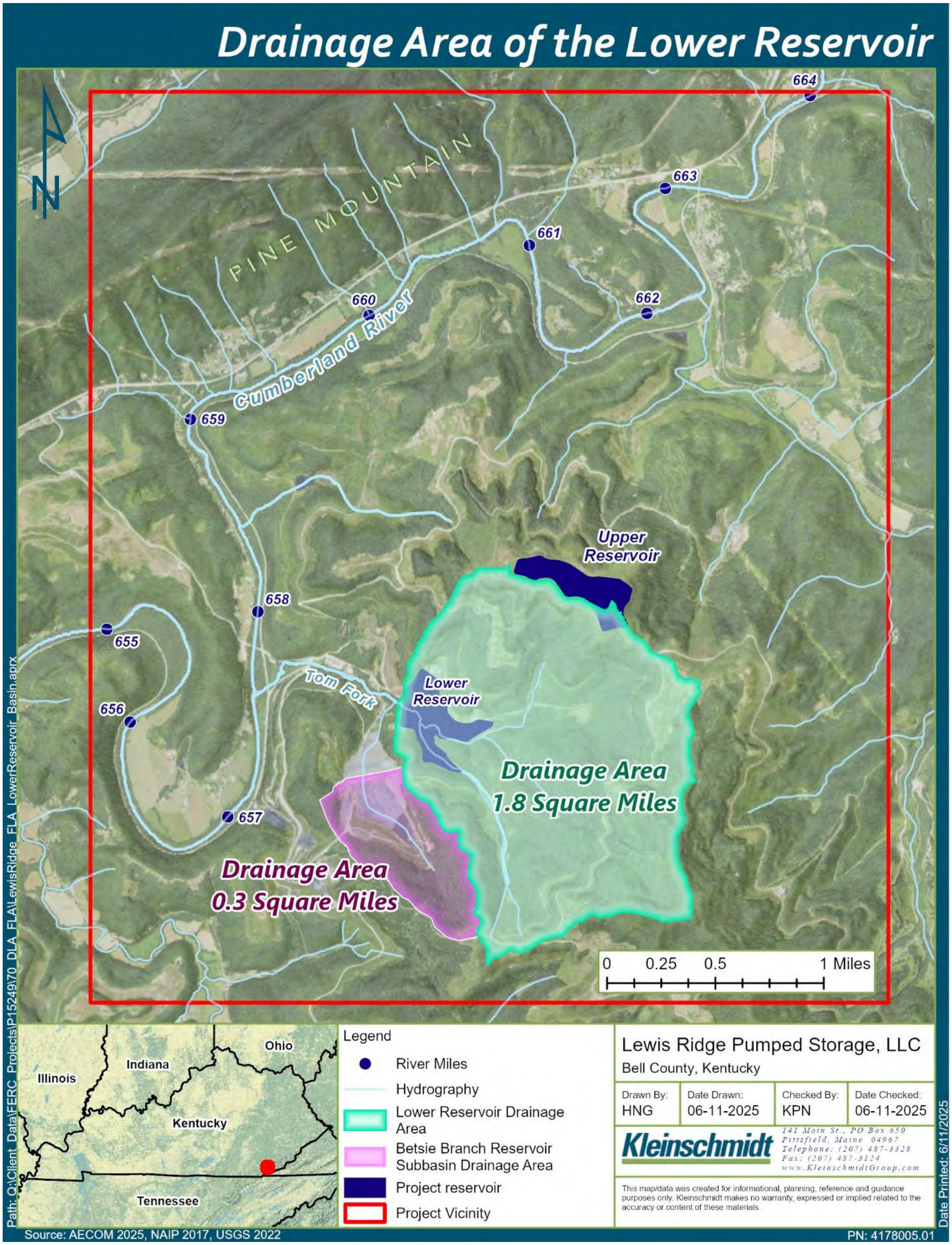
[14] The Betsie Branch Reservoir subbasin contributes to the lower reservoir drainage basin when water levels exceed the Betsie Branch Dam normal pool elevation during storm events exceeding the 100-year storm.

Figure 5-1: NHD Mapped Features in the Project Vicinity



Source: ESRI 2022, Kleinschmidt Associates 2022, NAIP 2017, NHD 2022, USGS 2022

Figure 5-2: Drainage Area of Lower Reservoir



Source: AECOM 2025, NAIP 2017, USGS 2022

5.2.1.1 Streamflow, Gage Data, and Flow Statistics

Table 5-2 provides information about two USGS gage sites on the Cumberland River. USGS Gage #03401000 (Harlan gage) is located approximately 20 miles upstream of the Project Vicinity, and USGS Gage #03402900 (Pineville gage) is located approximately 15 miles downstream of the Project Vicinity. River flow data from both gages were obtained and linearly interpolated, based on drainage areas, to represent Cumberland River flow at the confluence with Tom Fork. Drought and wet years were classified as the 25th and 75th percentiles, respectively, of the annual monthly river flow (AECOM 2025). The monthly average flows for all data and for drought and wet years appear in Table 5-3 and Figure 5-3. The annual and monthly flow-duration curves were created using historical data from each gage's years of record (Figure 5-4, Figure 5-5).

Monthly average flows were highest in the winter through early spring months of December through April and lowest in the summer and early fall between July and October (Table 5-3, Figure 5-3). For all years, the highest and lowest monthly average flows occurred in March (1,749 cubic feet per second [cfs]) and October (232 cfs), respectively, whereas during drought and wet years, the highest and lowest monthly average flows occurred in March and September, respectively.

There is no historical gaged streamflow data available for Tom Fork. The estimated mean annual flow for Tom Fork at the location of the lower reservoir dam is 2.8 cfs, obtained from the USGS StreamStats program (AECOM 2025). Monthly flows were estimated by scaling the mean annual flow rate by monthly precipitation data. Monthly flows were estimated to range from approximately 2.1 cfs in October to approximately 3.3 cfs in March (Figure 5-6). Figure 5-7 and Figure 5-8 show the annual and monthly flow duration curves for Tom Fork. A stream gauge was installed in March 2025 on Tom Fork, where Hen Wilder Branch Road crosses Tom Fork; data are not yet available. LRPS plans to collect flow data at a second site in Tom Fork starting in 2025 after a damaged culvert is repaired; these locations are downstream of the proposed lower reservoir.

Table 5-2: Cumberland River USGS Gage Sites Near the Project Vicinity

USGS Gage Number	Description	Drainage Area (Square Miles)	Period of Record Used in Analysis
03401000	Cumberland River near Harlan, Kentucky (approximately 20 miles upstream of Project Vicinity)	374	1981-2023
03402900	Cumberland River at Pine St Bridge at Pineville, Kentucky (approximately 15 miles downstream of Project Vicinity)	770	1991-2005

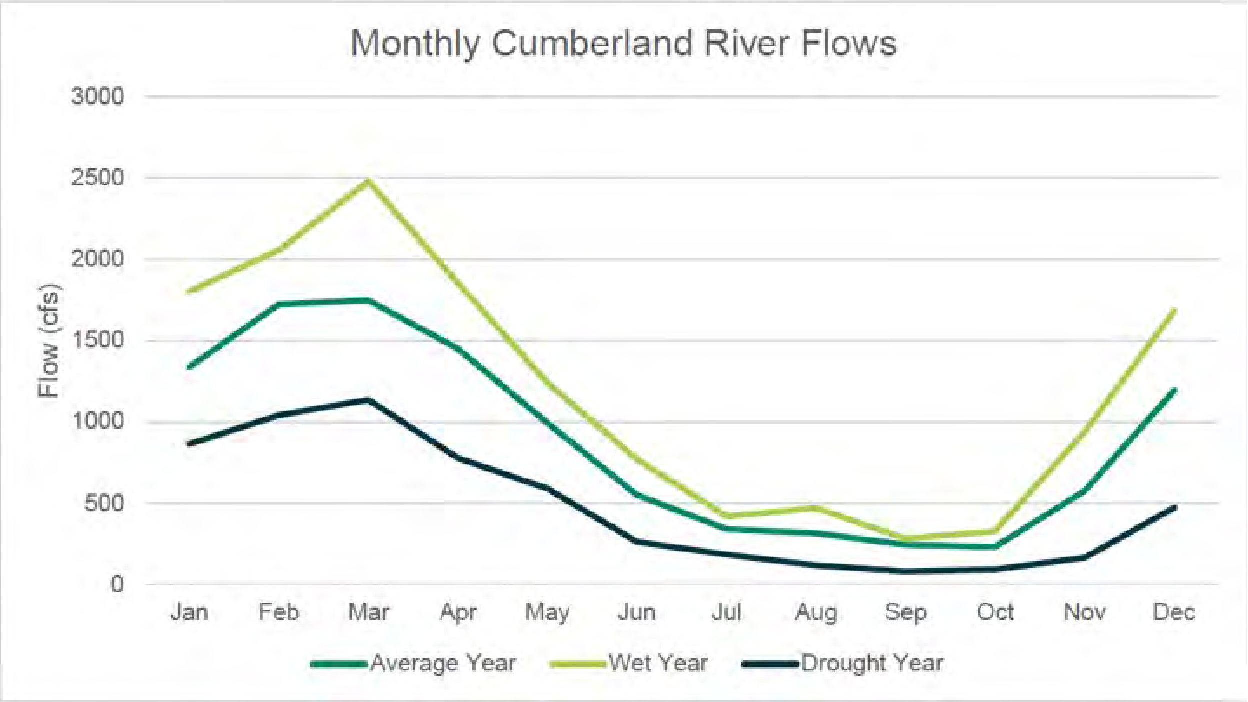
Source: USGS 2025a, 2025b, AECOM 2025

Table 5-3: Monthly Average Flows of the Cumberland River at the Confluence with Tom Fork

Month	Monthly Average Flow (cfs)		
	All Data	Drought Year	Wet Year
January	1,337	864	1,803
February	1,722	1,041	2,055
March	1,749	1,137	2,480
April	1,449	777	1,853
May	994	590	1,241
June	550	261	770
July	341	183	418
August	314	117	470
September	244	80	281
October	232	91	326
November	573	163	937
December	1,192	472	1,682

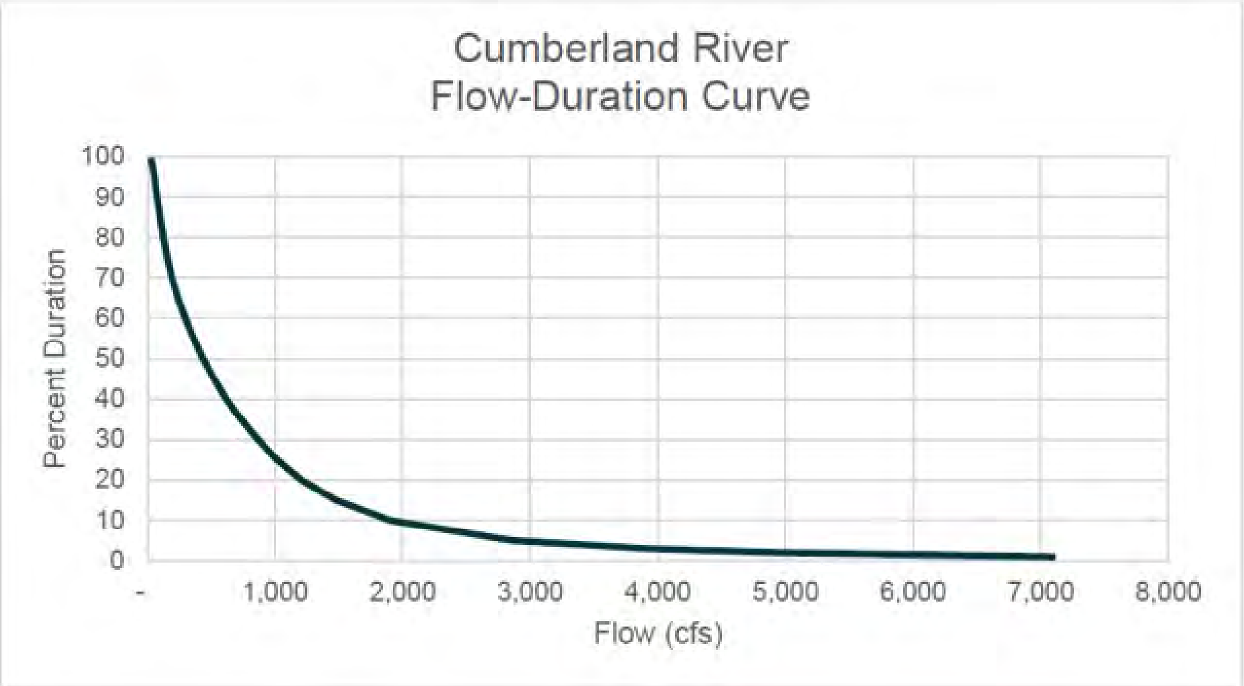
Source: AECOM 2025

Figure 5-3: Monthly Average Flow of the Cumberland River at the Confluence with Tom Fork



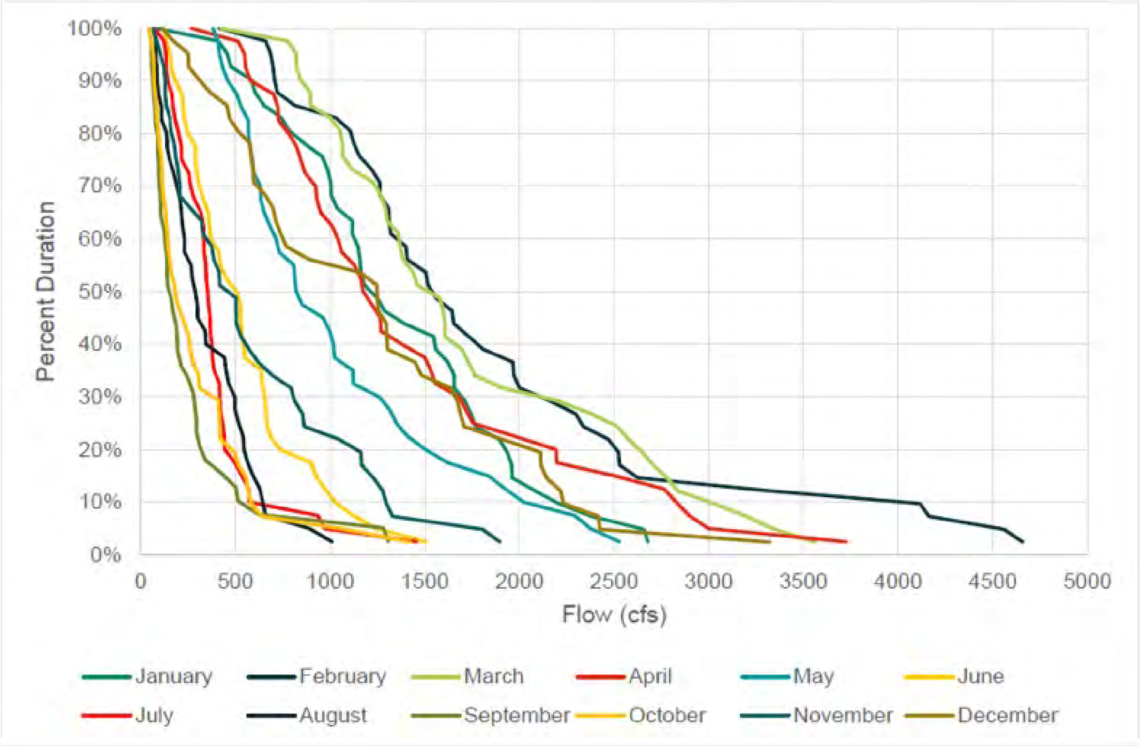
Source: AECOM 2025

Figure 5-4: Annual Flow Duration Curve for the Cumberland River at the Confluence with Tom Fork



Source: AECOM 2025

Figure 5-5: Monthly Flow-Duration Curves – Cumberland River at Confluence with Tom Fork

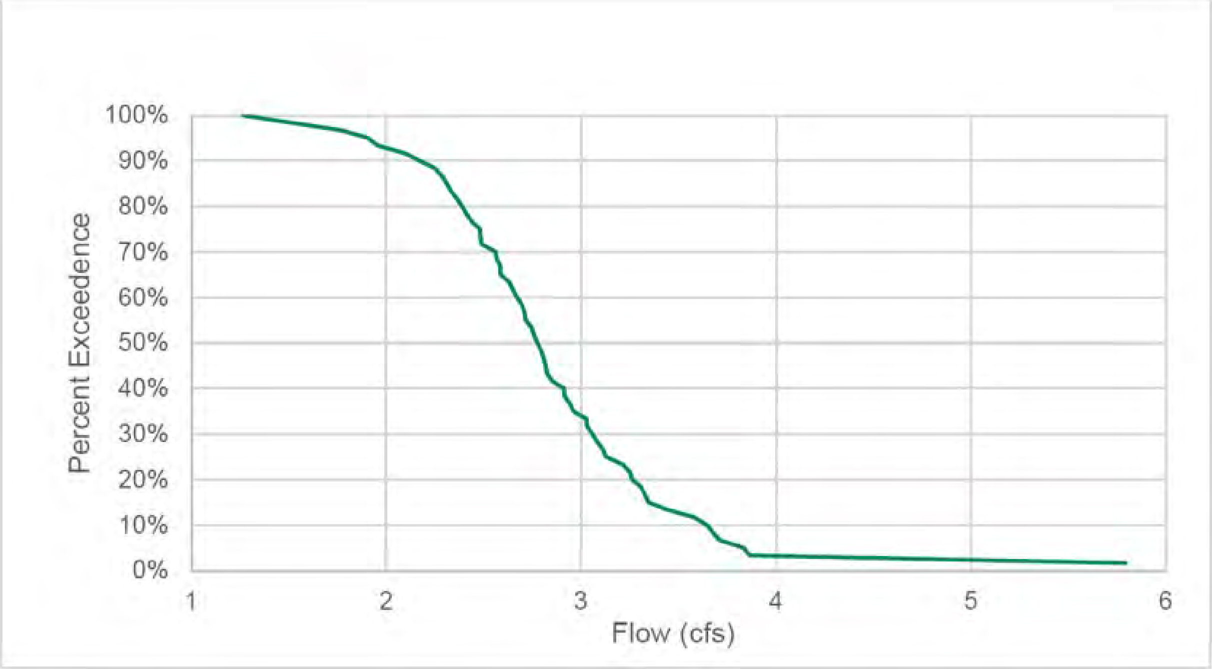


Source: AECOM 2025

Figure 5-6: Estimated Monthly Median Flow of Tom Fork

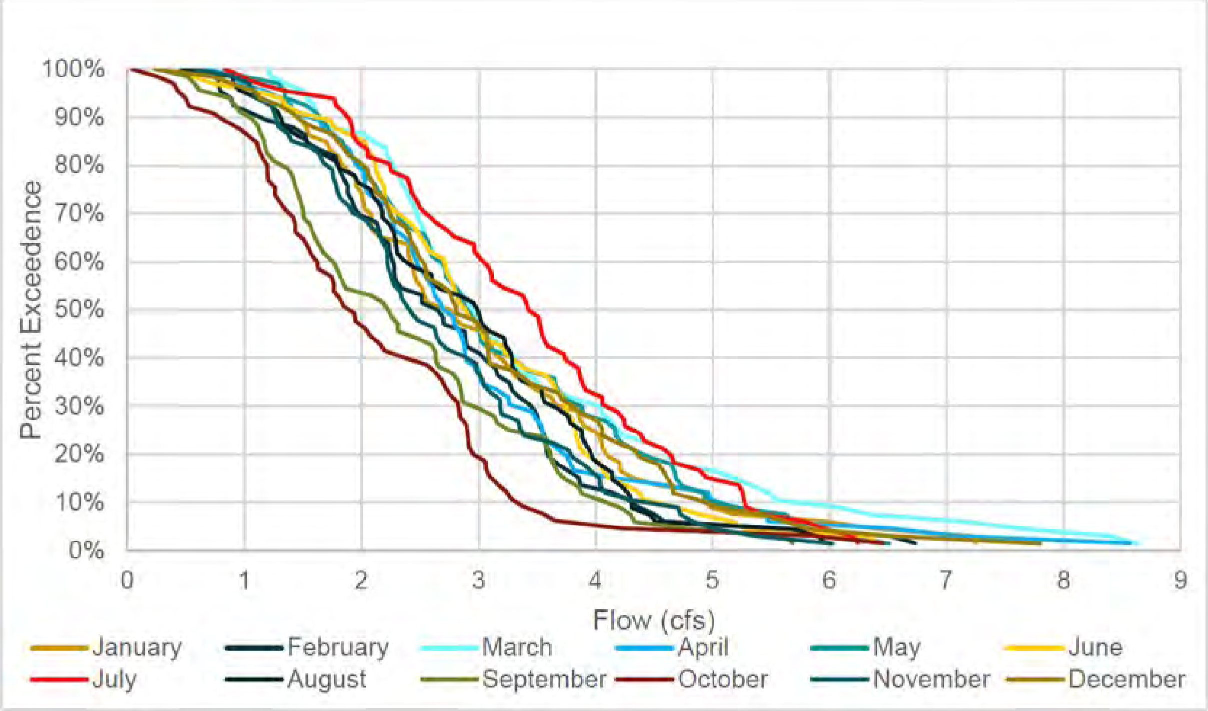
Source: AECOM 2025

Figure 5-7: Annual Flow Duration Curve for Tom Fork



Source: AECOM 2025

Figure 5-8: Monthly Flow Duration Curves for Tom Fork



Source: AECOM 2025

5.2.1.2 Existing and Proposed Uses of Waters

The proposed Lewis Ridge Project includes the construction of an upper and lower reservoir to store water to generate renewable energy. There are no natural inflows to the proposed upper reservoir other than rainfall directly on the footprint of the dam structure and reservoir. Initial fill water will primarily be sourced from the Cumberland River and supplemented by storm runoff from Tom Fork. During operation, the Lewis Ridge Project will experience water losses due to both evaporation and seepage. Annual refill, when needed, may be sourced by retaining a percentage of runoff from storm events in the Tom Fork basin when flow exceeds the annual mean of 2.8 cfs and supplemented by pumping from the Cumberland River.

5.2.1.3 Existing Instream Flow Uses

There is one active water withdrawal from the Cumberland River within the Project Vicinity that is permitted to Nally & Hamilton Enterprises, Inc. The withdrawal location is approximately 0.5 river miles downstream of the confluence of Tom Fork with the Cumberland River (permit number 1615) (Kentucky DEP 2025a). The permit allows a withdrawal of 0.075 million gallons per day (MGD) to 0.125 MGD depending on month. The Project Vicinity is located within the Knox County Utility Commission Source Water Protection Area Zone 3 (Kentucky DEP 2025b). The zones are defined based on the time of travel for a contaminant to the water supplier intake. Zone 3 has a 2.5-to-12.5-hour time of travel.

5.2.1.4 Federally Approved Water Quality Standards

The designated uses applicable to the Cumberland River and associated tributaries in the Project Vicinity, including Tom Fork, are warm water aquatic habitat, primary contact recreation, secondary contact recreation, domestic water supply, and fish consumption (KAR 2022). Applicable water quality standards for the Cumberland River and associated tributaries are summarized in Table 5-4.

Table 5-4: Water Quality Standards Applicable to the Project Vicinity

Parameter	Standard
pH	6.0-9.0; shall not fluctuate by more than 1.0 pH unit over a 24-hour period
Temperature	<31.7 degrees Celsius (°C) (<89.0° Fahrenheit)
Dissolved Oxygen (DO) milligrams per liter (mg/L)	Minimum 5.0 mg/L daily average; Instantaneous minimum 4.0 mg/L
Alkalinity	As $CaCO_3$, shall not be reduced by more than 25 percent.
Total Dissolved Solids (TDS), Total Suspended Solids, or Specific Conductance	Shall not be changed to the extent that the indigenous aquatic community is adversely affected. Human Health (domestic water supply): TDS 250,000 µg/L (250 mg/L)
Settleable Solids	The addition of settleable solids that may alter the stream bottom so as to adversely affect productive aquatic communities shall be prohibited.
Ammonia Un-ionized (mg/L)	<0.05 mg/L
Color	75 platinum cobalt units
Escherichia coli or Fecal Coliform	Primary Contact Recreation: From May 1 to October 31, *E. coli* content shall not exceed 130 colonies per 100 milliliters (ml) as a geometric mean based on not less than five samples taken during a thirty-day period. The *E. coli* content also shall not exceed 240 colonies per 100 ml in twenty percent or more of all samples taken during a thirty-day period. Primary Contact Recreation from November 1 to April 30 and Secondary Contact Recreation: Fecal coliform criteria applies and shall not exceed 1,000 colonies per 100 ml as a thirty-day geometric mean based on not less than five samples nor exceed 2,000 colonies per 100 ml in twenty percent or more of all samples taken during a thirty-day period.
Flow	Shall not be altered to a degree that will adversely affect the aquatic community.
Nutrients	Shall not be elevated in a surface water to a level that results in a eutrophication problem
Iron[a]	Human Health (domestic water supply): 300 µg/L (0.3 mg/L); Warm Water Aquatic Habitat: Acute – 4,000 µg/L (4 mg/L), Chronic – 1,000 µg/L (1 mg/L)

Parameter	Standard
Sulfate	Human Health (domestic water supply): 250,000 (μg/L) (250 mg/L)
Copper[b,c,d]	Human Health (domestic water supply): 1,300 (μg/L) (1.3 mg/L); Warm Water Aquatic Habitat: Acute – 14 μg/L; Chronic – 9.3 μg/L
Lead[b,c,d]	Human Health (domestic water supply): 15 (μg/L) (0.015 mg/L); Warm Water Aquatic Habitat: Acute – 65 μg/L, Chronic – 2.5 μg/L
Manganese (secondary standard)[e]	50 μg/L (0.05 mg/L)

Source: 40 CFR Part 141; KAR 2022; USEPA 2024a, 2024b

[a] The chronic criterion for iron shall not exceed three and five tenths (3.5) mg/L (thirty-five hundred μg/L) if aquatic life has not been shown.

[b] Acute criteria = protective of aquatic life based on one (1) hour exposure that does not exceed the criterion for a given pollutant.

[c] Chronic = protective of aquatic life based on ninety-six (96) hour exposure that does not exceed the criterion of a given pollutant more than once every three (3) years on average.

[d] The acute and chronic criteria are based on a hardness (as carbonate) level of 100 mg/L which is consistent with values recorded at sites 20K_WQX-PRI086 and 21KY_WQX-CRW022 in the Cumberland River.

[e] Secondary drinking water standards are guidelines for aesthetic purposes and are not enforceable.

5.2.1.5 Water Quality Data

In accordance with Section 303(d) of the CWA, states are required to develop a list of impaired waters that do not meet water quality standards. Two reaches of the Cumberland River near the Project Vicinity are on the 303(d) list of impaired water bodies. The northeastern portion of the Project Vicinity includes approximately 1.5 river miles of a 7.5-river mile reach of the Cumberland River that is listed as partially supporting warm water aquatic habitat use because of elevated dissolved substances from small flow discharges or surface mining (Kentucky DEP 2025c, 2025d). There is also an approximately 7-river mile reach listed as not supporting the warm water aquatic habitat designated use because of elevated levels of copper and lead from mining located just downstream of the southwestern portion of the Project Vicinity. This reach is also listed as partially supporting the primary contact recreation use because of high levels of *E. coli.* This means the reach does not meet *E. coli* water quality standards and that a total maximum daily load (TMDL) is required; this reach has been identified as a high priority for TMDL development (Kentucky DEP 2025d).

Kentucky DEP Water Quality Data

The Kentucky DEP Division of Water monitors surface water quality throughout the state (Kentucky EEC 2022b). Water quality data for the Cumberland River near the Lewis Ridge Project are available approximately 20 river miles upstream of the Project Vicinity in the town of Harlan (21KY_WQX-CRW022) and approximately 8 miles downstream at the State Highway 1344 Bridge in Calvin (21KY_WQX-PRI086). The site in Harlan, Kentucky, has been monitored approximately once each month every 5 years since 2010. The site in Calvin, Kentucky, has been monitored approximately every one to two months since 2008. The ranges of water quality data collected for select parameters are summarized in Table 5-5. Time series of select parameters for Site 21KY_WQX-CRW022 are provided in Figure 5-9 to Figure 5-18 and for Site 21KY_WQX-PRI086 in Figure 5-19 to Figure 5-23.

At both monitoring sites, pH, dissolved oxygen (DO) concentration, and water temperature standards were attained throughout the monitored periods of record (Table 5-5). Overall, the range of values for each parameter were consistent year to year and between the two sites. Total alkalinity and conductivity were higher in spring through early fall and lowest in the winter. DO was lower in late spring through early fall when water temperatures were warmest. DO was highest in the winter months.

The alkalinity levels were consistent with typical freshwater sources (i.e., rivers, streams) (20 to 200 mg/L) (e.g., Datastream 2025). There were a few individual high data points for iron, copper, and lead that exceeded the warm water aquatic habitat standards, but on average, their levels were below the standard. All iron, copper, and lead values were below the domestic water supply standard.

Table 5-5: Water Quality Data for Select Parameters at Two Locations in the Cumberland River

Parameter	Cumberland River at Harlan (21KY_WQX-CRW022) (2010-2011, 2015-2016, 2020-2021)	Cumberland River at 1344 Bridge (21KY_WQX-PRI086) (2008-2022)
DO (mg/L)	4.9-16.2	4.8-16.3
DO (% saturation)	73.0-124.6 (2015-2016, 2020-2021 only)	63.0-121.8 (2013-2022 only)
Total Alkalinity (mg/L)	35.4-158.0	39.1-294.0
Conductivity (microsiemens per centimeter [µS/cm])	176-615	50-864
pH	6.8-8.3	6.2-8.8
Temperature (degrees °C)	0.6-25.2	2.4-27.9 °C
Total suspended solids (mg/L)	1.5-1,110	2-890 mg/L
Turbidity (Nephelometric Turbidity Units [NTU])	1.9-70.9 (2015-2016, 2020-2021 only)	1.7-572
E. coli (MPN/mL)	69.7-1,553 MPN	1-1,986 MPN (2011-2021)
Acidity (mg/L)	2.7-5.0 (2015-2016, 2020-2021 only)	2.5-7.6 (2014-2022)
Copper (µg/L)	0.6-5.4	0.5-23.2
Lead (µg/L)	0.2-3.1	0.2-14.8
Iron (mg/L)	0.2-2.3	0.1-14.7
Manganese (µg/L)	29.6-855	9.4-1140

Source: NWQMC 2025

MPN: Most Probably Number

Figure 5-9: Total Alkalinity (mg/L) at Site 21KY_WQX-CRW022

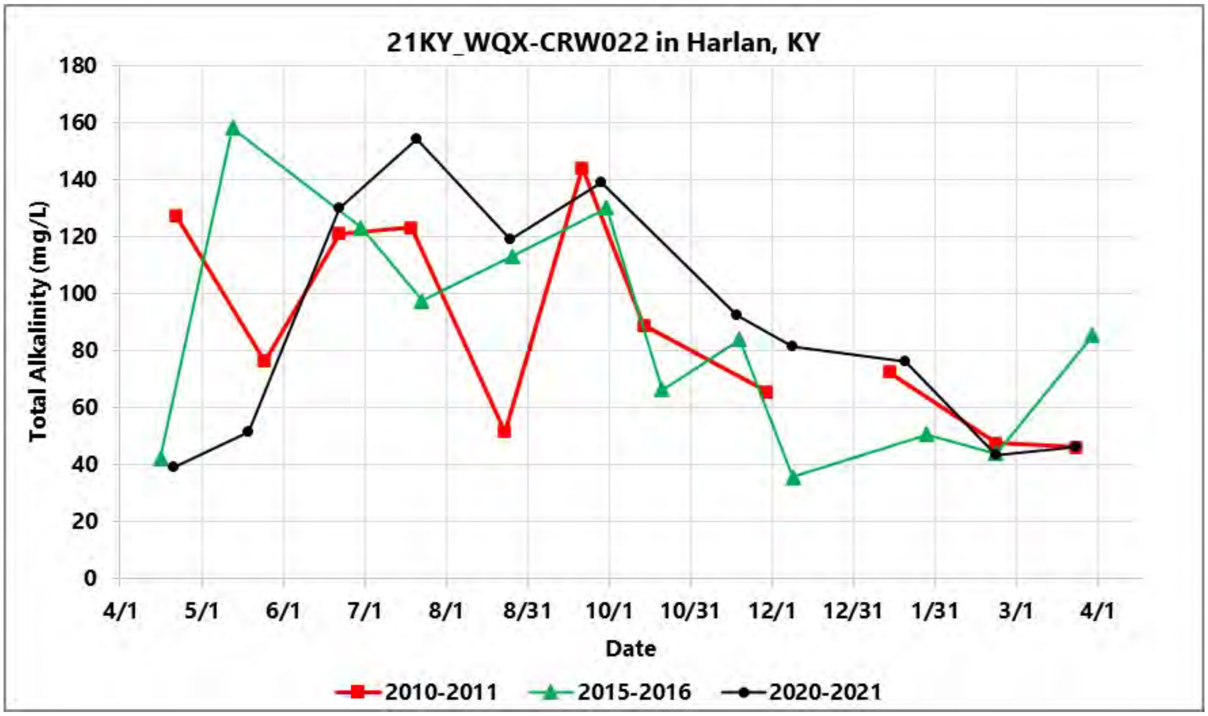


Figure 5-10: Conductivity (µS/cm) at Site 21KY_WQX-CRW022

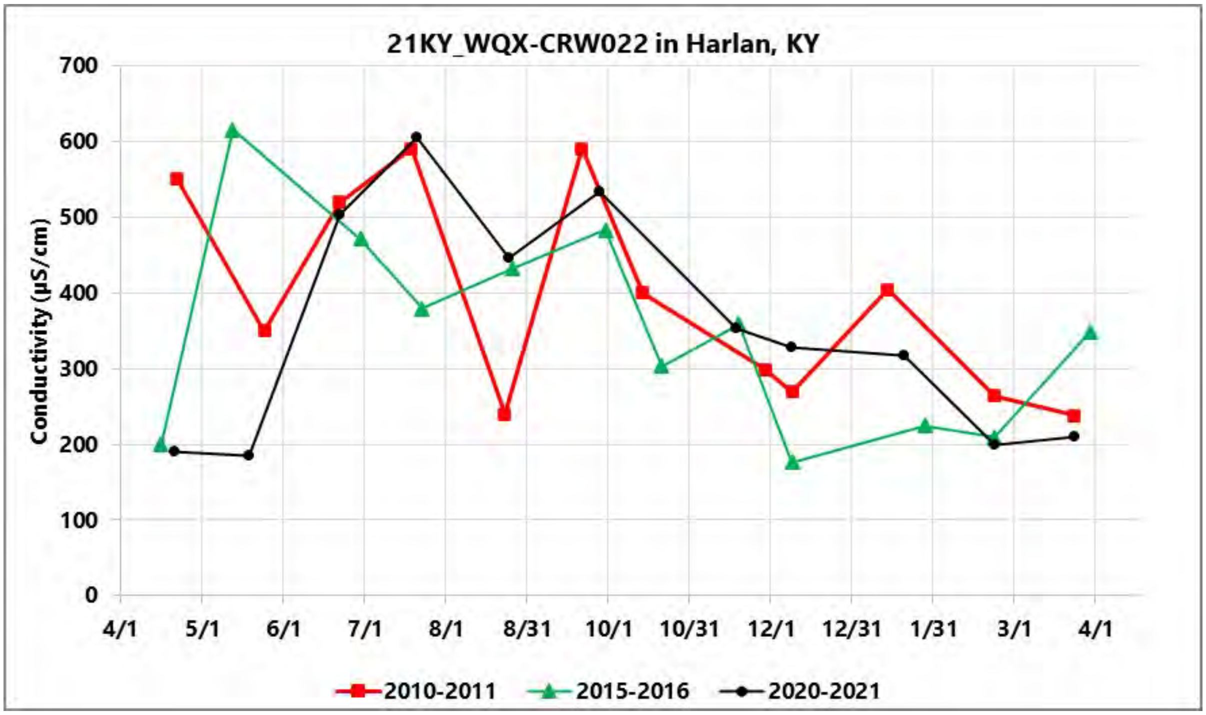


Figure 5-11: DO Concentration (mg/L) at Site 21KY_WQX-CRW022

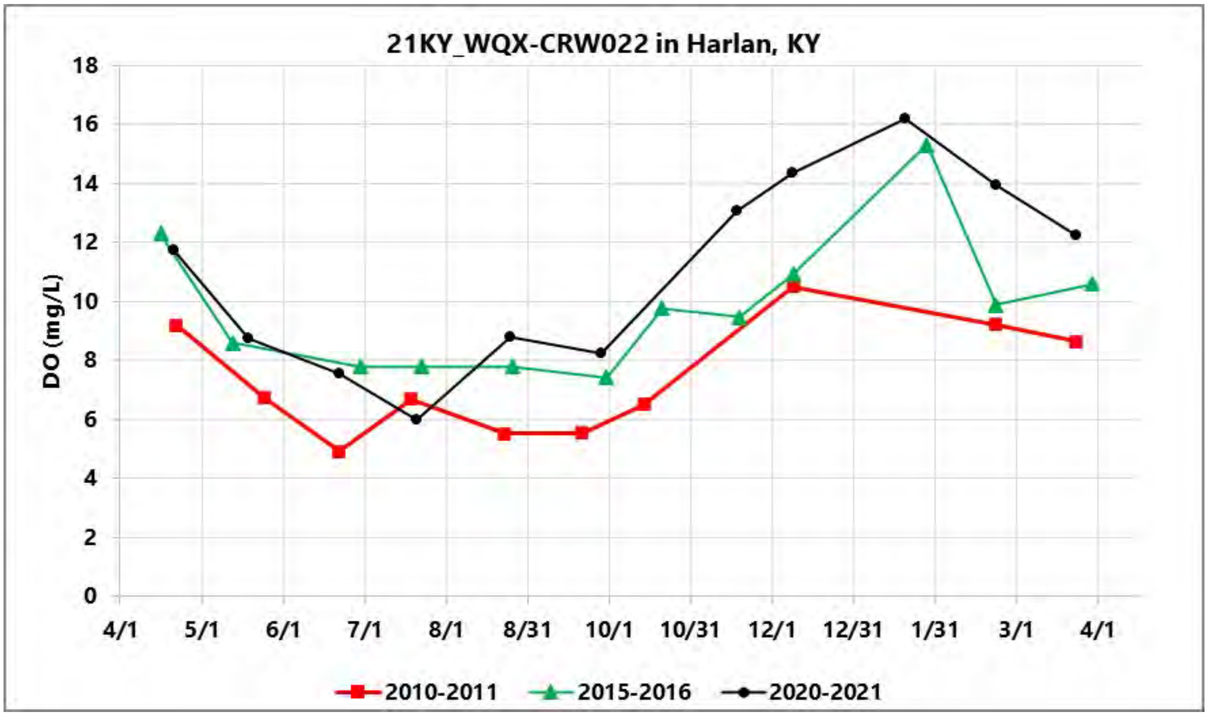


Figure 5-12: DO Percent Saturation at Site 21KY_WQX-CRW022

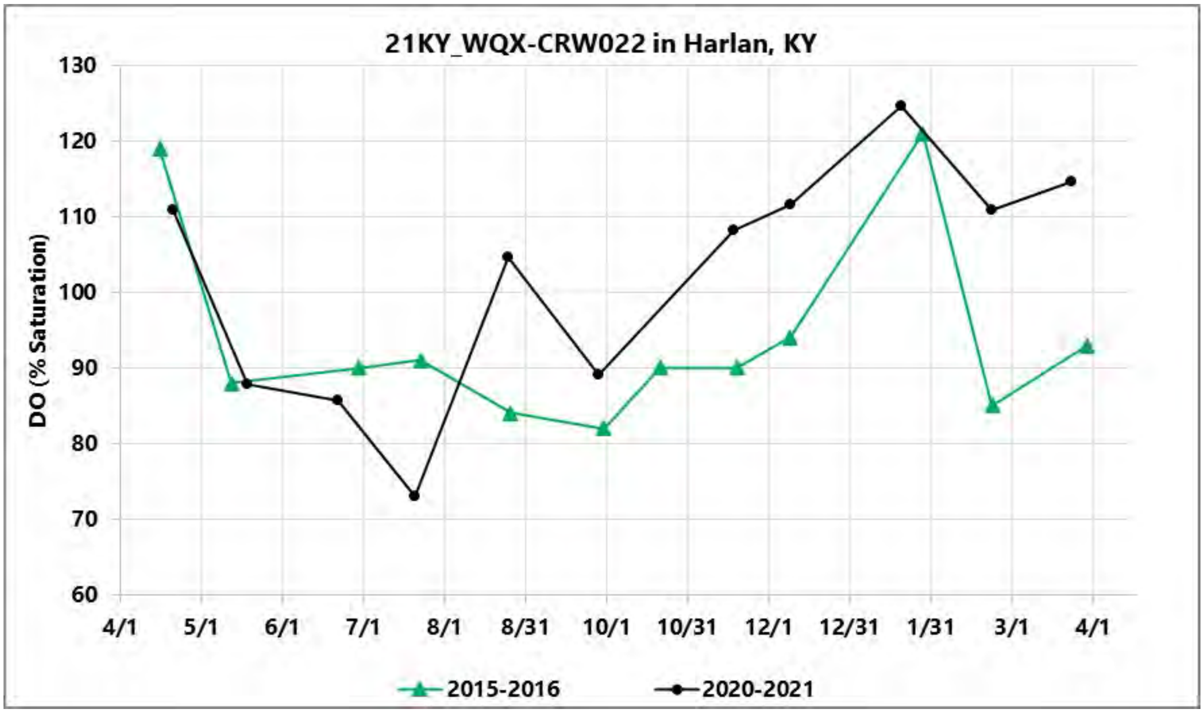


Figure 5-13: pH at Site 21KY_WQX-CRW022

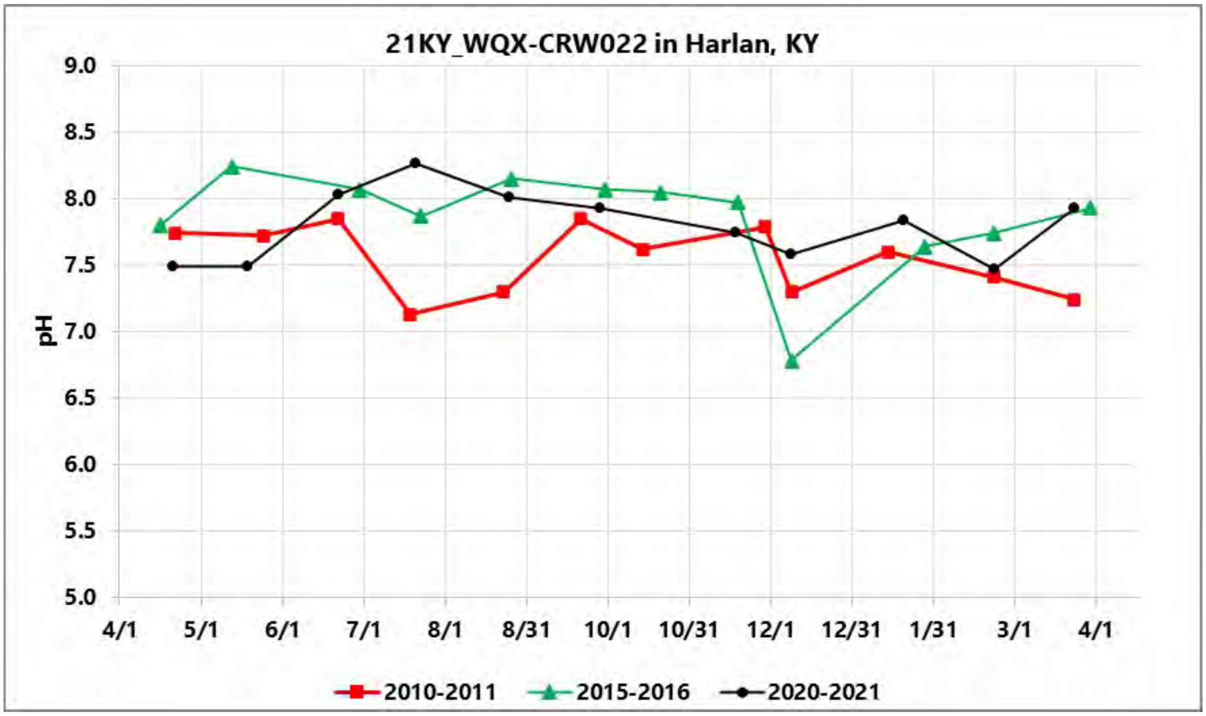


Figure 5-14: Water Temperature (°C) at Site 21KY_WQX-CRW022

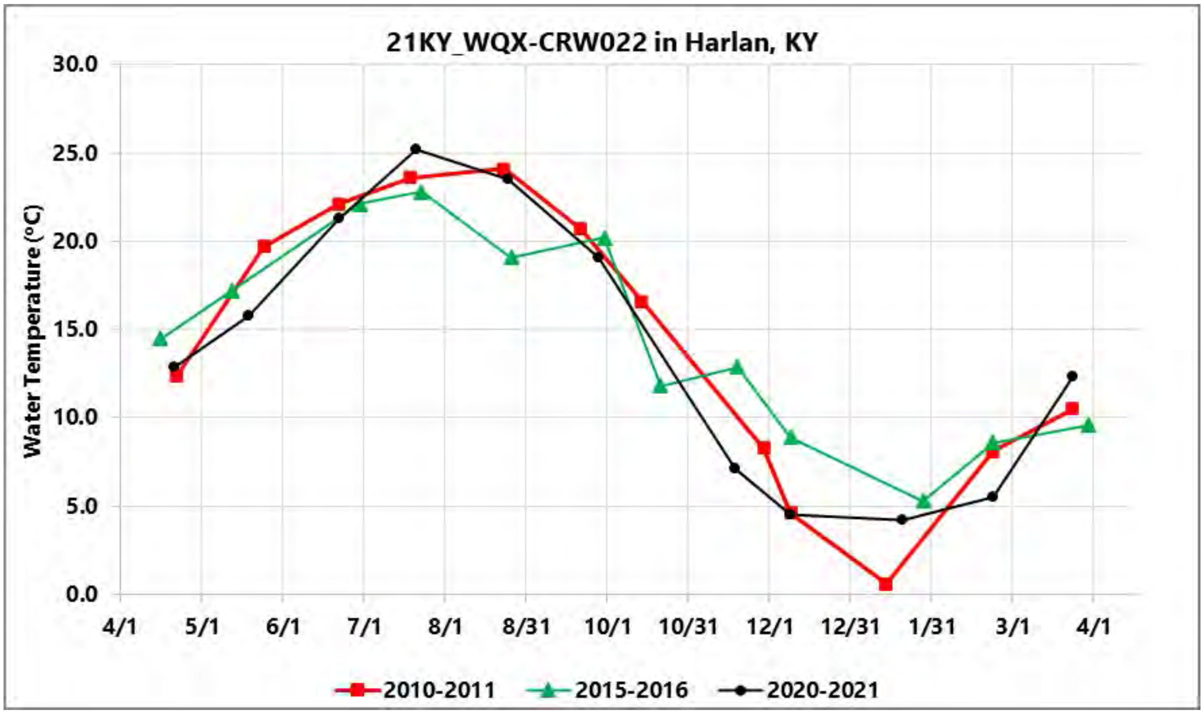


Figure 5-15: Copper (µg/L) at Site 21KY_WQX-CRW022

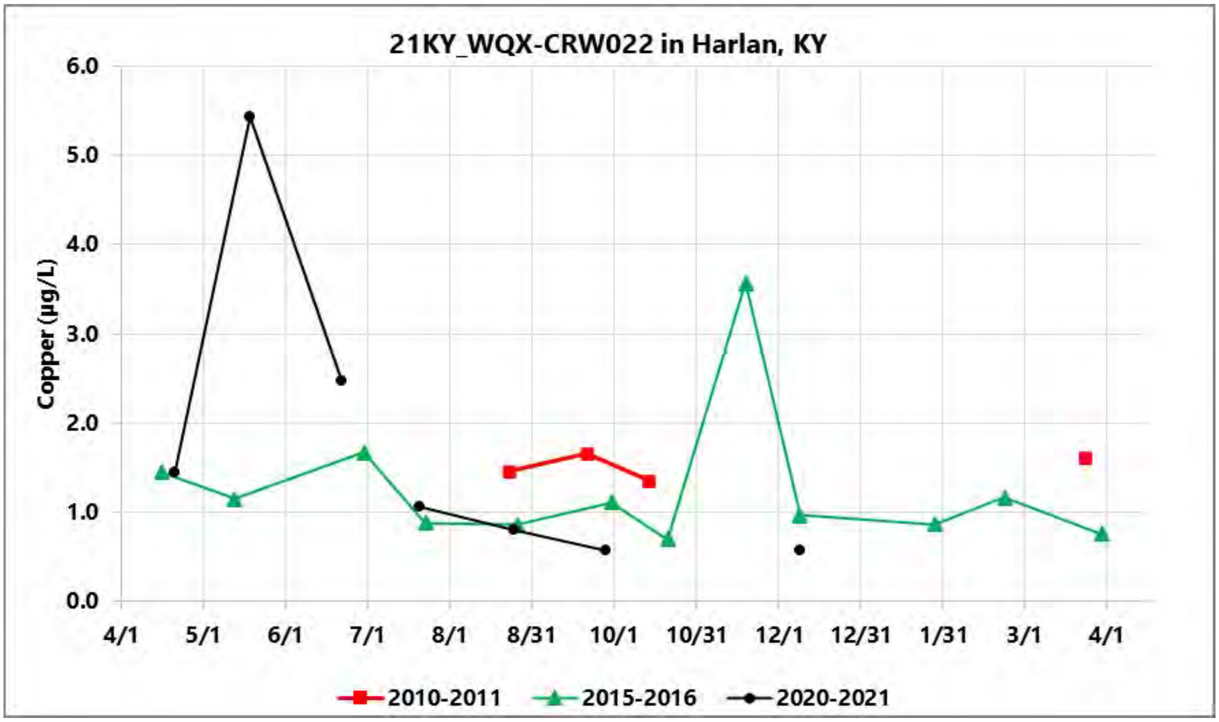


Figure 5-16: Lead (µg/L) at Site 21KY_WQX-CRW022

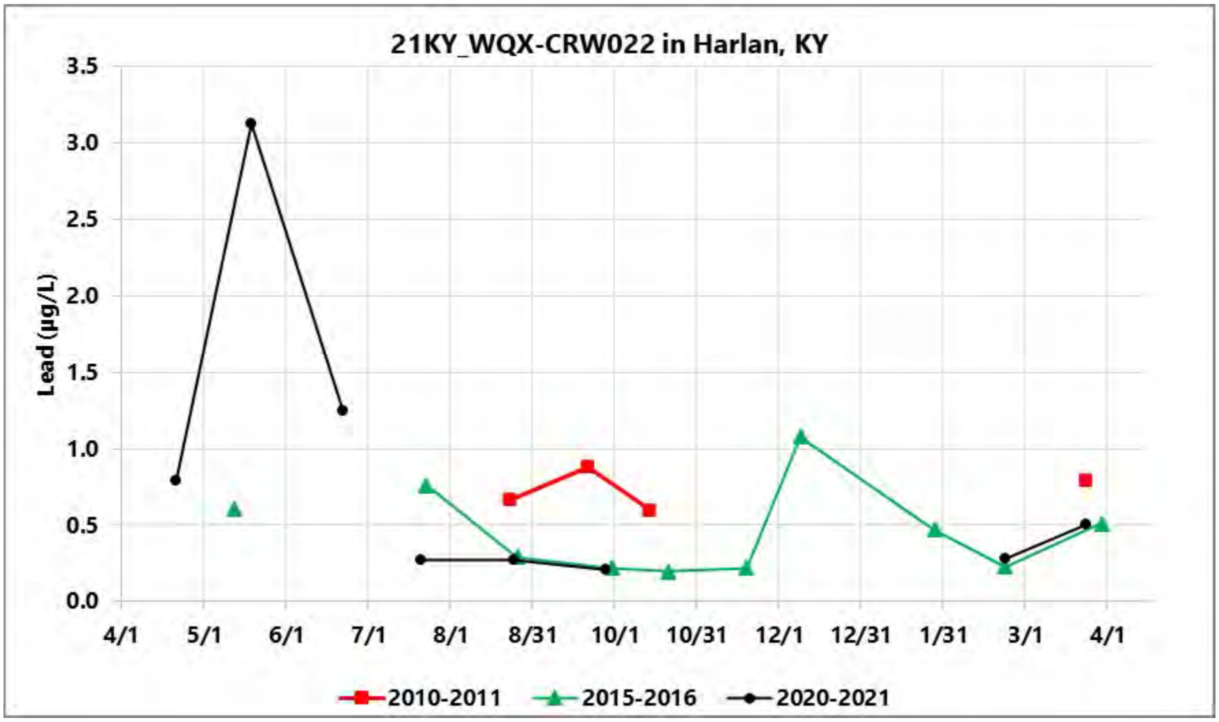


Figure 5-17: Iron (mg/L) at Site 21KY_WQX-CRW022

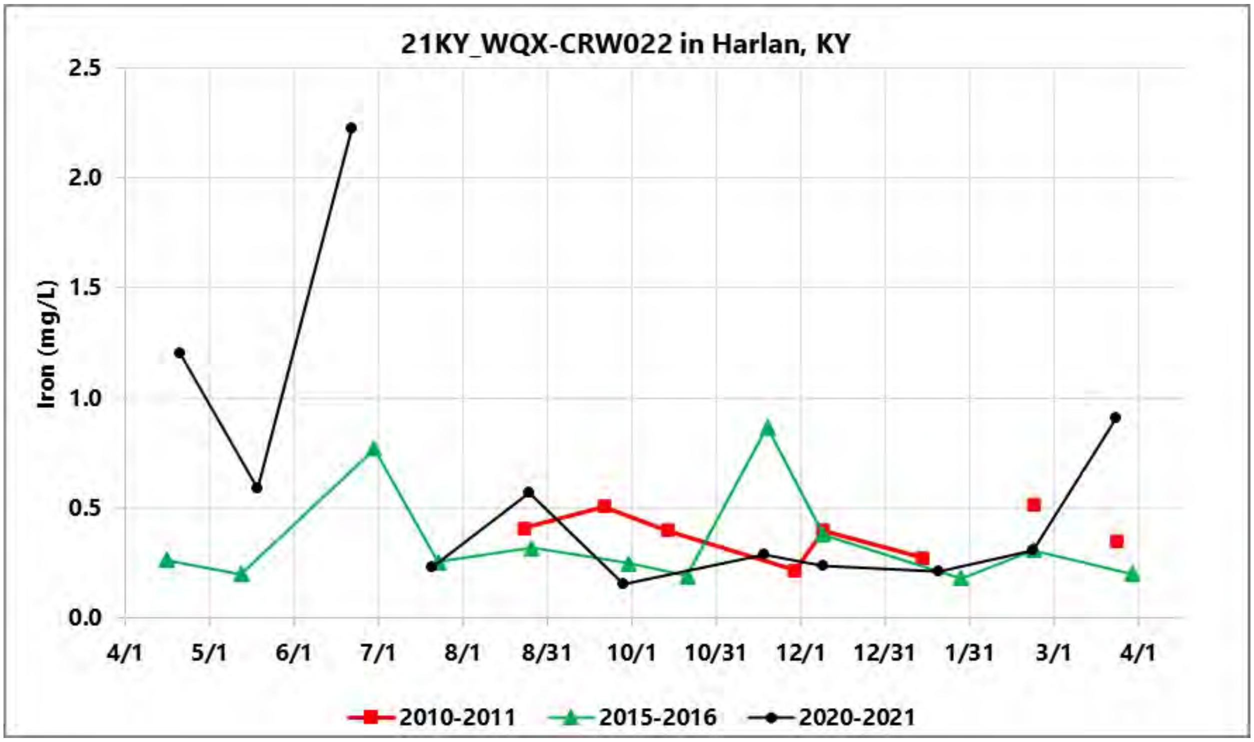


Figure 5-18: Manganese (μg/L) at Site 21KY_WQX-CRW022

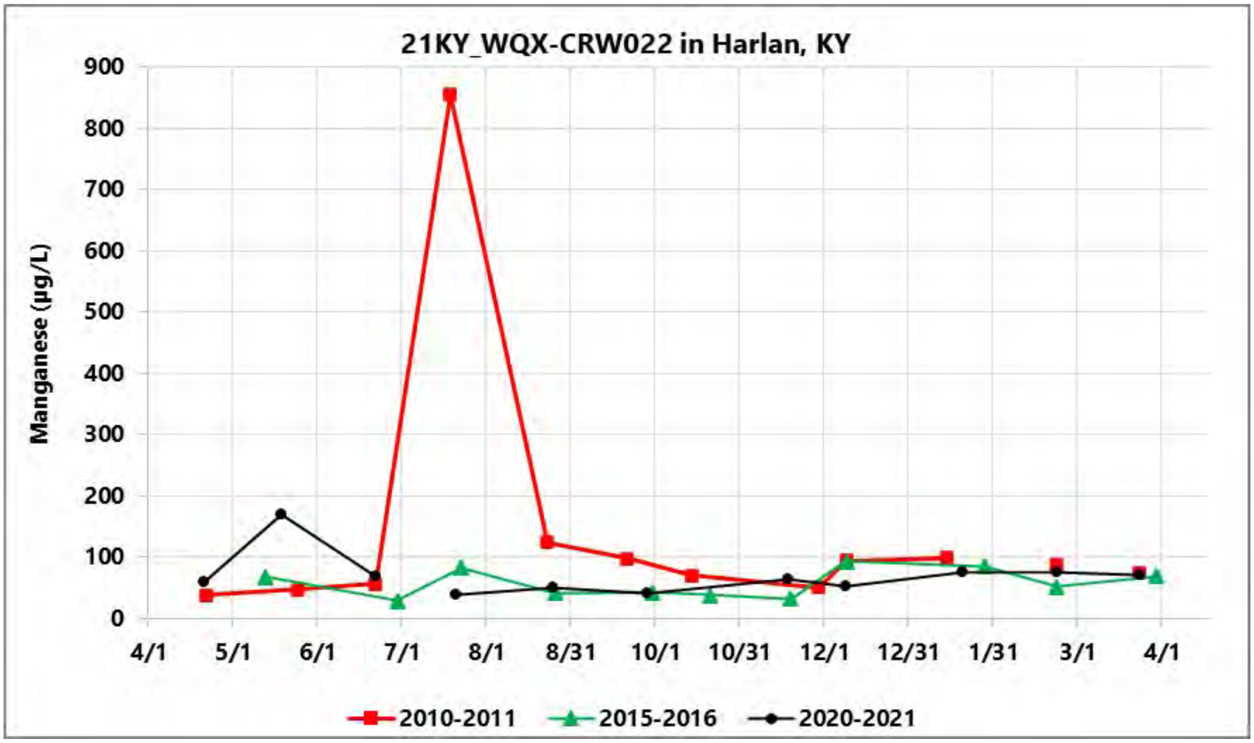


Figure 5-19: Total Alkalinity (mg/L) and Conductivity (µS/cm) at Site 21KY_WQX-PRI086

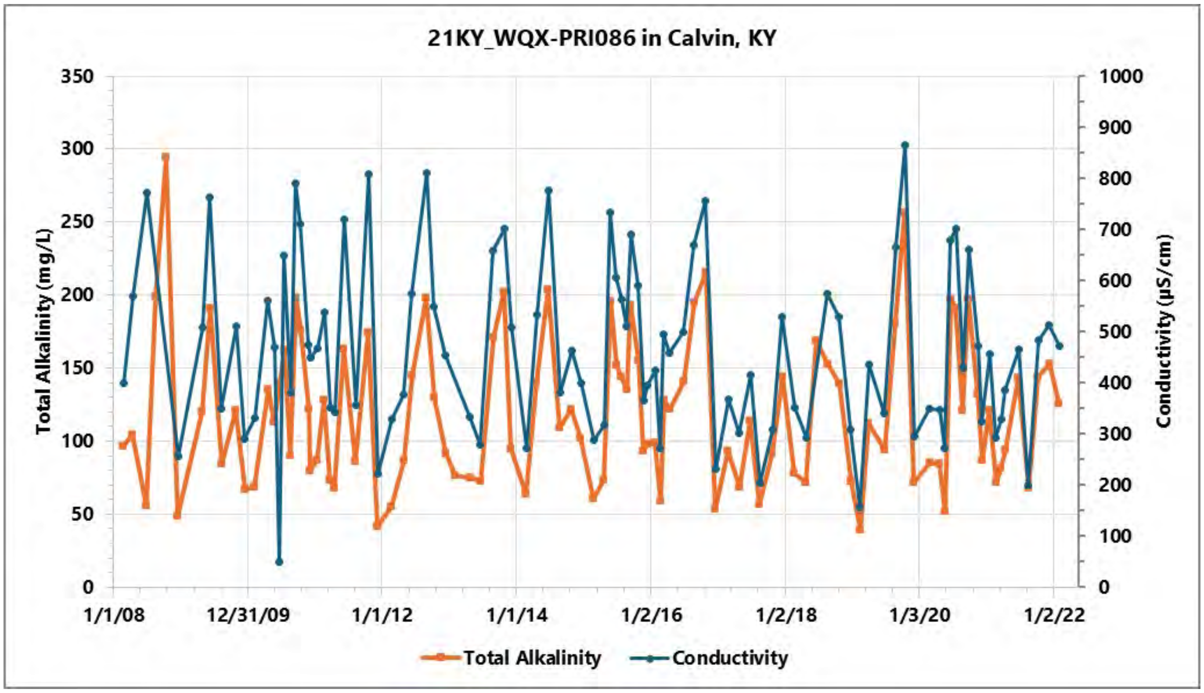


Figure 5-20: DO Concentration (mg/L) and Percent Saturation at Site 21KY_WQX-PRI086

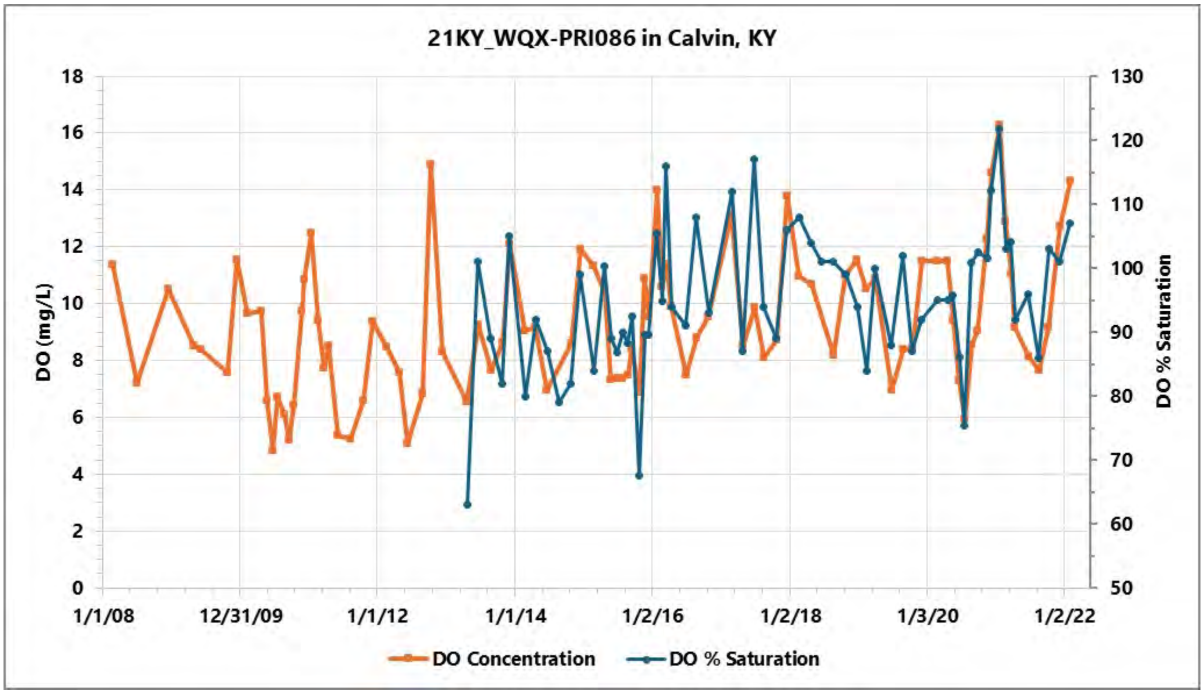


Figure 5-21: pH and Water Temperature (°C) at Site 21KY_WQX-PRI086

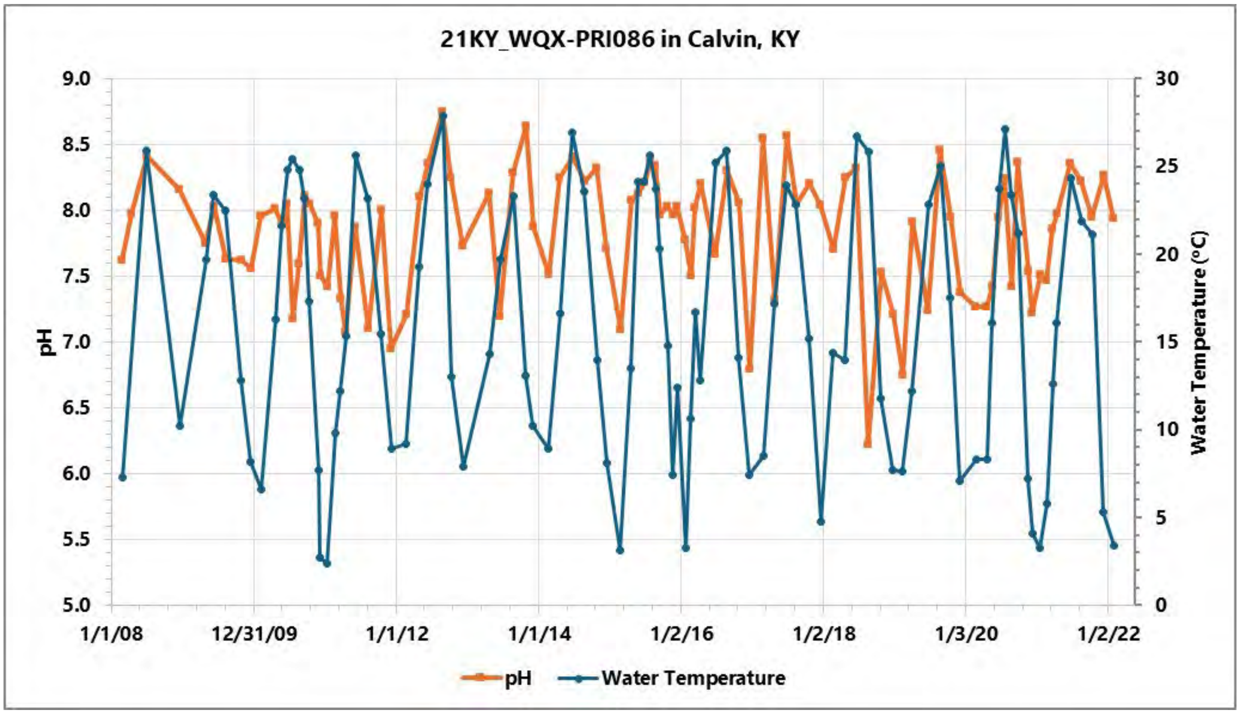


Figure 5-22: Copper and lead (µg/L) at Site 21KY_WQX-PRI086

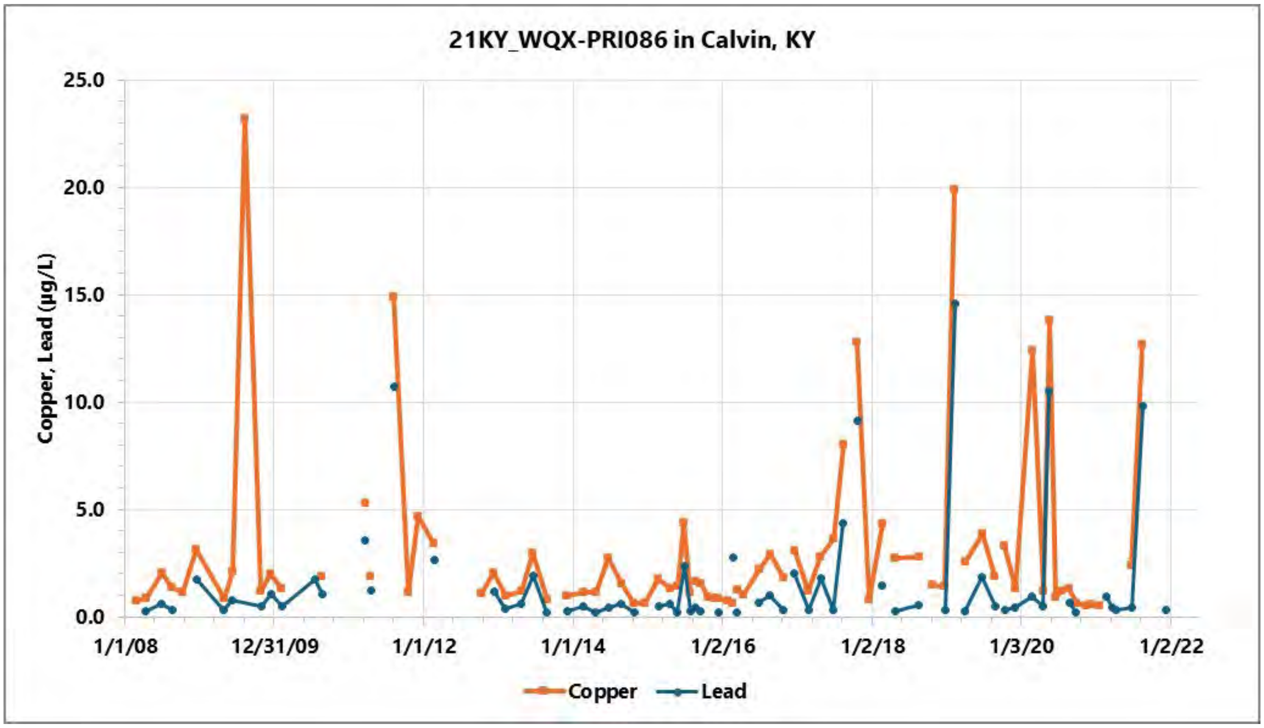
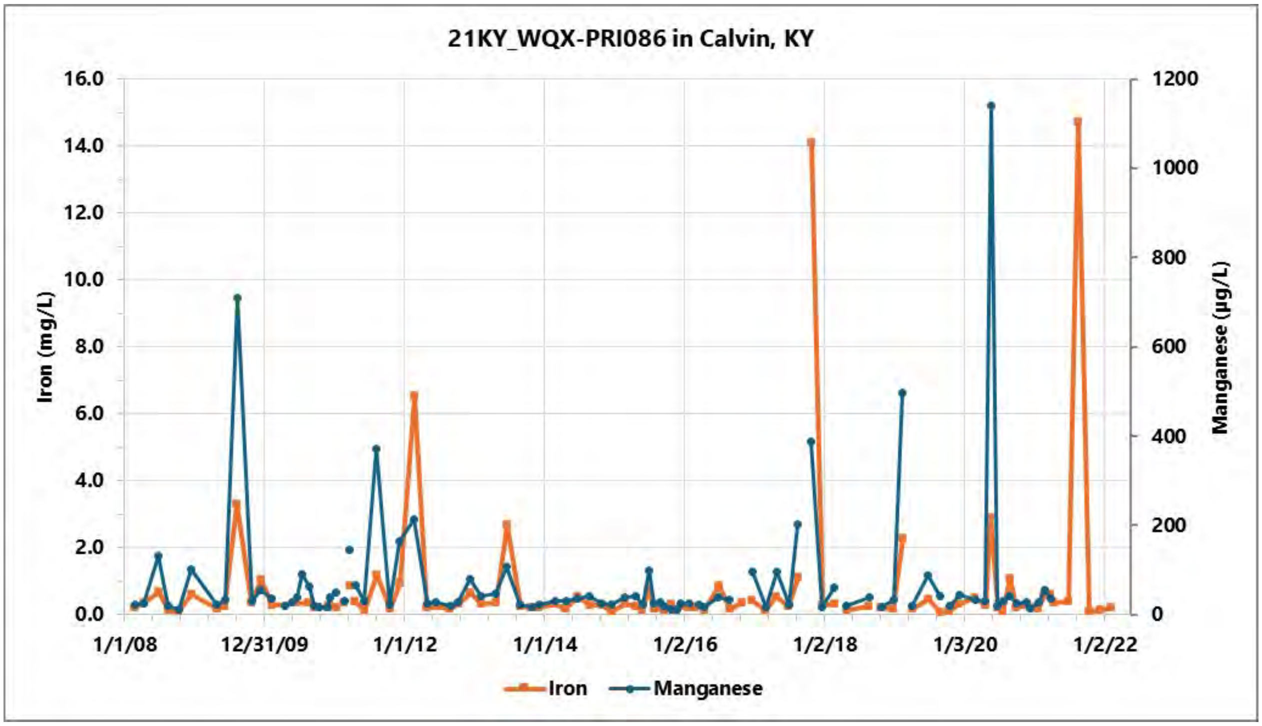


Figure 5-23: Iron (mg/L) and Manganese (µg/L) at Site 21KY_WQX-PRI086



Blackside Dace Habitat Assessment Water Quality Data

As part of the 2024 Blackside Dace Habitat Assessment, LRPS measured water quality at 10 stations along Tom Fork on July 25, 2024 (Table 5-6, Figure 5-24). The DO concentration, DO percent saturation, water temperature, pH, and specific conductance were measured at each site; Table 5-6 provides the results (Third Rock Consultants 2024). Water temperature generally decreased from downstream to upstream in Tom Fork. Water temperature, DO concentration, and pH met the water quality standards for warm water aquatic habitat at all 10 stations. The specific conductance at all stations exceeded the value (343 µS/cm) considered suitable for blackside dace (Hitt et al. 2016).

Table 5-6: Water Quality Data Collected in Tom Fork, July 25, 2024

Parameter	S1	S2	S3	S4	S5	S6	S7*	S8	S9	S10
Water Temperature (°C)	21.3	21.2	20.0	20.5	20.3	20.4	23.9	18.5	18.1	17.7
DO (mg/L)	8.6	8.3	11.3	8.3	8.4	8.4	7.3	8.6	9.0	8.8
DO (percent saturation)	96.7	94.9	98.8	93.6	95.7	95.2	88.4	93.9	97.4	95.7
pH	7.8	8.2	7.6	7.7	7.9	7.9	7.6	8.0	7.9	8.0
Specific Conductance (µS/cm)	888	894	746	754	684	688	581	772	774	775

Source: Third Rock Consultants 2024

* Tributary site

Aquatic Resource Assessment Water Quality Data

As part of the 2025 Aquatic Baseline Assessment, LRPS collected water quality data at five sites in Tom Fork; the sites corresponded to S1, S3, S5, S7, and S9 sampled during the 2024 Blackside Dace Habitat Assessment (Table 5-7, Figure 5-24). The DO concentration was above the water quality standard (instantaneous minimum of 4.0 mg/L) at all sites. The DO concentration and percent saturation were lowest at S7 (4.6 mg/L and 47 percent) and were similar at the other four sites (8.9 mg/L to 9.9 mg/L and 96.7 percent to 99.1 percent). pH was within the range of the standard at all sites. The specific conductance ranged from 522 µS/cm to 695 µS/cm.

Table 5-7: Water Quality Data Collected in Tom Fork, May 14 and 15, 2025

Parameter	S1	S3	S5	S7*	S9
Date	5/14/2025	5/14/2025	5/14/2015	5/15/2025	5/15/2025
Water Temperature (°C)	17.8	18.9	19.2	16.8	14.6
DO (mg/L)	9.3	9.1	8.9	4.6	9.9
DO (percent saturation)	99.1	98.5	96.7	47.0	98.2
pH	8.1	8.1	8.1	7.2	8.1
Specific Conductance (µS/cm)	695	621	574	522	686

Source: Third Rock Consultants 2025

* Tributary site

Tom Fork Mining Permit Water Quality Data

Water quality data have been collected at several sites in Tom Fork in accordance with mining permits (Figure 5-24).[15] Data collected in 2021 through March 2025 at sites SW009 (approximately 0.4 river miles upstream of confluence with Cumberland River), SW0016 (approximately 0.6 river miles upstream of confluence), and SW1 (approximately 0.7 river miles upstream of confluence) are shown in Table 5-8 (Kentucky EEC 2024). Water quality parameter concentrations were consistent across the three sites. pH values were within the range of the standard (6.0-9.0). Alkalinity was consistent with levels typically found in freshwater rivers and streams. Total iron concentrations were well below the standards for warm water aquatic habitat and were below the domestic water supply standard except for the February 5, 2024, value at sites SW1 and SW0016. Most sulfate concentrations were above the standard for domestic water supply.

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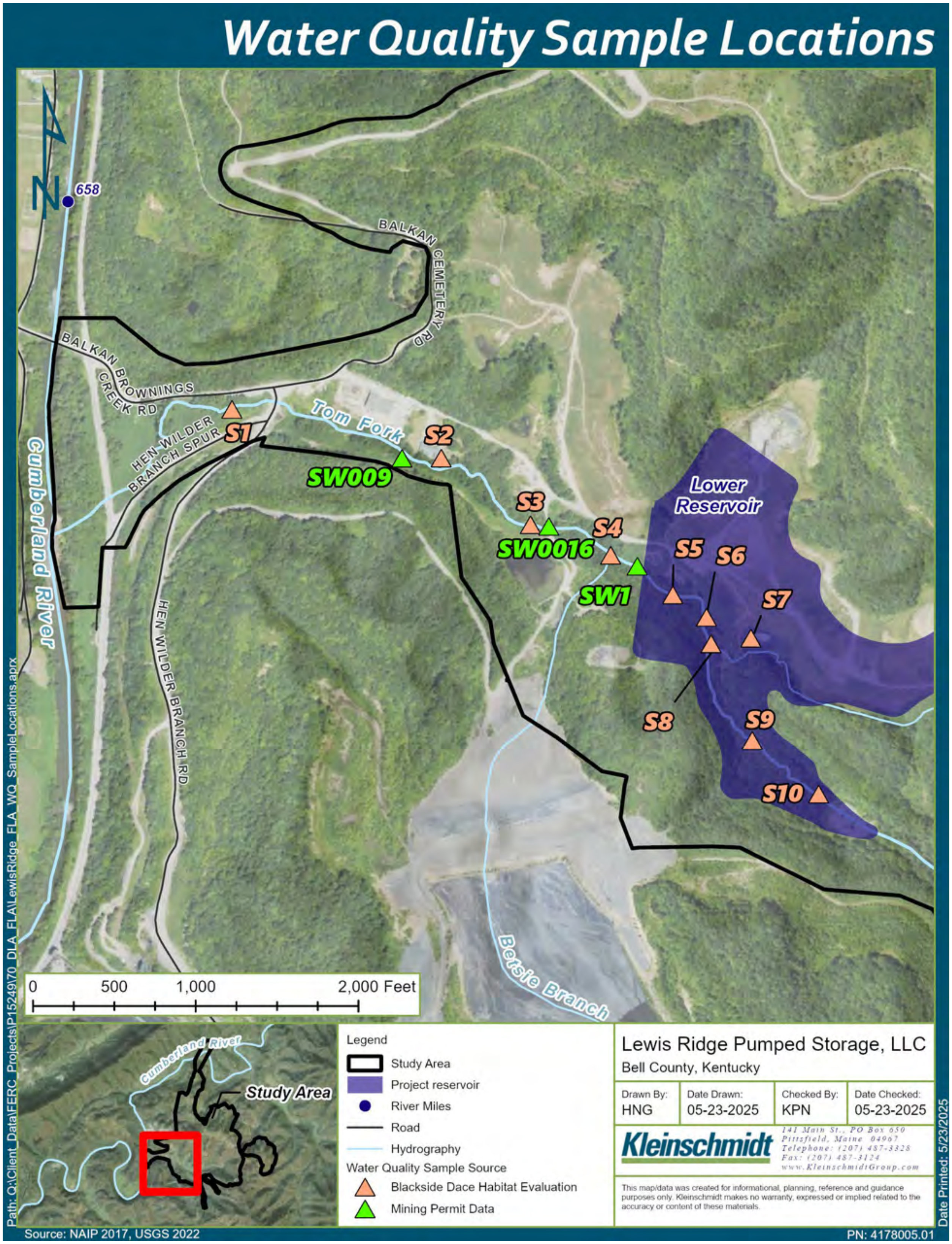
[15] Mining permits are outlined in Table 5-32 in Section 5.8.

Table 5-8: Water Quality Data Collected in Tom Fork, 2021 to 2025

Parameter	3/13/25	11/07/25	8/26/24	6/20/24	2/05/24	12/15/23	8/23/23	6/15/23	3/26/23	12/26/22	8/21/22	6/10/22	3/11/22	11/08/21	9/13/21	6/21/21	3/02/21
Site SW0016																	
Acidity (mg/L)	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Alkalinity (mg/L)	67	251	189	187	138	158	157	189	144	195	171	174	32	224	187	193	65
Total Iron (mg/L)	0.03	0.31	0.16	0.08	0.56	0.12	0.24	0.08	0.23	0.08	0.03	0.03	0.08	0.11	0.31	0.12	0.21
Total Manganese (mg/L)	0.24	0.1	0.05	0.03	0.17	0.26	0.06	0.03	0.12	0.30	1.26	0.06	0.32	0.20	0.19	0.03	0.15
pH	7.5	7.5	7.7	7.3	7.4	7.5	7.9	7.6	7.0	7.4	7.5	7.1	7.3	6.9	7.8	8.0	7.6
Sulfate (mg/L)	294	425	339	374	344	358	671	428	243	274	846	1,172	429	386	395	384	168
Specific Conductance (µS/cm)	671	1,103	937	937	644	945	1,393	991	684	1,175	1,513	1,630	708	1,044	1,124	974	417
Total Suspended Solids (mg/L)	19	5	5	15	16	5	5	12	23	25	5	9	5	5	6	24	27
Site SW1																	
Acidity (mg/L)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Alkalinity (mg/L)	71	246	192	190	138	160	158	191	135	195	175	173	200	202	189	192	68
Total Iron (mg/L)	0.03	0.11	0.1	0.08	0.53	0.10	0.18	0.10	0.09	0.05	0.03	0.05	0.03	0.25	0.36	0.08	0.21
Total Manganese (mg/L)	0.15	0.06	0.15	0.03	0.17	0.08	0.04	0.03	0.09	0.29	1.26	0.11	0.03	0.23	0.23	0.03	0.17
pH	7.5	7.5	7.6	7.3	7.4	7.5	7.9	7.6	7.0	7.4	7.5	7.1	7.2	7.1	8.0	8.1	7.7
Sulfate (mg/L)	293	465	352	395	383	374	719	578	260	287	895	1,405	455	386	401	366	186
Specific Conductance (µS/cm)	662	1,093	917	931	675	903	1,347	954	656	1,110	1,518	1,672	724	1,067	1,064	971	400
Total Suspended Solids (mg/L)	17	8	5	13	18	6	5	86	23	26	5	6	5	5	5	5	10
Site SW009																	
Acidity (mg/L)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Alkalinity (mg/L)	82	185	162	172	135	134	183	172	132	182	177	175	108	193	184	182	66
Total Iron (mg/L)	0.03	0.06	0.14	0.07	0.26	0.07	0.06	0.11	0.15	0.03	0.03	0.06	0.19	0.11	0.19	0.06	0.22
Total Manganese (mg/L)	0.26	0.03	0.32	0.03	0.37	0.96	0.08	0.18	0.22	0.55	0.03	0.03	0.18	0.19	0.04	0.03	0.17
pH	7.9	7.9	7.6	7.5	7.4	7.4	7.3	7.6	7.0	7.5	7.3	7.3	7.4	7.0	8.4	8.4	7.9
Sulfate (mg/L)	332	542	503	516	430	536	695	540	332	367	472	401	529	524	518	398	203
Specific Conductance (µS/cm)	755	1,228	1,005	1,065	777	1,152	1,237	1,108	814	1,259	967	946	751	1,192	1,157	1,022	455
Total Suspended Solids (mg/L)	11	5	5	8	6	20	5	7	23	10	5	5	5	5	5	8	20

Source: Kentucky EEC 2025

Figure 5-24: Tom Fork Water Quality Sample Locations



Cumberland River and Tom Fork Water Quality Data

LRPS initiated water quality monitoring at two sites in Tom Fork and two sites in the Cumberland River near the confluence with Tom Fork in March 2025 to collect baseline information on water quality conditions (Figure 5-25). This information will be used to evaluate potential effects of construction and operation activities on water quality in the Study Area and for the 401 WQC application with the Kentucky DEP Division of Water. Sampling of multiple parameters occurs once a month at all four sites.

Tom Fork 1 (TF1) in Tom Fork is approximately 0.63 river miles (3,330 feet) upstream of the confluence with the Cumberland River at a culvert crossing under an access road (Figure 5-25). This site is located where the proposed lower reservoir spillway and low-level outlet will discharge into Tom Fork. Tom Fork 2 (TF2) is approximately 0.28 river miles (1,470 feet) upstream of the confluence with the Cumberland River where Hen Wilder Road crosses Tom Fork at a bridge. This corresponds to the approximate location where the initial fill and recharge water supply pipeline will cross Tom Fork.

Cumberland Upstream (CUS) is on the Cumberland River approximately 0.82 river miles (4,345 feet) upstream of the confluence with Tom Fork and approximately 300 feet upstream of the confluence with Dry Branch (Figure 5-25). Cumberland Downstream (CDS) is approximately 0.2 river miles (1,070 feet) downstream of the confluence of Tom Fork with the Cumberland River and approximately 600 feet downstream of the proposed intake location. The two monitoring sites in the Cumberland River (CUS and CDS) represent the water quality before and after Tom Fork enters the Cumberland River, respectively.

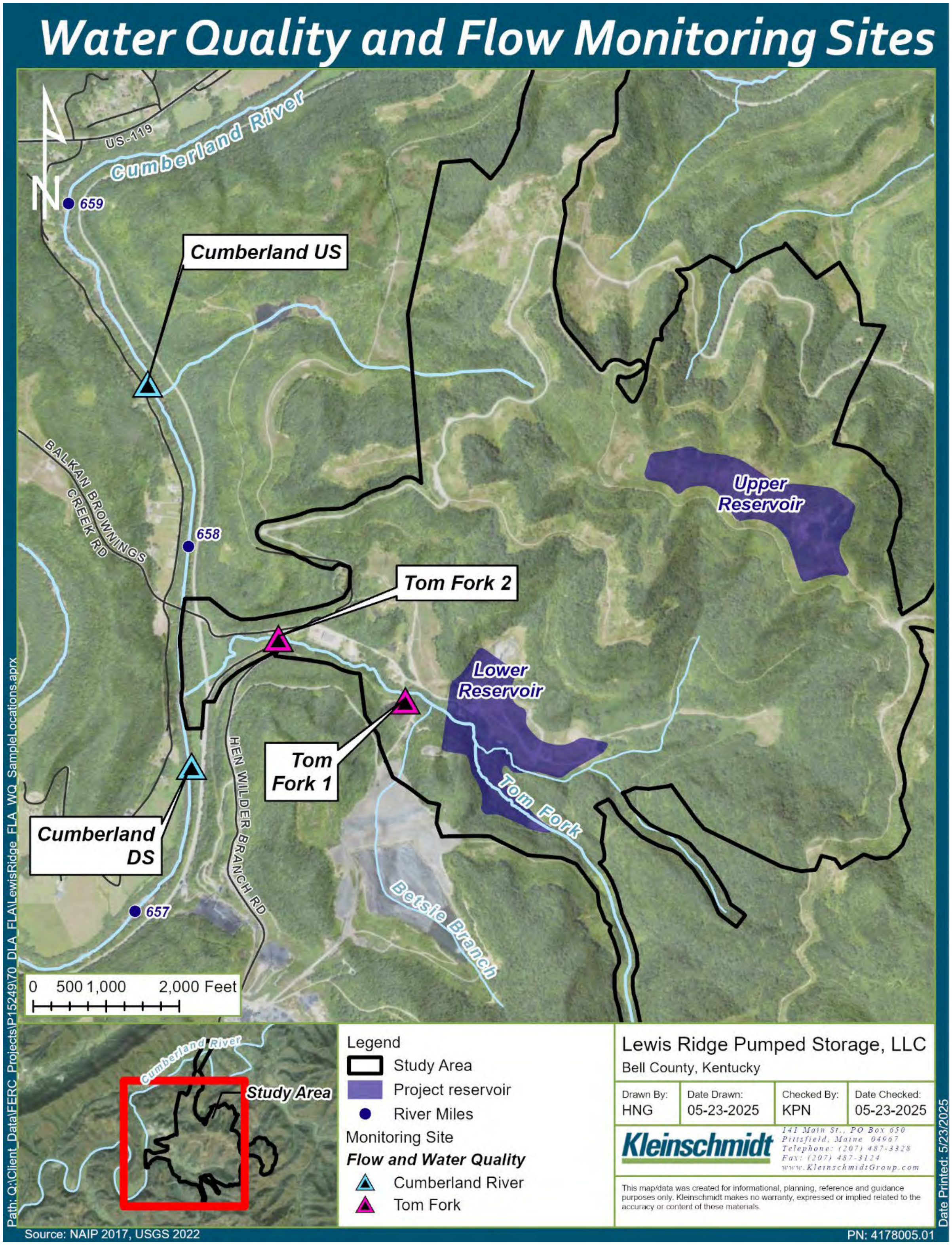
In March and April 2025 at the sites in the Cumberland River and Tom Fork, pH and DO were in attainment with the standards (DO missing from Tom Fork in March) (Table 5-9). Iron and manganese were low and below the guidelines. Both copper and lead were below the reporting level of the laboratory method and well below the human health and warm water aquatic habitat standards. Specific conductance was higher in Tom Fork than the Cumberland River. Alkalinity was consistent with levels typically found in freshwater. Sulfate was below the standard for domestic water supply in the Cumberland River but above the standard at TF1 and TF2. Total dissolved solids were above the domestic water supply standard in Tom Fork.

Table 5-9: Water Quality Data Collected in the Cumberland River and Tom Fork, March and April 2025

Parameter	Cumberland Downstream		Cumberland Upstream		Tom Fork 1		Tom Fork 2	
	3/28/25 15:51	4/30/25 21:32	3/28/25 16:05	4/30/25 21:25	3/28/25 15:40	4/30/25 21:40	3/28/25 15:31	4/30/25 21:46
Water Temperature (°C)	13.4	13.7	13.9	13.8	13.8	12.4	14.2	11.8
pH	8.17	8.28	8.22	8.33	7.61	7.79	7.7	7.76
DO (mg/L)	7.9	8.7	7.6	8.7	NA	8.5	NA	8.6
Total Dissolved Iron (mg/L)	0.15	0.073	0.061	0.033	<0.025	0.075	0.026	0.085
Total Recoverable Iron (mg/L)	0.157	0.044	0.066	0.033	<0.025	0.078	0.025	0.149
Total Dissolved Manganese (mg/L)	0.031	<0.025	<0.025	<0.025	<0.025	0.126	0.16	0.109
Total Recoverable Manganese (mg/L)	0.029	<0.025	<0.025	<0.025	0.077	0.127	0.172	0.133
Total Recoverable Copper (µg/L)	<5.0	<5	<5.0	<5	<5.0	<5	<5.0	<5
Total Recoverable Lead (µg/L)	<2.0	<2	<2.0	<2	<2.0	<2	<2.0	<2
Acidity (mg/L)	<5	<5	<5	<5	<5	<5	<5	<5
Alkalinity (mg/L)	97	132	97	132	102	168	110	167
Specific Conductance (uS/cm)	376	480	378	480	674	1010	756	1009
Total Sulfate (as SO_4) (mg/L)	94	107	96	101	282	402	326	387
Total Dissolved Solids (mg/L)	134	266	146	264	322	700	444	702
Total Suspended Solids (mg/L)	5	8	5	11	<5	6	<5	10
Flow (cfs)	22.3	0.033*	22.3	0.033*	0.16	0.18	0.14	0.19

NA = Not Available. *The flow measurement of 0.033 cfs is presumably an error; data from USGS Gage #03401000 and USGS Gage #03402900 exceeded 500 cfs during the same time period.

Figure 5-25: Water Quality and Flow Monitoring Locations in the Cumberland River and Tom Fork



5.2.1.6 Proposed Project Reservoirs

The Lewis Ridge Project will create two reservoirs on previously disturbed land used for coal mining activities. Water for the initial fill and annual recharge will be sourced from the Cumberland River via a permanent river intake, temporary pump station, pipeline, and from natural inflows from precipitation events. Storm runoff flows from Tom Fork may also be used to support the initial fill and annual recharge. The initial fill volume includes filling the lower reservoir to its maximum water surface elevation, the penstock, and the upper reservoir to an elevation just above its minimum operating level. The estimated initial fill volume is approximately 2,808 acre-feet (AECOM 2025).

The proposed water withdrawal from the Cumberland River will use flows that scale with river conditions. The general framework for withdrawals from the Cumberland River for the initial fill and annual recharge is described below (AECOM 2025):

- At Mean Monthly Flow[16] (MMF): Up to 10 percent of MMF may be withdrawn.
- Above MMF: Additional withdrawals may occur that will include all or a portion of the surplus above the MMF.
- Below MMF: Withdrawals will be reduced proportionally, not exceeding 10 percent of available flow.[17]

Flows from Tom Fork may also be used to support the initial fill and annual recharge when storm runoff flows opportunistically exceed the average annual mean of 2.8 cfs. Base flows (below or equal to mean annual flow) in the Tom Fork will be maintained throughout the year.

The proposed upper reservoir will have a surface area of 48.2 acres at the maximum water surface elevation of 2,150 feet[18] and a surface area of 22.8 acres at the normal minimum water surface elevation of 2,076 feet. During normal operations, the change in elevation (or water depth) will be 74 feet. The maximum water depth in the upper reservoir will be

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[16] Mean monthly flow: Derived from USGS gage data at Cumberland River near Harlan, KY (03401000; 1981–2023) and at Pine Street Bridge, Pineville, KY (03402900; 1991–2005). Flow values were interpolated based on drainage area to estimate conditions at the confluence with Tom Fork.

[17] Available flow is defined as the interpolated flow between upstream and downstream USGS gages 03401000 (Cumberland River near Harlan, KY) and 03402900 (Cumberland River at Pine Street Bridge, Pineville, KY). Both gages are real-time monitoring stations operated by the USGS.

[18] Elevations are based on NAVD 88.

79 feet. The upper reservoir will have a gross storage capacity[19] of 2,877 acre-feet at the spillway crest elevation and an active storage capacity of approximately 2,600 acre-feet[20] at the normal maximum water surface elevation. The upper reservoir shoreline will be approximately 8,240 feet (1.3 miles).

The upper reservoir will be refilled via pumping water back from the lower reservoir. There are no inflows or contributing drainage area to the proposed upper reservoir other than pumping flows during normal Lewis Ridge Project operations and rainfall on the footprint of the dam structure and reservoir. Flood storage is assumed to be the volume resulting from an over-pumping event. In such an event, the additional (flood) volume is limited to the dead storage available in the lower reservoir, which is approximately 77 acre-feet. This will result in a water level in the upper reservoir of about 2,152 feet, leaving approximately 8 feet as freeboard available for the unlikely occurrence of an over-pumping event.

The proposed lower reservoir will have a surface area of 51.6 acres at the normal maximum water surface elevation of 1,234 feet and a surface area of 9.3 acres at the normal minimum water surface elevation of 1,134 feet. During normal operations, the change in elevation (water depth) will be 100 feet. The maximum water depth in the lower reservoir will be 109 feet. The lower reservoir will have a gross storage capacity[21] of 3,486 acre-feet at the probable maximum flood elevation and an active storage capacity of approximately 2,602 acre-feet at the normal maximum water surface elevation. The shoreline length of the lower reservoir will be approximately 9,270 feet (1.8 miles).

Both the upper reservoir and the lower reservoir will include low-level outlets for use during emergency situations and for discharging base flows from the lower reservoir to Tom Fork. The low-level outlets will allow the evacuation of 80 percent of the reservoir storage within 10 days. The low-level outlet for the upper reservoir will tee off from the

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[19] Gross storage in the upper reservoir includes dead storage, active storage, and additional capacity to accommodate direct runoff from a probable maximum precipitation (PMP) event over the reservoir surface.

[20] Active storage capacity is equal to the volume at the normal maximum water surface elevation minus the volume at the normal minimum water surface elevation.

[21] The gross storage capacity of the lower reservoir consists of dead storage, active storage, flood storage for a probable maximum flood (PMF) event, and the volume of water contained in the conveyance system, which may return to the reservoir during non-operational periods.

penstock above the powerhouse, with an outlet into the lower reservoir.[22] For the lower reservoir, the low-level outlet will be located beneath the dam in the lowest part of the valley and will discharge just downstream of the spillway and flow into Tom Fork. Under normal conditions, the operating levels in the lower reservoir will be maintained by releasing flows through the low-level outlet works. Flow gauges will be installed at sediment traps where Tom Fork enters the lower reservoir to continuously measure the inflow into the lower reservoir. The flow will be monitored and released at the same rate through the low-level outlet works, maintaining the Tom Fork base flow.

During operation, the reservoirs will experience losses due to both evaporation and seepage. Annually, evaporation accounts for approximately 128 acre-feet, while leakage is estimated to be 20.5 acre-feet, resulting in an estimated total annual loss of 149 acre-feet. The upper and lower reservoirs will both be lined to the dam crest elevations with an asphalt concrete (AC) lining system to minimize seepage. The estimated seepage rate in the upper reservoir will be 8.6 gallons per minute (gpm) at the maximum water surface elevation and 0.3 gpm at the minimum water surface elevation (AECOM 2025). In the lower reservoir, the estimated seepage rates will be 12.4 gpm and 0.2 gpm at the maximum and minimum water surface elevations, respectively.

The approximate gradient of Tom Fork between the proposed location of the lower reservoir and the confluence with the Cumberland River is 2 percent (change in elevation of approximately 100 feet over approximately 0.85 miles or 4,500 feet); this estimate was obtained using the Google Earth elevation profile.

5.2.1.7 Groundwater

The geology of the Project Vicinity is described in detail in Section 5.8. The Project Vicinity is underlain by the Breathitt Formation, which consists of siltstone, shale, sandstone, and coal. The predominant aquifer type in the Project Vicinity is shallow fracture flow and deep granular consolidated (Kentucky EEC 2022b). Fracture flow aquifers transmit groundwater within fractures in the bedrock.

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[22] In an emergency situation, the powerhouse units may not be available for upper reservoir drawdown. As such, the reservoirs will require dedicated bottom outlets to release water via gravity drainage without requiring the power generation pumping system to provide for safety of the dams.

The overall groundwater system at the Lewis Ridge Project site is inferred (based on limited observations to date) as precipitation (rain and snowmelt) infiltrating vertically down through steep to near-vertical geologic discontinuities (i.e., joints, fractures, shears and faults), and flowing laterally through relatively flat-lying coal seam aquifers to surface discharge areas (seeps). Surface water, including groundwater seepage and direct precipitation runoff, discharges along small tributary drainages to the Cumberland River. Tom Fork is assumed to represent the approximate local static groundwater table in the area of the Lower Reservoir, while the Cumberland River is assumed to be the regional groundwater table hydrologic base level.

5.2.1.8 Wetlands, Riparian, and Littoral Habitat

Wetland Habitat

The U.S. Fish and Wildlife Service (USFWS) classification scheme for wetlands serves as the national standard and is used to classify wetlands in the National Wetlands Inventory (NWI) (USFWS 2024). The NWI coverage is developed from aerial photography. USFWS defines wetlands as: "*…lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. For the purpose of the classification, wetlands must have one or more of these three attributes: (1) at least periodically, the land must support predominantly wetland plants; (2) the substrate is predominantly undrained hydric soil; and (3) rocky, gravelly, or sandy areas that are saturated with or covered by shallow water at some time during the growing season*" (USFWS 1993).

Wetlands have the potential to provide a variety of ecological functions including groundwater discharge and recharge; floodflow management; fish and shellfish habitat, sediment, toxicant, and pathogen retention; nutrient removal, retention, and transformation; production export, sediment and shoreline stabilization, and wildlife habitat. Wetlands also support human-defined values such as recreation, educational and scientific use, uniqueness and heritage, visual quality, and threatened and endangered species habitat (USACE 1999). Understanding the distribution and characteristics of wetlands on the landscape is useful for land use planning and management.

Information regarding the location and spatial extent of wetland resources in the Project Vicinity and Study Area was obtained from the NWI (USFWS 2025). The mapped NWI features in the Project Vicinity are presented in Figure 5-26. Within the Project Vicinity, there are approximately 5.5 acres mapped on the NWI as freshwater emergent wetland, 31.3 acres mapped as freshwater forested/shrub wetland, and 19.9 acres mapped as freshwater pond. Within the Study Area, there are no areas mapped as freshwater wetland and approximately 5.5 acres mapped on the NWI as freshwater pond. The 5.5 acres of freshwater pond include areas classified as PUBHh and PUBHx (palustrine, unconsolidated bottom, permanently flooded, diked/impounded, or excavated).

LRPS conducted a Jurisdictional Streams and Wetlands Determination assessment to determine the presence of jurisdictional waters in the Study Area (Appendix F). The assessment involved compiling background information (sources included the Bell County Soil Survey located on the U.S. Department of Agriculture [USDA] Web Soil Survey, the NWI Map, USGS topographic map, and Google Earth) and field reconnaissance. The assessment identified emergent type wetlands and streams inside the Study Area. A total of 0.92 acres of wetlands were delineated in the Study Area, of which 0.63 acres were palustrine emergent and 0.29 acres were palustrine scrub-shrub. The streams were also designated as Jurisdictional/Relatively Permanent Water (RPW) and Non-Jurisdictional/Non-RPW (Table 5-10). A total of 31,522 feet of streams were delineated within the Study Area, of which 14,630 feet were perennial streams, 4,483 were intermittent streams, and 12,409 were ephemeral streams (EcoSource, Inc. 2025). Development of the Lewis Ridge Project will not permanently impact any wetlands within the Study Area but will permanently impact Tom Fork and two intermittent streams (Figure 5-27).

Table 5-10: Length (linear feet) of Jurisdictional and Non-jurisdictional Streams within Study Area

Designation	Ephemeral	Intermittent	Perennial	Total
Jurisdictional/RPD	1,651	2,804	14,280	18,735
Non-Jurisdictional/Non-RPD	10,758	1,679	350	12,787
Total	**12,409**	**4,483**	**14,630**	**31,522**

Source: EcoSource, Inc. 2025

Impacts to several jurisdictional streams and one wetland within the Study Area have been previously permitted in association with active mining under Kentucky DNR jurisdiction (labeled Old Reach 1 to 6 in Attachment A in Appendix F). These additional jurisdictional waters include a 0.05-acre wetland[23] and approximately 10,942 linear feet of streams (Appendix F, Ecosource, Inc. 2025). The existing permits related to the site are further discussed in Sections 5.8.1 and 5.11.1, and locations of approved post mining land uses are depicted in Figure 5-41. LRPS met with Kentucky DNR on July 24, 2024, and discussed permitting needs and post-mining land use commitments (mine reclamation requirements, protection enhancement plans) associated with existing permits at the Lewis Ridge Project (Appendix A). LRPS will continue to consult with Kentucky DNR regarding existing permits at the project site under Kentucky DNR jurisdiction.

Information regarding floodplains in the Project Vicinity were obtained using Federal Emergency Management Agency (FEMA) flood mapping and the Kentucky Flood Hazard Portal (Figure 5-27) (FEMA 2024, Kentucky DEP 2024). As shown, FEMA mapped floodways in the Project Vicinity are primarily associated with the Cumberland River. The section of Tom Fork from the proposed lower reservoir downstream to the Cumberland River is mapped as a 1 percent annual chance flood hazard. The proposed interconnection line would cross the Cumberland River, its regulatory floodway, and an area mapped as a 1 percent annual chance flood hazard.

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[23] This wetland has been disturbed and not yet reconstructed. This wetland is labeled MA5 Old Wetland in Attachment A of Appendix F and is located at the southern end of the primary disposal area.

Figure 5-26: USFWS NWI Wetlands in the Project Vicinity

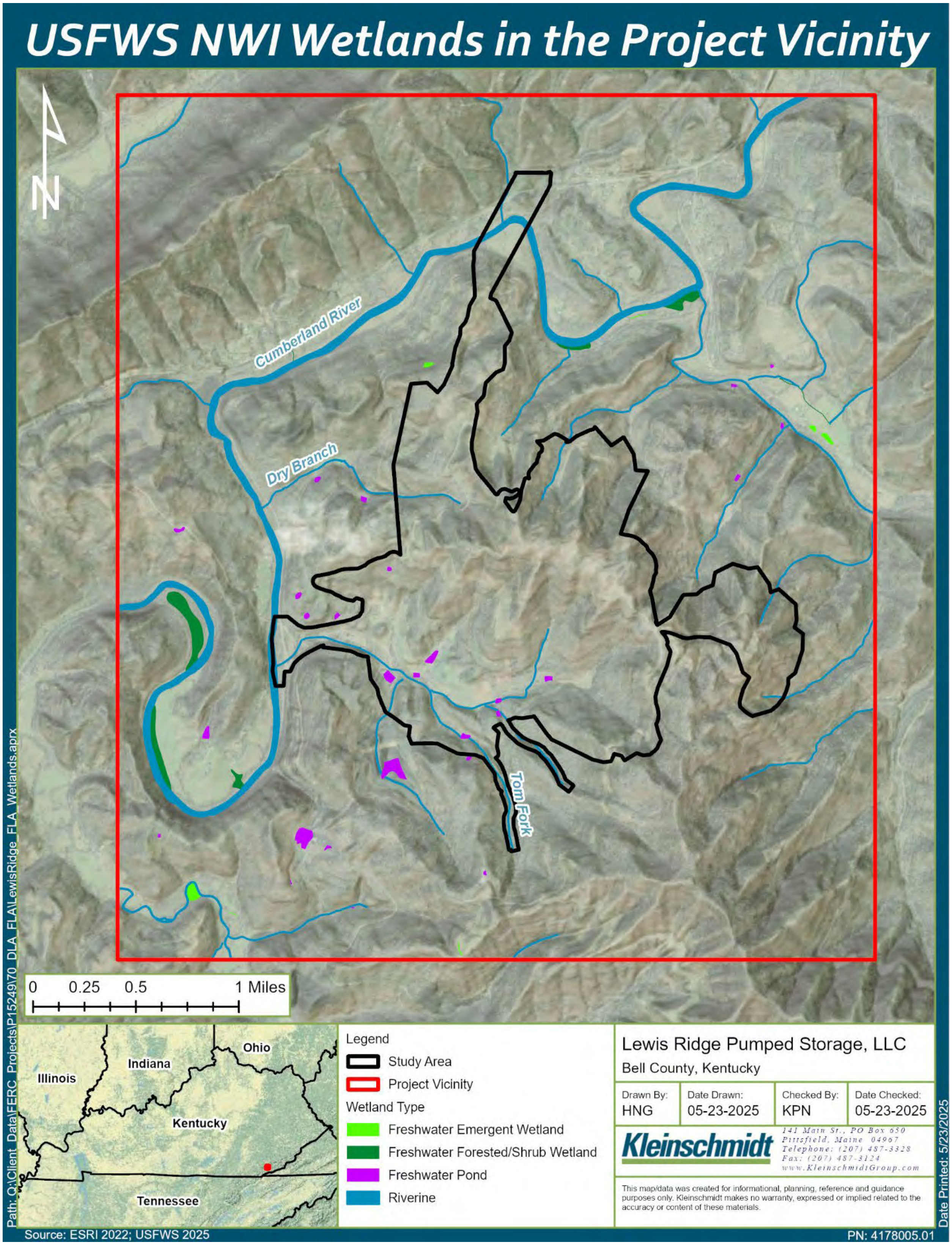
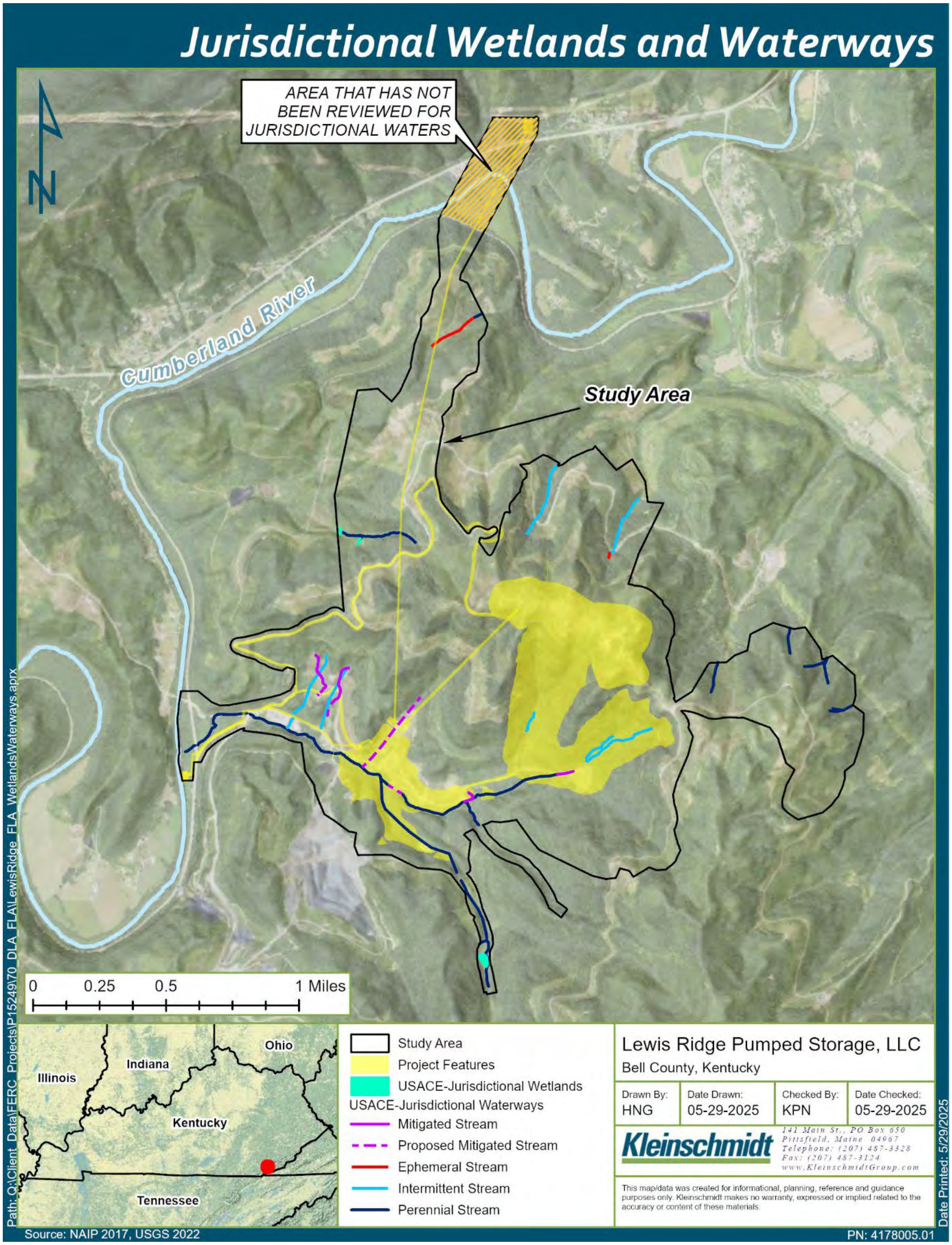
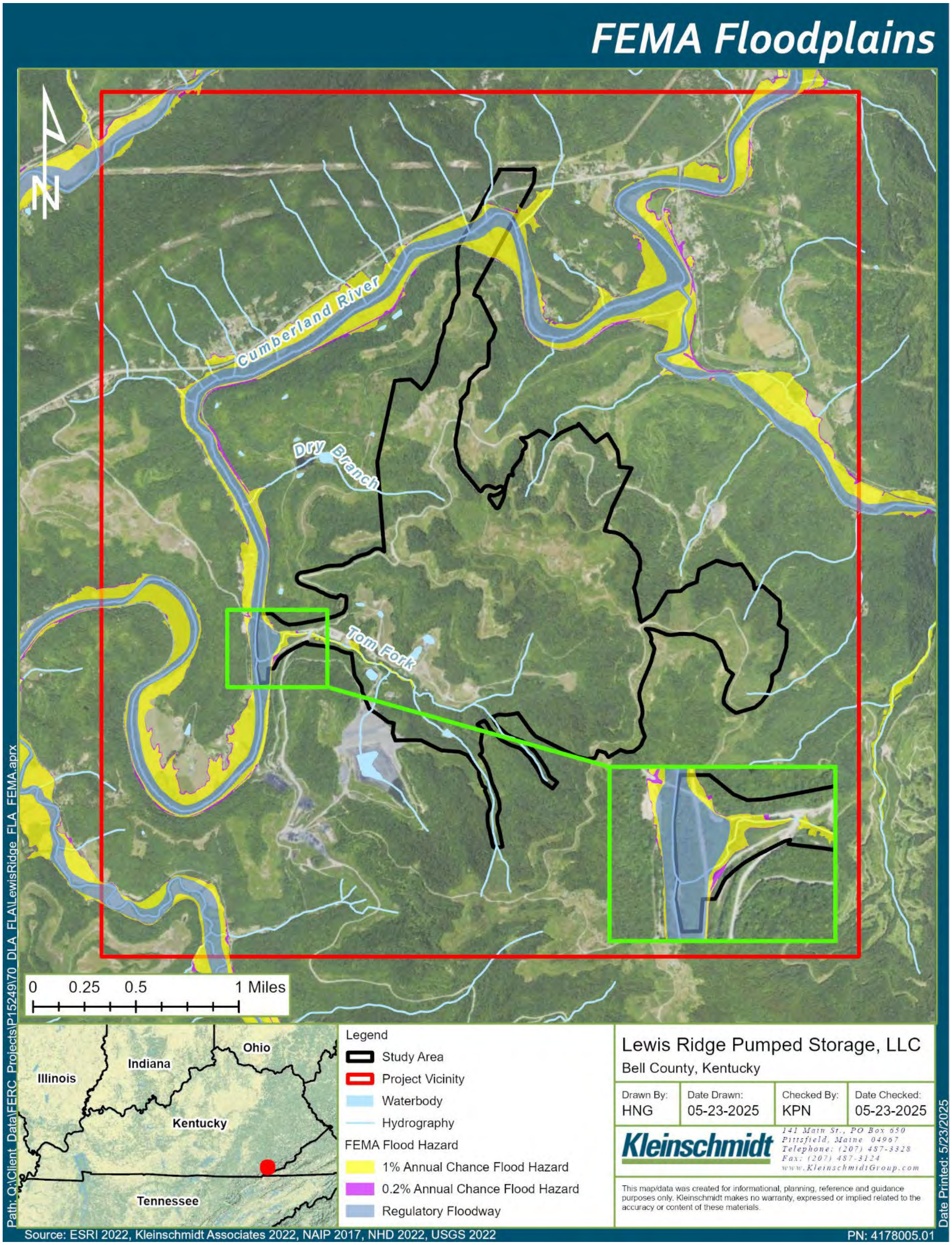


Figure 5-27: Jurisdictional Wetlands and Waterways and Project Features within the Study Area



Source: NAIP 2017, USGS 2022

Figure 5-28: FEMA Mapped Floodplain Areas in the Project Vicinity



Riparian and Littoral Habitat

Riparian habitat is located along streams, rivers, and lakes, and provides important ecosystem functions related to hydrology and flooding, nutrient cycling, and plant and wildlife habitat (Mitsch and Gosselink 2000). The littoral zone acts as an interface between the open water aquatic environment and the terrestrial environment (Wetzel 2001). The size and extent of the littoral zone within a waterbody varies depending upon geomorphology and sedimentation within the aquatic system (Wetzel 2001).

Riparian habitat in the Project Vicinity includes floodplains and land adjacent to the Cumberland River as well as several associated tributaries. There are six streams in the Study Area that are mapped on the NWI: Tom Fork, Dry Branch, Betsie Branch, Pound Mill Branch, Campbell Branch, and one unnamed stream. These streams are classified on the NWI as R4SBC, which indicates that the system is riverine, subsystem is intermittent, class is streambed, and water regime is seasonally flooded (USFWS 2024).

Wetland, Riparian, and Littoral Plant and Animal Species

LRPS conducted a wetland and waterway delineation, which provides detail on plant species within the Study Area. Dominant plants within the wetlands included box elder (*Acer negundo*), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), tulip poplar (*Liriodendron tulipifera*), American sycamore (*Platanus occidentalis*), black cherry (*Prunus serotina*), black willow (*Salix nigra*), Joe-pye weed *(Eutrochium fistulom*), soft-stem bulrush (*Schoenoplectus tabernaemontani),* dark-green bulrush (*Scirpus atrovirens*), woolgrass (*Scirpus cyperinus*), and narrowleaf cattail (*Typha angustifolia*). LRPS anticipates that a variety of animal species, including birds, insects, mammals, snakes, turtles, and amphibians such as frogs, toads, and salamanders may use the wetland, riparian, and littoral habitat.

5.2.2 Potential Impacts of the Proposed Lewis Ridge Project

LRPS anticipates the proposed Lewis Ridge Project to have temporary and permanent impacts on water resources in Tom Fork and the Cumberland River during the construction and operation phases. The proposed Lewis Ridge Project has been designed to minimize or avoid impacts to the quantity and quality of waterbodies and wetlands within the Study Area through the implementation of best management practices (BMPs), appropriate permits, and monitoring plans (see Section 5.2.3 below).

5.2.2.1 Construction

During construction, Tom Fork will be temporarily rerouted around the proposed location of the lower reservoir. This would not likely impact the quantity of water within Tom Fork nor the quantity of water entering the Cumberland River. LRPS initiated flow monitoring in Tom Fork in 2025 to collect baseline flow information that will be used in developing a comprehensive initial fill plan during the final design. LRPS will continue monitoring at TF1 and TF2 (Figure 5-25) throughout construction to verify that flows are maintained. LRPS will continue to consult with USACE, the Kentucky DEP Division of Water, and the Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR) regarding permitting and details of stream mitigation requirements through the Wetland and Stream Mitigation “Fee-in-Lieu-Of” Program (e.g., Kentucky DFWR 2025). Mitigation is provided through purchasing Ecological Integrity Unit credits from an approved mitigation bank.

LRPS anticipates there will be a temporary, minor impact on the quantity of water in the Cumberland River and in Tom Fork during the initial fill of the reservoirs and the conveyance system because of the flexible, flow responsive approach that optimizes water availability. The Cumberland River will be the primary water source. During periods when flows in the Cumberland River are at or below the historic mean monthly flow, withdrawals will not exceed 10 percent of the available flow. When flows in the Cumberland River are above the historic mean monthly flow, additional withdrawals may include all or a portion of the surplus above the mean monthly flow. Supplemental water from Tom Fork will only be used for the initial fill during storm events if the flow is in excess of 2.8 cfs. LRPS will develop a comprehensive initial fill plan to further develop the details for the withdrawal for the initial fill. LRPS will apply for and obtain the appropriate Water Withdrawal Permits from the Kentucky DEP Division of Water prior to beginning any withdrawal activities.

Potential temporary impacts on the quality of water in Tom Fork and the Cumberland River during construction from runoff, erosion, or potential spills will be minimized or avoided through implementation of BMPs and other PM&E measures including a Stormwater Pollution Prevention Plan, a Hazardous Substances Spill Prevention and Cleanup Plan, an Erosion and Sediment Control Plan, and a Groundwater Protection Plan (see Section 5.2.3.2). Further, LRPS developed a Water Quality Monitoring Plan (Appendix B), which outlines the monitoring methods that will be implemented to assess and identify potential effects of construction activities on water quality in Tom Fork and the Cumberland River.

There will be negligible temporary impacts on water quality in the Cumberland River resulting from the installation of the intake, pump station, and initial fill and recharge water supply pipelines. The pumps and any associated motors or compressors will be located on land within a stabilized and contained area adjacent to the Cumberland River. LRPS plans to use temporary pumps for the initial fill, which allows for flexibility to quickly move the pumps out of the floodway in the event of a significant storm event and minimizes permanent disturbance within the floodway. For the initial fill, the pumps will be connected to the local power supply.

The installation of the intake and screens will have a permanent impact on the aquatic habitat of the Cumberland River riverbed. Three sets of screens, each set on a 3-foot by 31-foot concrete pad, will be placed on the bed of the Cumberland River. LRPS will consult with the Kentucky DEP Division of Water and USACE regarding obtaining the appropriate permits for installing the concrete pads within the Cumberland River regulatory floodway.

The initial fill and recharge water supply pipeline will be installed using an open cut and cover method through Tom Fork, which will involve excavating a trench, laying the pipeline, and then backfilling with soil to restore the creek bed. This may also include the temporary installation of a small cofferdam and a bypass/pump around system. LRPS will implement appropriate stream buffers and BMPs to avoid and minimize potential effects on the quantity and quality of Tom Fork during pipeline installation. Prior to the pipeline installation work, LRPS will consult with and obtain the appropriate permits from the Kentucky DEP Division of Water and USACE.

The proposed interconnection line will cross the Cumberland River, Dry Branch, and an ephemeral stream in the northern portion of the Study Area in single spans, and LRPS anticipates no impacts to water quantity, water quality, or wetland resources. The majority of the interconnection line structures will be steel monopoles either directly embedded or placed on reinforced concrete foundations. Lattice tower structures will be used at locations where the span length needs to be increased to cross the Cumberland River and to provide adequate clearances over existing overhead lines per the latest standards.

5.2.2.2 Operation

Development of the lower reservoir will permanently impact approximately 2,800 feet of Tom Fork. Other permanent impacts will be approximately 450 feet of one intermittent stream in the primary disposal area and approximately 2,350 feet of two intermittent streams in the secondary disposal area. LRPS is not proposing any action that will impact wetlands. LRPS is currently consulting with Kentucky DEP,[24] Kentucky DNR, and USACE regarding permitting requirements, potential mitigation for impacts to Tom Fork, as well as the previously permitted jurisdictional streams and wetland within the Study Area.

There will be a minor, permanent impact on the quantity of water in the Cumberland River and Tom Fork due to the annual recharge during operation. LRPS proposes to source annual refill water by retaining a percentage of runoff from storm events in the Tom Fork basin when flows exceed the average annual mean of 2.8 cfs and to supplement this by pumping from the Cumberland River. Thus, when the flow in Tom Fork exceeds 2.8 cfs during or following a storm event, there may be less water available downstream. LRPS anticipates this will have a minor impact on water quantity and quality as flows will remain above average levels in the Cumberland River and Tom Fork. Furthermore, the estimated amount of precipitation on the upper and lower reservoirs during a dry year (approximately 319 acre-feet) exceeds the estimated annual loss of water (149 acre-feet) suggesting that annual refill may largely be accomplished through precipitation.

Base flows in Tom Fork will be maintained throughout the year. The flow in Tom Fork will be continuously monitored upstream of the inlet to the lower reservoir, within the sediment traps, and downstream of the lower reservoir to verify that the inflow and outflow match. LRPS will release water at the same rate through the low-level outlet works maintaining the Tom Fork base flow.

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[24] The Division of Water is within Kentucky DEP.

During operation, several measures will be taken to protect the quality of water within the reservoirs, Tom Fork, and the Cumberland River. For annual recharge operations, diesel-powered pumps may be used with appropriate BMPs to minimize or avoid accidental spills or leaks. Three sediment traps will be located upstream of the lower reservoir on Tom Fork and its tributary to minimize sediment entering the lower reservoir. The sediment traps will be inspected regularly following guidelines specified by Kentucky EEC, and accumulated sediment will be removed before it fills half the trap volume.

The upper reservoir and lower reservoir will be lined with AC to minimize seepage of water from the reservoirs into the groundwater. AC liners are regularly used in pumped storage and water supply reservoirs and have been shown to be chemically stable (Brandt and De Groot 2001) and have low permeability. During normal operation, LRPS anticipates no impacts on groundwater from the lower and upper reservoirs. LRPS will monitor water quality in Tom Fork downstream of the lower reservoir as outlined in the Water Quality Monitoring Plan (Appendix B) to identify any potential issues.

The intake will not likely affect water quality during operation. The components of the intake that will be within the Cumberland River will likely include piping and fittings made from materials less susceptible to corrosion, such as stainless steel and high-density polyethylene (HDPE), and concrete for anchoring and weighting. There will not be any mechanical components (e.g., pumps, motors, generators, compressors) that require fuel, lubricating oils, and coolants within the waterway. No cleaning agents (e.g., solvents, oxidizers, disinfectants) will be allowed within the waterway. If a screen becomes compromised or fouled and air or mechanical scrubbing does not suffice, the screen will be removed from the waterway for additional cleaning, repair, or replacement as required.

Components of the intake within the Cumberland River will not dissipate heat unless indirectly due to solar reflection/refraction. The proposed layout does not include mechanical equipment that relies on submergence for cooling, and water will not be cycled from/to the waterway for cooling purposes, thereby avoiding the introduction of a thermal plume.

Currently available water quality data in the Cumberland River and Tom Fork indicates that water quality standards are met. LRPS does not anticipate pollutant or nutrient inputs to the upper reservoir during normal operations because there are no inflows or contributing drainage area other than pumping flows during normal Lewis Ridge Project operations and rainfall on the footprint of the dam structure and reservoir. Similarly, the only inputs to the lower reservoir would be pumping flows from the upper reservoir, annual recharge, and rainfall. Thus, LRPS does not anticipate water quality issues in the reservoirs due to using the Cumberland River and Tom Fork as sources for annual refill or from the exchange of water between reservoirs during normal pumping operations.

The development and operation of the Lewis Ridge Project will permanently impound and has potential to affect water quality within Tom Fork. For example, surface water temperatures within the lower reservoir may increase with a corresponding decrease in surface DO concentrations compared to the naturally flowing water in Tom Fork upstream of the reservoir. Thus, there is the potential for slightly warmer water with lower DO to be released downstream to Tom Fork. Water quality within Tom Fork downstream of the lower reservoir and in the Cumberland River will be monitored during operation in accordance with the Water Quality Monitoring Plan (Appendix B); this monitoring will assist in identifying changes in the quality of water in Tom Fork and the Cumberland River due to operation of the Lewis Ridge Project compared to baseline conditions.

LRPS anticipates that the lower reservoir and the upper reservoir will be well mixed due to the pump and generation cycle. However, in the unlikely scenario that either reservoir thermally stratifies, there is the potential for water with low temperatures and low DO concentrations to be released to the lower reservoir from the upper reservoir or for water with low temperatures and low DO concentrations to be released downstream from the lower reservoir to Tom Fork. The water quality in the reservoirs will be monitored for several parameters, including water temperature, DO, TDS, and metals during operation in accordance with the Water Quality Monitoring Plan (Appendix B).

5.2.3 Agency Consultation and Applicant Recommendations

5.2.3.1 Agency Consultation

Documentation of consultation is provided in Appendix A. Consultation specific to water resources is summarized below.

USFWS submitted preliminary comments on February 9, 2022, in response to FERC’s December 16, 2021 Notice of Preliminary Permit Application to assist FERC and LRPS in assessing the potential environmental impacts of construction and operation of the proposed project. USFWS recommended evaluating the following related to water resources:

- Potential for interception of any watercourse by the new reservoirs.
- Potential entrainment of aquatic species if the source water for the project is from surface water.
- Potential for groundwater contamination (from the development of salts and alkaline conditions within reservoirs over time due to evaporative losses).

On November 23, 2022, USEPA commented on the NOI and PAD providing recommendations and considerations for FERC to include in its draft NEPA document. USEPA recommended inclusion of the following related to water resources:

- Additional reservoir operation information, including plans for emergency releases and additional withdrawals.
- Analysis of the Cumberland River to determine potential impacts if supplemental water is needed for the proposed reservoirs, or if reduced flows from Tom Fork will have any short or long-term effects on water quality downstream.
- Evaluate the potential for eutrophication as well as maintenance activities to address eutrophication issues.
- Development of an adaptive water quality monitoring program for the proposed reservoirs to estimate the accretion of constituents (including aerial disposition) over time.
- Evaluate Kentucky water quality standards, potential impacts of reduced flows, and impacts from adjacent mining operations or mobilization of sediments from proposed construction in proposed water quality studies of Tom Fork and the Cumberland River.
- Perform water quality monitoring at representative locations at the Lewis Ridge Project to characterize existing water quality.
- Utilize groundwater observation wells to explore the possibility of installing high volume extraction wells to use in conjunction with other water resources to fill the upper reservoir.

At the January 25, 2023, Joint Agency and Public Meeting, LRPS presented existing water resources information from the PAD. During the meeting, discussion occurred with USACE regarding the initial wetland and waterway assessment that was conducted in 2022.

LRPS distributed a Draft Study Plan on June 13, 2024. The Draft Study Plan included two studies related to water resources: Wetland and Waterway Evaluation and Blackside Dace Habitat Evaluation (which included documenting water quality parameters in Tom Fork). LRPS did not receive any comments specific to the Wetland and Waterway Evaluation or Blackside Dace Habitat Evaluation study plan. On June 20, 2024, USACE commented on the PAD and stated that the Lewis Ridge Project will require evaluation under their standard individual permit review process. USACE provided a list of information required for the application, which includes delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams on the Lewis Ridge Project site. LRPS filed the Revised Study Plan with FERC on August 16, 2024.

The Kentucky DEP submitted comments on April 6, 2023 (following the Joint Agency and Public Meeting) and on July 9, 2024 (following the distribution of the Draft Study Plan). In its comments the Kentucky DEP provided state permitting information pertaining to water resources. Kentucky DEP requested impacts to Tom Fork be addressed with the Kentucky DEP Division of Water. In addition, the Kentucky DEP Water Resources Branch requested LRPS to determine if the Lewis Ridge Project is located in the 1 percent chance floodplain. Kentucky DEP Groundwater Section of the Watershed Management Branch requested that a Groundwater Protection Plan is developed for the Lewis Ridge Project.

USFWS provided preliminary information on NWI wetland types within the Study Area for the Lewis Ridge Project on July 19, 2024.

LRPS met with Kentucky DEP, Kentucky DNR, and USACE on August 12, 2024, to discuss sources of initial fill and recharge water and associated withdrawal permitting, routing and/or diversion of Tom Fork at the lower reservoir, and project design around these topics.

LRPS filed its DLA on September 30, 2024. The Environmental Report (Exhibit E) of the DLA included a jurisdictional streams and wetlands determinations study report. The USEPA, FERC, and Kentucky DEP provided comments on the DLA or accompanying study reports related to water resources (Appendix A). USEPA and FERC requested additional information on potential impacts to water quality and water quantity in the Cumberland River and Tom Fork, specifically as it relates to initial fill and diversion of flow. In addition, USEPA and FERC requested additional information on potential Lewis Ridge Project impacts on wetland, riparian, and littoral habitat. Kentucky DEP Division of Water commented that the Lewis Ridge Project could require multiple water withdrawal applications (depending on source of initial fill and recharge water), and Kentucky DEP Groundwater Section requested that a Groundwater Protection Plan be developed. As appropriate, LRPS addressed comments in the FLA and in the accompanying Summary Response Table to Comments provided in Appendix A. In addition, LRPS met with Kentucky DEP on December 2, 2024, to further discuss design and permitting needs for water withdrawal and CWA Section 401 WQC. LRPS met with the USEPA on December 11, 2024, to discuss EPA's preliminary comments on the DLA. Meeting summaries are provided in Appendix A.

5.2.3.2 Applicant Recommendations

LRPS proposes to implement the following PM&E measures to minimize impacts on water resources:

- **Water Quality Monitoring Plan:**
    - LRPS proposes to develop and implement a Water Quality Monitoring Plan outlining the methods for monitoring baseline water quality in Tom Fork and the Cumberland River prior to construction and during operations, and in the water conveyance penstock throughout operations. Parameters include water temperature, DO, pH, metals, alkalinity, total dissolved solids, and total suspended solids. The Water Quality Monitoring Plan is filed as Appendix B.
- **Stream Mitigation:**
    - Stream mitigation will be required for placement of concrete pads on the bed of the Cumberland River for intake screens and the alteration of Tom Fork. Permitting and details of stream mitigation requirements will be coordinated with USACE and Kentucky DEP Division of Water.
- **Stormwater Pollution Prevention Plan:**
    - LRPS proposes to develop and implement a Stormwater Pollution Prevention Plan (SWPPP) to address prevention of potential erosion, scouring, and general water quality degradation during construction. The SWPPP will be filed with the Commission after license issuance and implemented at the start of construction. The SWPPP will include:
        - A description of the potential sources of stormwater pollution.

    - Maintenance measures (i.e., regular inspections, good housekeeping practices) used to control stormwater runoff and prevent contamination of stormwater during construction.
    - Control measures, such as soil stabilization, diversions or infiltration, to manage the flow of stormwater.
    - Monitoring and inspections will be conducted during construction in accordance with permit requirements.

- **Hazardous Substances Spill Prevention and Cleanup Plan:**
  - LRPS proposes to develop and implement a Hazardous Substances Spill Prevention and Cleanup Plan to address potential issues resulting from spills of hazardous substances during construction, operations or maintenance. The plan will be filed with the Commission after license issuance and will be implemented at the start of construction. The Hazardous Substances Spill Prevention and Cleanup Plan will:
    - Specify materials handling procedures and storage requirements and identify spill cleanup procedures for areas and processes in which spills may potentially occur.
    - Standardize operations procedures and employee training to minimize accidental pollutant releases, which could contaminate surface water, groundwater, or stormwater runoff.
- **Groundwater Protection Plan:**
  - LRPS proposes to develop and implement a Groundwater Protection Plan during the construction period to meet the requirements of 401 KAR 5:037. The Groundwater Protection Plan will be filed with the Commission after license issuance and will be implemented at the start of construction.

LRPS is also proposing to develop and implement an Erosion and Sediment Control Plan (as discussed in Section 5.8.3.2) to reduce potential downstream impacts to water quality.

5.2.4 References

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5.3 Fish and Aquatic Resources (18 CFR § 4.41 (f)(3))

5.3.1 Existing Environment

The Project Vicinity includes the reach of the Upper Cumberland River approximately 654 to 664 river miles upstream of its confluence with the Ohio River, as well as Tom Fork, Dry Branch, and several unnamed tributaries to the Cumberland River. Aquatic habitat in the Upper Cumberland River consists mainly of riffles, runs, and pools, with cobble, boulder, and bedrock as dominant substrates (Kentucky DFWR 2024a).

Tom Fork's stream characteristics, water quality, and physical habitat conditions were documented through studies conducted for this licensing process, including a 2024 Blackside Dace Habitat Assessment (Appendix G) and a 2025 Aquatic Baseline Assessment (Appendix H). Reaches of Tom Fork have been impacted by previous surface mining operations, with some areas covered by silt and sediment. Rocky substrates are generally partially embedded by fine sediment throughout the reach, and some streambank erosion is present (EcoSource, Inc. 2025). During the 2024 Blackside Dace Habitat Assessment, researchers documented water quality and physical habitat at 10 locations in the Tom Fork watershed (Appendix G). Physical habitat was documented using the USEPA's Rapid Bioassessment Protocol (Barbour et al. 1999). General habitat ratings scored "Fair" under USEPA Mountain Bioregion protocols when accounting for habitat parameters including riparian vegetation, bank stability, flow characteristics, and sedimentation. Habitat scores less than 117 are labeled "Poor," and scores greater than 159 are labeled "Good." Habitat scores at the 10 sites documented during 2024 ranged from 118 to 140, with minimal instream cover (e.g., undercut banks) and areas with narrow bands of riparian vegetation. The stream gradient is higher in the upstream reaches of Tom Fork. DO levels remained above 7 mg/L throughout the Tom Fork watershed, and specific conductance was high (>580 µS/cm) across all sites.

Additional habitat surveys occurred throughout Tom Fork[25] in May 2025 as part of the Aquatic Baseline Assessment (Appendix H). Documented habitat parameters included riparian and bank structure, substrate composition, and canopy cover. Habitat conditions were similar to those observed during 2024. Available cover was greater in downstream reaches, downstream of the proposed lower reservoir. Root wads and undercut banks

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[25] Stations S1, S3, S5, S7, and S9 (as depicted on Figure 5-24) established during the 2024 Blackside Dace Habitat Assessment were utilized for the 2025 Aquatic Baseline Assessment.

were less abundant moving upstream and were entirely absent from the most upstream stations in the vicinity of the proposed lower reservoir. Habitat rating scores ranged from 103-141, with all sites rated "Fair" except for one site that was rated "Poor." The "Poor" score occurred at station S7, where a constructed beaver dam reduced the frequency of riffles and increased substrate embeddedness.

A total of 59 fish species have been documented in the Upper Cumberland River Basin (Table 5-11). Electrofishing surveys were conducted by the Kentucky DFWR in 2017 in the Cumberland River approximately 35 river miles downstream of the proposed Lewis Ridge Project location. The surveys targeted sportfish species, and 66 individual fish were documented over 1.5 hours of effort (Table 5-12). Shad, sucker, and minnow species were not netted or enumerated when observed. Overall catch per unit effort (CPUE) for gamefish species was 44 fish/hour. The most abundant species captured were channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), and spotted bass (*Micropterus punctulatus*) (Kentucky DFWR 2018). Due to its proximity to the proposed Lewis Ridge Project site and similar aquatic habitat characteristics throughout the Upper Cumberland River, the sportfish community in the Cumberland River within the Project Vicinity is expected to be relatively similar to the reach sampled by the Kentucky DFWR.

The Kentucky DFWR established a conservation and management plan to conserve and enhance existing native walleye (*Sander vitreus*) populations in Kentucky (Kentucky DFWR 2014). Between 2014 and 2022, Kentucky DFWR has stocked an average of approximately 26,000 2- to 3-inch fingerling native strain walleye per year, totaling over 275,000 individuals, in the Upper Cumberland River as part of these conservation and management efforts (Kentucky DFWR 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023a) (Table 5-13).

Table 5-11: Fish Species Known to Occur in the Upper Cumberland River Basin

Family	Common Name	Scientific Name
Acipenseridae	lake sturgeon	*Acipenser fulvescens*
Atherinopsidae	brook silverside	*Labidesthes sicculus*
Catostomidae	white sucker	*Catostomus commersonii*
	northern hog sucker	*Hypentelium nigricans*
	black redhorse	*Moxostoma duquesnei*
	golden redhorse	*Moxostoma erythrurum*
Centrarchidae	rock bass	*Ambloplites rupestris*
	redbreast sunfish	*Lepomis auritus*
	green sunfish	*Lepomis cyanellus*
	warmouth	*Lepomis gulosus*
	bluegill	*Lepomis macrochirus*
	longear sunfish	*Lepomis megalotis*
	redear sunfish	*Lepomis microlophus*
	smallmouth bass	*Micropterus dolomieu*
	spotted bass	*Micropterus punctulatus*
	largemouth bass	*Micropterus salmoides*
	white crappie	*Pomoxis annularis*
Clupeidae	gizzard shad	*Dorosoma cepedianum*
Cottidae	banded sculpin	*Cottus carolinae*
Cyprinidae	central stoneroller	*Campostoma anomalum*
	blackside dace	*Chrosomus cumberlandensis*
	southern redbelly dace	*Chrosomus erythrogaster*
	whitetail shiner	*Cyprinella galactura*
	spotfin shiner	*Cyprinella spiloptera*
	steelcolor shiner	*Cyprinella whipplei*
	flame chub	*Hemitremia flammea*
	striped shiner	*Luxilus chrysocephalus*
	warpaint shiner	*Luxilus coccogenis*
	scarlet shiner	*Lythrurus fasciolaris*
	river chub	*Nocomis micropogon*
	silverjaw minnow	*Notropis buccatus*
	highland shiner	*Notropis micropteryx*
	rosyface shiner	*Notropis rubellus*
	sawfin shiner	*Notropis sp.*
	mimic shiner	*Notropis volucellus*
	bluntnose minnow	*Pimephales notatus*
	fathead minnow	*Pimephales promelas*
	western blacknose dace	*Rhinichthys obtusus*

Family	Common Name	Scientific Name
	creek chub	*Semotilus atromaculatus*
Ictaluridae	black bullhead	*Ameiurus melas*
	yellow bullhead	*Ameiurus natalis*
	channel catfish	*Ictalurus punctatus*
	brindled madtom	*Noturus miurus*
	flathead catfish	*Pylodictis olivaris*
Moronidae	white bass	*Morone chrysops*
Percidae	emerald darter	*Etheostoma baileyi*
	greenside darter	*Etheostoma blennioides*
	rainbow darter	*Etheostoma caeruleum*
	stripetail darter	*Etheostoma kennicotti*
	redline darter	*Etheostoma rufilineatum*
	arrow darter	*Etheostoma sagitta*
	snubnose darter	*Etheostoma simoterum*
	Cumberland darter	*Etheostoma susanae*
	logperch	*Percina caprodes*
	blackside darter	*Percina maculata*
	olive darter	*Percina squamata*
	walleye	*Sander vitreus*
Petromyzontidae	least brook lamprey	*Lampetra aepyptera*
Poeciliidae	western mosquitofish	*Gambusia affinis*

Source: Natureserve 2010; Kentucky DFWR 2018

Table 5-12: Fish Captured During 2017 Survey on the Upper Cumberland River at Barbourville, Kentucky

Common Name	Number Captured	CPUE (fish/hr)
smallmouth bass	3	2.0
spotted bass	11	7.3
bluegill	1	0.7
longear sunfish	4	2.7
redbreast sunfish	1	0.7
green sunfish	1	0.7
black crappie	1	0.7
walleye	6	4.0
channel catfish	27	18.0
flathead catfish	11	7.3
Total	**66**	**44.1**

Source: Kentucky DFWR 2018

Table 5-13: Walleye Stocking Rates in the Upper Cumberland River from 2014-2023

Year	Number Stocked	Approximate Length (inches)
2014	40,681	2.0
2015	40,360	1.8
2016	27,221	2.3
2017	27,182	2.3
2018	9,870	3.2
2019	23,852	2.3
2020	13,156	2.7
2021	27,283	2.4
2022	28,834	2.2
2023	37,975	2.1
Total	**276,414**	-

Sources: Kentucky DFWR 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023a

LRPS conducted fish sampling efforts in five reaches throughout Tom Fork during May 2025 to document the existing fish assemblage (Appendix H). Two sampling stations (S1 and S3) were located in the reach of Tom Fork between the proposed lower reservoir and the Cumberland River. Three sampling stations (S5, S7, and S9) were located in the proposed lower reservoir. Backpack electrofishing documented a total of 12 fish species in Tom Fork. A majority of fish were collected from the two most downstream study sites, with fewer fish collected from the three upstream sites in the proposed lower reservoir (Table 5-14). A total of 127 fish were collected at S1, and 117 fish were collected at S3, while fish collections at the upstream stations ranged from 7-59 individuals. Species richness was also greatest at the downstream stations, with 8 species collected at S1 and 10 species collected at S3. A total of four species were collected at S5, four species were collected at S7, and three species were collected at S9. The most abundant fish species collected were rainbow darter (*Etheostoma caeruleum*), bluntnose minnow (*Pimephales notatus*), and stoneroller (*Campostoma anomalum*). Calculated index of biotic integrity scores were highest at the downstream sites, with "Good" ratings at sites S1, S3, and S5, and "Fair" ratings at sites S7 and S9. Limited upstream habitat suitability suggests that fish presence is unlikely to occur upstream of the sampling stations.

Table 5-14: Fish Collected from Tom Fork During 2025 Backpack Electrofishing Surveys

Species Common Name	Site				
	S1	S3	S5	S7	S9
blacknose dace		3	5		3
bluegill	2	2			
bluntnose minnow	34	22	1	1	
creek chub	6	5			3
fathead minnow				1	
green sunfish	11	12	1	1	1
juvenile sunfish		4		18	
rainbow darter	38	38	52	1	
redbreast sunfish	8	1			
stoneroller	22	27			
striped shiner	6	2			
white sucker		1			
Total	**127**	**117**	**59**	**22**	**7**

Source: Third Rock Consultants 2025

5.3.1.1 Temporal and Spatial Distribution of Aquatic Communities

Most seasonal movements of fish are associated with spawning activities, foraging, or changes in water temperature that prompt movements into available seasonal refugia. Although there are no diadromous fish species present in the Upper Cumberland River, some resident fish species may exhibit seasonal movements or migrations within the river to locate foraging or spawning habitat. Examples of such species include white sucker (*Catostomus commersonii*) and walleye (Jenkins and Burkhead 1993; Etnier and Starnes 1993).

Habitat in the Cumberland River near the Lewis Ridge Project is relatively homogenous (i.e., shallow flowing riffles runs over cobble, boulder, and bedrock) (Kentucky DFWR 2022). Accordingly, the fish assemblage is expected to consist of smaller individuals and lotic species that prefer those habitats, such as minnows, suckers, and darters. Further downstream of the Project Vicinity on the Cumberland River, as habitat becomes more diverse with deeper water and more abundant pools, a more diverse range of fish species and sizes are expected, including an increased prevalence of habitat generalist and more lentic species (Jenkins and Burkhead 1993).

Habitat surveys in Tom Fork conducted in 2024 and 2025 documented a mix of riffle, run, and pool habitats, with the upstream reaches characterized by steeper gradients and fewer pools (Appendix G, Appendix H). Riffles and runs throughout Tom Fork were generally dominated by cobble and boulder substrates, and pools were generally dominated by finer sand and gravel substrates. Survey results indicate that the reach would not be suitable for blackside dace due to high specific conductance levels (581-895 µS/cm documented during 2024 and 522-686 µS/cm documented during 2025). Blackside dace are usually excluded from streams with conductivities below 343 µS/cm (Hitt et al. 2016). Additionally, backpack electrofishing surveys conducted during 2025 documented a total of 12 fish species throughout Tom Fork, and blackside dace were not collected. The greatest abundance and diversity of fish species occurred in the reach of Tom Fork between the proposed lower reservoir and the Cumberland River.

5.3.1.2 Rare, Threatened, and Endangered Aquatic Species

The USFWS Information for Planning and Consultation (IPaC) tool was reviewed for the Lewis Ridge Project Study Area on May 9, 2025. The IPaC did not identify any federal listed fish species in the Lewis Ridge Project Study Area (USFWS 2025). One proposed-endangered amphibian species, the eastern hellbender, was identified. Eastern hellbender are further described in Section 5.4.1.1 Rare, Threatened, and Endangered Wildlife Resources. Although the federally threatened blackside dace was not identified in the IPaC report, the USFWS noted in February 2022 comments on the preliminary permit application that blackside dace is a federally threatened species that may occur in the Lewis Ridge Project Study Area.

A request was submitted to the Office of Kentucky Nature Preserves (OKNP) on May 9, 2025, to perform review of the Kentucky Biological Assessment Tool (KY-BAT) and obtain a Standard Occurrence Report. OKNP’s Standard Occurrence Report did not identify any federal or state listed fish or aquatic species within the Lewis Ridge Project Study Area (Appendix I, Rare Species Reports [Privileged]). OKNP’s Standard Occurrence Report listed one federal and state listed fish species, and four state listed aquatic species with reported occurrences within the 5-mile buffer of the Lewis Ridge Project Study Area. Species specific information is being filed with FERC as a privileged document (Appendix I).

Blackside Dace

Blackside dace is a small minnow endemic to the upper Cumberland River drainage in southeastern Kentucky and northeastern Tennessee. The species has a pointed snout, a wide, black lateral stripe on its side, and an olive to gold colored back. Spawning males are brightly colored, with yellow dorsal fins and scarlet on the lower head, nape, and belly (NatureServe 2024). Blackside dace generally reach a maximum length of 3 inches and are found in small upland streams with cool water temperatures, moderate flows, and minimal silt. Higher blackside dace occupancy has been documented in streams with conductivity levels below 343 µS/cm (Hitt et al. 2016). Preferred habitat consists of streams with instream cover (e.g., submerged root wads, undercut banks, woody debris, and large rocks). The spawning period is April to July, with the greatest spawning activity occurring in May and June (Floyd 2016). The blackside dace has an approved recovery plan (USFWS 1988).

Results of the Blackside Dace Habitat Assessment completed in 2024 and the Aquatic Baseline Assessment completed in 2025 (Appendix G, Appendix H) suggest that Tom Fork is uninhabitable for blackside dace, with conductivity levels two or three times higher than the specific conductance level threshold associated with occupancy by the species. Stream gradient is also likely too high for the species throughout much of Tom Fork, and instream cover is minimal throughout parts of the reach. Backpack electrofishing throughout Tom Fork did not document the presence of blackside dace.

5.3.1.3 Invasive and Nonindigenous Fish and Aquatic Species

Nonindigenous aquatic species known to occur in the Upper Cumberland River Basin (HUC6 051301) are listed in Table 5-15. Nonindigenous aquatic species are defined as an aquatic species that has entered a body of water or aquatic ecosystem outside of its historic or native range. This can include fish species that are native to surrounding watersheds in the United States and have expanded their range, or individual occurrences of aquatic species escaping captivity or being released. Invasive species are defined as nonnative species that compete with native species for resources, alter habitat, and impact biological diversity (Kentucky DFWR 2024b) Invasive carp species (bighead carp [*Hypophthalmichthys nobilis*], black carp [*Mylopharyngodon piceus*], grass carp

[*Ctenopharyngodon Idella*], and silver carp [*Hypophthalmichthis molitrix*]) are known to occur in the Cumberland River (Kentucky DFWR 2023b). The species have not been documented in the reach of the Cumberland River that includes the Project Vicinity but do occur further downstream in the Cumberland River system. Silver carp have been documented as far upstream as Cordell Hull dam, which is more than 300 river miles downstream of the Lewis Ridge Project (Tennessee WRA 2024).

Table 5-15: Nonindigenous Aquatic Species Known to Occur in the Upper Cumberland River Basin

Scientific Name	Common Name*	Native Habitat
Coelenterates-Hydrozoans		
Craspedacusta sowerbyi	freshwater jellyfish	Freshwater
Crustaceans-Crayfish		
Cambarellus shufeldtii	cajun dwarf crayfish	Freshwater
Cambarus cumberlandensis	Cumberland crayfish	Freshwater
Faxonius rusticus	rusty crayfish	Freshwater
Fishes		
Alosa chrysochloris	skipjack herring	Freshwater-Marine
Alosa pseudoharengus	alewife	Freshwater-Marine
Carassius auratus	goldfish	Freshwater
Culaea inconstans	brook stickleback	Freshwater
Cyprinus carpio	common carp	Freshwater
Dorosoma cepedianum	gizzard shad	Freshwater-Marine
Dorosoma petenense	threadfin shad	Freshwater-Marine
Dorosoma petenense atchafalayae	Mississippi threadfin shad	Freshwater
Esox masquinongy	muskellunge	Freshwater
Fundulus catenatus	northern studfish	Freshwater
Gambusia affinis	western mosquitofish	Freshwater
Lepomis auritus	redbreast sunfish	Freshwater
Lepomis gibbosus	pumpkinseed	Freshwater
Lepomis gulosus	warmouth	Freshwater
Lepomis microlophus	redear sunfish	Freshwater
Lepomis miniatus	redspotted sunfish	Freshwater
Micropterus coosae	redeye bass (sensu lato)	Freshwater
Micropterus dolomieu	smallmouth bass	Freshwater
Micropterus punctulatus	spotted bass	Freshwater
Micropterus salmoides	largemouth bass	Freshwater
Morone saxatilis	striped bass	Freshwater-Marine
Moxostoma lachneri	greater jumprock	Freshwater
Notemigonus crysoleucas	golden shiner	Freshwater
Oncorhynchus clarkii	cutthroat trout	Freshwater
Oncorhynchus kisutch	coho salmon	Freshwater-Marine
Oncorhynchus mykiss	rainbow trout	Freshwater-Marine

Scientific Name	Common Name*	Native Habitat
Perca flavescens	yellow perch	Freshwater
Piaractus brachypomus	pirapitinga, red-bellied pacu	Freshwater
Pimephales promelas	fathead minnow	Freshwater
Pomoxis annularis	white crappie	Freshwater
Pomoxis nigromaculatus	black crappie	Freshwater
Rhinichthys atratulus	blacknose dace	Freshwater
Salmo trutta	brown trout	Freshwater
Salvelinus fontinalis	brook trout	Freshwater
Salvelinus namaycush	lake trout	Freshwater
Sander canadensis x vitreus	saugeye	Freshwater
Sander vitreus	walleye	Freshwater
Tinca tinca	tench	Freshwater
Mollusks-Bivalves		
Corbicula fluminea	basket clam	Freshwater
Dreissena polymorpha	zebra mussel	Freshwater
Plants		
Acorus calamus	single-vein sweetflag	Freshwater
Alternanthera philoxeroides	alligatorweed	Freshwater
Egeria densa	Brazilian waterweed	Freshwater
Lythrum salicaria	purple loosestrife	Freshwater
Murdannia keisak	marsh dewflower	Freshwater
Myriophyllum aquaticum	parrot feather	Freshwater
Myriophyllum spicatum	Eurasian watermilfoil	Freshwater-Brackish
Najas minor	brittle waternymph	Freshwater
Nasturtium officinale	water-cress	Freshwater
Potamogeton crispus	curly-leaf pondweed	Freshwater
Reptiles		
Alligator mississippiensis	American alligator	Freshwater
Trachemys scripta troostii	Cumberland slider	Freshwater

Source: USGS 2024

* This table includes nonindigenous aquatic species that have been observed in the Upper Cumberland River Basin. Some unexpected species listed in the table (such as American alligator), have one or few documented occurrences in the basin. This list includes species associated with past fish stocking efforts in Tennessee, as well as the likely escape of nonindigenous species.

5.3.1.4 Benthic Macroinvertebrates and Freshwater Mussels

A distribution checklist of Kentucky mussels (Cicerello and Haag 2016) described 12 mussel species within the Upper Cumberland River Basin upstream of Cumberland Falls (Table 5-16). Cumberland Falls is located on the Cumberland River, approximately 110 river miles downstream of the Lewis Ridge Project. Four mussel species were observed in the mainstem upper Cumberland River during a 2001 survey: pheasantshell, wavy-rayed lampmussel, spike, and plain pocketbook (Cicerello and Laudermilk 2001). Mussel surveys occurred throughout Tom Fork in May 2025 to evaluate for mussel presence and distribution (Appendix H). Sieving fine sediments, riffle kick sampling, and searches for relict or dead mussels were conducted at multiple stations. No live, fresh dead, or relict mussels were collected. Results of the mussel survey and associated habitat assessment suggests that Tom Fork is unlikely to support a native mussel population (Appendix H).The Kentucky DEP Division of Water monitors physical, chemical, and biological elements of waterbodies to assess the quality of the aquatic environment of waterbodies across the state, and documents algal, macroinvertebrate, and fish community structure as indicators of waterbody health. Macroinvertebrate assemblages have proven to be useful in detecting even subtle changes in habitat and water quality. The Kentucky DEP Division of Water has developed a Macroinvertebrate Bioassessment Index (MBI) based on macroinvertebrate community attributes (Pond et al. 2003). The Lewis Ridge Project is located in the mountain ecoregion.

Macroinvertebrate sampling was conducted throughout Tom Fork in May 2025. Riffle collections and microhabitats (rocks, root wads, undercut banks, leaf packs, woody debris, emergent vegetation, and fine sediments) were sampled across five stations in the vicinity of the proposed lower reservoir and in the reach of Tom Fork between the proposed lower reservoir and the Cumberland River. A total of 14 benthic macroinvertebrate orders were represented. MBI scores were generally low across sampling stations (Table 5-16). Ephemeroptera, Plectoptera, Tricoptera (EPT) richness and abundance generally contributed to low scores. The most upstream station (S9) had the highest MBI score (66.7), with a rating of “Fair;” the remaining stations had a rating of “Poor.” A relatively high concentration of pollution intolerant EPT and Ephemeroptera (mayflies) at this station contributed to the higher score. Ephemeroptera are generally sensitive to brine, and pasting mining activity downstream of S9 has likely impacted abundance.

Table 5-16: Mussel Species Known to Occur in the Upper Cumberland River Basin Upstream of Cumberland Falls

Scientific Name	Common Name
Alasmidonta atropurpurea	Cumberland elktoe
Alasmidonta viridis	slippershell mussel
Anodontoides denigrata	Cumberland papershell
Elliptio dilatata	spike
Lampsilis cardium	plain pocketbook
Lampsilis fasciola	wavy-rayed lampmussel
Lampsilis ovata	pocketbook
Ortmanniana pectorosa	pheasantshell
Strophitus undulatus	creeper
Toxolasma parvum	lilliput
Utterbackia imbecilis	paper pondshell
Villosa lienosa	little spectaclecase

Source: Cicerello and Haag 2016

Table 5-17: May 2025 Tom Fork Macroinvertebrate Survey Results

Parameter	Site				
	S1	S3	S5	S7	S9
Taxa Richness	32	41	46	34	40
EPT Richness	7	11	9	7	12
Modified Hilsenhoff Biotic Index	5.28	4.90	4.50	6.88	3.52
EPT Abundance (%)	26.8	23.9	34.7	2.7	83.6
Ephemeroptera Abundance (%)	20.3	11.3	8.6	0.9	51.7
Midge and Aquatic Worm Abundance (%)	26.8	45.8	38.8	7.9	9.7
Primary Clingers (%)	43.5	34.9	27.5	10.0	9.4
MBI Score	47.1	45.1	46.9	32.9	66.7
MBI Rating*	Poor	Poor	Poor	Poor	Fair

Source: Third Rock 2025

* Mountain Bioregion Headwater Stream MBI Ratings: 0-23 (very poor), 24-47 (poor), 48-71 (fair), 72-82 (good), >82 (excellent).

5.3.1.5 Essential Fish Habitat

There are no federal management plans for fish species that occupy the freshwater, inland regions of Kentucky and Tennessee, and there is no designated EFH near the proposed Lewis Ridge Project.

5.3.2 Potential Impacts of the Proposed Lewis Ridge Project

Flow diversions and filling of the lower reservoir have the potential to impact aquatic habitat in Tom Fork. These impacts are expected to occur in areas that currently exhibit effects of past mining operations. The Lewis Ridge Project will cause temporary and permanent impacts to fish and aquatic resources in Tom Fork. The proposed lower reservoir is located within a valley that contains Tom Fork, a tributary to the Cumberland River.

Existing lotic habitat in Tom Fork will be altered through construction of the lower reservoir. However, fish habitat studies conducted during 2024 and 2025 documented a limited amount of suitable habitat throughout much of the reach under current conditions. Conditions in Tom Fork are not suitable for intolerant species like blackside dace, and relatively few fish were collected from the sampling stations located in the proposed lower reservoir during backpack electrofishing surveys. Due to existing habitat conditions including high specific conductance levels, minimal instream cover, low summertime flow rates, and high gradients in upstream reaches, Tom Fork currently does not provide conditions to support a robust or diverse aquatic community of fish, invertebrates, or freshwater mussels; therefore, impacts from the proposed Lewis Ridge Project are expected to be minimal.

Construction of the lower reservoir dam and low level outlet will create a barrier to upstream fish movement from Tom Fork into the lower reservoir. Results of 2025 habitat and fish collection surveys suggest that fish are not likely present upstream of the proposed lower reservoir or are present in very low numbers. The development of the hydraulic asphalt concrete (AC) lined lower reservoir combined with daily water level fluctuations and lack of recruitment from upstream or downstream portions of Tom Fork are expected to exclude most fish species from the reservoir.

For the limited fish species that may utilize the lower reservoir, there is potential for fish to become entrained at the intake or impinged on the intake bar racks. However, given the low habitat suitability for fish species in the constructed lower reservoir, the extent of potential entrainment and impingement are minimal.

Localized impacts to the Cumberland River are expected at the pump site. Six pumps will be supported by six screens, with each screen measuring 15 feet in length and 30 inches in diameter. Two screens will be installed on a concrete pad, with each pad measuring 31 feet by 3 feet. A total of three concrete pads will be placed on the riverbed. A mussel reconnaissance and removal effort will occur within the footprint prior to installation. Intake velocities below 0.5 fps will be maintained during pumping activities to reduce impacts to macroinvertebrates, juvenile and larval fish life stages. Withdrawals from the Cumberland River will not exceed 10 percent of available river flow when flows in the Cumberland River are below the historic average, MMF. Adjusting withdrawal rates based on water availability will maintain downstream aquatic habitat availability and conditions across seasons and flow regimes.

Air compressors will be used to periodically backwash screens with air bursts for cleaning. Some localized turbulence may occur in the vicinity of the intakes during periodic cleaning. LRPS does not anticipate downstream impacts to water quality or conditions as a result of screen cleaning.

The interconnection line will cross the Cumberland River, Dry Branch, and unnamed tributaries in single spans, with no anticipated impacts to aquatic habitat or aquatic species.

5.3.3 Agency Consultation and Applicant Recommendations

5.3.3.1 Agency Consultation

Documentation of consultation is provided in Appendix A. Consultation specific to fish and aquatic resources is summarized below.

On February 9, 2022, USFWS submitted preliminary comments in response to FERC’s December 16, 2021, notice of Preliminary Permit Application to assist FERC and LRPS in assessing the potential environmental impacts of construction and operation of the proposed project. USFWS noted the blackside dace as a federally listed (threatened) species having the potential to occur in the Lewis Ridge Project area. In addition, USFWS recommended evaluating the following related to fish and aquatic resources:

- Potential impacts of the project to aquatic resources as a result of water withdrawal from the Cumberland River.
- Potential impacts to aquatic species that could result from construction activities.
- Potential impacts to fish related recreational activities.
- Potential impacts to existing or proposed fishing access facilities such as parking lots, walkways, and riprap structures.
- Potential impacts to fish resources resulting from interconnection corridor alignment and the project's footprint.
- Potential entrainment of aquatic species if the source water for the project is from surface water.

LRPS initiated consultation in July and August 2022 with resource agencies and stakeholders. On August 26, 2022, NOAA confirmed that the Lewis Ridge Project was not near any habitats where National Marine Fisheries Service ESA-listed species may be present. LRPS conducted a meeting with the USFWS on September 9, 2022, during which USFWS identified blackside dace and Cumberland arrow darter as fish and aquatic species of interest.

On November 23, 2022, USEPA commented on the NOI and PAD providing recommendations and considerations for FERC to include in its draft NEPA document. USEPA recommended extended studies on fish and aquatic species habitat to include the Cumberland River, as well as Tom Fork. In addition, USEPA requested the scope of the study be expanded beyond water quality and aquatic habitat data to include sampling and analysis of the fish, mussel, and macroinvertebrate communities in Tom Fork and the Cumberland River.

LRPS held a Joint Agency and Public Meeting on January 25, 2023, at which existing fish and aquatic information from the PAD were presented. USFWS confirmed that although the blackside dace was not listed on the Lewis Ridge Project IPaC, the species is federally listed and should be considered. USFWS confirmed the Cumberland arrow darter does not have federal protection.

LRPS distributed a Draft Study Plan on June 13, 2024. The Draft Study Plan included one study related to fish and aquatic resources: the Blackside Dace Habitat Evaluation. LRPS did not receive any comments specific to the Blackside Dace Habitat Evaluation study plan. LRPS filed the Revised Study Plan with FERC on August 16, 2024.

The Kentucky DEP submitted comments on April 6, 2023 (following the Joint Agency and Public Meeting), on July 9, 2024 (following the distribution of the Draft Study Plan), and on October 28, 2024 (following the distribution of the DLA). In their comments, the Kentucky DEP requested review of the OKNP's KY-BAT to obtain a standard occurrence report for sensitive species within the Lewis Ridge Project area. LRPS obtained a standard occurrence report from OKNP on May 9, 2025 (OKNP 2025), and results are summarized in applicable sections of this Exhibit E and provided in Appendix I, Rare Species Reports (Privileged).

On July 19, 2024, and May 9, 2025, USFWS provided an official species list for the Lewis Ridge Project identifying threatened, endangered, proposed, and candidate species that may occur in the Study Area of the Lewis Ridge Project. Results are summarized in applicable sections of this Exhibit E and provided in Appendix A.

LRPS filed its DLA on September 30, 2024. The Environmental Report (Exhibit E) of the DLA included the blackside dace habitat assessment study report. The USEPA, FERC, and Kentucky DEP provided comments on the DLA or accompanying study reports related to fish and aquatic resources. USEPA requested additional information on the timing of initial fill and fish passage at the Lewis Ridge Project. FERC requested an updated IPaC be performed with additional discussion on the potential project-related effects on all federally listed, proposed, and candidate species and their habitats; additional information on potential impacts on aquatic habitat and fish entrainment (if the Cumberland River is to be used as a fill or make-up water source); and clarification on existing native or exotic aquatic species within the Cumberland River. Kentucky DEP reiterated the availability of its KY-BAT tool to obtain a standard occurrence report for sensitive species within the Lewis Ridge Project area. As appropriate, LRPS addressed comments in the FLA and in the accompanying Summary Response Table to Comments provided in Appendix A.

5.3.3.2 Applicant Recommendations

LRPS proposes to implement the following PM&E measures to minimize impacts on fish and aquatic resources:

- **Fish Exclusion Measures:**
    - LRPS proposes to install and maintain fish exclusion bar racks at the lower reservoir intake/outlet to minimize fish entrainment.

  - LRPS proposes to install fish screens with appropriately sized mesh on water pumps and maintain intake velocities below 0.5 fps to minimize impingement and entrainment of macroinvertebrates, larval fish, and juvenile fish.

- **Mussel Relocation**
  - Prior to installation of the pump system for initial fill, a certified malacologist will perform a spot check of the area for the presence of mussel species. If mussel presence is documented, individuals will be moved out of the pump intake area.

LRPS is proposing to develop and implement an Erosion and Sediment Control Plan (as discussed in Section 5.8.3.2) to reduce potential downstream impacts.

5.3.4 References

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5.4 Wildlife Resources (18 CFR § 4.41 (f)(3))

5.4.1 Existing Environment

Major wildlife species in the Cumberland Plateau MLRA area include white-tailed deer (*Odocoileus virginianus*), elk (*Cervus canadensis*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), cottontail (*Sylvilagus nuttallii*), muskrat (*Ondatra zibethicus*), gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), mink (*Mustela lutreola*), ruffed grouse (*Bonasa umbellus*), woodcock (*Scolopax minor*), bobwhite quail (*Colinus virginianus*), and mourning dove (*Zenaida macroura*) (NRCS 2022).

According to the Kentucky DFWR, wildlife with known occurrences within Bell County includes 180 birds, 47 mammals, 30 reptiles, 9 insects, and 33 amphibians. Similar to vegetative communities, wildlife occurrence and distribution varies by habitat, local aspect, and elevation. Reptile species occurring within Bell County include various turtles, snakes, skinks, and lizards. Amphibians include a variety of frogs, toads, and salamanders. Mammal species within Bell County include small mammals such as shrews (*Sorex* spp.), voles (*Microtus* spp.), mice (*Mus* spp.), rabbits and bats; medium mammals such as red fox, gray fox (*Urocyon cinereoargenteus*), river otter (*Lontra canadensis*), and beaver (*Castor canadensis*); and large mammals such as black bear (*Ursus americanus*), white-tailed deer, and elk. (Kentucky DWFR 2014).

Bell County is within the Kentucky Elk Restoration Zone, which encompasses 16 counties and approximately 4.1 million acres in the Cumberland Plateau physiographic ecoregion (Figure 5-29) (Kentucky DFWR 2015). Kentucky's present elk herd is a free ranging, wild herd established from 1,550 wild elk captured out-of-state and released into southeast Kentucky between December 1997 and March 2002. Contributing states included Utah, Kansas, Oregon, North Dakota, Arizona, New Mexico, with the majority of elk captured in Utah. Release sites were located in Harlan, Knott, Leslie, Letcher, Martin, Perry, and Pike counties. The current elk population is estimated at over 10,000 animals according to two different models. (Kentucky DWFR 2023a). Human land use within the elk restoration zone has resulted in a landscape mosaic of approximately 80 percent deciduous forest, 10 percent active and reclaimed surface mine, 9 percent agricultural or cleared land, and 1 percent urban matrix (Kentucky DFWR 2015). The Lewis Ridge Project area is entirely located within the Kentucky Elk Restoration Zone and elk have been observed at the Lewis Ridge Project and surrounding areas. Tracking data indicate that the herd utilizing projects lands maintains an extensive home range that extends several miles outside of the Lewis

Ridge Project Study Area in multiple directions (John Hast, Kentucky DFWR, personal communication). Preferred habitat in the Lewis Ridge Project Vicinity includes early successional areas created on disturbed lands, as well as forested habitats and agricultural areas.

Figure 5-29: Kentucky Elk Restoration Zone

Source: Kentucky DFWR 2015

Initial research following the elk reintroduction in Kentucky demonstrated that elk favored the food resources on recently established grassland at mine sites and used the adjacent forests for cover and refuge (Kentucky DFWR 2015). However, forage quality of established grassland generally degrades over time as the newly planted wheat, rye, and clover transition to less-nutritious, competitive, or invasive species (Kentucky DFWR 2015). Increased elk utilization of forested habitats became especially evident to elk managers by 2012-2013 and is associated with increased hunting pressure, high hunter use of roads, and a loss habitat associated with recently reclaimed mining sites (Kentucky DFWR 2015).

One of the goals set forth in the Kentucky DFWR 2030 Elk Management Plan is to improve habitat in the elk zone. A grant through the Rocky Mountain Elk Foundation provided the opportunity to aerial spray approximately 1,800 acres on Boone Forestland Wildlife Management Area and Asher Hunter Access Area (located in Harlan and Bell counties north of the Cumberland Ridge and Lewis Ridge Project site) in September of 2023. These areas will be targeted for prescribed burning in the future as a secondary treatment to improve habitat conditions (Kentucky DWFR 2023a). The Kentucky DFWR manages grasslands in areas near the Lewis Ridge Project with a combination of prescribed burning and herbicide applications, as well as planting seed mixes that promote grasses and forbs utilized as elk forage (John Hast, Kentucky DFWR, personal communication). Other management activities near the Lewis Ridge Project have included elk relocation. In partnership with the Appalachian Wildlife Foundation (AWF), the Kentucky DFWR relocated elk from areas of southeast Kentucky with denser elk populations to the southern end of the 16-county elk zone where fewer elk were present. The elk released at the proposed site of the Appalachian Wildlife Center[26] near Pineville (approximately three miles southwest of the Lewis Ridge Project site) serve as a source herd for future trapping and relocation efforts to increase populations and hunting opportunities in targeted areas of the elk zone (Kentucky Living 2018). From 2017-2019, 241 elk were relocated to AWF's property, which is unfenced. The relocation effort has helped grow and spread the elk population in the broader area. Kentucky DFWR has documented separate instances of elk previously relocated to the AWF property that have been harvested by legal hunters off the AWF property, calved over one mile outside the AWF boundary, and trapped more than ten miles away from the AWF property for a separate restocking effort (Kentucky DFWR n.d.). The Appalachian Wildlife Center is an elk restricted hunting area; however, Kentucky DFWR manages multiple tracts as elk regulated areas within several miles to the north, east, and southeast of the Lewis Ridge Project.

Cumberland Gap National Historic Park is located approximately 10 miles from the proposed Lewis Ridge Project site and extends from 1,000 to 3,500 feet above sea level across diverse habitat types. The park currently has 371 species documented (33 mammals, 89 birds, 29 amphibians, 15 reptiles, 27 fish, and 178 insects). Visitors of the park could expect to see cottontail, gray squirrel, opossum (*Didelphis virginiana*), striped skunk (*Mephitis mephitis*), bobcat (*Lynx rufus*), white-tailed deer, raccoon, gray fox, black

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[26] The Appalachian Wildlife Center is now called Boone's Ridge (SOAR 2020).

bear, various bats, songbirds, wild turkey (*Meleagris gallopavo*), hawks and vultures, snakes, turtles, and, less commonly, elk (NPS 2024).

Boone's Ridge is an identified eBird hotspot[27] and is located approximately 2 miles west of the Lewis Ridge Project Study Area. Over 150 species have been reported at this location since 2018 (eBird 2024). Table 5-18 provides the 68 bird species observed at Boone's Ridge from January to December 2024.

Table 5-18: Bird Species Observed at Boone's Ridge in 2024

Scientific Name	Common Name	Count[28]	Date Observed (2024)
Agelaius phoeniceus	red-winged blackbird	250	November 9
Ammodramus savannarum	grasshopper sparrow	7	May 18
Archilochus colubris	ruby-throated hummingbird	4	July 3
Ardea alba	great egret	2	September 29
Asio flammeus	short-eared owl	1	November 9
Baeolophus bicolor	tufted titmouse	1	July 3
Botaurus lentiginosus	American bittern	1	September 29
Buteo jamaicensis	red-tailed hawk	1	November 9
Buteo lineatus	red-shouldered hawk	2	November 16
Buteo platypterus	broad-winged hawk	2	September 29
Butorides virescens	green heron	1	May 18
Cardinalis cardinalis	northern cardinal	2	July 3
Cathartes aura	turkey vulture	1	July 3
Charadrius vociferus	killdeer	5	November 16
Circus hudsonius	northern harrier	3	November 16
Colaptes auratus	northern flicker	1	November 9
Colinus virginianus	northern bobwhite	2	August 8
Corvus brachyrhynchos	American crow	12	November 16
Corvus corax	raven	2	November 16
Cyanocitta cristata	blue jay	4	November 9

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[27] Hotspots are public birding locations created by eBird users and allow multiple birders to enter data into the same shared location.

[28] This is the "last observed" count as of December 2024.

Scientific Name	**Common Name**	**Count**[28]	**Date Observed (2024)**
Dryobates pubescens	downy woodpecker	1	November 9
Empidonax virescens	acadian flycatcher	2	May 18
Falco sparverius	American kestrel	1	July 3
Geothlypis trichas	common yellowthroat	4	July 3
Haliaeetus leucocephalus	bald eagle	1	September 29
Hirundo rustica	barn swallow	12	May 18
Hylocichla mustelina	wood thrush	2	May 18
Icteria virens	yellow-breasted chat	8	July 3
Junco hyemalis	dark-eyed junco	4	November 16
Meleagris gallopavo	wild turkey	26	November 16
Melanerpes carolinus	red-bellied woodpecker	1	November 9
Melospiza georgiana	swamp sparrow	2	November 9
Melospiza melodia	song sparrow	4	November 9
Mniotilta varia	black-and-white warbler	2	May 18
Passerino cyanea	indigo bunting	10	July 3
Petrochelidon pyrrhonota	cliff swallow	1	July 3
Pheucticus ludovicianus	rose-breasted grosbeak	1	September 29
Pipilo erythrophthalmus	eastern towhee	2	July 3
Piranga olivacea	scarlet tanager	2	July 3
Podilymbus Podiceps	pied-billed grebe	2	September 29
Poecile carolinensis	Carolina chickadee	4	November 16
Polioptila caerulea	blue-gray gnatcatcher	1	July 3
Regulus satrapa	golden-crowned kinglet	4	November 9
Sayornis phoebe	eastern phoebe	2	August 8
Scolopax minor	American woodcock	2	February 6
Seiurus aurocapilla	ovenbird	4	May 18
Setophaga americana	northern parula	3	May 18
Setophaga coronata	yellow-rumped warbler	2	November 9
Setophaga citrina	hooded warbler	1	July 3
Setophaga discolor	prairie warbler	2	August 8

Scientific Name	**Common Name**	**Count[28]**	**Date Observed (2024)**
Setophaga dominica	yellow-throated warbler	5	May 18
Setophaga ruticillla	American redstart	3	May 18
Setophaga virens	black-throated green warbler	2	May 18
Sialia sialis	eastern bluebird	1	August 8
Spinus tristis	American goldfinch	18	November 9
Spizella pusilla	field sparrow	2	August 8
Stelgidopteryx serripennis	northern rough-winged swallow	1	July 3
Sturnella magna	eastern meadowlark	21	November 16
Tachycineta bicolor	tree swallow	40	August 8
Thryothorus ludovicianus	carolina wren	2	November 9
Tringa solitaria	solitary sandpiper	2	August 8
Troglodytes hiemalis	winter wren	1	November 9
Turdus migratorius	American robin	35	November 9
Vireo flavifrons	yellow-throated vireo	2	July 3
Vireo griseus	white-eyed vireo	4	July 3
Vireo olivaceus	red-eyed vireo	4	July 3
Zenaida macroura	mourning dove	16	November 16
Zonotrichia albicollis	white-throated sparrow	5	November 9

Source: eBird 2024

5.4.1.1 Rare, Threatened, and Endangered Wildlife Resources

The OKNP KY-BAT and USFWS's IPaC tool were reviewed to identify rare, threatened, and endangered wildlife resources potentially occurring in the Project Vicinity. A request was submitted to OKNP on May 9, 2025 to review the KY-BAT and obtain a Standard Occurrence Report. OKNP's Standard Occurrence Report identified three sensitive wildlife species as having reported occurrences that intersected the Lewis Ridge Project Study Area: one insect with a reported occurrence in 1938 and two bat species each with a reported occurrence from 2007. OKNP's Standard Occurrence Report listed six bat species, two insect species, and one bird species with reported occurrences within the 5-mile buffer of the Lewis Ridge Project Study Area. Species specific information is being filed with FERC as a privileged document (Appendix I).

The USFWS IPaC tool was reviewed for the Lewis Ridge Project Study Area on May 9, 2025 (Project Code 2025-0094672). The IPaC identified seven wildlife threatened, endangered, candidate, or experimental population species potentially occurring in the Lewis Ridge Project Study Area (Table 5-19). There is no designated Critical Habitat for any species within the Lewis Ridge Project Study Area.

Table 5-19: Potentially Occurring Federal Listed, Proposed, and Candidate Wildlife Species in the Study Area

Common Name	Scientific Name	Status	Critical Habitat
Mammals			
gray bat	*Myotis grisescens*	Endangered	None designated
Indiana bat	*Myotis sodalist*	Endangered	Study area does not overlap with final designated critical habitat
northern long-eared bat	*Myotis septentrionalis*	Endangered	None designated
tricolored bat	*Perimyotis subflavus*	Proposed Endangered	None designated
Birds			
whooping crane	*Grus americana*	Experimental Population, Non-essential[29]	None designated
Amphibians			
eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*	Proposed Endangered	None designated
Insects			
monarch butterfly	*Danaus plexippus*	Proposed Threatened	None designated

Source: USFWS 2025

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[29] A population that has been established within its historical range under section 10(j) of the ESA to aid recovery of the species. The USFWS has determined a non-essential population is not necessary for the continued existence of the species. For the purposes of consultation, non-essential experimental populations are treated as threatened species on National Wildlife Refuge and National Park land (require consultation under 7(a)(2) of the ESA) and as a proposed species on private land (no Section 7(a)(2) requirements, but Federal agencies must not jeopardize their existence (section 7(a)(4))) (USFWS 2024b).

LRPS conducted bat surveys in 2024 and 2025 to determine if federally endangered bats are present at the Lewis Ridge Project. Bat surveys were conducted within the 2024 Study Area (Appendix J) and a revised 2025 Study Area (Appendix L) to determine the presence/probable absence of federally endangered bat species during the maternity season Mist-netting occurred during the maternal roosting season in accordance with the USFWS 2024 Range-wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines (USFWS 2024f) following the level of effort recommended for detection of Indiana, northern long-eared, and tricolored bats: 10 net nights per 123 acres of suitable habitat for nonlinear projects.

In 2024, forty net nights were conducted across the 2024 Study Area, meeting the minimum level of effort outlined in the guidelines for detection of Indiana, northern-long-eared, and tricolored bats. Surveys were completed within the first 5 hours following sunset from July 29 to 30 and from August 5 to 8, 2024. Individual mist net sites encompassed a variety of suitable bat habitat. In total, 22 individual bats of 5 species were captured: 11 big brown bats (*Eptesicus fuscus*), 7 red bats *(Lasiurus borealis*), 2 small-footed bats (*Myotis lebelii*), 1 gray bat (*Myotis grisescens*), and 1 adult male tricolored bat (*Perimyotis subflavus)* that was too small to radio-tag (Appendix J).

In 2025, a combination of mist netting and acoustic surveys were conducted. Three mist net sites and seven acoustic sites were surveyed, resulting in 30 net nights and 42 detector nights. Surveys were completed within the first 5 hours following sunset from May 15 to 22, 2025, except for May 16, 2025, and May 20, 2025, due to inclement weather. In total, 21 individual bats of 3 species were captured: 19 red bats, 1 silver-haired bat (*Lasionycteris noctivagans*), and 1 small-footed bat. Acoustic surveys, after manual vetting, identified the following species as likely present in the 2025 Study Area: big-eared bat (*Corynorhinus townsendii*), big brown bat, red bat, hoary bat (*Lasiurus cinereus*), silver-haired bat, gray bat, small-footed bat, little brown bat (*Myotis lucifugus),* evening bat (*Nycticeius humeralis*), and tricolored bat (Appendix L).

No Indiana bats or northern long-eared bats were captured during the 2024 or 2025 mist net surveys, nor were they detected during the acoustic survey, indicating these species are not likely present in the 2024 or 2025 Study Area during the maternity season or are present in numbers too low to be detected by the approved USFWS protocols. The tricolored bat and gray bat are confirmed present at the Lewis Ridge Project; one tricolored bat and one gray bat were captured in 2024, and one tricolored bat call and three gray bat calls were detected during the 2025 acoustic survey.

Additional surveys during 2025 included an assessment of the only known mine opening in the 2025 Study Area for presence/probable absence of Indiana bats, northern long-eared bats, tricolored bats, and gray bats. Surveys were conducted following the 2024 USFWS Range-wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines, specifically following Appendix H: Potential Hibernaculum Survey Guidance to determine bat presence/probable absence in potential hibernacula. Sampling was conducted over a period of 9 nights during April. A harp trap was deployed over the mine portal entrance for a period of 5 hours after sunset on each survey night. No bats were captured, suggesting that the species are not likely utilizing the portal as winter habitat. This mine portal entrance was closed on May 6, 2025, following the survey to exclude future potential use by bats.

Gray Bat

The gray bat is a highly colonial species in eastern North America distinguished from other species of the genus *Myotis* by its larger size and the uniformly gray fur on its back. The primary range of the species is centered in the cave regions of Alabama, Missouri, Arkansas, Kentucky, and Tennessee, with smaller populations found in adjacent states (USFWS 2009, Ozier et al. 2020). Gray bats inhabit caves year-round, occupying cold hibernating caves or mines in winter and dispersing to warmer maternity and bachelor caves during summer. Mating occurs in the fall prior to hibernation, and females deliver a single pup after arriving at the maternity cave in late May or early June. The summer caves are almost always near a river or reservoir, where gray bats feed on night-flying aquatic and terrestrial insects. Most foraging occurs over open water near a forested shoreline, and bats forage up to 12 miles or more from roost sites. A primary threat to the gray bat is anthropogenic disturbance to their caves. Infection of gray bats by the fungus causing white-nose syndrome, a disease that infects the skin of hibernating bats and has devastated populations of other bat species, is also a possible threat (Ozier et al. 2020). The gray bat has an approved recovery plan from 1982 (USFWS 1982).

One gray bat was captured during the 2024 bat survey (Appendix J), and three gray bat calls were detected with acoustic monitoring in 2024 (Appendix L). Capture of the adult reproductive gray bat confirmed presence during the maternity season within the Study Area. Gray bats do not roost in trees during the summer, and therefore, radio telemetry was not performed as it is almost impossible to track them during the day to find their underground roost. The only known mine portal was surveyed, and no bat species were captured, indicating the gray bat was not using the portal as winter habitat prior to closure. The presence of gray bats on the property indicates they forage there, but no gray bat hibernacula were identified in the Study Area. As such, forested acreage removal and earth moving activities associated with the Lewis Ridge Project will not impact their roosting habitat. (Copperhead 2024, 2025a, 2025b).

Indiana Bat

The Indiana bat is a nocturnal insectivore, emerging from roosts shortly after sunset, and feeding almost exclusively on flying insects, but will consume terrestrial prey on occasion (USFWS 2007). Summer roost habitats are underneath exfoliating bark in mature trees that receive direct sunlight for more than half a day. Foraging typically occurs in semi-open to closed forested habitats with an open understory, forested edges, or riparian or wetland areas. During the winter, Indiana bats are restricted to suitable underground hibernacula. Hibernacula are predominantly caves but can include other cave-like structures such as mines and shafts. Typical hibernacula provide variable vertical relief and a range of temperatures and microclimates during the winter months (USFWS 2007). Threats to Indiana bat include human disturbance of hibernating bats, loss of summer habitat, pesticides and other contaminants, and white-nose syndrome (USFWS 2022). The Indiana bat has a draft recovery plan from 2007 (USFWS 2007).

In association with the mining facility’s permitting process, mist netting, acoustic monitoring, and habitat assessments were performed for the Indiana bat near the lower reservoir location in 2010. The report concluded that the Indiana bats were not using the then proposed permit area as summer roost or forage habitat and no portals were located that would provide potential winter habitat to bats (Biological Systems 2010). No Indiana bats were captured during the 2024 or 2025 bat surveys (Appendix J, Appendix K, and Appendix L), indicating the species is not likely present within the Lewis Ridge Project Study Area during the maternity season or is present in numbers too low to be detected by approved USFWS protocols (Copperhead 2024, 2025b).

Northern Long-eared Bat

The northern long-eared bat, distinguished from other species of *Myotis* by its long ears, is a wide-ranging species found in a variety of forested habitats in summer and hibernates in caves in winter (USFWS 2016). The species is found across eastern and north-central U.S. and southern Canada and is generally associated with old-growth forests (NatureServe 2021). Northern long-eared bats overwinter in hibernacula that include caves and abandoned mines (USFWS 2016). Rarely are there more than 100 individuals per hibernation colony (NatureServe 2021). Mating occurs in late summer or fall prior to hibernation, and each female delivers a single pup in June or early July. In summer, the bats generally are colonial but tend to be more solitary than other *Myotis* species, often roosting alone in deep cracks and crevices, under bark, or in hollows of live and dead trees. Foraging occurs within forests, along forest edges and clearings, and occasionally over ponds. Principal threats to the species include human disturbance of hibernating bats and mortality due to white-nose syndrome (USFWS 2016). No northern long-eared bats were captured during the 2024 or 2025 bat surveys (Appendix J, Appendix K, and Appendix L) indicating the species is not likely present within the Lewis Ridge Project Study Area during the maternity season or is present in numbers too low to be detected by approved USFWS protocols (Copperhead 2024, 2025b).

Tricolored Bat

The tricolored bat is found throughout the forests of the eastern United States, Canada and Mexico, and as far west as Minnesota and Texas (USFWS 2024b). The tricolored bat is found in Kentucky in the summer and during migration (Kentucky DFWR 2024). Tricolored bat maternity colonies are small, forming in hollow trees, buildings, and caves during the summer. Males are likely solitary, roosting in trees, crevices, caves, and mines (Kentucky DFWR 2024). Tricolored bats most frequently hibernate in caves, but also utilize mines, rock shelters, and quarries near the summer roosts (Kentucky DFWR 2024). White-nose syndrome continues to be the primary threat to this bat species within Kentucky. Aside from stopping the spread of white-nose syndrome, destruction of roost sites due to deforestation and disturbances to hibernacula and maternity colonies are other potential threats to the species (USFWS 2024b).

One adult male tricolored bat was captured during the 2024 bat survey (Appendix J), and one additional bat call was detected during the 2025 acoustic survey (Appendix L). Capture of the adult male tricolored bat confirmed presence during the maternity season within the Study Area (Copperhead 2024).

Whooping Crane

The whooping crane (*Grus americana*) occurs within Canada and the United States. The whooping crane breeds, migrates, winters, and forages in a variety of habitat, including coastal marshes and estuaries, inland marshes, lakes, open ponds, shallow bays, salt marsh, upland swales, wet meadows and rivers, and pastures/agricultural fields. The species has experienced population declines and strict legal protection, habitat preservation, captive breeding, and international cooperation between Canada and the United States have helped promote recovery of the species (USFWS 2024c). Four populations of whooping cranes currently exist in the wild, with the Aransas-Wood Buffalo population as the only self-sustaining remnant of the original migratory population. Three additional distinct populations (Florida (non-migratory), Eastern Migratory, and Louisiana (non-migratory) populations) have been introduced within the United States and are considered experimental and nonessential to the whooping crane population as designated by the ESA (CCS 2019). The Eastern Migratory population was created and intended to breed in central Wisconsin and winter between the central Gulf Coast of Florida and southeastern United States (CCS 2019). The current estimated population size of the Eastern Migratory population is 72, with 15 individuals being wild-hatched and the remaining captive-reared. In February 2024, most birds stayed at their typical wintering grounds, but some had begun their northward migration with warmer temperatures. As of March 1, 2024, 3 individuals were in Wisconsin, 4 in Illinois, 28 in Indiana, 8 in Kentucky, 14 in Alabama, and 2 in Georgia (the remaining birds' locations had not been confirmed) (ICF 2024). While the migratory population numbers are low, it is possible a whooping crane may fly through the Project Vicinity during migration.

Eastern Hellbender

The eastern hellbender is a large, fully aquatic salamander species that inhabits cool, fast-flowing, well-oxygenated streams and rivers with abundant rocky substrates. Adults primarily utilize large rocks for cover (Center for Biological Diversity 2025). Breeding generally occurs in late-summer and early-fall months. Nests are created in gravel substrates below large, flat rocks. Males fertilize the eggs and guard nests for several weeks. Newly hatched larvae develop rapidly and maintain external gills until the second summer after hatching. Sexual maturity generally occurs at 5 to 8 years (USDA 2025). Crayfish make up a majority of adult hellbender diets. Additional forage for adults includes fish and insects. Larvae primarily feed on aquatic insects. Predators of eastern hellbender include raccoons, river otters, and predatory fish, including trout species. Multiple fish species also predate on eastern hellbender eggs and larvae. Populations have declined due to sedimentation, pollution, habitat destruction, and disease, and have been extirpated from much of their historic range (USDA 2025).

The 2025 Aquatic Baseline Assessment (Appendix H) noted that eastern hellbender habitat is not present within Tom Fork. The Upper Cumberland River may provide suitable eastern hellbender habitat within the Project Vicinity. An aquatic resources assessment of the Cumberland River is planned in 2025 when water levels are safe for survey.

Monarch Butterfly

Monarch butterfly is a candidate species not yet proposed for listing under the ESA of 1973 (USFWS 2020). The species is a large and conspicuous butterfly that exhibits long-distance migration and overwinters as adults at forested locations in Mexico and California. Adult monarch butterflies feed on nectar from a wide variety of flowers. Reproduction is dependent on the presence of milkweed (*Asclepias* spp.), the sole food source for larvae. Larvae develop and feed on the milkweed plant, sequestering chemicals as a defense against predators. Adults live up to six to nine months, and multiple generations are produced over the course of the breeding season. Monarch butterflies occur across the continental U.S., but populations have been declining over the past 20 years. Primary threats to the species include the loss and degradation of habitat from conversion of grasslands to agriculture, widespread use of herbicides, exposure to insecticides, land-clearing activities in overwintering sites, urban development, and general loss of milkweed and nectar sources across the species' range from various land development activities (USFWS 2020). Milkweed is known to occur in Bell County, Kentucky and may be present within grassland habitat in the Project Vicinity. Milkweed was not observed in the Study Area during the various site visits and resources studies conducted.[30] Given the lack of documented milkweed in the Study Area, suitable habitat for this species is not likely present in the Study Area.

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[30] Vegetative species observed in the Study Area based on observations from Kleinschmidt, Copperhead, and EcoSource, Inc. during site visits, bat survey, wetland assessments, and vegetation surveys are documented in Section 5.5.

5.4.1.2 Invasive Wildlife Species

Wild pigs (*Sus scrofa*) are a non-native invasive species known to Kentucky and have the potential to occur in the Project Vicinity. Wild pigs in Kentucky are the result of released domestic pigs and hybrids of domestic and Eurasian boar. They are highly adaptable to a variety of habitats and have a high reproductive potential, making population control difficult. In favorable habitat conditions, sows can breed as young as five to ten months old and are capable of producing litters of three to eight piglets twice a year. (Kentucky DFWR 2022).

Mute swans (*Cygnus olor*) are a non-native, bird species in Kentucky that was introduced to the United States to decorate lakes and ponds often in parks and zoos. They are known to be aggressive to other bird species, reduce availability of resources needed for other waterfowl, and cause damage by trampling nests of other bird species (USFWS 2018; Kentucky DFWR 2008). European starlings (*Sturnus vulgaris*) were also introduced in Kentucky and threaten native bird species that nest in cavities. European starlings are known to cause crop damage and are considered a nuisance bird in Kentucky nearly year around because of large flock size (Kentucky DFWR 2008).

Several invasive insect species have been reported in Kentucky including the kudzu bug (*Megacopta cribraria*), spongy moth (Lymantria dispar), imported fire ant (*Solenopsis invicta*), Asian longhorned tick (*Haemaphysalis longicornis)*, spotted lanternfly (*Lycorma delicatula*), and emerald ash borer (*Agrilus planipennis*) (Giffin 2023). Kudzu bug was first found in Bell, Christian, Laurel, Perry, and Whitley counties of Kentucky in 2015 and is a significant pest of soybean and other legume crops in the southeast (University of Kentucky 2024a). Since its discovery in 2009, the emerald ash borer has spread dramatically throughout Kentucky, and infestations have been found in Bell County, Kentucky (University of Kentucky 2024b). Emerald ash borers kill ash trees within three to five years after they become infested. Spread is caused by short-range dispersal flights of the insect and long-distance transport of infested wood, primarily firewood. (University of Kentucky 2024b).

5.4.1.3 Migratory Birds and the Bald and Golden Eagle Protection Act

Certain birds are protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. One migratory bird listed by the USFWS as a Bird of Conservation Concern (BCC), the wood thrush (*Hylocichla mustelina*), potentially occurs in the area associated with the Lewis Ridge Project Study Area. The wood thrush is designated as a BCC throughout its range in the continental United States and Alaska, and breeds between May 10 and August 31. The wood thrush inhabits forested areas, particularly those dominated by deciduous trees (USFWS 2024d).

The bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. The IPaC report noted no documented cases of bald or golden eagles being present in the Study Area. The KDFWR conducted aerial and ground surveys of all known eagle nests, statewide from 1986 to 2019 (Kentucky DFWR 2023b). Bell County, Kentucky did not have any known eagle nests from 2000 to 2023 (Kentucky DFWR 2023).

5.4.2 Potential Impacts of the Proposed Lewis Ridge Project

The Lewis Ridge Project features will primarily be located within areas previously disturbed for mining activities. Vegetation clearing will result in the alteration of habitat for the construction of project facilities and potentially displace terrestrial wildlife. The wildlife resources in the region are well understood and it is expected that common terrestrial wildlife inhabit or use the Project Vicinity, including small and large mammals, birds, reptiles, and amphibians. Elk in the Project Vicinity have been documented transversing large areas over short timeframes, and the presence of the water conveyance is not expected to limit mobility or reduce access to habitat for elk and other species that inhabit the area.

The Applicant does not anticipate the Lewis Ridge Project to impact any caves (or associated wildlife in caves) within the Study Area.[31] Surveys of the only known mine opening in the Lewis Ridge Project area did not document bat presence. Based on negative results of the mist-net surveys for Indiana and northern long-eared bats, the Lewis Ridge Project will have no effect on summer populations of these bat species. The capture of a tricolored bat, which are proposed for listing, indicates that the Lewis Ridge Project may affect summer populations of the species but is not likely to jeopardize the survival of the species. The capture of a gray bat, which forages but has no known

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[31] LRPS submitted a data request to the Kentucky Speleological Survey (KSS) on August 1, 2024, to determine the presence of any caves within the Study Area. Search of the KSS database did not identify any cave locations within the Study Area.

hibernacula or maternity roosts in the Study Area, indicates that the Lewis Ridge Project may affect but is not likely to adversely affect the species.

There are no anticipated impacts to wildlife-related recreational activities as recreation is not permitted on the private property with active and reclaimed mining operations; due to the industrial nature of this land, public access is restricted for public safety.

The Lewis Ridge Project has the potential to impact terrestrial wildlife temporarily and permanently within the limits of disturbance during and after construction due to increased noise and human presence. In addition, the Lewis Ridge Project will permanently alter the habitat within the construction footprint, including land that will be inundated for the development of the upper and lower reservoirs, which would result in the permanent displacement of terrestrial wildlife habitat.

5.4.3 Agency Consultation and Applicant Recommendations

5.4.3.1 Agency Consultation

Documentation of consultation is provided in Appendix A. Consultation specific to wildlife resources is summarized below.

On February 9, 2022, USFWS submitted preliminary comments in response to FERC's December 16, 2021 notice of Preliminary Permit Application to assist FERC and LRPS in assessing the potential environmental impacts of construction and operation of the proposed project. USFWS's comments included PM&E measure recommendations. In addition, USFWS recommended evaluating the following related to wildlife resources:

- Potential impacts to wildlife related recreational activities.
- Potential impacts to wildlife resources resulting from interconnection corridor alignment and the Lewis Ridge Project's footprint.
- Potential effects of alkaline water conditions within reservoirs on waterfowl.

LRPS conducted a meeting with the USFWS on September 9, 2022, at which USFWS identified the following wildlife species of interest: federally listed bats, yellow-spotted salamander (not currently listed under the ESA), and monarch butterfly (candidate for listing under ESA). USFWS requested LRPS to determine if the Lewis Ridge Project will impact any caves, and recommended LRPS to either conduct a bat survey or assume presence of protected bats at the Lewis Ridge Project.

On November 23, 2022, USEPA commented on the NOI and PAD providing recommendations and considerations for FERC to include in its draft NEPA document. USEPA recommended inclusion of plans to provide passages for local wildlife that may be affected by the proposed steel penstock, if the penstock structure would be attached/flushed to the ground instead of buried.

LRPS distributed a Draft Study Plan on June 13, 2024. The Draft Study Plan included one study related to wildlife resources, the bat survey. LRPS did not receive any comments specific to the bat survey study plan. LRPS filed the Revised Study Plan with FERC on August 16, 2024.

The Kentucky DEP submitted comments on April 6, 2023 (following the Joint Agency and Public Meeting), on July 9, 2024 (following the distribution of the Draft Study Plan), and on October 28, 2024 (following the distribution of the DLA). In the comments, the Kentucky DEP requested review of the OKNP's KY-BAT to obtain a standard occurrence report for sensitive species within the Lewis Ridge Project area. LRPS obtained a standard occurrence report from OKNP on May 9, 2025, and results are summarized in applicable sections of this Exhibit E and provided in Appendix I, Rare Species Reports (Privileged).

USFWS provided an official species list for the Lewis Ridge Project on July 19, 2024, and on May 9, 2025, identifying threatened, endangered, proposed, and candidate species that may occur in the Study Area of the Lewis Ridge Project. Results are summarized in applicable sections of this Exhibit E and provided in Appendix I.

LRPS filed its DLA on September 30, 2024. The Environmental Report (Exhibit E) of the DLA included the listed bat presence/probable absence survey study report. The USEPA, FERC, and Kentucky DEP provided comments on the DLA or accompanying study reports related to wildlife resources. The USEPA requested inclusion of potential impacts associated with discharge of dredged or fill material to wildlife associated with aquatic ecosystems. FERC requested an updated IPaC be performed with additional discussion on the potential project-related effects on all federally listed, proposed, and candidate species and their habitats; and additional information on elk reintroduction, avian protection measures, and existing subsurface mine cavities and associated protective bat measures. Kentucky DEP reiterated the availability of its KY-BAT tool to obtain a standard occurrence report for sensitive species within the Lewis Ridge Project area. As appropriate, LRPS addressed comments in the FLA and in the accompanying Summary Response Table to Comments provided in Appendix A.

5.4.3.2 Applicant Recommendations

LRPS proposes to implement the following PM&E measures to minimize impacts on wildlife resources:

- Where practicable, construction activities, infrastructure, and man-made structures (e.g., roads, parking lots, staging areas) will be concentrated on lands already altered. Implementation of this recommendation by the USFWS will minimize habitat fragmentation.
- Revegetation of disturbed areas with seed mixes to promote growth of native grasses and forbs that will provide habitat for elk and grassland obligate species. Planned management activities, including planting and maintenance of disturbed areas, are described in the Vegetation Management Plan (Appendix D).
- LRPS will implement a Wildlife Management Plan that includes measures to avoid and minimize impacts to wildlife resources during construction and operation of the Lewis Ridge Project (Appendix C).

5.4.4 References

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5.5 Botanical Resources (18 CFR § 4.41 (f)(3))

5.5.1 Existing Environment

The Lewis Ridge Project is located in the Cumberland Mountain Thrust Block (Level IV ecoregion 69e) within the Central Appalachians ecoregion (Level III ecoregion 69), which consists primarily of forested high, steep ridges, hills, coves, narrow valleys, and the Pine Mountain Overthrust Fault (Woods et al. 2002). In general, maximum elevations are greater in this ecoregion than elsewhere in Kentucky. Forest composition is highly variable, and is influenced by local aspect, slope position and gradient, topographic shading, soil moisture, and past land usage (Woods et al. 2002).

The ecoregion was formerly dominated by American chestnut (*Castanea dentata*) on drier sites. Following logging and the disappearance of American chestnut in the mid-twentieth century, second- or third-growth forests typically contain white oak (*Quercus alba*), black oak (*Quercus velutina*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), yellow poplar (*Liriodendron tulipifera*), black walnut (*Juglans nigra*), black locust (*Robinia pseudoacacia*), hickory (*Carya spp.*), white ash (*Fraxinus americana*), American beech (*Fagus grandifolia*), black cherry (*Prunus serotina*), buckeye (*Aesculus spp*), Eastern hemlock (*Tsuga canadensis*), and American basswood (*Tilia americana*) (Woods et al. 2002). Forests are mixed on mesic sites, dominated by American beech, yellow poplar, sugar maple, and white oak, with co-dominants of ash, black walnut, buckeye, basswood, northern red oak (*Quercus rubra*), and others. On drier sites, white oak and hickories dominate the landscape. Pines (*Pinus spp.*) tend to dominate areas with shallow, sandy soils on steep-dipping sandstone. Species composition within shady gorges features eastern hemlock and various magnolias (*Magnolia spp.*) with an understory of rhododendrons (*Rhododendron spp.*) (Woods et al. 2002).

Conversely, areas heavily impacted by anthropogenic disturbances, such as mining, are often dominated by invasive shrubs, forbs, grasses, and early-successional tree species (Kentucky EEC 2022). Invasive species are discussed in Section 5.5.1.2. Common forbs on previously disturbed sites include narrow-leaf pinweed (*Lechea tenuifolia*), Ozark tickseed sunflower (*bidens polylepis*), and Pennsylvania smartweed (*polygonum pensylvanicum*). Common grasses include fescues (*Festuca spp.*) and oatgrass (*Danthonia spp.*). Common early-successional tree species include Virginia pine (*Pinus virginiana*) and black tupelo (*Nyssa sylvatica*) (Reiss 1986).

Forest structure documented during 2024 bat survey (Listed Bat Presence/Probable Absence Survey) included a mixed deciduous hardwood composition throughout much of the Study Area, with areas of more open land associated with reseeded mining areas (Appendix J). Some diversity in age of trees was documented, with a tree diameter range of 5 to 40 inches at breast height. The most common tress species in the Study Area included box elder (*Acer negundo*), tulip tree (*Liriodendron tulipifera)*, American sycamore *(Platanus occidentalis)*, and Virginia pine.

A vegetation community assessment was conducted in the Lewis Ridge Study Area in 2025 (Appendix M). The vegetation community assessment noted that historical logging and coal mining disturbances have influenced the structure and distribution of existing forest communities with many areas resulting in patchwork forests with a range of age classes and species compositions. Vegetation communities observed during the study were categorized as mixed evergreen deciduous forest (mixed forest), deciduous hardwood forest, disturbed shrubland, and disturbed herbaceous vegetation. Vegetation communities were mapped, and areas of nonnative vegetation were documented. Mature deciduous forest and disturbed shrubland comprised over half of the total acreage within the Study Area.

Vegetation communities mapped in the Study Area are outlined in Figure 5-30. Vegetative communities, observed disturbance, and invasive species presence in the proposed Project Boundary are described in Table 5-20 below.

Table 5-20: Vegetative Communities in the Proposed Project Boundary

Vegetation Community	Area within Proposed Project Boundary (Acres)	Estimated Tree Stem Density (Stems/Acre)	Disturbance*	Invasive Species**
Disturbed Herbaceous	48	NA	Surface mined, highwall mined, mine roads	**kudzu, tall fescue, coltsfoot, sericea lespedeza
Disturbed Shrubland	98	NA	Surface mined, highwall mined, mine roads	**autumn olive, European privet, tree of heaven, sericea lespedeza
Mature Deciduous Forest	158	230	Portions highwall mined, mine roads	tree of heaven, Queen Anne's lace, autumn olive, winter creeper, ground ivy, purple dead nettle, sericea lespedeza, field cress, Japanese knotweed, honeysuckle species
Mature Mixed Forest	82	260	Mine roads	autumn olive, sericea lespedeza, multiflora rose, common chickweed, tall fescue, honeysuckle species
Young Deciduous Forest	4	470	Mine roads	multiflora rose, common chickweed, honeysuckle species
Young Mixed Forest	6	370	Surface mined, mine roads	royal paulownia, kudzu, Japanese knotweed, Japanese barberry, autumn olive, privet

Source: Copperhead 2025

* Forest cover in the Study Area includes second- or third-growth forests with signs of disturbance within approximately the last 50 to 100 years.

**Invasive species generally comprise 20 percent or more of total vegetation cover.

Deciduous forests and mixed forests are generally located on steep slopes, ridgetops, and adjacent to waterways. Dominant tree species in both community types generally included oaks (*Quercus* species), hickories (*Carya* species), American beech, and tulip tree. Additional dominant tree species in mixed forests included eastern redcedar (*Juniperus virginiana*), white pine (*Pinus strobus*) and Virginia pine (*Pinus virginiana*). Canopy cover in both deciduous forest and mixed forest are generally greater than 60 percent, and understory density is variable depending on slope, aspect, soil type, and hydrologic conditions. Young deciduous and mixed forests are generally comprised of abundant fast-growing species, including tulip tree. Mature deciduous and mixed forest are generally comprised of larger trees (>12-inch diameter at breast height and up to 40-inch diameter at breast height) with denser canopy cover and more open understory.

Disturbed shrublands are generally documented in areas where mining has impacted the landscape. Much of the woody vegetation cover is comprised of plants with diameter at breast height of less than 3 inches. Woody invasive species, including autumn olive (*Elaeagnus umbellata*) comprise a large percentage of the woody vegetation. Native shrubs include eastern redbud (*Cercis canadensis*) and serviceberry (*Amelanchier arborea*). Disturbed herbaceous areas are comprised of greater than 25 percent cover of graminoids, forbs, and ferns, and less than 25 percent cover of trees and shrubs. Community composition in disturbed herbaceous areas is impacted by soil type (e.g., exposed rock, shallow soils, or well-formed soils) and abundance of non-native invasive vegetation (Appendix M). Documented vegetation communities are described in Figure 5-30. Botanical species observed in the Study Area during site visits in May, October, and November 2022, June, July, and August 2024, and April 2025 are included in Table 5-21.

The upper reservoir location encompasses an area that is largely comprised of disturbed shrubland. This area was historically surface mined and reseeded and largely consists of cool season grasses and lespedeza. Shrubs include woody invasive species (e.g., autumn olive, European privet) and native species (e.g., eastern redbud, serviceberry, and eastern redcedar). The water conveyance traverses mature deciduous forest, disturbed shrubland, and young mixed forest. The lower reservoir encompasses areas of mature mixed forest and disturbed herbaceous communities. Kudzu (*Pueraria lobata*) is ubiquitous throughout the disturbed herbaceous portion of the lower reservoir. The fill areas are located in hollows, comprised of mature deciduous forest, mature mixed forest, and disturbed herbaceous communities. The proposed interconnection line traverses all the mapped community types in the Study Area.

Figure 5-30: Vegetation Communities at the Lewis Ridge Project

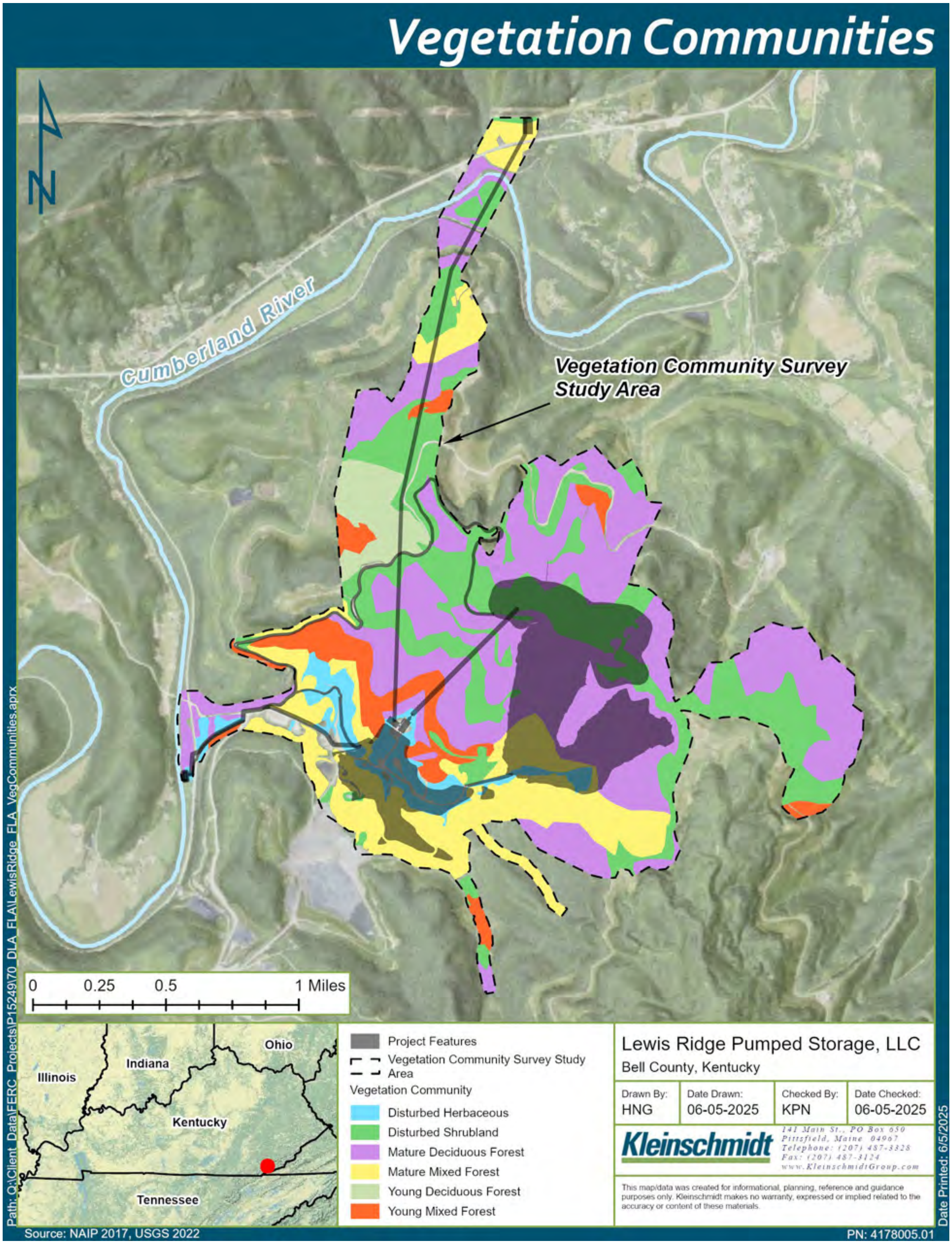

Table 5-21: Botanical Species Observed in Study Area

Scientific Name	Common Name	Native and/or Non-native
Acer negundo	box elder	Native
Acer rubrum	red maple	Native
Acer saccharum	sugar maple	Native
Aesculus flava	yellow buckeye	Native
Agrimonia rostellata	woodland agrimony	Native
Ailanthus altissima	tree-of-heaven	Non-native
Albizia julibrissin	silktree	Non-native
Allium vineale	field garlic	Non-Native
Ambrosia artemisiifolia	common ragweed	Native
Ambrosia trifida	giant ragweed	Native
Amelanchier arborea	serviceberry	Native
Andropogon virginicus var. decipiens	deceptive bluestem	Native
Andropogon virginicus var. virginicus	broomsedge	Native
Antennaria plantaginifolia	plantain-leaved pussytoes	Native
Aplectrum hyemale	puttyroot	Native
Arctium minus	burdock	Non-native
Berberis thunbergii	Japanese barberry	Non-native
Betula lenta var. lenta	sweet birch	Native
Betula nigra	river birch	Native
Bignonia capreolata	cross-vine	Native
Boehmeria cylindrica	false nettle	Native
Cardamine dissecta	fork-leaf toothwort	Native
Cardamine hirsuta	hairy bittercress	Non-native
Carpinus caroliniana	American hornbeam	Native
Carex nigromarginata	black-edged sedge	Native
Caulophyllum thalictroides	blue cohosh	Native
Cercis canadensis	redbud	Native
Chimaphila maculata	spotted wintergreen	Native
Claytonia caroliniana	Carolina spring beauty	Native
Dactylis glomerata	orchard grass	Non-native
Danthonia spicata	poverty oatgrass	Native
Daucus carota	Queen Anne's lace	Non-native
Dendrolycopodium obscurum	common tree-clubmoss	Native
Dichanthelium boscii	Bosc's panic grass	Native

Scientific Name	**Common Name**	**Native and/or Non-native**
Diospyros virginiana	common persimmon	Native
Dryopteris marginalis	marginal wood fern	Native
Elaeagnus umbellata	autumn olive	Non-native
Elymus virginicus	Virginia wild rye	Native
Epigaea repens	trailing arbutus	Native
Euonymus fortune	winter creeper	Non-native
Eutrochium fistulosum	Joe-pye weed	Native
Fagus grandifolia	American beech	Native
Festuca spp.	festuca	Both
Fraxinus pennsylvanica	green ash	Native
Galium aparine	cleavers	Native
Gaultheria procumbens	wintergreen	Native
Geranium maculatum	wild geranium	Native
Glechoma hederacea	ground ivy	Non-native
Gleditsia triacanthos	honeylocust	Native
Halesia tetraptera	common silverbell	Native
Heuchera pubescens	marbled alumroot	Native
Hexastylis arifolia var. ruthii	Appalachian little brown jug	Native
Hydrangea arborescens	wild hydrangea	Native
Ilex opaca var. opaca	American holly	
Impatiens capensis	jewelweed	Native
Iris cristata	dwarf crested iris	Native
Juglans nigra	black walnut	Native
Juniperus virginiana	eastern red cedar	Native
Kalmia latifolia	mountain laurel	Native
Lamium purpureum	purple dead nettle	Non-native
Lespedeza cuneata	sericea lespedeza	Non-native
Leucanthemum vulgare	oxeye daisy	Non-native
Ligustrum vulgare	privet	Non-native
Lindera benzoin	spicebush	Native
Liquidambar styraciflua	sweetgum	Native
Liriodendron tulipifera	tulip poplar	Native
Lolium arundinaceium	tall fescue	Non-native
Lonicera maackii	amur honeysuckle	Non-native
Lonicera spp.	Honeysuckle	Both

Scientific Name	**Common Name**	**Native and/or Non-native**
Melilotus alba	white sweet clover	Non-native
Melilotus officinalis	yellow sweet clover	Non-native
Medicago sativa	alfalfa	Non-native
Microstegium vimineum	Japanese stilt grass	Non-native
Mitchella repens	partridge-berry	Native
Osmorhiza claytonii	sweet cicely	Native
Paulownia tomentosa	royal paulownia	Non-native
Penstemon spp.	penstemon	Both
Phytolacca americana	American pokeweed	Native
Pinus strobus	eastern white pine	Native
Pinus virginiana	Virginia pine	Native
Plantago rugelii	American plantain	Native
Platanus occidentalis	American sycamore	Native
Podophyllum peltatum	mayapple	Native
Polygonum cuspidatum	Japanese knotweed	Non-native
Polystichum acrostichoides	Christmas fern	Native
Potentilla canadensis	dwarf cinquefoil	Native
Potentilla indica	Indian-strawberry	Native
Populus deltoides	cottonwood	Native
Prunus serotina var. serotina	black cherry	Native
Pueraria montana var. lobata	kudzu	Non-native
Quercus alba	white oak	Native
Quercus montana	chestnut oak	Native
Quercus rubra	red oak	Native
Ranunculus bulbosus	bulbous buttercup	Non-native
Reynoutria japonica	Japanese knotweed	Non-native
Rhus typhina	staghorn sumac	Native
Rhododendron maximum	great laurel	Native
Rhus typhina	staghorn sumac	Native
Robinia pseudoacacia	black locust	Native
Rosa multiflora	multiflora rose	Non-native
Rubus spp.	raspberry	Native
Rudbeckia hirta	blackeyed Susan	Native
Rumex crispus	curly dock	Non-native
Salix interior	sandbar willow	Native

Scientific Name	**Common Name**	**Native and/or Non-native**
Salix nigra	black willow	Native
Sambucus spp.	elderberry	Native
Sanguinaria canadensis	bloodroot	Native
Sanicula canadenis var. canadensis	black snakeroot	Native
Schoenoplectus tabernaemontani	soft-stem bulrush	Native
Scirpus atrovirens	dark-green bulrush	Native
Scirpus cyperinus	woolgrass	Native
Smilax rotundifolia	common greenbrier	Native
Solidago spp.	goldenrod	Native
Stellaria media	common chickweed	Non-native
Symphoricarpos orbiculatus	coralberry	Native
Taraxacum officinale	common dandelion	Non-native
Thlaspi alliaceum	roadside pennycress	Non-native
Tiarella cordifolia	heart-leaved foamflower	Native
Tipularia discolor	cranefly orchid	Native
Trifolium pratense	red clover	Non-native
Trillium sulcatum	southern red trillium	Native
Tussilago farfara	coltsfoot	Non-native
Toxicodendron radicans	poison ivy	Native
Typha angustifolia	narrowleaf cattail	Non-native
Ulmus americana	American elm	Native
Ulmus rubra	slippery elm	Native
Uvularia grandifloria	large-flowered bellwort	Native
Uvularia perfoliata	perfoliate bellwort	Native
Vaccinium corymbosum	highbush blueberry	Native
Vaccinium pallidum	early lowbush blueberry	Native
Veronica persica	bird’s-eye speedwell	Non-native
Viola hastata	halberd-leaved yellow violet	Native
Viola sororia	common blue violet	Native
Vitis spp.	wild grape	Native
Zizia aptera	heart-leaf golden-alexanders	Native

Source: Kleinschmidt Associates 2022, 2024; EcoSource, Inc. 2024; Copperhead 2024, 2025. This list is based on observations from May, October, and November 2022,June, July, and August 2024, and April 2025 site visits, bat surveys, wetland assessments, and vegetation assessments.

5.5.1.1 Rare, Threatened, and Endangered Botanical Resources

The USFWS IPaC tool was reviewed for the Lewis Ridge Project Study Area on May 9, 2025. The IPaC did not identify any federal listed botanical species in the Lewis Ridge Project Study Area (USFWS 2025).

A request was submitted to the OKNP on May 9, 2025, to perform review of the KY-BAT and obtain a Standard Occurrence Report. OKNP's Standard Occurrence Report identified one botanical species that intersected the Lewis Ridge Project Study Area with an observation date within the Study Area occurring in 1937 (OKNP 2025). OKNP's Standard Occurrence Report listed 13 botanical species with reported occurrences within the 5-mile buffer of the Lewis Ridge Project Study Area. Species specific information is being filed with FERC as a privileged document (Appendix I, Rare Species Reports [Privileged]). The OKNP Rare Plant Database lists 29 endangered, threatened, or species of conservation concern plants with known occurrences in Bell County (OKNP 2018) (Table 5-22). Desktop review and field surveys were conducted to identify potential Roan Mountain goldenrod habitat, which is the only federal listed species identified in the OKNP. No suitable habitat for the species was documented at the Lewis Ridge Project Study Area (Appendix M).

Table 5-22: Rare, Threatened, and Endangered Plant Species with Known Records of Occurrence in Bell County, Kentucky

Scientific Name	Common Name	Federal Status[a]	KY Status[b]	Global Rank, State Rank[c]
Adlumia fungosa	Allegheny-vine	-	H	G4, SH
Amianthium muscitoxicum	fly poison	-	T	G4G5, S1
Baptisia tinctoria	yellow wild indigo	-	T	G5, S1S2
Boykinia aconitifolia	brook saxifrage	-	T	G4, S2
Calamagrostis odali ssp. Porteri	Porter's reedgrass	-	T	G4T4, S2S3
Calopogon tuberosus var. tuberosus	tuberosus grass pink	-	E	G5T5, S1
Capnoides/Corydalis sempervirens	rock harlequin	-	S	G5, S3?
Carex austrocaroliniana	tarheel sedge	-	S	G4, S3
Castanea pumila	Allegheny chinkapin	-	T	G5, S2
Chelone obliqua var. obliqua	red turtlehead	-	E	G4T3T4Q, S1

Scientific Name	Common Name	Federal Status[a]	KY Status[b]	Global Rank, State Rank[c]
Chrysosplenium americanum	American golden-saxifrage	-	T	G5, S2?
Convallaria montana	American lily-of-the-valley	-	E	G4?, S1
Deschampsia/Avenella flexuosa	crinkled hairgrass	-	T	G5, S2
Gentiana decora	showy gentian	-	S	G4?, S3
Houstonia serpyllifolia	Michaux's bluets	-	E	G4?, S1
Lathyrus venosus	smooth veiny peavine	-	S	G5, S2S3
Liparis loeselii	Loesel's twaybay	-	T	G5, S2S3
Listera smallii	kidney-leaf twaybay	-	T	G4, S2
Melampyrum lineare var. latifolium	American cowwheat	-	T	G5T5, S2
Monotropsis odorata	sweet pinesap	-	T	G3, S2
Polytrichum pallidisetum	a hair cap moss	-	T	G5, S2?
Prosartes maculata	nodding mandarin	-	S	G4, S3?
Salvia urticifolia	nettle-leaf sedge	-	E	G5, S1
Silene ovata	ovate catchyfly	-	E	G3, S1
Solidago curtisii	Curtis' goldenrod	-	T	GNR, S3
Solidago puberula	downy goldenrod	-	S	G5, S2
Solidago roanensis	Roan Mountain goldenrod	LT	T	G4G5, S1S2
Trillium undulatum	painted trillium	-	T	G5, S2
Veratrum parviflorum	Appalachian bunchflower	-	E	G4?, S1

Source: OKNP 2018

A – Federal status: LE = listed endangered; LT = listed threatened; C = candidate species, not yet listed or proposed for listing; SOMC = Species of Management Concern.

B – Kentucky state status: E = endangered; T = threatened; S = special concern; H=historic.

C – Global ranks: G1 = critically imperiled, at very high risk of extinction due to extreme rarity; G2 = imperiled, at high risk of extinction due to very restricted range; G3 = vulnerable, at moderate risk of extinction due to restricted range; G4 = apparently secure, uncommon but not rare; G5 = secure – common, widespread, abundant; G#? = denotes inexact numeric rank; GNR = unranked, conservation status not yet assessed; G#Q = questionable taxonomy that may reduce conservation priority; G#T# = T denotes rarity of a subspecies.

State ranks: S1 = critically imperiled, at very high risk of extinction due to extreme rarity; S2 = imperiled, at high risk of extinction due to very restricted range; S3 = vulnerable, at moderate risk of extinction due to restricted range; S4 = apparently secure, uncommon but not rare; S5 = secure – common, widespread, abundant; S#? = denotes inexact numeric rank; S#B = refers to breeding population in Kentucky; S#N = refers to non-breeding population in Kentucky.

5.5.1.2 Invasive Botanical Species

Lands in the Central Appalachians ecoregion have been subject to disturbance by activities such as mining, logging, fire, loss of American chestnut, and infestation of southern pine beetles, which have allowed for the spread of non-native invasive species. These previously disturbed landscapes exhibit altered vegetative communities, which are dominated by introduced species, like multiflora rose, autumn olive, royal paulownia, and early-successional native species such as black locust and red maple (Kentucky EEC 2022).

In 2008, the Kentucky DFWR developed a Terrestrial Nuisance Species Management Plan. As described in the plan, terrestrial nuisance species (TNS) are non-native invasive species that threaten the diversity or abundance of native terrestrial species or the ecological stability of ecosystems, or commercial, agricultural, or recreational activities dependent on such ecosystems. Kentucky DFWR produced a list of the most problematic TNS in Kentucky, which included six microorganisms, four insects, two birds, one mammal, and 39 plant species (Kentucky DFWR 2008).

In 2000, the Kentucky Invasive Plant Council was established as a state chapter of the Southeast Exotic Pest Plant Council and works to serve as a technical support resource on invasive species in Kentucky, facilitate the exchange of information concerning the management and control of invasive plant species, and support research and monitoring of those species (Kentucky Invasive Plant Council 2019). A list of invasive plant species of Kentucky and associated threat category is provided in Table 5-23. A total of 16 plant species included in this list have been documented in the Study Area. Invasive plants were identified within all community types during 2025 vegetation surveys. Disturbed shrublands and disturbed herbaceous community types were frequently comprised of numerous invasive plant species. Some areas in the southern portion of the Project Study Area have >90 percent cover of kudzu (Appendix M).

Table 5-23: Threat Category[1] of Invasive Plants Species Known to Occur in Kentucky

Scientific Name	Common Name	On Most Problematic Kentucky TNS List?[2]
Category 1 – Severe Threat		
Achyranthes japonica	Japanese chaff flower	-
Ailanthus altissima	tree-of-heaven*	Yes
Alliaria petiolata	garlic mustard	Yes
Ampelopsis brevipedunculata	porcelain berry	-
Arthraxon hispidus	hairy jointgrass	-
Carduus nutans	musk thistle	Yes
Celastrus orbiculatus	oriental bittersweet	Yes
Cirsium arvense	Canada thistle	-
Clematis terniflora	leatherleaf clematis	-
Conium maculatum	poison hemlock	Yes
Coronilla varia	crown vetch	Yes
Dioscorea oppositifolia	Chinese yam	Yes
Elaeagnus umbellata	autumn olive*	Yes
Euonymus alatus	winged euonymus, burning bush	Yes
Euonymus fortunei	winter creeper*	Yes
Festuca arundinacea (=Lolium arundinaceum)	tall fescue	Yes
Glechoma hederacea	ground ivy*	-
Lespedeza cuneata	sericea lespedeza*	Yes
Lespedeza stipulacea (=Kummerowia)	Korean lespedeza	Yes
Ligustrum sinense, L. vulgare	Chinese privet, European privet*	Yes
Lonicera japonica	Japanese honeysuckle*	Yes
Lonicera maackii	amur honeysuckle*	Yes
Lonicera fragrantissima, L. standishii	bush honeysuckles	Yes
Lysimachia nummularia	moneywort	-
Lythrum salicaria	purple loosestrife	-
Melilotus alba	white sweet clover*	Yes
Melilotus officinalis	yellow sweet clover*	Yes
Microstegium vimineum	Japanese stiltgrass*	-

Scientific Name	Common Name	On Most Problematic Kentucky TNS List?[2]
Miscanthus sinensis	Chinese silver grass	Yes
Paulownia tomentosa	royal paulownia*	Yes
Phragmites australis	common reed	-
Polygonum cuspidatum	Japanese knotweed*	-
Pueraria lobata	kudzu*	Yes
Pyrus calleryana	callery pear	Yes
Ranunculus ficaria	lesser celandine	Yes
Rhamnus cathartica	European buckthorn	-
Rosa multiflora	multiflora rose*	Yes
Sorghum halepense	Johnson grass	Yes
Stellaria media	common chickweed*	Yes
Category 2 – Significant Threat		
Agrostis stolonifera	weeping love grass	-
Akebia quinata	akebia	-
Albizia julibrissin	mimosa	-
Alternanthera philoxeroides	alligatorweed	-
Berberis thunbergii	Japanese barberry*	-
Bromus inermis	smooth bromegrass	Yes
Bromus tectorum, B. japonicus	cheatgrass	Yes
Cardiospermum halicacabum	balloon vine	-
Centaurea biebersteinii	spotted knapweed	Yes
Cirsium vulgare	bull thistle	-
Daucus carota	Queen Anne’s lace*	Yes
Dipsacus sylvestris, D. laciniata	common teasel, cutleaf teasel	-
Echinochloa crus-galli	barnyard grass	-
Eleusine indica	goose grass	-
Galium pedemontanum	cleavers	-
Hedera helix	English ivy	-
Hemerocallis fulva	day lily	-
Humulus japonicus	Japanese hops	-
Hydrilla verticillata	hydrilla	-

Scientific Name	**Common Name**	**On Most Problematic Kentucky TNS List?**[2]
Lespedeza bicolor, L. thunbergii	bicolor lespedeza, shrubby lespedeza	Yes
Lespedeza striata (= Kummerowia)	Japanese clover/Kobe lespedeza	Yes
Leucanthemum vulgare	ox-eye daisy	-
Medicago lupulina	black medic	-
Mentha x piperata	peppermint	-
Morus alba	white mulberry	-
Mosla dianthera	miniature beefsteak	-
Najas minor	water nymph	-
Ornithogalum umbellatum	star-of-Bethlehem	-
Pastinaca sativa	wild parsnip	-
Perilla frutescens	beefsteak	-
Poa compressa	Canada bluegrass	-
Poa pratensis	Kentucky bluegrass	-
Polygonum cespitosum	bunchy knotweed	-
Polygonum persicaria	lady's thumb	-
Populus alba	white poplar	-
Potamogeton crispus	curlyleaf pondweed	-
Rhodotyps scandens	Jetbead	-
Rorrippa nasturtium-aquaticum	water-cress	-
Rubus phoenicolasius	wineberry	-
Schedonorus pratensis	meadow fescue	-
Setaria faberi	giant foxtail	-
Setaria viridis	green foxtail	-
Spiraea japonica	Japanese spiraea	-
Thlaspi alliaceum	garlic peppergrass	-
Tussilago farfara	coltsfoot	-
Typha x glacua	cattail	-
Ulmus pumila	Siberian elm	-
Verbascum thapsus	common mullein	-
Vinca minor	lesser periwinkle	-

Scientific Name	Common Name	On Most Problematic Kentucky TNS List?[2]
Category 3 – Moderate Threat		
Argopyron repens	quack grass	-
Allium vineale	field garlic	-
Arctium minus	common burdock	-
Arenaria serpyllifolia	thyme-leaf sandwort	-
Barbarea vulgaris	yellow rocket	-
Bromus arvensis, B. catharcticus,B. hordeaceus, B. racemosus	field bromes	-
Buddleja davidii	orange-eye butterfly bush	-
Carduus acathoides	spiny plumeless thistle	-
Chenopodium album	lamb’s quarters	-
Cichorium intybus	chicory	-
Commelina communis	dayflower	-
Convolvulus arvensis	field bindweed	-
Duchesnea indica	Indian strawberry	-
Duetzia scabra	fuzzy deutzia	-
Elaeagnus angustifolia	Russian olive	-
Eleusine indica	goose grass	-
Fatoua villosa	hairy crabweed	-
Hesperis matronalis	dame’s rocket	-
Holcus lanatus	velvet grass	-
Hypericum perforatum	common St. John’s-wort	-
Ipomoea hederacea	ivy-leafed morning-glory	-
Ipomoea purpurea	purple morning-glory	-
Iris pseudoacorus	pale yellow iris	-
Lamium purpureum	purple deadnettle*	-
Lamium amplexicaule	henbit	-
Lithospermum arvense	corn-gromwell	-
Lolium multiflorum	Italian rye	-
Lonicera x bella, L. morrowii, L. tartarica	bush honeysuckles	Yes
Lotus corniculatus	birdsfoot trefoil	-
Mohonia bealei	leatherleaf mahonia	-

Scientific Name	Common Name	On Most Problematic Kentucky TNS List?[2]
Mentha spicata	spearmint	-
Nepeta cataria	catnip	-
Oxalis stricta (= O. europea)	common yellow wood-sorrel	-
Paspalum dilatatum	dallisgrass	-
Phyllostachys aura	golden bamboo	-
Poa annua	speargrass	-
Potentilla recta	sulphur five-fingers	-
Prunus mahalab	mahalab cherry	-
Ranunculus bulbosus	bulbous buttercup*	-
Rumex acetosella	dock, sheep sorrel	-
Solanum dulcamara	bitter nightshade	-
Thlaspi perfoliatum	field cress	-
Torillis arvensis, T. japonica	hedge parsley	-
Wisteria sinensis, W. floribunda, W. x formosa	exotic wisterias	-

Source: Kentucky Invasive Plant Council 2019

* Species documented in Study Area based on observations from Kleinschmidt, Copperhead, and EcoSource, Inc. May, October, and November 2022, June, July, and August 2024, and April 2025 site visits, bat survey, and wetland assessments, and vegetation surveys.

[1] Threat Categories and Descriptions (Kentucky EPPC 2013)

- Category 1 – Severe Threat: Exotic plant species which possess characteristics of invasive species and spread easily into native plant communities and displace native vegetation; includes species which are or could become widespread in Kentucky.
- Category 2 – Significant Threat: Exotic plant species which possess some invasive characteristics but have less impact of native plant communities; may have the capacity to invade natural communities along disturbance corridors, or to spread from stands in disturbed sites in undisturbed areas but have fewer characteristics of invasive species than Category 1.
- Category 3 – Moderate Threat: Exotic plant species which seem to principally spread and remain in disturbed corridors, not readily invading natural areas; also, some agronomic weeds.

[2] Most Problematic Kentucky TNS List (Kentucky DFWR 2008)

5.5.2 Potential Impacts of the Proposed Lewis Ridge Project

The Lewis Ridge Project features will primarily be located within areas previously disturbed for mining activities, or along existing access. Both native and non-native vegetation typical of the region are present in the Study Area. The proposed upper reservoir location encompasses an area that is largely comprised of disturbed shrubland, and the proposed lower reservoir location encompasses an area that is comprised of disturbed herbaceous land cover and mature mixed forest. Kudzu is currently ubiquitous throughout portions of the proposed lower reservoir area, and both disturbed herbaceous and disturbed shrubland areas are currently dominated by non-native invasive plant species. The proposed water conveyance transverses mature deciduous forest, disturbed shrubland, and young mixed forest. The disposal areas are located in hollows, and are comprised of mature and mixed deciduous forest, and disturbed herbaceous communities. The proposes interconnection line transverses all mapped community types.

The construction and operation of the Lewis Ridge Project will permanently alter habitat and is anticipated to displace vegetation, including some forested habitat and areas disturbed from previous mining operations. Vegetation disruption will primarily occur over areas that have been historically logged and more recently disturbed from mining operations. The project footprint encompasses vegetative communities that are characterized by previous anthropogenic disturbances associated with logging, surface mining, highwall mining, and construction of mining access roads. Although LRPS anticipates permanent vegetation disruption, the Applicant does not anticipate that the Lewis Ridge Project will have long-term effects on plant communities within the Project Vicinity, which are currently characterized by previous anthropogenic disturbances associated with mining and logging practices. Implementation of the Vegetation Management Plan (Appendix D) will reduce impacts to local plant communities and establish beneficial forage habitat for elk and other grassland obligate species. Post-construction operation and maintenance activities are not expected to have negative effects on plant communities.

There are no anticipated impacts to rare, threatened, or endangered botanical species, as no federal listed species were documented in the Study Area during desktop and field surveys.

5.5.3 Agency Consultation and Applicant Recommendations

5.5.3.1 Agency Consultation

Documentation of consultation is provided in Appendix A. Consultation specific to botanical resources is summarized below.

On February 9, 2022, USFWS submitted preliminary comments in response to FERC's December 16, 2021 notice of Preliminary Permit Application to assist FERC and LRPS in assessing the potential environmental impacts of construction and operation of the proposed project. USFWS recommended evaluating the potential to utilize existing utility rights-of-way that occur near the project location to minimize impacts to terrestrial habitats.

The Kentucky DEP submitted comments on April 6, 2023 (following the Joint Agency and Public Meeting), on July 9, 2024 (following the distribution of the Draft Study Plan), and on October 28, 2024 (following the distribution of the DLA). In the comments, the Kentucky DEP requested review of the OKNP's KY-BAT to obtain a standard occurrence report for sensitive species within the Lewis Ridge Project area. LRPS obtained a standard occurrence report from OKNP on May 9, 2025, and results are summarized in applicable sections of this Exhibit E and provided in Appendix I, Rare Species Reports (Privileged).

USFWS provided an official species list for the Lewis Ridge Project on July 19, 2024 and on May 9, 2025 identifying threatened, endangered, proposed, and candidate species that may occur in the Study Area of the Lewis Ridge Project. Results are summarized in applicable sections of this Exhibit E and provided in Appendix I.

LRPS filed its DLA on September 30, 2024. FERC and Kentucky DEP provided comments on the DLA related to botanical resources. FERC requested an updated IPaC review be performed with additional discussion on the potential project-related effects on all federally listed, proposed, and candidate species and their habitats; and additional information on the specific vegetation that would be permanently removed or temporarily disturbed during construction. Kentucky DEP reiterated the availability of its KY-BAT tool to obtain a standard occurrence report for sensitive species within the Lewis Ridge Project area. As appropriate, LRPS addressed comments in the FLA and in the accompanying Summary Response Table to Comments provided in Appendix A.

5.5.3.2 Applicant Recommendations

LRPS proposes to implement the following PM&E measures to minimize impacts on botanical resources:

- **Vegetation Management Plan:**
    - LRPS proposes to develop and implement a Vegetation Management Plan. The Vegetation Management Plan will include revegetation specifications and invasive species management protocols. The Vegetation Management Plan is filed as Appendix D and will be implemented at the start of construction.
    - Revegetation of disturbed areas will emphasize habitat creation and maintenance for elk and grassland obligate species.
    - The Vegetation Management Plan describes specific practices for managing vegetation in human use areas and restored grassland habitats.

5.5.4 References

Copperhead Environmental Consulting (Copperhead). 2025. Vegetation Assessment Report for the Proposed Lewis Ridge Pumped Storage Project, Bell County, Kentucky.

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Reiss, R. 1986. Early Successional Plant Communities on an Abandoned Strip Mine in Butler County, Kentucky. Masters Theses & Specialist Projects. Paper 2764. Available Online: https://digitalcommons.wku.edu/theses/2764. Accessed July 2024.

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Woods, A.J., J.M. Omernik, W.H. Martin, G.J. Pond, W.M. Andrews, S.M. Call, J.A. Comstock, and D.D. Taylor. 2002. Ecoregions of Kentucky (color poster with map, descriptive text, summary tables, and photographs): Reston, VA, U.S. Geological Survey (map scales 1:1,000,000).

5.6 Historic and Archaeological Resources (18 CFR § 4.41 (f)(4))

5.6.1 Existing Environment

A summary of the prehistoric and historic context, previous historic and archaeological resource surveys, and known historic and archaeological resources within the Project Vicinity is provided below.

5.6.1.1 Prehistoric Context

The proposed Lewis Ridge Project is situated in southeast Kentucky near the borders of Tennessee and Virginia. Archaeological evidence suggests that humans have occupied the region for more than 12,000 years (Kentucky Heritage Council 2022).

The earliest evidence of human occupation in the southeastern United States is identified as the Paleoindian Stage, which began approximately 12000 B.C. and continued to approximately 8000 B.C. The climate in Kentucky was much colder and wetter upon the estimated first arrival at the end of the last ice age at least 12,000 years ago. Mammoth, mastodon, and bison provided meat, and hides were used for temporary shelters and clothing. In this time frame, people lived in small groups and migrated frequently. The Paleoindian toolkit consisted of well-crafted spearpoints of stone. It is likely Paleoindians also made tools from wood and animal bones. (Kentucky Heritage Council 2022).

During the Archaic period (8000 to 1000 B.C.), the region's climate gradually trended toward that of modern weather patterns, which led to the extinction of large animals such as the mastodon and giant bison. Hunting shifted to smaller game animals such as deer, turkey, and rabbit. Archaic groups collected wild plants for food and medicine and made baskets for collecting, transporting, and storing their food. Sedentism increased during this period compared to the Paleoindian period, but groups still migrated every few months. Archaic hunters used notched and stemmed (not fluted) stone spearpoints and used a spear-thrower (atlatl) to improve velocity and accuracy. By 1000 B.C., some Archaic groups began experimenting with growing food. (Kentucky Heritage Council 2022).

The Woodland period (1000 B.C. to A.D. 1000) is marked by the introduction of pottery, which was used for cooking and food storage. During this period, gardening and cultivating plants increased and groups tended to live in larger communities. Large earthen enclosures were used in religious ceremonies, and burial mounds were constructed over decades. Evidence from this period suggests that long-distance exchange networks appeared, and people began to explore caves (such as Mammoth Cave in Kentucky). The bow and arrow were invented late in this period and spearpoints were replaced with arrowheads. The use of groundstone tools continued and were used for processing corn. (Kentucky Heritage Council 2022).

The Late Prehistoric period (A.D. 1000-1750) represents the last pre-contact cultural traditions prior to the introduction of European settlers and diseases that decimated Native populations. Late Prehistoric groups focused on planting, growing, and harvesting corn and beans. The toolkit was expanded to include the hoe for agricultural fields. New forms of pottery such as jars, bowls, plates, bottles, and colanders were developed. People lived in large year-round settlements and constructed rectangular houses. Communities were ruled by hereditary chiefs who lived on larger mounds near the center of the settlement. Religious and ceremonial life is depicted by the figures engraved on shell gorgets (necklace pendants) and placement of ceramic vessels with shell spoons, pipes, and shell necklaces with the deceased. (Kentucky Heritage Council 2022).

Several Native American Tribes once called Kentucky home, including the Cherokee, the Chickasaw, and the Shawnee (Lexington Visitors Center [VisitLex] 2022). From around 1650 to 1750, Native American wars ensued over control of Kentucky, or the "Great Meadow," between the Shawnee Tribes located north of the Ohio River and the Cherokee and Chickasaw Tribes located south of the Cumberland River (Kentucky Department of Tourism 2024). By the 1680s or 1690s, the Shawnee had one or more villages on the upper Cumberland River; however, the Cherokee claimed the upper Cumberland River as their hunting grounds (Henderson and Pollack 2012). The Cherokee forced the Shawnee out of the area around 1714 (Henderson and Pollack 2012).

5.6.1.2 Historic Context

Dr. Thomas Walker and Christopher Gist first explored Kentucky in 1750 and 1751, but outbreaks of conflict between the British and Native Americans delayed further exploration for over a decade (Kentucky Department of Tourism 2024). By the late 1700s, the newly formed United States began to put settlement pressure on the region (Kentucky Department of Tourism 2024). European settlement in the area was slower than along the East Coast of the modern United States due to the barrier of the Appalachian Mountains (VisitLex 2022). After 1775, Kentucky experienced rapid growth as the first settlements west of the Appalachian Mountains were founded with settlers primarily from Virginia, North Carolina, and Pennsylvania (accessing the area by the Cumberland and Ohio rivers). Daniel Boone first explored Kentucky in 1767 and returned in 1769 for a 2-year exploration of the area (Kentucky Department of Tourism 2024). In 1772, the Cherokee surrendered their claim to Kentucky to the colony of Virginia (VisitLex 2022). During the American Revolutionary War, indigenous Native American tribes fought with the British against American colonists. Several conflicts took place in Kentucky, including the siege of Boonesboro, attacks on Martin's and Ruddle's Station, and the Battle of Blue Licks in 1782 (VisitLex 2022). The Battle of Blue Licks was one of the last Native American battles in Kentucky, although smaller conflicts occurred until 1813 (Kentucky Department of Tourism 2024). Kentucky became a state in 1792, and the westernmost region was annexed following its purchase from the Chickasaw Indians in 1818 (Kentucky Department of Tourism 2024). With passage of the "Indian Removal Act" in 1830, Native American tribes living east of the Mississippi River were required to move west to Indian Territory. However, Native American tribes left Kentucky earlier, first in response to the events of the French and Indian War, the American Revolution, and the War of 1812 (Henderson and Pollack 2012). In addition to aiding in immigration to the area, the Cumberland Gap had strategic value during the Civil War, as whoever occupied the pass controlled the railroad from Virginia to Tennessee.

The logging Industry in Bell County began after the Civil War ended in 1865, with its most active years continuing until around 1900. The coal industry in Bell County started around 1888, after the Louisville and Nashville Railroad Company built a railroad along the Cumberland River (Fuson 1939). The coal fields in eastern Kentucky peaked in 1928-1930 and maintained those production levels until the Second World War (Kentucky Foundation 2007).

5.6.1.3 Cultural Historic Resources in the Study Area

LRPS conducted a formal Section 106 cultural historic resources evaluation under the supervision of a qualified professional to document above-ground resources 50 years of age or older on in the Study Area (CRAI 2025a). The complete study is filed with this FLA as a privileged document (Appendix N) and the results are summarized herein. The field survey was conducted in August 2024, April 2025, and May 2025. Prior to the field assessment, available surveys, reports, studies, maps, and other data pertinent to the Study Area were reviewed. A review of records maintained by the Kentucky Heritage Council (KHC) was conducted to determine if previously recorded cultural historic resources were located in the Study Area. The review identified two resources with previously assigned KHC survey numbers (Sites 1 and 5 [BL 306 and BL 89]), as well as two previous cultural historic reports that overlapped the Study Area.

A field assessment was performed for cultural historic resources and identified 10 sites in the Study Area. Table 5-24 provides a summary of the cultural historic sites identified, including a brief description of each site, its evaluated eligibility for listing in the NRHP, and the associated effects determination. The Balkan School (BL 306) was identified to be eligible for the NRHP due to its association with Works Progress Administration, a program of President Franklin D. Roosevelt's Second New Deal. LRPS anticipates BL 306 will not be impacted by the proposed Lewis Ridge Project, as this resource would only be impacted by increased water levels from Tom Fork. LRPS proposes to avoid the Balkan School and an increase of Tom Fork flow is not proposed, as such, CRAI recommends that the Lewis Ridge Project will have No Effect on BL 306. CRAI recommended a finding of No Effect for BL 396. Although site BL 396 was inaccessible, LRPS anticipates that due to the dense vegetation between this site and the proposed project features, there will be minimal impact to the viewshed. CRAI recommended a finding of No Adverse Effect for BL 398., Although BL 398 was inaccessible, LRPS anticipates that there will be minimal impact to the viewshed from the Lewis Ridge Project.

Table 5-24: Cultural Historic Resources in the Study Area

Site No. in Report	Survey Number	Site Description	NRHP Eligibility Recommendation	Effects Determination
1	BL 306	Balkan School and associated structures	Eligible	No effect
2	BL 375	Louisville and Nashville (L&N) rail line and culvert	Not individually eligible[2]	No effect
17	BL 394	House	Not eligible	N/A
18[1]	BL 395	Commercial buildings	Not eligible	N/A
19[1]	BL 396	House	Undetermined due to inaccessibility	No effect
20	BL 397	Transmission line	Not eligible	N/A
21	BL 398	Cemetery	Undetermined due to inaccessibility	No adverse effect
22	BL 399	Mining related structure	Not eligible	N/A
23	BL 400	Cemetery	Not eligible	N/A
24	BL 401	Cemetery	Not eligible	N/A

Source: CRAI 2025a

[1] Indicates sites located within view of the Study Area but not within the Study Area.

[2] Historic site BL 375 was identified as a potentially contributing resource to the greater Louisville and Nashville Railroad if it is recommended eligible for listing in the NRHP in the future (CRAI 2025a).

5.6.1.4 Archaeological Resources in the Study Area

LRPS conducted a formal Section 106 archaeological resources evaluation in the Study Area[32] under the supervision of a qualified professional (CRAI 2025a).[33] The complete study is filed with this FLA as a privileged document (Appendix O) and the results are summarized herein. The field survey was conducted between July 29 and August 8, 2024, and between April 21 and May 1, 2025.[34] Prior to the archaeological field assessment, a

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[32] Property access was not yet granted for some private landowner parcels located at the northern end of the interconnection line and along the Cumberland at the time of the archaeology survey. Archaeology survey of these parcels will be conducted upon receipt of access approval.

[33] All Section 106 investigations subject to review by the Kentucky SHPO must be carried out under the direct supervision of a qualified Principal Investigator who meets or exceeds the minimum professional requirements established in the Secretary of the Interior's Standards, as determined by the Kentucky SHPO.

[34] In 2024, the Study Area outlined in the DLA was surveyed. In 2025, approximately 925 acres were incorporated to the Study Area for survey. The final 2025 archaeological survey report is specific to the current 2025 Study Area as described throughout this Exhibit E.

records review of the archaeological site files at the Kentucky Office of State Archaeology (OSA) was completed. The review indicated that 23 previous archaeological surveys and site investigations have been conducted within a 2-kilometer radius of the Study Area, nine of which intersect the Study Area (McGraw 2006a, 2006b, 2007, 2008, 2009; McIlhany 1987; Ross 2009; Sandefur and Wilkinson 2008; Winterhoff 2012). Nine archaeological sites have been recorded within a 2-kilometer radius of the Study Area, six of which intersect the Study Area (15Bl67, 15Bl126, 15Bl127, 15Bl128, 15Bl130, and 15Bl133). (CRAI 2025b).

A field assessment was performed for archaeological resources to survey lands in the Study Area that have not been previously mined. The survey followed standard archaeological methods and Kentucky SHPO specifications, including a pedestrian survey supplemented with screened shovel testing. Table 5-25 provides a summary of the archaeological sites identified within the Study Area, including a brief description of each site, its evaluated eligibility for listing in the NRHP, and the corresponding recommendations made by CRAI. Two new archaeological sites (15Bl157 and 15Bl158) and one twentieth-century oil/gas well (Non-Site Locality 1) were recorded. In addition, six previously recorded sites (15Bl67, 15Bl126, 15Bl127, 15Bl128, 15Bl130, and 15Bl133) were revisited (CRAI 2025b).

Table 5-25: Known Archaeological Sites in the Study Area

Site Number	Site Description	NRHP Eligibility	Recommendation
15Bl126	Mullins-Cox Cemetery. Late nineteenth to early twentieth-century cemetery	Not assessed*	Avoidance
15Bl127	Twentieth to the twenty-first century historic farmstead/residence	Not eligible	No further work recommended
15Bl128	Twentieth to the twenty-first century industrial site	Not eligible	No further work recommended
15Bl130	Slusher-Wolford Cemetery. Nineteenth to mid-twentieth-century Cemetery	Not assessed*	Avoidance
15Bl133 (and 15Bl133 extension)	Early twentieth-century school	Not eligible	No further work recommended

Site Number	Site Description	NRHP Eligibility	Recommendation
15Bl157	Early twentieth-century to modern-day cemetery	Not assessed*	Avoidance
15Bl158	Balkan Baptist Church. Early to mid-twentieth-century structural remnants of a church	Not eligible	No further work recommended
15Bl167	Twentieth-century historic farmstead/residence	Not eligible	No further work recommended
Non-Site Locality 1[35]	Mid-twentieth-century oil/gas well	Not eligible	No further work recommended

Source: CRAI 2025b

* Because the extent and preservation of the burials located in this cemetery is unknown, the site was not assessed for eligibility for NRHP inclusion.

5.6.2 Potential Impacts of the Proposed Lewis Ridge Project

Regarding cultural historic resources, the Applicant conducted a cultural historic resources evaluation of the Study Area (CRAI 2025a). There are 10 cultural historic sites in or near the Study Area. Of the identified sites, BL 306, the Balkan School was determined eligible for listing in the NRHP. The Applicant anticipates that no historic resources listed in or eligible for listing in the NRHP will be adversely affected by the proposed Lewis Ridge Project. Further, a determination of no effects was made for known cultural historic resources in the Study Area that were not evaluated for NRHP eligibility due to inaccessibility. The Applicant has prepared an HPMP (Appendix E) for proposed implementation and will consult with the Kentucky SHPO regarding this proposed HPMP. The HPMP outlines procedures for the protection of cultural historic resources.

Regarding archaeological resources, the Applicant conducted an archaeological survey of the Study Area. Nine archaeological sites and one twentieth-century oil/gas well are known in the Study Area. There are no known NRHP eligible archaeological sites in the Study Area. Among the identified sites are three cemeteries (Sites 15B1126, 15B1130, and 15B1157). These cemeteries were not formally assessed for NRHP eligibility due to uncertainties regarding the extent and preservation of the burials. To ensure their protection, the Applicant has proposed complete avoidance of these sites, along with a

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[35] An archaeological site number was not requested from the OSA because the area lacked archaeological deposits (CRAI 2025b).

100-foot (30-meter) protective buffer of areas not already disturbed[36] around each cemetery's documented boundary, as recommended by CRAI. As avoidance of the cemeteries is proposed and no other known NRHP-eligible archaeological resources are present, no previously identified archaeological sites listed in or eligible for listing in the NRHP will be affected by the proposed Lewis Ridge Project (CRAI 2025b). Construction activities have the potential to disturb unidentified archaeological resources that may be eligible for the NRHP, if those properties exist. The Applicant has prepared a HPMP (Appendix E) for proposed implementation and will consult with the Kentucky SHPO regarding this proposed HPMP. This HPMP outlines procedures should archaeological resources be discovered during project activities.

5.6.3 Agency Consultation and Applicant Recommendations

5.6.3.1 Agency Consultation

Documentation of consultation is provided in Appendix A. Consultation specific to historic and archaeological resources is summarized below.

LRPS filed a NOI and PAD to seek an original license for the Lewis Ridge Project on October 21, 2022. The Kentucky SHPO confirmed receipt of the NOI and PAD and noted their interest in continued consultation for the proposed Lewis Ridge Project.

Existing cultural resources information from the PAD was presented at the Joint Agency and Public Meeting. No comments were received specific to historic or archaeological resources during the Joint Agency and Public Meeting or in comments following the Joint Agency and Public Meeting.

LRPS distributed a Draft Study Plan on June 13, 2024. The Draft Study Plan included one study related to historic and archaeological resources, the Cultural Resources Evaluation. Kentucky SHPO provided comments on the draft Cultural Resources Evaluation study plan, and requested LRPS to include historic maps, soil maps, and any other relevant sources when performing file and archival research for archaeological resources. In addition, Kentucky SHPO requested the survey to include the entire Study Area, including lands not owned by Asher Land and Mineral, LLLP. LRPS filed the Revised Study Plan with FERC on August 16, 2024.

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[36] The existing Balkan Cemetery Road is currently located less than 100 feet from two of the cemeteries.

LRPS filed its DLA on September 30, 2024. The Environmental Report (Exhibit E) of the DLA included the historic cultural and archaeology survey study reports. The Kentucky SHPO and FERC provided comments on the DLA or accompanying study reports related to cultural resources. In their December 19, 2024 comments, Kentucky SHPO provided editorial comments on the survey reports and comments have been addressed in the revised study reports, which are included in Appendix N, Cultural Historic Survey Report (Privileged), and Appendix O, Archaeological Survey Report (Privileged). In their December 27, 2024 comments, FERC requested additional details of how each cultural site would be affected by the Lewis Ridge Project, inclusion of any specific protective or mitigation measures, and Kentucky SHPO's concurrence on the eligibility determinations and finding of effects. In response to Kentucky SHPO's December 19, 2024 comments on the reports, the cultural resource reports were revised and resubmitted to Kentucky SHPO on February 14, 2025. In a letter dated March 14, 2025, Kentucky SHPO acknowledged receipt of the revised reports and concurred with the eligibility determinations presented in the reports.[37]

On May 9, 2025, LRPS requested review and concurrence on the proposed Area of Potential Effects (APE) for the Lewis Ridge Project, which is divided into two phases: design and construction (Phase 1) and operations (Phase 2). For Phase 1, the APE is defined as the Study Area, encompassing the anticipated limits of disturbance during construction as well as additional lands evaluated for cultural resources in case project features shift during final design; this area is illustrated in Figure 5-31. Upon completion of construction, LRPS proposes that the Phase 2 APE be defined as the FERC Project Boundary, as approved in the FERC license, which represents the geographic extent of the hydropower project that the licensee must control for the duration of the license. The Phase 2 APE boundary as outlined in the FLA is shown in Figure 5-32. On June 4, 2025, the Kentucky SHPO concurred with the proposed Phase 1 and Phase 2 APE (Appendix A).

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[37] The Cultural Historic Survey Report (Appendix N) and Archaeological Survey Report (Appendix O) provided in this report pertain to the 2025 Study Area and supersede the revised version submitted on February 14, 2025.

Figure 5-31: Phase 1 Design and Construction APE

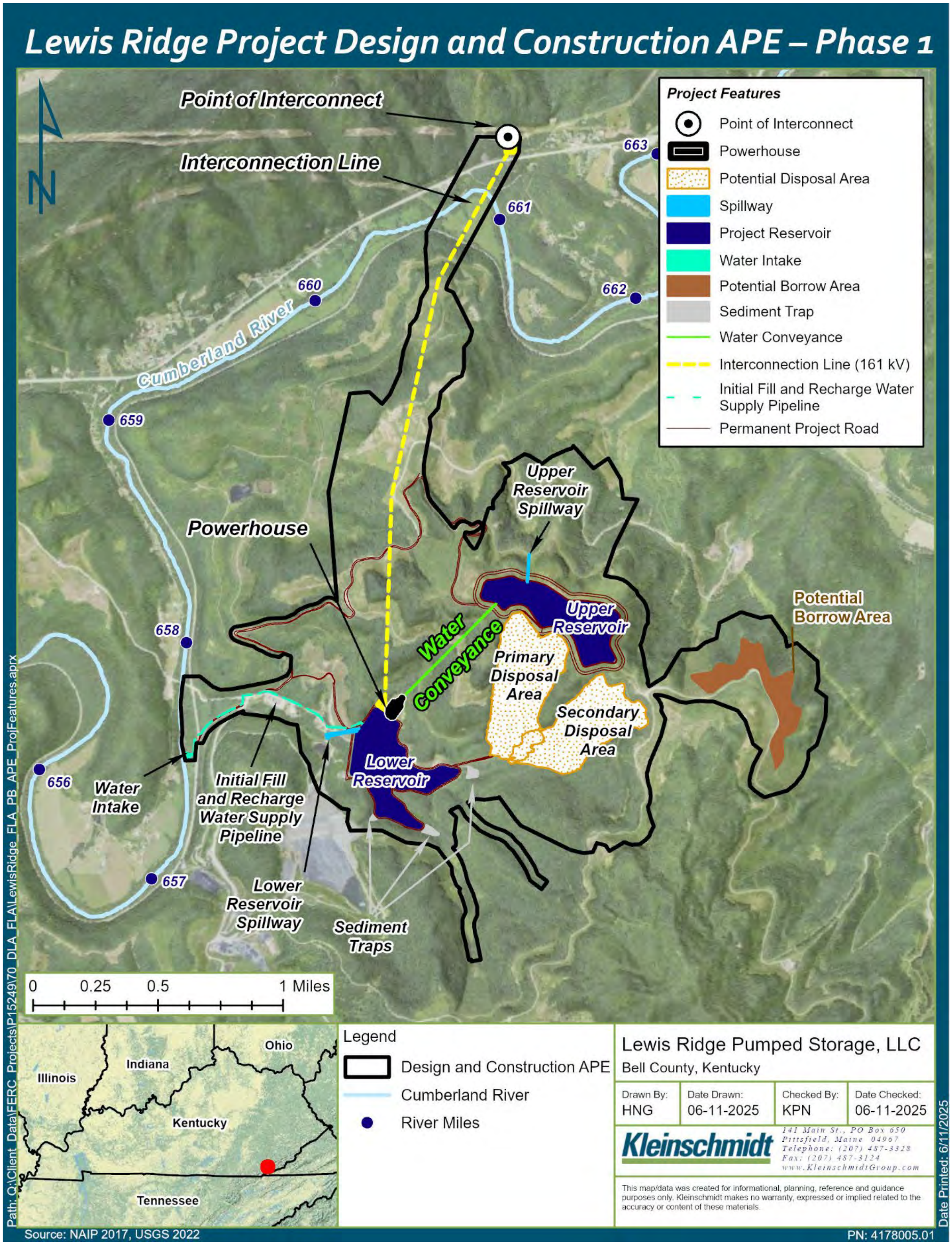
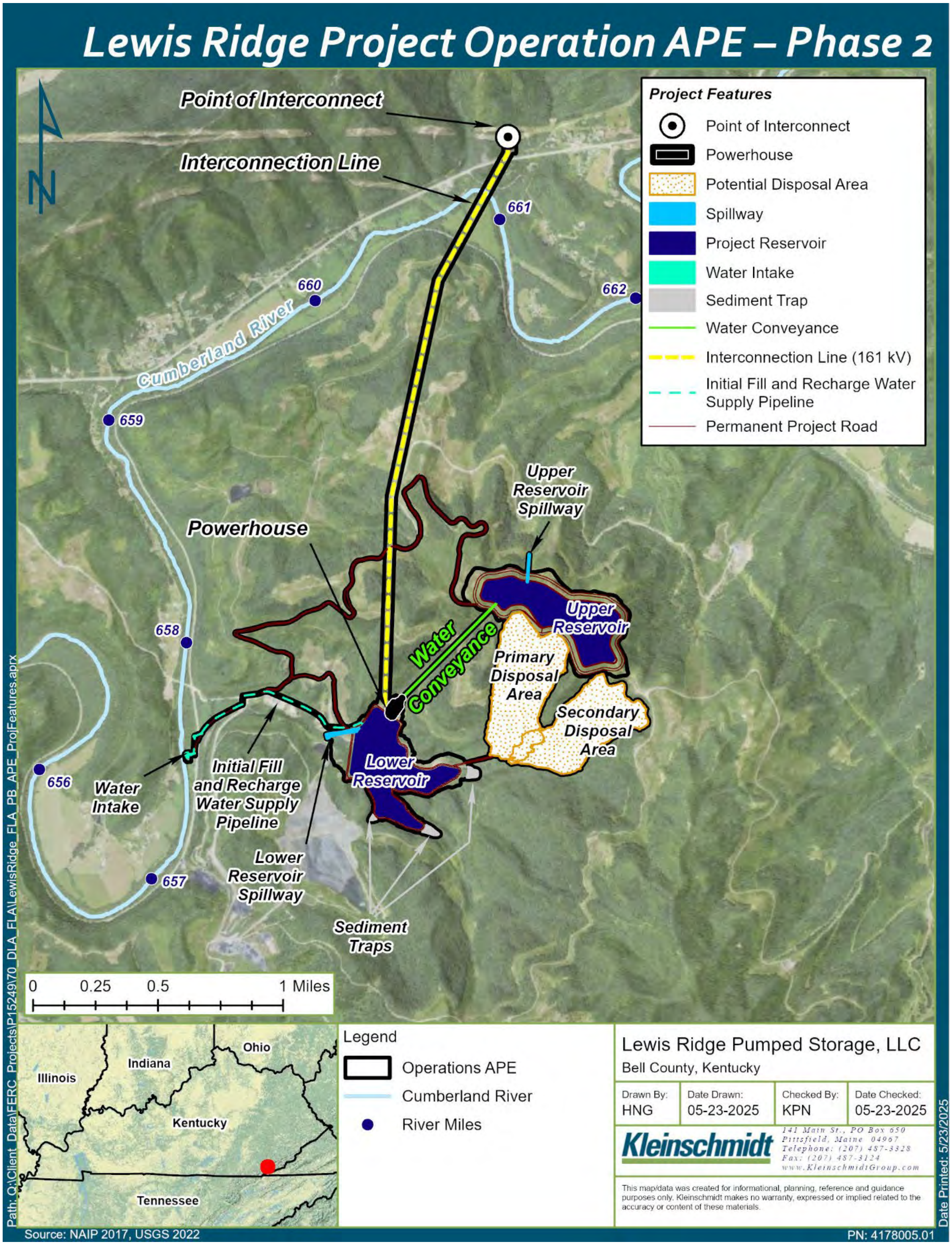


Figure 5-32: Phase 2 Project Operation APE



5.6.3.2 Applicant Recommendations

LRPS proposes to continue consultation with Kentucky SHPO and Native American Tribes throughout the licensing process and to implement the following PM&E measures to minimize impacts on historic and archaeological resources:

- LRPS will conduct additional archaeological survey in portions of the Study Area not previously surveyed due to lack of landowner permission, once access is granted.
- LRPS will avoid the cemeteries (Sites 15Bl126, 15Bl130, and 15Bl157) when constructing and operating the Lewis Ridge Project.
- **Historic Properties Management Plan:**
    - LRPS developed an HPMP, which specifies how historic properties will be managed within the Lewis Ridge Project APE. The HPMP identifies known historic properties within the Lewis Ridge Project's proposed APE (including archaeological and historic architectural resources); considers and manages potential effects on historic properties from activities associated with constructing, operating, and maintaining the Lewis Ridge Project; establishes a decision-making process for considering potential project effects on historic properties; and includes an Inadvertent Discovery Plan for use in the event that previously unknown historic properties are discovered during project activities. The HPMP is filed as Appendix E and includes inadvertent discovery protocol.

5.6.4 References

Cultural Resource Analysts, Inc. (CRAI). 2025a, June 4. Cultural Historic Survey for the Proposed Pumped Water Storage System in Bell County, Kentucky (Federal Energy Regulatory Commission Project No. 15249).

Cultural Resource Analysts, Inc. (CRAI). 2025b, June 9. An Archaeological Survey for a Portion of the Lewis Ridge Pumped Storage Project in Bell County, Kentucky.

Cultural Resource Analysts, Inc. (CRAI). 2025c, January 21. An Archaeological Survey for the Asher Land and Mineral Ltd. Property on the Lewis Ridge Pumped Storage Project in Bell County, Kentucky.

Cultural Resource Analysts, Inc. (CRAI). 2025d, January 14. Cultural Historic Survey for the Proposed Pumped Water Storage System in Bell County, Kentucky (Federal Energy Regulatory Commission Project No. 15249).

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5.7 Socioeconomic Resources (18 CFR § 4.41 (f)(5))

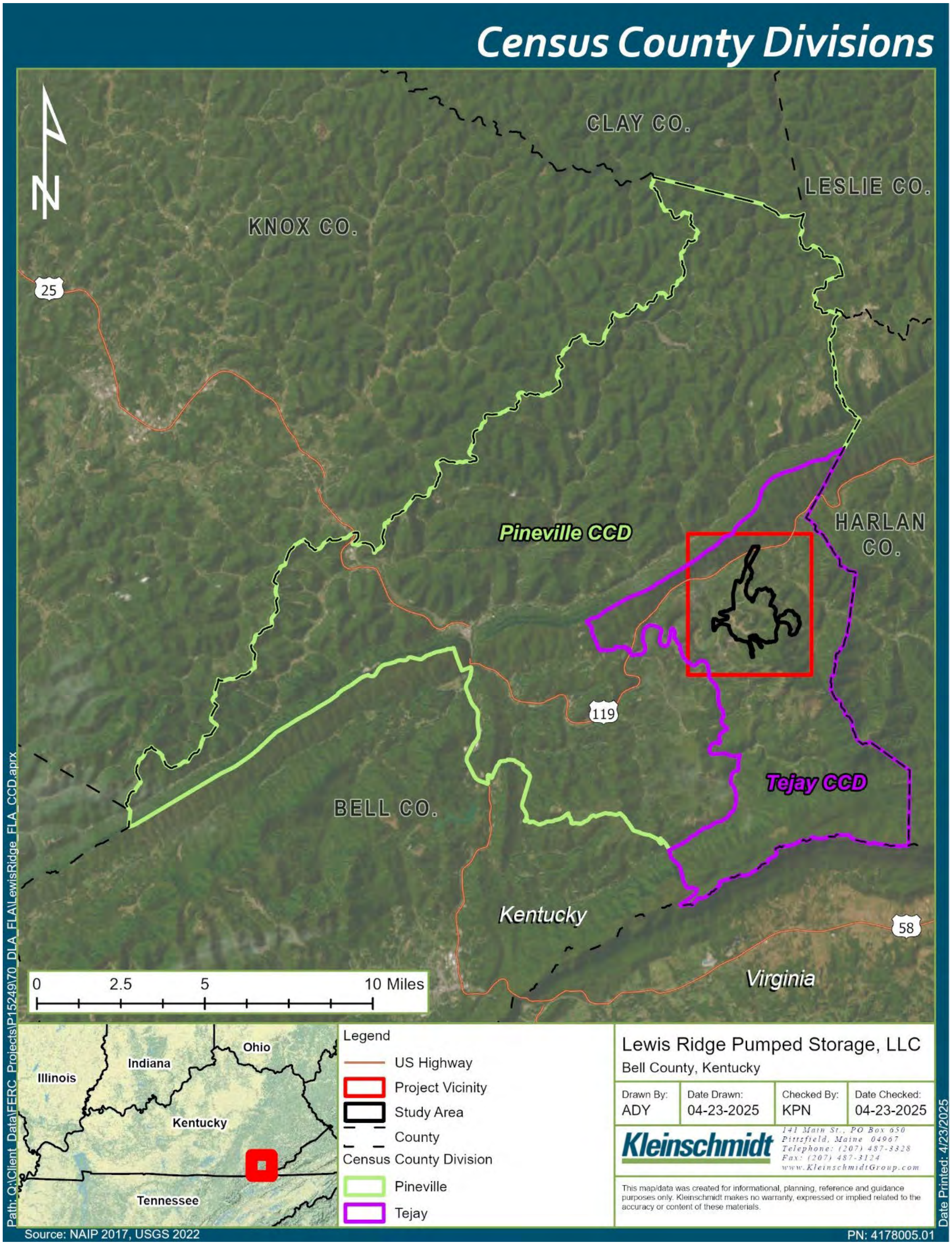
5.7.1 Existing Environment

5.7.1.1 General Land Use Patterns

The proposed Lewis Ridge Project is located in southeastern Kentucky near the borders of Tennessee and Virginia, within Bell County. The nearest communities to the proposed site are Blackmont, Tejay, Balkan, and Callaway. Bell County has a high number of mining, quarrying, oil and gas extraction, utilities, agriculture, forestry, fishing, and hunting industries (DataUSA 2025). Bell County, Kentucky, produced 302 million tons of coal from 1879 to 2004, with 108 million tons extracted by surface mining (Carey 2007). General land use in the Project Vicinity is further described in Section 5.11.

The counties of Kentucky are divided into Census County Divisions (CCDs), which are sub-county statistical geographic areas representing contiguous areas of one or more communities. These CCDs are used by the U.S. Census Bureau to tabulate and present data from the decennial census (U.S. Census Bureau 2018). Due to the relatively small population in the Project Vicinity and surrounding areas, the following socioeconomic data are presented by CCD, as tabulated by the U.S. Census Bureau. CCDs covering a 5-mile radius around the Lewis Ridge Project include the Tejay CCD to the east and south, and the Pineville CCD to the west and north (Figure 5-33).

Figure 5-33: Census County Divisions within a 5-Mile Radius of the Proposed Lewis Ridge Project



5.7.1.2 Population Patterns

Table 5-26 summarizes the population estimates for Bell County, Kentucky, the Commonwealth of Kentucky; Tejay CCD; and Pineville CCD.

Table 5-26: Estimated Population and Population Changes from 2010 to 2024

Place	2010 Census	2020 Census	Percent Change 2010 – 2020	2023/2024 Estimates*	Percent Change 2020 – 2023/2024
Kentucky	4,339,367	4,505,836	3.8%	4,588,372	1.8%
Bell County, Kentucky	28,691	24,097	-16.0%	23,051	-4.3%
Tejay CCD	1,896	1,292	-31.8%	1,801	39.4%
Pineville CCD	10,095	7,819	-22.5%	7,508	-4.0%

Sources: U.S. Census Bureau 2023a, 2023b, 2024

* Estimates include 2024 data for the Commonwealth of Kentucky and Bell County and 2023 data for Tejay and Pineville CCDs.

Population density is summarized in Table 5-27. The Tejay CCD (Figure 5-33) is approximately 53 square miles and includes the communities of Tejay, Balkan, and Callaway. The Tejay CCD has an estimated population of 1,801 with a population density of 33.9 people per square mile (U.S. Census Bureau 2023a). The Pineville CCD (Figure 5-33) is approximately 164 square miles and has an estimated population of 7,508 with a population density of 45.8 people per square mile (U.S. Census Bureau 2023b). Bell County is approximately 359 square miles and has a population density of 67.1 people per square mile; both of which are lower than the state average density of 114.1 people per square mile (U.S. Census Bureau 2024).

Table 5-27: Population Density Statistics

	Kentucky	Bell County	Tejay CCD	Pineville CCD
Population	4,505,836	24,097	1,801	7,508
Land Area (Square Miles)	39,492	359	53	164
Population per Square Mile	114.1	67.1	33.9	45.8

Source: U.S. Census Bureau 2023a, 2023b, 2024

In Bell County and Kentucky, the age distribution of men and women is relatively balanced, with populations generally declining after age 60–64. According to the U.S. Census Bureau (2023c), in Bell County, the most populous age group for men is 35–39, while for women it is 55–59. Statewide, the largest age group for men is 20–24, and for women, it is 60–64 (U.S. Census Bureau 2023d). The median age is 41.2 in Bell County, 39.2 in Kentucky, 40.8 in Tejay CCD, and 41.3 in Pineville CCD (U.S. Census Bureau 2023c, 2023d, 2023e, 2023f).

5.7.1.3 Economic Indicators and Employment

Table 5-28 presents household characteristics, vacancy rates, income levels, and poverty statistics for Bell County, Kentucky, and its subregions. As shown, the estimated median household incomes in Tejay CCD ($35,313), Pineville CCD ($36,796), and Bell County overall ($32,403) are all significantly lower than the statewide median of $61,118 (in 2023 dollars) (U.S. Census Bureau 2023c, 2023d, 2023e, 2023f). Additionally, poverty rates in these areas are notably higher than the state average, with Tejay CCD having the highest at 28 percent, compared to 16.4 percent for Kentucky (U.S. Census Bureau 2023c, 2023d, 2023e, 2023f). Regarding housing units and vacancy, the Pineville CCD had more housing units and a higher vacancy rate than the Tejay CCD, which had fewer units and a lower percentage of vacancies.

Table 5-28: Household Characteristics, Household Income, Poverty, and Vacancy Statistics

	Tejay CCD	Pineville CCD	Bell County, Kentucky	Commonwealth of Kentucky
Total Housing Units	631	3,827	11,517	1,769,102
Median Household Income in 2023 Dollars	$35,313	$36,796	$32,403	$61,118
Persons in Poverty (%)	28.0%	24.4%	27.1%	16.4%
Estimated Vacancy Rates	10.4%	21.7%	17.9%	9.0%

Sources: U.S. Census Bureau 2023c, 2023d, 2023e, 2023f, 2023g, 2023h, 2023i, 2023j

The largest industries in Bell County, Kentucky, are educational services, health care and social assistance, and retail trade. The highest paying industries are mining, quarrying, and oil and gas extraction ($70,551), finance and insurance ($59,286), and transportation and warehousing ($58,533). On average, males in Kentucky earn 1.32 times more than females.

Between 2022 to 2023, employment in Bell County declined by 1.53 percent. The most common job groups by number of people living in Bell County are office and administrative support occupations, education instruction and library occupations, and sales and related occupations. (DataUSA 2025).

5.7.2 Potential Impacts of the Proposed Lewis Ridge Project

The Lewis Ridge Project is expected to generate substantial economic benefits for Bell County and the surrounding region throughout both its construction and operational phases. Anticipated economic impacts of the Lewis Ridge Project are detailed in the *Economic and Financial Impact Analysis*, which assessed the total (direct, indirect, and induced) income, employment, and tax impacts of the construction and operations phases of the Lewis Ridge Project, and was completed by Highland Economics, LLC in 2025 (Appendix P). The economic analysis was based on an assumed construction cost of $1.68 billion and an estimated operating budget of approximately $15 million (Highland Economics, LLC 2025). The following section summarizes the potential impacts of the proposed Lewis Ridge Project on socioeconomic resources and summarizes the results of that economic analysis.[38]

As described in the economic analysis, the Lewis Ridge Project will generate economic activity throughout the nation, but the area with the most anticipated economic impact will be in Bell County and the states of Tennessee and Kentucky. Table 5-29 presents estimated direct employment and wages by place of residence during the projected 4-year construction period. An estimated 2,570 jobs, totaling an income of $534 million, is anticipated during construction. Similarly, Table 5-30 shows estimated direct employment and wages by location of residency during the operations of the Lewis Ridge Project (following completion of the construction). As shown, 45 to 55 direct, on-site jobs totaling an annual income of $6,750,000 to $8,250,000 are anticipated during operation of the Lewis Ridge Project. (Highland Economics, LLC 2025).

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[38] Figures presented herein regarding potential economic impact are considered to be estimates. The report includes detailed information on the methodology, analytical approach, and key assumptions underlying the analysis (Appendix P).

Table 5-29: Direct Project Jobs (Full-Time Equivalents) and Labor Income (2025 Dollars) by Residency During Construction Phase

Phase/Type of Impact by Worker Residency	Annual Average Impact	Total Average Impact
Bell County Residents		
Employment	190 to 240	860
Labor Income	$24,000,000 to $29,000,000	$106,000,000
Elsewhere KY/TN Residents (not including Bell County)		
Employment	290 to 360	1,290
Labor Income*	$55,000,000 to $68,000,000	$246,000,000
Total KY/TN Residents (including Bell County)		
Employment	490 to 590	2,150
Labor Income*	$79,000,000 to $97,000,000	$352,000,000
Other Area (Outside KY/TN) Residents		
Employment	90 to 120	420
Labor Income*	$41,000,000 to $50,000,000	$182,000,000
All Workers		
Employment	580 to 710	2,570
Labor Income*	$120,000,000 to $147,000,000	$534,000,000

Source: Highland Economics, LLC 2025

Table 5-30: Direct On-Site Project Jobs (Full-Time Equivalents) and Labor Income (2025 Dollars) by Residency During Operation Phase

Phase/Type of Impact by Worker Residency	Annual Average Impact
Bell County Residents	
Employment (Jobs)	20 to 30
Labor Income	$3,375,000 to 4,125,000
Elsewhere KY/TN Residents	
Employment (Jobs)	20 to 30
Labor Income	$3,375,000 to $4,125,000
All Workers	
Employment (Jobs)	45 to 55
Labor Income	$6,750,000 to $8,250,000

Source: Highland Economics, LLC 2025

Table 5-31 summarizes total economic impact (including direct, indirect, and induced) estimates across Kentucky and Tennessee. While direct impacts are the jobs and income to the construction and operations workers at the Lewis Ridge Project, indirect impacts refer to employment and income generated through the purchase of goods and services needed, which includes everything from legal and environmental services to tires and equipment. Induced impacts result from increased household spending by those workers, which supports additional jobs and income; this can include retail, healthcare, real estate, and food services. As shown, the Lewis Ridge Project is expected to support over 1,000 jobs and generate up to $157 million annually in labor income across Kentucky and Tennessee during the construction phase through direct, indirect, and induced impacts. During operations, the Lewis Ridge Project is anticipated to support up to 170 jobs and generate approximately $17.2 million in annual labor income through similar economic channels (Highland Economics, LLC 2025).

Table 5-31: Summary of Total Economic Impacts (Direct, Indirect, Induced) in Kentucky and Tennessee

Geography/Type of Impact	Annual Average Impact	
	Construction	Operations
Bell County		
Total Employment (Part and Full-Time Jobs)	240 to 300	30 to 40
Total Labor Income	$26,000,000 to $32,000,000	$3,900,000 to $4,700,000
Elsewhere in KY/TN		
Total Employment (Part and Full-Time Jobs)	1,060 to 1,290	100 to 130
Total Labor Income	$102,000,000 to $125,000,000	$10,100,000 to $12,400,000
Total KY/TN		
Total Employment (Part and Full-Time Jobs)	1,300 to 1,590	130 to 170
Total Labor Income	$128,000,000 to $157,000,000	$14,000,000 to $17,200,000

Source: Highland Economics, LLC 2025

With respect to in-migration, it is anticipated that the construction phase of the Lewis Ridge Project will result in a temporary influx of workers; however, there is no evidence to suggest that long-term in-migration will place a substantial burden on regional governmental services or public facilities. Approximately half of the projected 45 to 55 on-site operational employees are expected to reside in Bell County, while the remainder are likely to commute from surrounding areas in Kentucky and Tennessee (Highland Economics, LLC 2025). During the construction period, an estimated one-third of the annual workforce (approximately 190 to 240 individuals) is expected to be composed of Bell County residents (Highland Economics, LLC 2025). The geographic dispersion of the workforce across Bell County, Kentucky, Tennessee, and throughout the nation is anticipated to help spread potential burden on governmental services in the region such as police, fire, health, and educational facilities. Additionally, it is anticipated that costs associated with potential additional public services that may be needed in the area would be offset by the anticipated economic stimulus to the region and additional tax revenues generated by the Lewis Ridge Project.

Regarding housing impacts, as shown in Table 5-28, Bell County has a vacancy rate of approximately 17.9 percent, corresponding to an estimated 2,082 vacant housing units (U.S. Census Bureau 2023i). As noted in the economic analysis, a portion of the workforce is expected to commute from outside the county, which will help distribute housing demand across a broader region. The existing total housing units are anticipated to be sufficient to accommodate the temporary population increase associated with the Lewis Ridge Project; however, the economic activity generated may also stimulate new residential development. This activity includes the hiring of workers from both the local area and the broader region, procurement of materials and equipment, and the payment of sales, property, and income taxes. In turn, workers are expected to spend their earnings within the community, supporting local businesses and contributing to public revenues. This circulation of income is projected to create a multiplier effect, indirectly supporting additional employment, income, and tax generation, which may further incentivize housing construction in the area.

There will be no residences or business establishments displaced by the proposed Lewis Ridge Project.

In conclusion, the Lewis Ridge Project is expected to provide a substantial economic boost to the region both temporarily and permanently through job creation and tax revenue.

The Lewis Ridge Project will substantially increase demand for labor, materials, and services for the construction of the project. The Lewis Ridge Project is projected to support thousands of temporary jobs over the construction period, including Bell County residents, and generate hundreds of millions in labor income. The broader regional impact could reach up to 6,300 job-years and $627 million in labor income. Based on the economic study conducted, it is anticipated that Bell County alone could see up to 1,200 job-years and $127.6 million in labor income from the construction of the Lewis Ridge Project, based on the available workforce. Additionally, the Lewis Ridge Project is expected to contribute approximately $60 million in state tax revenue during construction, and $16.5 million in property tax revenue for Bell County in the first year following construction.

Once operational, the Applicant anticipates the Lewis Ridge Project to continue to provide jobs and substantial tax revenue for the area. Bell County will continue to receive annual property tax revenue based on net profitability. It is anticipated that the Lewis Ridge Project will directly employ 45 to 55 people, with roughly half of those positions anticipated to be filled by local residents. These positions, along with indirect and induced employment, could support up to 170 jobs and generate as much as $17.2 million in annual labor income across the region. These long-term benefits will be further enhanced by efforts to prioritize local hiring, utilize apprenticeship programs, and engage experienced regional labor so that economic gains are rooted in the local community. LRPS is partnered with a local non-profit, Shaping our Appalachian Region (SOAR), to help the local workforce meet project needs.

5.7.3 Agency Consultation and Applicant Recommendations

5.7.3.1 Agency Consultation

Documentation of consultation is provided in Appendix A. Consultation specific to socioeconomic resources is summarized below.

LRPS conducted a meeting with the Kentucky Cabinet for Economic Development on September 9, 2022, during which the Kentucky Cabinet for Economic Development noted their interest in the economic impacts of the Lewis Ridge Project and stated their support of the Lewis Ridge Project.

LRPS held a Joint Agency and Public Meeting and Site Visit on January 25, 2023. Brief discussion occurred regarding the economic impacts of the Lewis Ridge Project (temporary and permanent jobs). No comments were received specific to socioeconomics in comments following the Joint Agency and Public Meeting.

LRPS distributed a Draft Study Plan on June 13, 2024. LRPS filed the Revised Study Plan with FERC on August 16, 2024. No studies pertaining to socioeconomic resources were requested or included in the Revised Study Plan. LRPS filed its DLA on September 30, 2024, and no comments pertaining to socioeconomic resources were received.

5.7.3.2 Applicant Recommendations

LRPS anticipates the Lewis Ridge Project to provide broad benefits to socioeconomic resources through both its construction and operational phases. As a result, LRPS is not proposing any specific PM&E measures related to socioeconomic resources.

5.7.4 References

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5.8 Geological and Soil Resources (18 CFR § 4.41 (f)(6))

5.8.1 Existing Environment

5.8.1.1 Topography

The existing ground surface elevations in the Project Vicinity range from approximately 1,100 to 2,200 feet,[39] according to the Kentucky State Geographic Information System website. Mountainous topography is predominant. The sides of many of the mountain peaks and ridges are quite steep. Local relief may be as great as 1,500 feet over a horizontal distance of 0.5 mile in the area south of Pine Mountain (McGrain and Currens 1978). The Pine Mountain ridge extends southwest/northeast from Jellico, Tennessee, to Elkhorn City, Kentucky, and runs through the northwest corner of the Project Vicinity (Commonwealth of Kentucky 2022). The Pine Mountain Overthrust Fault Line is a 125-mile-long overthrust fault created by mountain-building forces that occurred in the area roughly 230 million years ago. South of Pine Mountain, the rocks of the Breathitt Formation underlie the narrow valleys and form high, rugged hills. The tops of hills and ridges are commonly capped with sandstone. Shales form wide valleys and moderate or gentle slopes on hills (Kilburn et al. 1962).

The current topography within the Project Vicinity has been modified by past mining activities. At the upper reservoir site, more than 70 feet of native rock and soil have been removed and redeposited from the ridgetop as part of mountain top removal mining activities. Additionally, mine spoils have been deposited at both proposed reservoir locations. Contour mining between the reservoir sites has reshaped the slopes, creating wide benches and near-vertical highwalls up to 70 feet tall. The highwalls have been backfilled using mine spoils placed on the benches to cover the steep cuts (AECOM 2025a).

Figure 5-34 below shows the topography in the Project Vicinity.

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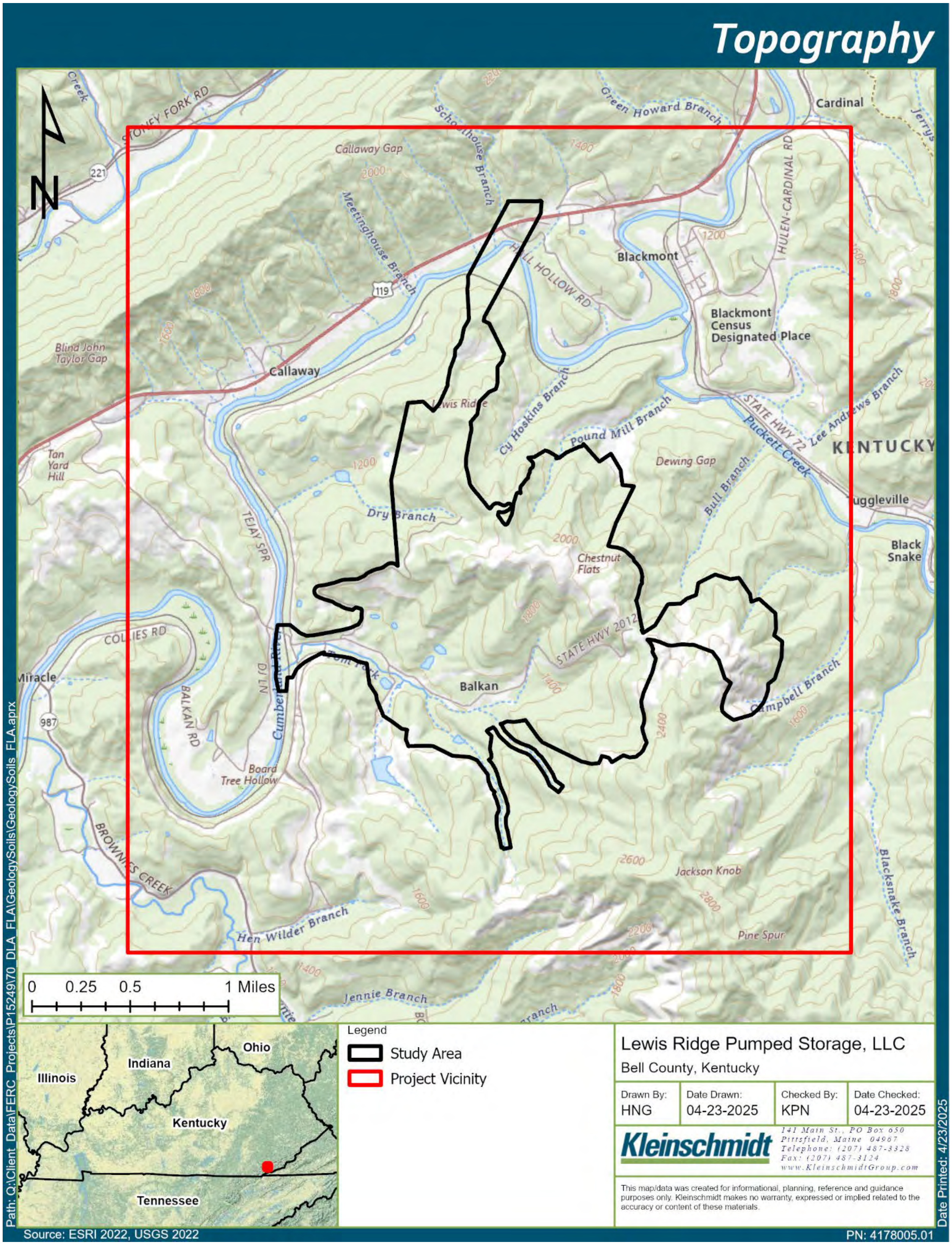
[39] Elevations are based on NAVD 88.

Figure 5-34: Topography in the Project Vicinity



5.8.1.2 Bedrock Geology

Figure 5-35 shows the geology in the Project Vicinity and the Project Study Area. As shown, the Pikeville, Grundy, and Hyden Formations of the Breathitt Group are the most common in the Study Area, which consist of siltstone, shale, sandstone, and coal. Using the Kentucky Geologic Map interactive geologic map (Kentucky Geologic Survey [KGS] 2024), the Pikeville Formation (mapped as the lower part of the Mingo and upper part of the Hance formations on historic geology maps) is the most abundant in the Project Vicinity and consists of siltstone, shale, sandstone, and coal.

Appendix Q, Geological and Soil Resources Information, contains historic geologic maps, including a geologic map of Kentucky (USGS and KGS 1988), a geologic map of the Balkan quadrangle, Bell and Harlan counties, Kentucky (Froelich and Tazelaar 1973), a geologic map of a part of the Cumberland Gap Coal Field (USGS n.d.), and a geologic map of the Middlesboro and part of the Bristol quadrangles, Southeastern Kentucky (KGS 2004). In these historic geologic maps, the bedrock is primarily mapped as the Breathitt Formation.

USGS and KGS Geologic Map of Kentucky (1988) confirms the presence of the upper, middle, and lower parts of the Breathitt Group. The Breathitt consists of sandy shale and coarse ferruginous sandstone with occasional coal seams. Members of the Pikeville Formation (also known as the Mingo Formation and the Hance Formation in historic maps) are located within the Breathitt Group.

A general stratigraphic section includes the Mingo Formation, underlain by the Hance and Lee formations.

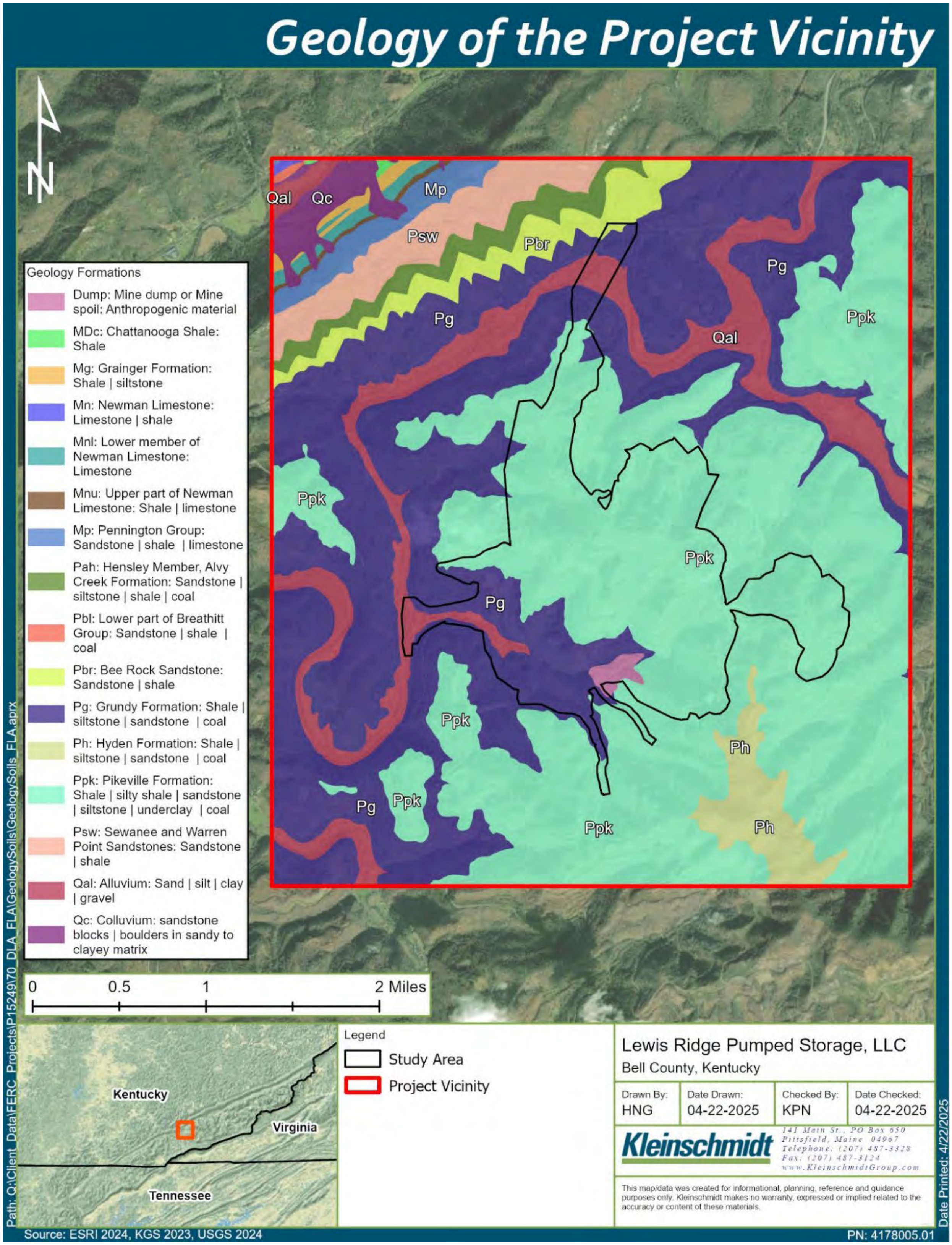
The Mingo Formation is comprised of shale, siltstones, sandstone, and coal. Named coal seams of the Mingo Formation identified in the Project Vicinity include the Darby coal seam, the Kellioka coal seam, and the Harlan coal seam. Both the Darby and Kellioka seams are known to have coal seam riders (more than one elevation) in the Project Vicinity. The Harlan coal seam, which is about 4 to 5 feet thick, is at the base of the Mingo Formation. Three drill holes penetrated the Mingo Formation as part of the 2006 boring investigation by Nally & Hamilton Enterprises, Inc. (2006, 2007), which described the formation as consisting of “Hard Massive Sandstone, Sandstone w/Shale Streaks, Lt. Gray Sandy Shale, Lt. Gray Shale, Dark Gray Shale and Coal (Darby Seam, Kellioka Rider Seam, Kellioka Seam and Harlan Seam).” The Mingo Formation is comprised of about 50 percent shale and sandy shale, 34 percent hard massive sandstone, 12 percent sandstone with shale streaks, and 4 percent surficial material and coal (AECOM 2025a). Three hard massive sandstone beds in the Mingo Formation have been identified in the Project Vicinity. The first layer is the Clover Fork Sandstone, which varies in thickness and is located above the Harlan coal seam (Nally & Hamilton Enterprises, Inc. 2007); the second hard massive sandstone layer, which is 22 to 30 feet thick, is located about 101 to 106 feet above the Clover Fork Sandstone, and the third hard massive sandstone layer is located between approximate elevations 2,210 and 2,250 feet and was mostly removed during the mining of the Chestnut Flats. In the Upper Reservoir footprint the Clover Fork Sandstone is 30 and 33 feet thick and 50 feet above the Harlan coal seam, however in recent geologic reconnaissance this sandstone layer was observed to range from 12 to 35 feet thick and lies directly above the Harlan coal seam in some locations. In the eastern portion of the proposed upper reservoir footprint, there are outcrops of the upper sandstone unit where it has not been mined. There are other minor coal seams throughout the formation and range from a few inches thick to occasionally 1 or 2 feet thick (AECOM 2025a).

The Hance Formation underlies the Mingo Formation in the Study Area and outcrops along the penstock alignment (AECOM 2025a). The Hance Formation is described as mainly shale, with some sandstone, siltstone, and coal. The mined coal seams in the Hance Formation are the Pathfork, Hance, and at least two elevations of Mason (Mason Rider and Mason), from highest to lowest elevation. The seams are typically 4 to 5 feet thick with other minor coal seams throughout, ranging from a few inches to 1 to 2 feet thick (AECOM 2025a). Other coal seams are present below the Mason seam, but they are not relevant to the Lewis Ridge Project.

The above descriptions and summary of the rock in the Project Vicinity and Study Area are subject to change based on the preliminary results of the ongoing geotechnical investigations.

The geologic structure of the bedrock in the Project Vicinity features near-horizontal bedding planes along with steeply dipping joint sets primarily oriented west-northwest, north-northwest, and north-northeast. No major faults or shear zones have been identified, though localized folding has been observed in some bedrock outcrops. Some steep joints above mined-out coal seams may be the result of stress relief in the rock mass following coal extraction (AECOM 2025a).

Figure 5-35: Geology of the Project Vicinity



Source: ESRI 2024, KGS 2023, USGS 2024

5.8.1.3 Surficial Geology and Soils

The Kentucky Geologic Map interactive geologic map (KGS 2024) identifies two soil units, alluvium and mine dump, within the Project Vicinity. These areas are also identified in Figure 5-36. The alluvium occurs primarily proximate to the Cumberland River and is described as poorly stratified, unconsolidated sand, silt, clay, and gravel. The mine dump is located in the Study Area and is described as tailings and mine waste from coal mining operations.

Based on available information from the recent geotechnical investigations and geologic reconnaissance, native overburden materials at the Lewis Ridge Project are observed to consist of residuum, colluvium, and alluvium. The residuum is described as completely weathered rock exposed at or near surface grading to less weathered bedrock. The colluvium is described as fine-grained soil, sand, and gravel- to cobble-sized rock fragments derived from physical weathering of surficial bedrock and deposition downslope. The alluvium at the Lewis Ridge Project was deposited by Tom Fork and its tributaries (AECOM 2025a). Talus, described as cobble- to boulder-sized rock clasts, has also been mentioned but may have been interpreted from mine spoils that have been displaced into the valleys and slopes.

The Study Area has been heavily disturbed by human activities, and coal mining operations have been performed since the 1940s. From 2007 to 2008, mountain top removal (MTR) mining was performed in the vicinity of the upper reservoir. Both contour mining and highwall mining have been performed in multiple coals seams until about 2017. Deep underground mining was performed in at least two elevations of Mason, and the Hance, Pathfork, and Harlan coal seams. Deep underground mining in the Mason seam was ongoing until 2020. The result is that large portions of the site are covered in mine spoils. Therefore, the date of publication for surface geology and soils references are important, as they were likely published prior to mining. Test pit excavations were completed in the mine spoils by Schnabel in 2024. Laboratory testing on samples of the surficial mine spoil materials in the footprints of the upper and lower reservoirs were reported to consist of mainly boulder, cobble, or gravel-sized fragments of sandstone, siltstone, shale, and mudstone. Minor amounts of gravel or cobble-sized coal fragments were observed in these test pit samples (Schnabel 2025b).

Soil survey maps provided by NRCS are typically the most accurate soils maps publicly available. However, these published maps do not appear to reflect recent mining activities.

Available NRCS maps provide value by describing typical soil types in the Project Vicinity and Study Area, and in the locations that have not been disturbed, but they should be used with caution, as human activity has significantly impacted the surficial deposits at the site. Previously mapped soil types in the Project Vicinity and Study Area are tabulated in Table 5-32 and Table 5-33, respectively (USDA NRCS 2022). Previously mapped soil types in the Project Vicinity and Study Area are depicted in Figure 5-36 (USDA NRCS 2022). Appendix Q, Geological and Soil Resources Information, provides the USDA NRCS Physical Soil Properties of Bell and Harlan Counties, Kentucky, and includes a description of physical characteristics, erodibility, and erosion factors associated with each soil type.

Table 5-32: Mapped Soils in the Project Vicinity

Map Symbol	Soil Type	Acres	% of Project Vicinity
SkF	Shelocta-Kimper-Cloverlick complex, 20 to 80 percent slopes, very stony	2,253	23
ShF	Shelocta-Highsplint-Gilpin complex, 20 to 70 percent slopes, very stony	1,505	15
GtF	Gilpin-Rayne-Sequoia complex, 25 to 55 percent slopes, very stony	1,109	11
FbF	Fairpoint and Bethesda soils, 20 to 70 percent slopes, stony	896	9
HeF	Helechawa-Varilla-Jefferson complex, 35 to 75 percent slopes, very rocky	667	7
CgF	Cloverlick-Guyandotte-Highsplint complex, 20 to 80 percent slopes, very stony	516	5
AtF	Alticrest-Totz-Helechawa complex, rocky, 20 to 55 percent slopes	513	5
Sb	Shelbiana loam, occasionally flooded	478	5
SmF	Shelocta-Kimper-Cutshin complex, 20 to 55 percent slopes, very stony	423	4
HsF	Highsplint-Cloverlick-Guyandotte complex, 35 to 75 percent slopes, very stony	405	4
Po	Pope fine sandy loam, occasionally flooded	182	2
W	Water	175	2
SgE	Shelocta-Gilpin silt loams, 20 to 35 percent slopes	128	1

Map Symbol	Soil Type	Acres	% of Project Vicinity
GsD	Gilpin-Shelocta silt loams, 12 to 20 percent slopes	122	1
KrF	Kimper-Renox-Sharondale complex, very rocky, 35 to 75 percent slopes	95	1
AgB	Allegheny loam, 2 to 6 percent slopes	75	<1
Du	Dumps, mine; tailings; and tipples	56	<1
FbC	Fairpoint and Bethesda soils, 2 to 20 percent slopes	55	<1
VrD	Varilla very stony loam, 5 to 20 percent slopes, extremely bouldery	55	<1
UrE	Udorthents-Urban land complex, 15 to 35 percent slopes	51	<1
Cr	Craigsville-Philo complex, occasionally flooded	26	<1
UrC	Udorthents-Urban land complex, 3 to 15 percent slopes	24	<1
Ph	Philo fine sandy loam, occasionally flooded	23	<1
Ud	Udorthents-Urban land complex, occasionally flooded	21	<1
SeB	Shelocta gravelly silt loam, 2 to 6 percent slopes	20	<1
SeC	Shelocta channery silt loam, 6 to 12 percent slopes	17	<1
HgD	Highsplint very flaggy silt loam, 5 to 20 percent slopes, extremely bouldery	9	<1
	Total	**9,899**	

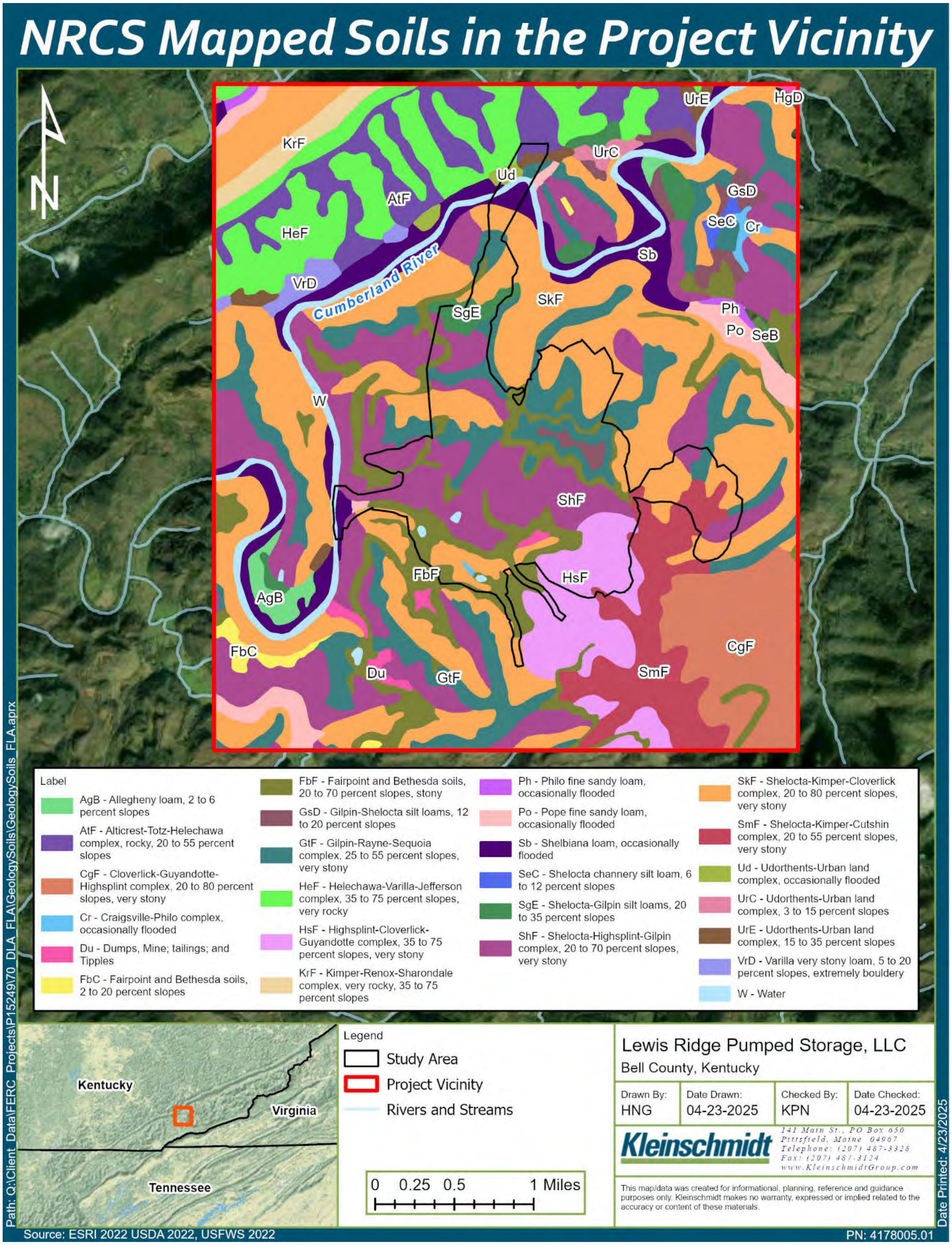
Source: USDA NRCS 2022

Table 5-33: Mapped Soils in the Study Area

Map Symbol	Soil Type	Acres	% of Study Area
ShF	Shelocta-Highsplint-Gilpin complex, 20 to 70 percent slopes, very stony	437	27
SkF	Shelocta-Kimper-Cloverlick complex, 20 to 80 percent slopes, very stony	319	20
FbF	Fairpoint and Bethesda soils, 20 to 70 percent slopes, stony	311	19
GtF	Gilpin-Rayne-Sequoia complex, 25 to 55 percent slopes, very stony	238	15
HsF	Highsplint-Cloverlick-Guyandotte complex, 35 to 75 percent slopes, very stony	141	9
SmF	Shelocta-Kimper-Cutshin complex, 20 to 55 percent slopes, very stony	45	3
SgE	Shelocta-Gilpin silt loams, 20 to 35 percent slopes	39	2
GsD	Gilpin-Shelocta silt loams, 12 to 20 percent slopes	25	2
W	Water	11	<1
AtF	Alticrest-Totz-Helechawa complex, rocky, 20 to 55 percent slopes	9	<1
Du	Dumps, mine; tailings; and tipples	8	<1
Ud	Udorthents-Urban land complex, occasionally flooded	7	<1
UrE	Udorthents-Urban land complex, 15 to 35 percent slopes	6	<1
Po	Pope fine sandy loam, occasionally flooded	4	<1
Cr	Craigsville-Philo complex, occasionally flooded	3	<1
HeF	Helechawa-Varilla-Jefferson complex, 35 to 75 percent slopes, very rocky	1	<1
	Total	**1,635**	

Source: USDA NRCS 2022

Figure 5-36: NRCS Mapped Soils in the Project Vicinity



5.8.1.4 Geological and Soil Hazards

5.8.1.4.1 Seismic Hazards

The Lewis Ridge Project is in the Appalachian Plateau of the eastern United States in the Paleozoic Extended Crust Seismotectonic Zone (PEZ) and near the northwestern margin of the Eastern Tennessee Seismic Zone (ETSZ), the primary source of seismic activity in the eastern United States. The largest recorded earthquake within the ETSZ had a magnitude of 5.1 M and occurred near Sparta, North Carolina, on August 9, 2020, approximately 130 miles from the Lewis Ridge Project (USGS 2025a). The ETSZ regularly produces earthquakes with low magnitudes (less than 2.5 M), with moderate quakes occurring about once per year (USGS 2020). These earthquakes have not been definitively linked to known mapped Quaternary faults in the area (USGS 2020).

The PEZ is an area of low to moderate seismicity with the largest recorded historical earthquakes having magnitudes less than 6 M. Paleoseismic investigations in the PEZ have shown no evidence for earthquakes larger than a magnitude of 6.5 M, and seismicity does not typically correlate with active structural boundaries or Quaternary faults. The reactivation of ancient structures in the present-day compressive stress field is widely accepted as the cause for seismicity in the area (AECOM 2025a, 2025b).

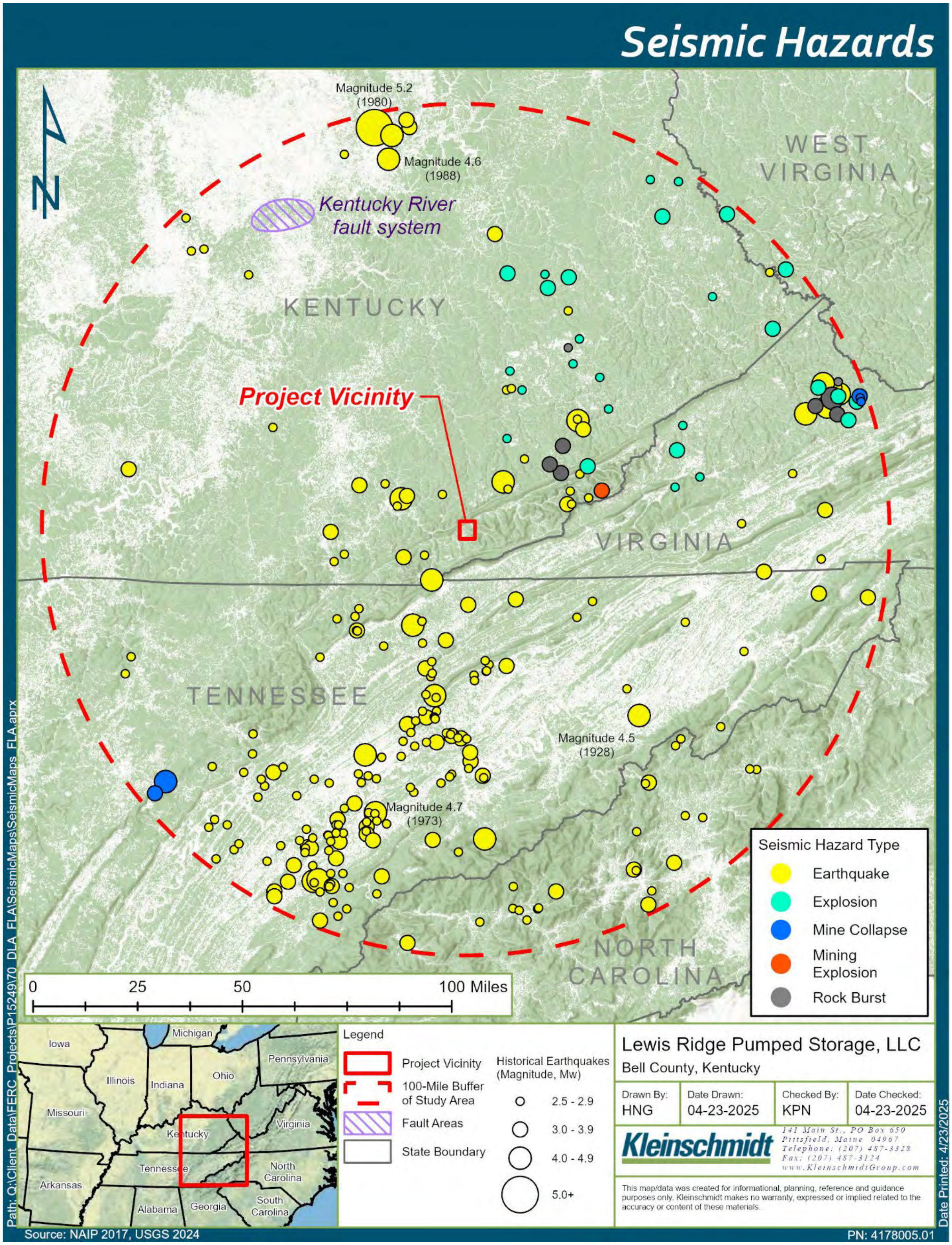
Figure 5-37 shows the seismic hazards, historical earthquakes, and Quaternary faults or fault areas within 100 miles of the proposed Lewis Ridge Project site. The types of seismic activity identified on Figure 5-37 include earthquakes, explosions, mining explosions, mine collapses, and rock bursts. Mining explosions, mine collapses, and rock bursts are all seismic hazards related to historic and current mining activities. A rock burst is defined as a violent expulsion of rock from the walls of a mine opening caused by heavy pressure on brittle rocks in deep mines where mining has deprived the rock of support on one side. A mine explosion is a sudden, intense combustion process that occurs in underground mines and surface processing facilities when flammable gas or combustible dust mixes with air and is ignited. A mine explosion releases large amounts of heat energy and pressure waves. A mine collapse, also known as mine subsidence, is when the ground surface moves due to the collapse of an underground mine. This can happen when the roof, floor, or pillars of a mine collapse.

Based on data from the USGS Quaternary Fault and Fold Database (USGS 2025b), there are no discrete faults of Quaternary age (<1.6 million years old) or younger in the Project

Vicinity, and there is one "fault area" within 100 miles of the Lewis Ridge Project. Approximately 80 miles northwest of the Lewis Ridge Project, there is a Quaternary fault area identified as the "Kentucky River fault system (Class B) No. 2650." This fault system is identified as a Normal-Reverse fault system, with a slip rate category of less than 0.2 millimeters/year (USGS 2025b). No recorded earthquakes with magnitudes greater than 2.5 M have been associated with this fault zone (USGS 2025a). The potential for surface fault rupture at the Lewis Ridge Project is regarded as not possible by AECOM (2025a).

Based on data from USGS (2025a), 267 earthquakes greater than 2.5 M occurred within 100 miles of the proposed Lewis Ridge Project site since 1834. This includes four earthquakes greater than 4.5 M; two of these earthquakes are associated with an unknown seismic source in northern Kentucky, including the largest event, which occurred 1.8 miles south-southeast of Sharpsburg, Kentucky (approximately 100 miles north-northwest of the Lewis Ridge Project) on July 27, 1980, and had a magnitude of 5.2 M.

Figure 5-37: Seismic Hazards within 100 Miles of the Study Area



A site-specific probabilistic seismic hazard analysis and deterministic seismic hazard analysis of the Lewis Ridge Project site were completed by AECOM in 2025. Deterministic ground motions and probabilistic ground motions were developed for a range of return periods to comply with USACE criteria (Engineer Regulation 1110-2-1806) and International Commission on Large Dams (ICOLD Bulletin 148 2016) recommendations (AECOM 2025b). Probabilistic peak ground accelerations (PGA), 0.1 second spectral accelerations (SA), and 1.0 second SA for the 225-year, 475-year, 975-year, 2,475-year, 5,000-year, and 10,000-year return period events in the vicinity are presented in Table 5-34. Calculations are for an assumed Vs_{30} (i.e., average shear wave velocity to a depth of 30 meters or approximately 100 feet) of 570 meters per second (1,870 feet per second). The 2025 AECOM Site-Specific Seismic Hazard Analysis also includes uniform hazard spectra for a range of return periods and deterministic spectra based on the maximum considered earthquake for each nearest identified fault source.

Table 5-34: Summary of Probabilistic Horizontal Ground Motions (Vs_{30} = 570 m/sec)

Return Period (Years)	PGA (g)	0.1 Sec SA (g)	1.0 Sec SA (g)
225	0.0253	0.0971	0.0291
475	0.0422	0.162	0.0489
975	0.0672	0.257	0.0737
2,475	0.121	0.461	0.114
5,000	0.190	0.705	0.154
10,000	0.289	1.045	0.201

Source: AECOM 2025b

5.8.1.4.2 Landslide Hazards

KGS developed the web-based Landslide Information Map (KGS 2024b), a compilation of landslides and landslide features mapped within the state. The dataset includes location data from recorded (historic) landslides, landslides mapped on 1:24,000-scale geologic maps from 1960 to 1978, landslide features identified from LiDAR and aerial imagery, and areas identified as susceptible to debris flows based on aerial photographs and historical records. There are multiple landslides and landslide features shown on the KGS Landslide Information Map within the Project Vicinity, as shown in Figure 5-38.

The majority of landslides and rockfalls in Kentucky occur in geologic units containing shale or in soils that develop in those formations (Crawford 2012, 2014). Shale is abundant in most parts of the state and is present within all primary geologic units at the Lewis Ridge Project, as described in Section 5.8.1.2, Bedrock Geology (Overfield et al. 2015). Many shales absorb and hold water, causing them to weather easily, erode, and potentially create stability problems (Potter et al. 2005). Roadways constructed within the Pikeville Formation (prevalent in the Study Area, including portions of the Mingo and Hance formations), Hyden Formation, Grundy Formation, and Kope Formation require the majority of the landslide and rockfall maintenance repairs in Kentucky (Overfield et al. 2015). Notably, according to data sourced from Crawford et al. (2023), eight landslides have been mapped in the Grundy Formation (which is a more recent stratigraphic unit name for the Hance Formation prevalent in the Study Area) within 2 miles of the proposed upper and lower reservoirs, and one landslide has been mapped in the Pikeville Formation.

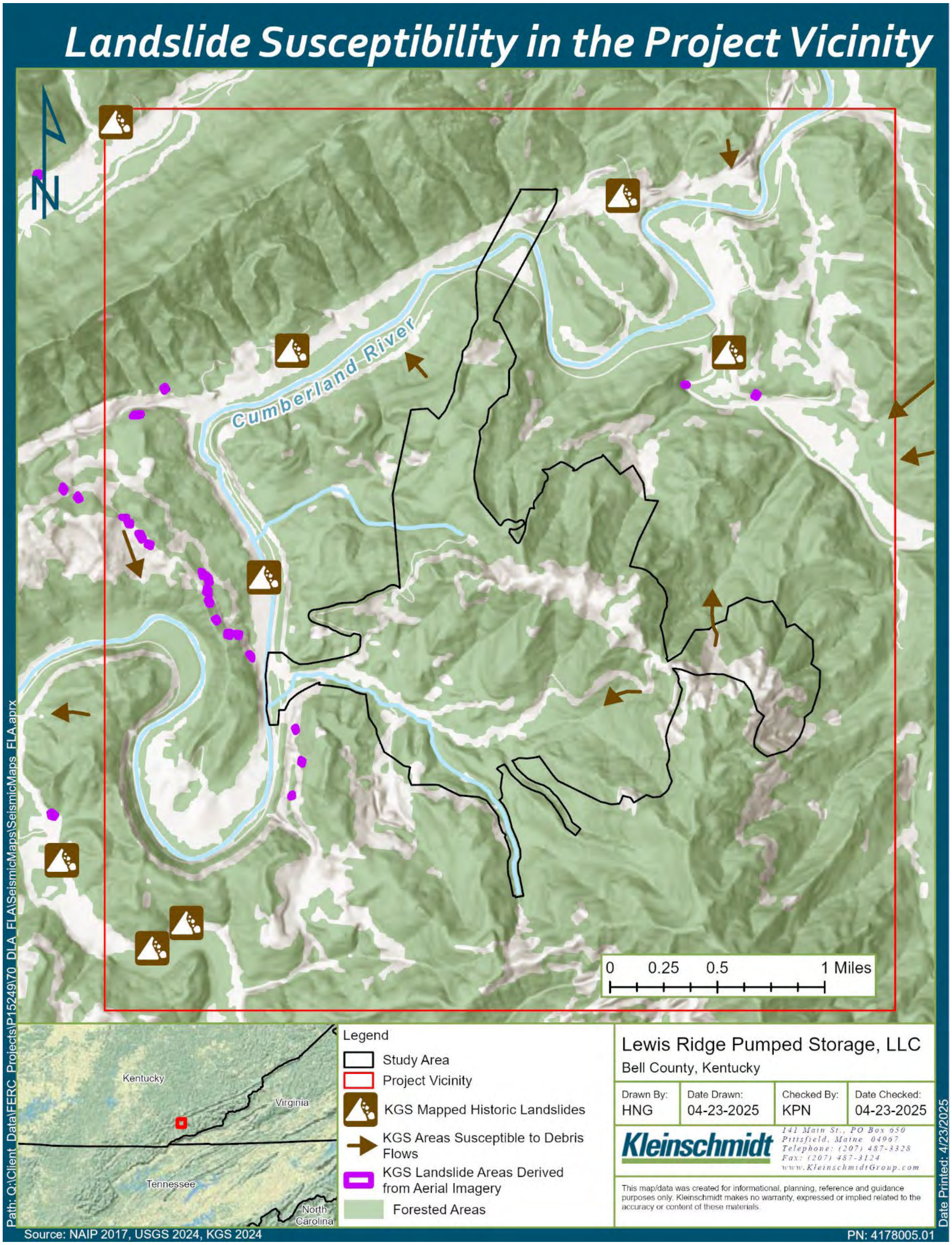
As described in Section 5.8.1.1, Topography, and Section 5.8.1.3, Surficial Geology and Soils, the Project Vicinity is mountainous with steep ridges. This may contribute to landslide susceptibility, as the soils above the bedrock on steep slopes may tend to be unstable, resulting in soil creep and landslides. In the Project Vicinity, mine spoils have been stored, or dumped in low areas including valleys and drainages. The mine spoils that have been placed without foundation preparation, compaction, or sufficient drainage are susceptible to slope movements.

Human-induced slope modification, including cut (excavating) and fill (loading) processes are common for road and building construction in steep terrains with narrow valleys in eastern Kentucky. These cuts and fills create changes in the balance of forces on a slope, which then can establish more favorable conditions for triggering landslides commonly induced by heavy rainfall. Most landslides in Kentucky are rainfall-triggered, meaning that an increase in pore-water pressure (a force) occurs as rain infiltrates the soil and underlying rock. This force overcomes the strength of the soil and rock material, causing landslides (Crawford et al. 2023).

Based on the mapped landsliding surrounding the Lewis Ridge Project (Figure 5-38) and published descriptions of landsliding in Kentucky as summarized above, it can be inferred that the region is susceptible to landslide activity, with landslides occurring in the Project Vicinity as recently as 2019, but there are no currently mapped landslide features present in the Project Boundary (KGS 2024b).

Based on AECOM’s review of available LiDAR imagery, there were no apparent deep-seated landslides on the slopes below the upper reservoir, above the lower reservoir, or along the conveyance and interconnection line alignments. Slope stability in these areas will be further evaluated during a future design phase, including assessment of published geologic maps, previous geologic reconnaissance (Schnabel 2023, 2025a), statewide and project-specific LiDAR data (Kentucky Geography Network 2024), and findings from the ongoing geotechnical investigations (AECOM 2025a).

Figure 5-38: Recorded Landslides and Landslide Susceptibility in the Project Vicinity



5.8.1.4.3 Mining Activities

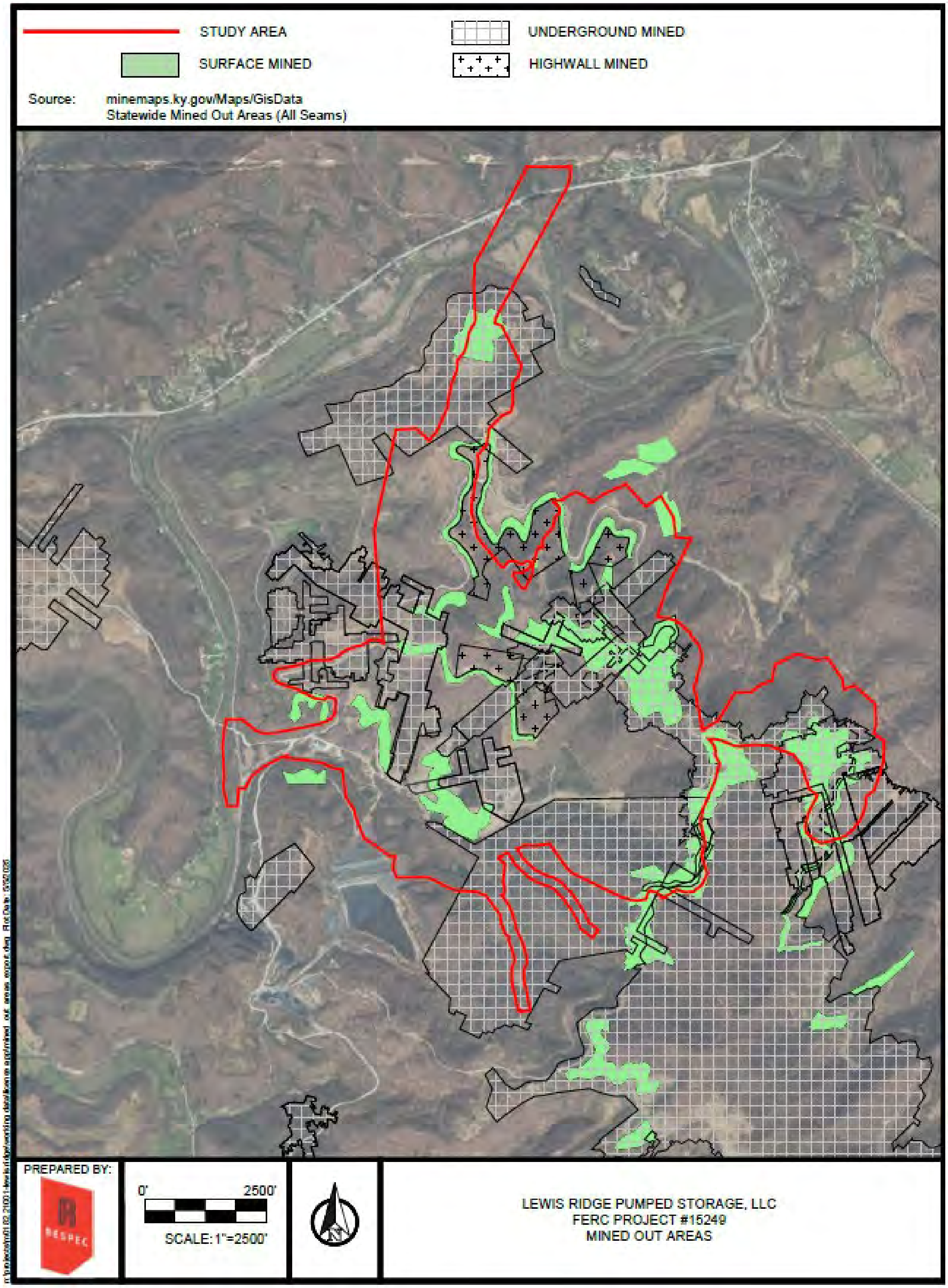
The Lewis Ridge Project is located primarily on a property used for coal mining (Figure 5-39). There are active mining permits in the Project Vicinity and areas that have been reclaimed. There are approximately eight identified coal seams in the Project Vicinity. From highest to lowest elevation, the seams are Darby, Kellioka Rider, Kellioka, Harlan, Upper Path Fork, Hance, and at least two elevations of Mason works (Mason Rider and Mason). All these coal seams have been mined within the Project Vicinity; however, the Hance, and Mason seams (multiple elevations) mine works are of interest due to their proximity to the proposed reservoirs, with the Hance seam located below the upper reservoir and the Mason seams located adjacent to the lower reservoir. Approximate coal seam elevations at the Lewis Ridge Project are depicted on Figure 5-40. Table 5-35 provides a summary of the identified primary mine works at these coal seams in the Project Vicinity (Schnabel 2023; AECOM 2025a). Mapped estimated limits to mine works are shown on plans included in the Preliminary SDR Attachment 1: 2025 AECOM Preliminary Engineering Geology Technical Memo Appendix, Mine Map Data (Schnabel 2025c).

In their March 21, 2023 letter, Kentucky DNR identified mining permits in the Study Area and potential conflicts with existing permitted activities. Kentucky DNR noted that the proposed location of the Lewis Ridge Project has been extensively mined by both surface and underground methods, with six existing permits bonded under the jurisdiction of Kentucky DNR. Under Kentucky’s SMCRA program, permitted areas are mined and reclaimed pursuant to the approved permit application. The Kentucky DNR identified extensively mined coal seams in the locations of the proposed reservoir locations as tabulated below (Table 5-36).

The six existing permits bonded under Kentucky DNR jurisdiction, in or partially in the Lewis Ridge Project Study Area, are tabulated in Table 5-37. The permitted post-mining land use for each existing bonded mining permit is depicted on Figure 5-41. The incremental bonding status for each existing bonded mining permit is depicted on Figure 5-42. The incremental bonding status shows the current phase of the bond. The permittee posts a reclamation bond to guarantee reclamation of all disturbed areas. Bond is typically released in phases. A Phase 1 release is granted after the area is fully graded, topsoiled, and seeded. Typically, for a Phase 1 release, approximately 60 percent of the original bond is released. A Phase 2 release can be released following 2 growing seasons after the Phase

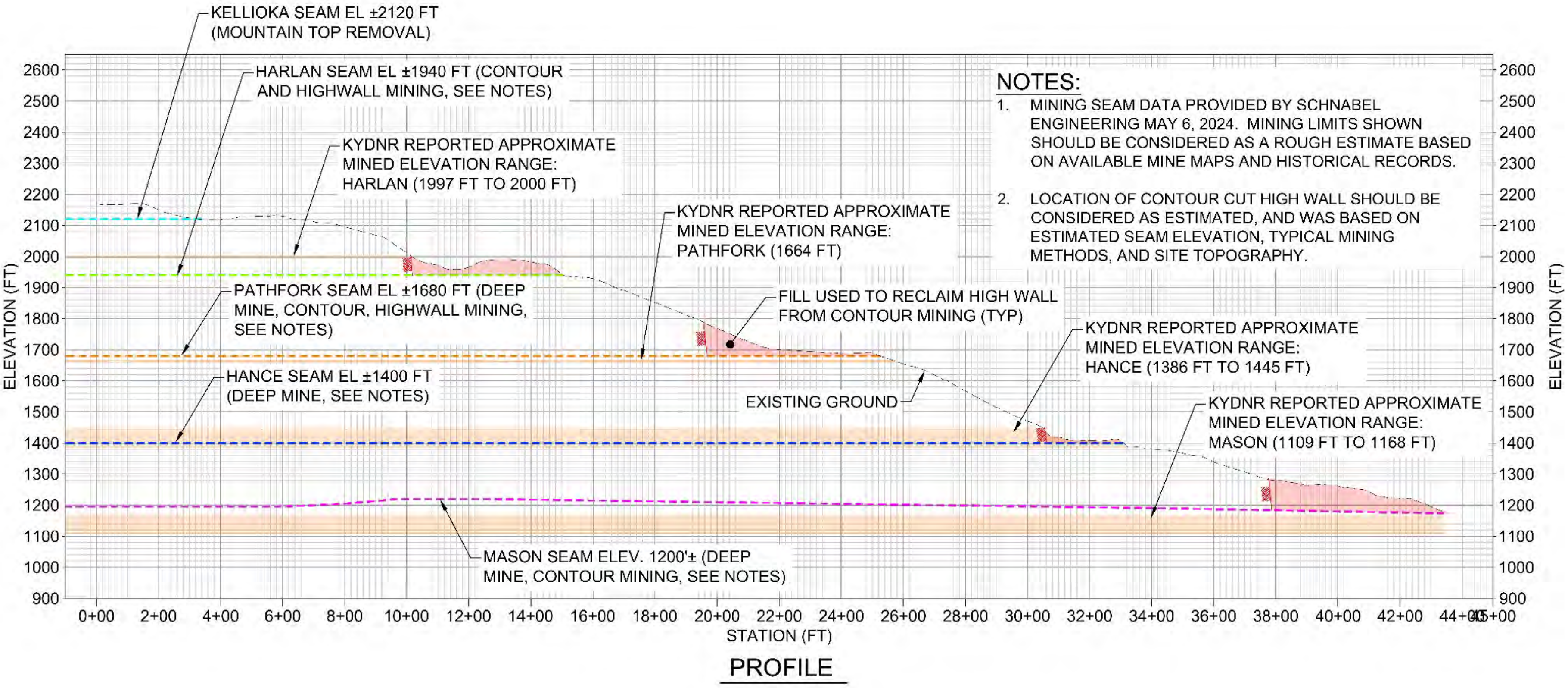
1 release. Typically, 25 percent of the original bond can be released for Phase 2. A Phase 3 release can be released 3 growing seasons after the Phase 2 release. Under Phase 3, the release is for all remaining bond, generally 15 percent of the original full bond amount.

Figure 5-39: Mined Areas Near the Lewis Ridge Project Study Area



Source: minemaps.ky.gov/Maps/GisData
Statewide Mined Out Areas (All Seams)

Figure 5-40: Coal Seam Elevations at the Lewis Ridge Project



NOTES:

1. MINING SEAM DATA PROVIDED BY SCHNABEL ENGINEERING MAY 6, 2024. MINING LIMITS SHOWN SHOULD BE CONSIDERED AS A ROUGH ESTIMATE BASED ON AVAILABLE MINE MAPS AND HISTORICAL RECORDS.

2. LOCATION OF CONTOUR CUT HIGH WALL SHOULD BE CONSIDERED AS ESTIMATED, AND WAS BASED ON ESTIMATED SEAM ELEVATION, TYPICAL MINING METHODS, AND SITE TOPOGRAPHY.

Source: AECOM 2024

Note: Darby and Kellioka Rider coal seams not called out in this profile since they are above the elevations in this section.

Table 5-35: Summary of Mined Coal Seams in the Project Vicinity

Coal Seam	Approximate Elevation[1] (feet)	Mining Type	Comments[2]
Darby	2,180	Mountain Top Removal	This coal seam, and the materials previously located above it, have been removed over most of Chestnut Flats (the vicinity of the upper reservoir).
Kellioka-Rider	2,164	Mountain Top Removal	This coal seam, and the materials previously located above it, have been removed over most of Chestnut Flats (the vicinity of the upper reservoir).
Kellioka	2,110	Mountain Top Removal	This coal seam, and the materials previously located above it, have been removed over most of Chestnut Flats (the vicinity of the upper reservoir). Mountain top removal was not performed to the Kellioka in a small location at the very eastern end of the proposed reservoir. Floor elevation 2,120± ft.
Harlan	1,997 – 2,000	Room and Pillar	No pillars pulled. Average pillar dimensions 66.5 ft by 28.1 ft with 20 ft spacing.
		Highwall	Auger mining (round) and highwall mining (rectangular). Workings vary from 10 ft to 660 ft in length with an estimated width of 10.5 ft.
		Contour	Bench elevation 1,940± ft.
Pathfork	1,580 – 1,740	Room and Pillar	Some pulled pillars. Average pillar dimensions 50 ft by 40 ft with 20 ft spacing
		Highwall	Auger mining (round) and highwall mining (rectangular). Workings vary from 110 ft to 910 ft in length with an estimated width of 10.5 ft.
		Contour	Bench elevation 1,680± ft.
Hance	1,240 – 1,445	Room and Pillar	Large areas of pulled pillars. Approximate pillar dimensions 50 ft by 40 ft with 20 ft spacing.
		Contour	Bench elevation 1,200± ft.
Mason Rider	1,160 – 1,250	Room and Pillar	Pillar dimensions highly variable – up to 150 ft by 30 to 80 ft.
Mason	1,109 – 1,225	Room and Pillar	Very limited areas with pulled pillars. Approximate average pillar dimensions in the vicinity of the lower reservoir 60 ft by 35 ft with 20 ft spacing.
		Contour	Bench elevation 1,200± ft.

Source: Schnabel 2023; AECOM 2025a

[1] The approximate mine seam elevations are based on values provided in Kentucky DNR (2024), Kentucky EEC (2024a), Kentucky EEC (2024b), and the Kentucky Geography Network (2024).

[2] Mining seam data provided by Schnabel (2025a).

Table 5-36: Summary of Mined Coal Seams at the Proposed Reservoir Locations

Project Feature	Coal Seam	Approximate Mined Elevation (feet)[40]	State File No.
Upper Reservoir	Harlan	1,997 to 2,000	111674, 00381-2
	Pathfork	1,664	10383-3
	Hance	1,386 to 1,445	111474
Lower Reservoir	Mason	1,120 to 1,165	11541-127
		1,109 to 1,168	08053

Source: Kentucky DNR 2023

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[40] Elevations are based on NAVD 88.

Table 5-37: Summary of Existing Mining Permits Bonded Under Kentucky DNR Jurisdiction in or Partially in the Study Area

DNR Permit No.	Permit Holder	Permit Status	Coal Seam	Coal Seam Elevation (feet)	Permit Activities
807-0339	Nally & Hamilton Enterprises, Inc.	A-1[1]	Hance	Between 1,240 and 1,300[2]	Contour and road
807-0345	Nally & Hamilton Enterprises, Inc.	P-1[3]	Hance	1,300[2]	Area and auger
807-0347	Nally & Hamilton Enterprises, Inc.	A-1[1]	Mason	Between 1,120 and 1,165[2]	Surface contour and refuse disposal
807-0353	Nally & Hamilton Enterprises, Inc.	A-1[1]	Mason	Between 1,120 and 1,165[2]	Surface contour, auger, and underground operation
807-0372	Nally & Hamilton Enterprises, Inc.	P-1[3]	Pathfork	Between 1,580 and 1,740[2]	Surface contour, area, and auger operations
807-5220	Nally & Hamilton Enterprises, Inc.	P-1[3]	Hance	1,375[2]	Contour, underground

Sources: Kentucky EEC 2024a; Kentucky EEC 2024b; Kentucky Geography Network 2024

[1] A-1 status is defined as follows: The permit is actively conducting mining activities (no coal removal occurring); and/or the permit has not expired, coal reserves remain, and the future possibility of coal removal still exists; and/or all non-producing facilities will remain in A-1 status until expiration of the permit (this includes preparation plants, haul roads, and impoundment facilities).

[2] Mine Seam elevations were obtained from the most recently issued Mine Reclamation Plan (MRP) Map for each permit.

[3] P-1 status is defined as follows: Reclamation has been completed for all disturbed areas in accordance with 405 KAR 10:040 Section 2 (4)(a). The Permittee has submitted a request to the Cabinet for Phase I bond release and the request has been approved by the Cabinet. If the permit is incrementally bonded, EACH bonded increment that is disturbed must meet and be approved to Phase I standards prior to the ENTIRE permit being assigned P-1 status.

Figure 5-41: Permitted Post-Mining Land Use for Existing Mining Permits Bonded Under Kentucky DNR Jurisdiction

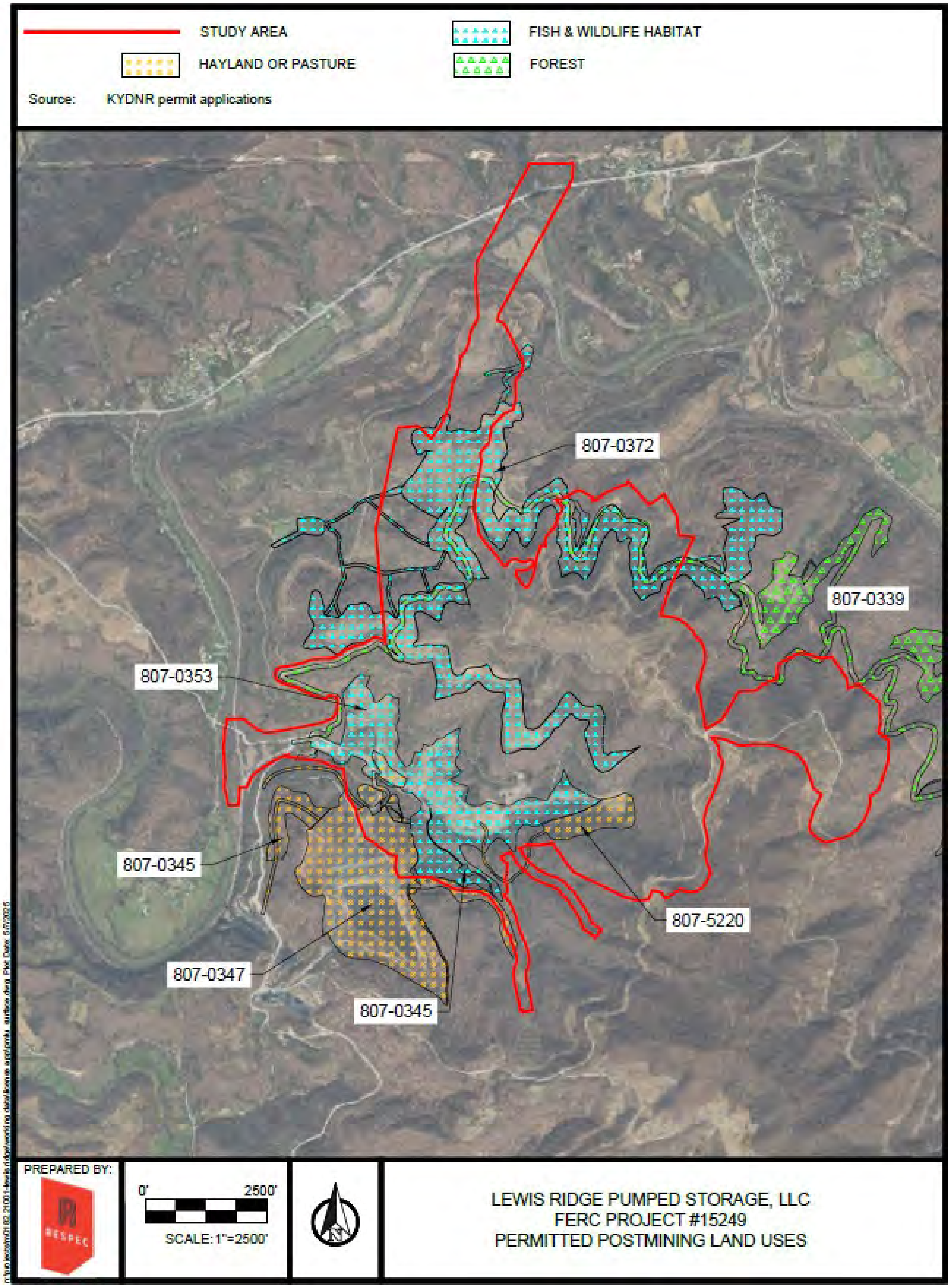
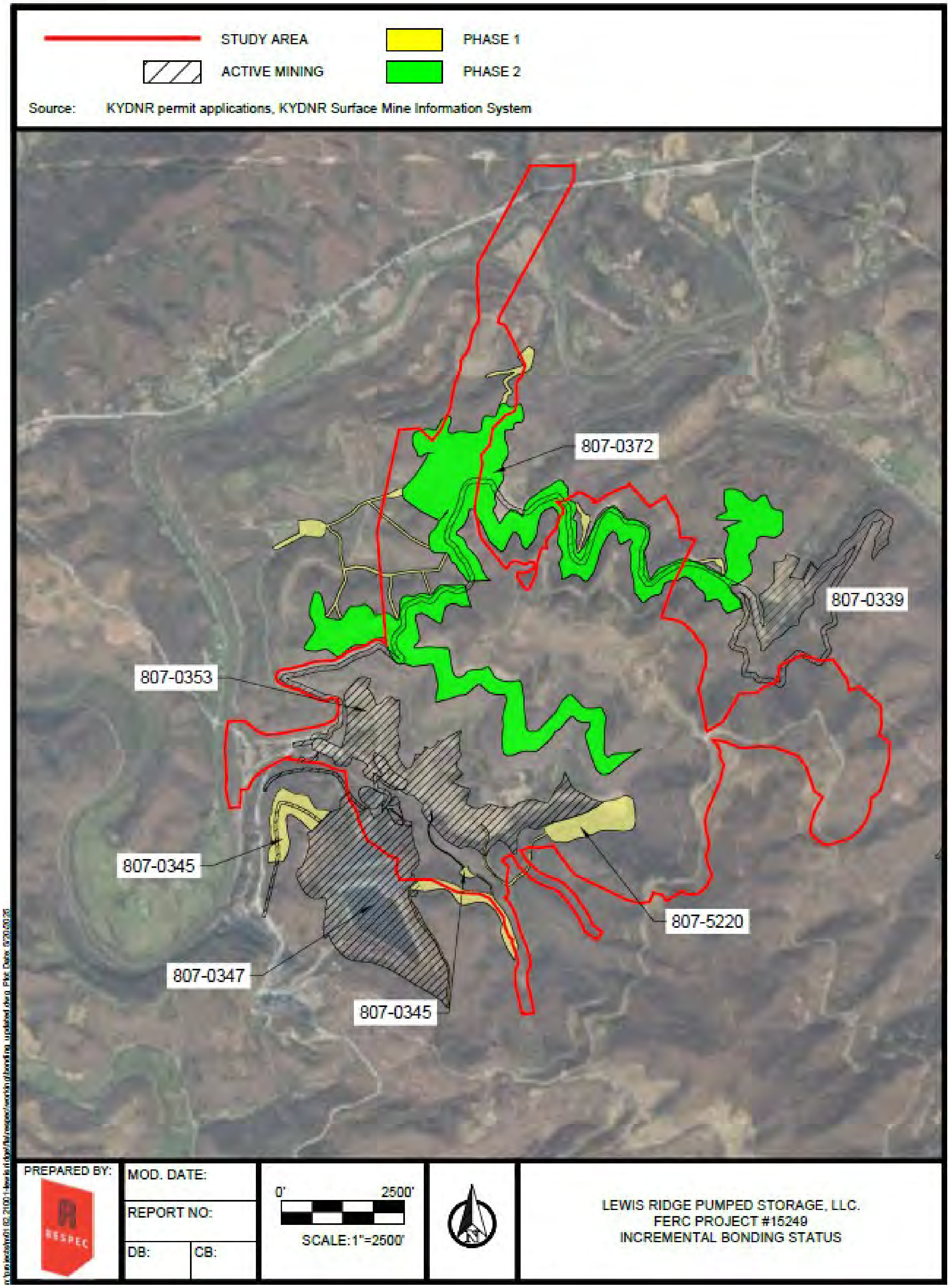


Figure 5-42: Incremental Bonding Status for Existing Mining Permits Bonded Under Kentucky DNR Jurisdiction



Source: KYDNR permit applications, KYDNR Surface Mine Information System

In the portion of the Study Area where the proposed upper reservoir will be located, there is a large volume of mine spoils that will have to be relocated, or reused, as part of the project configuration (Schnabel 2023). The upper reservoir site is currently characterized by the presence of up to 80 feet of mine spoils, averaging about 47 feet thick, with a total volume of approximately 2,970,000 cubic yards that remain overlying bedrock beneath the currently proposed footprint of the upper reservoir from prior MTR mining that targeted the Darby, Kellioka Rider, and Kellioka coal seams. The excavated rock was presumably temporarily cast adjacent to the area of the coal seam being extracted and then placed back over the mined-out area without intentional compaction, followed by excavating, and temporarily casting aside adjacent rock to expose and extract adjacent coal. This MTR mining continued to rock underlying the base of the largely mined-out Kellioka seam (approximate elevation 2,120 feet), resulting in the mine spoil now present (AECOM 2025a and AECOM 2024).

Auger and highwall mine workings in the Harlan seam extend into the bedrock beneath the proposed upper reservoir, conveyance alignment, and emergency spillway outlet. Additionally, extensive room and pillar mines of the Harlan seam are located beneath the upper reservoir and conveyance alignment, and the proposed disposal sites have undergone partial to complete retreat mining (AECOM 2025a).

Underground room and pillar mine workings in the Pathfork seam are located beneath the westernmost edge and extending west of the proposed upper reservoir. The conveyance alignment crosses a bench and highwall of the Pathfork mining efforts, and the bedrock below the alignment has also been mined by auger and highwall workings. In the Mason seam, one of the room and pillar mines with portions of retreat mining extends beneath the upper reservoir (AECOM 2025a).

In the portion of the Study Area where the proposed lower reservoir will be located, geophysical investigations, review of historic aerial imagery, and field reconnaissance observations carried out by Schnabel in 2023 indicated that large portions of the valley have been mined and that much of the current topography in the lower reservoir consists of mine spoils placed as part of site reclamation. The Mason seam was mined on the lower valley slopes and locally beneath the valley floor, so there is potential for highwall and auger mine adits to exist along the valley floor. Associated adits are likely covered with mounds of mine spoils and will need to be identified and plugged prior to reservoir filling due to the potential impacts of fluctuating water levels (Schnabel 2023). Most of the mine spoils at the lower reservoir site are inferred as redistributed excavated overburden and rock from contour mining of the Mason coal seam, possibly intermixed with some spoils from contour mining and MTR, especially in the tributary drainages in the valley associated with Tom Fork. Under the northeastern half of the proposed lower reservoir, the right abutment and downstream of the right abutment of the lower reservoir, and at the powerhouse, the Mason coal seam was mined using contour mining methods. Room and pillar mining occurred beneath the lower reservoir, the conveyance alignment, and at the right abutment of the dam (AECOM 2025a). The nature of auger and highwall mining at several coal seams/elevations (Harlan, Pathfork, Hance seams) has left the slopes between the proposed upper and lower reservoirs in a sawtooth shape. As a result, the proposed conveyance will pass over residual soil slopes, rock knobs left as artifacts of highwall benches, and the uncompacted fill used to reclaim/fill the highwall benches. Along the proposed penstock alignments, there are known steep to nearly vertical highwall excavations that have been reclaimed by covering some or all the highwall rock face with mine spoils up to 40 or more feet deep to meet state reclamation requirements (AECOM 2024).

An additional geophysical investigation with several more geophysical lines using seismic refraction and MASW was conducted by Schnabel in 2024 to evaluate the amount of overburden and the accuracy of available mine maps. Based on the interpretations of velocities from this investigation, elevations 2,180, 2,110, 1,950, 1,660, and 1,390 feet were identified as estimates of the average elevation of the Darby, Kellioka, Harlan, Pathfork, and Hance coal seams, respectively. The Mason seam was estimated at elevation 1,185 feet in the northern portion of the lower reservoir and elevation 1,140 feet in the southern part of the lower reservoir. (Schnabel 2024). These geophysical results are expected to be calibrated with data from the ongoing geotechnical boring investigation once it is completed.

Geotechnical investigations are ongoing to characterize the mine spoils. A preliminary geotechnical test pit investigation was completed by Schnabel in 2024 that included laboratory testing on mine spoil samples from the upper and lower reservoir footprints. Surficial mine spoil materials sampled in the footprint of the upper and lower reservoirs were characterized as mainly boulder, cobble, or gravel-sized fragments of sandstone, siltstone, shale, and mudstone, with minor amounts of gravel, or cobble-sized, coal fragments. Test pit logs and laboratory testing data from the 2024 investigation are included in the Schnabel Test Pit Investigation Report, which is attached to the AECOM

Preliminary SDR Attachment 1: Preliminary Engineering Geology Technical Memo. Additional representative samples of the rock types from the ongoing drilling investigation will be tested to address variability observed in the test pit laboratory results (Schnabel 2025b). Geotechnical boring drilling at the upper and lower reservoir footprints is currently in progress and expected to continue through June 2025.

5.8.2 Potential Impacts of the Proposed Lewis Ridge Project

Lewis Ridge Project final design and construction could be complicated by historic mining features in the Project Vicinity. These mining features include the drainage corridors, sediment ponds, hollow fill or mine spoil areas, adits, and disturbed areas with previous backfilled surficial or underground mines.

According to available historic boring logs and recent geologic reconnaissance and investigations, there are varying thicknesses/volumes of overburden in the Study Area. The overburden consists of mine spoils, native alluvium, and colluvium. Construction of a perimeter dam to create the upper reservoir impoundment will require significant volumes of suitable aggregate (gravel to cobble-sized rock) for rocky earthfill, which may be sourced from excavations from the upper reservoir area and/or require use of the borrow area identified in the Study Area. This potential development of an onsite quarry in the borrow area will require rock sourced via stripping, excavation, and/or blasting. The Dam Construction Materials Investigation Background, Plan, and Summary (Schnabel, 2024-05-07) details potential coarse aggregate sources for dam construction. In August 2024, Schnabel excavated test pits to examine mine spoil properties on the Study Area. These spoils were preliminarily evaluated for durable rock to assess their suitability as borrow material and coarse aggregate for the dam construction (Schnabel 2025a).

Constructing the Lewis Ridge Project over historic mining features may increase the risk for potential subsidence, surface tensile strain and associated cracking, and/or instability. One area of an underground mine for the Hance coal seam was mined in 1982 and abandoned in February 1986 by Brownies Creek Colleries, Inc. This mine used the room and pillar mining method, and many of the pillars in the deep mine have been robbed, leaving little or no roof support. This area is underneath a current hollow fill area, identified as Hollow Fill #1. There are no reports or observations of ground surface subsidence in this area, but it is still possible subsidence of these mined areas with little roof support could occur in the future. The hard rock sandstone occurring above the deep mined areas may be a factor in preventing or reducing subsidence (Nally & Hamilton Enterprises, Inc. 2010). In order to determine the stability of the hollow fill on top of some of these areas, Nally & Hamilton Enterprises, Inc. performed stability analyses for scenarios considering maximum subsidence (thickness of the deep mine seam) and the analyses indicated the fill would be stable. Construction of a new project in the area, however, may possibly disturb this fill or hard rock causing future subsidence in this area. Construction activities in other areas of the Lewis Ridge Project could also potentially disturb areas underlain by similar conditions and cause subsidence.

A conservative preliminary subsidence analysis was conducted by Schnabel in 2023 to characterize potential subsidence and strain beneath the upper dam and reservoir. The Surface Deformation Prediction System software was used to evaluate the range of possible subsidence and strain in the foundation of the upper dam and reservoir. Results were calculated for individual coal seams and for cumulative effects across all identified modeled coal seams. Within the preliminary project upper reservoir footprint at that time, maximum cumulative predicted subsidence was estimated to be 3.4 feet along the western extent (Schnabel 2023). AECOM has indicated that, based on available information and pending the ongoing geotechnical investigation, subsidence areas of the first room and pillar mining are not expected to result in significant impacts to the overburden rock, which is the floor and foundation subgrade of the upper reservoir and dam. A more comprehensive analysis of potential surface subsidence due to collapse of mine works below the upper reservoir will be performed as part of a future design phase. The subsidence analyses will be coordinated with breakthrough analyses. Potential impacts of mine subsidence at the Lewis Ridge Project to be investigated include vertical and horizontal movements, including strain, tilt, and curvature that could result in surface cracks, fissures or fractures, pits or sinkholes, and/or troughs or sags extending to the floor of the reservoir and foundation of the dam (AECOM 2025a).

The potential for a vertical breakthrough of the upper reservoir into the Harlan seam mines and a lateral breakthrough into the Mason seam mines (likely multiple) will be performed as part of a future design phase. Based on information available to date, AECOM (2025a) has inferred that, if subsidence is not likely, overburden breakthrough is also unlikely.

The floor of the lower reservoir and the foundation of the corresponding dam, as well as the powerhouse, will be below the base of the lowest mined Mason coal seam, so the subsidence potential for the lower reservoir, dam, and powerhouse is negligible. The conveyance alignment overlies mine workings of the Harlan, Hance, Pathfork, and Mason seams and may be susceptible to subsidence. Future subsidence evaluations of these mine workings will address ground disturbance and loading from the conveyance pipe and its foundations (AECOM 2025a). The Lewis Ridge Project may be subject to potential reservoir leakage/flow through fractures in the rock without appropriate geotechnical design and foundation treatment. Groundwater flow in this region occurs primarily through fractures and openings in the rock (e.g., joints, faults) or along bedding planes. Blasting due to the mining activities in the area has broken up the strata over and under the coal seams, opening more fractures and increasing the permeability of the surrounding material. There are also known locations and the potential for surface contour mining having created highwall access for underground auger or other mine adits to exist along the valley floor at the lower reservoir location. Associated adits are likely covered with mounds of mine spoils as reclamation cover and will need to be identified and plugged prior to reservoir filling due to the potential impacts of fluctuating water levels (Schnabel 2023). LRPS proposes an AC liner in the upper reservoir and lower reservoir to help address these concerns. The construction of the Lewis Ridge Project will create significant volumes of excavated soil, rock, and coal mine spoils that will need to be disposed of across the site. The excess material is currently planned to be disposed of in fill areas and tributary “hollows” along the south slope below Chestnut Flats. The spoils will be placed using end dumping and/or the conventional grading method. The disposal area foundations will be cleared of organic material and topsoil prior to placement. The conventional method will be used to place material from the lower reservoir at the bottom of the fill areas to create a rock underdrain. The end dump method will be used to place material from the upper reservoir into the head of the hollow to create drainage channels at the base of the fill. The construction of the drainage features will accommodate groundwater seepage and surface-water infiltration at the disposal sites. Results from the ongoing geotechnical investigations will be used to design the disposal fills in a future design phase, and the disposal fill areas will be designed and constructed to comply with requirements in Kentucky Administrative Regulations, Kentucky EEC, and the office of Surface Mining Reclamation and Enforcement (AECOM 2025a).

5.8.3 Agency Consultation and Applicant Recommendations

5.8.3.1 Agency Consultation

Documentation of consultation appears in Appendix A. Consultation specific to geological and soil resources is summarized below.

LRPS conducted a meeting with the Kentucky Resource Council on September 13, 2022. During the September 13, 2022 meeting, the Kentucky Resource Council expressed concerns regarding site stability and existing fill and provided recommendations regarding Lewis Ridge Project feature locations as it related to site stability.

LRPS filed a NOI and PAD to seek an original license for the Lewis Ridge Project on October 21, 2022. On November 23, 2022, USEPA commented on the NOI and PAD providing recommendations and considerations for FERC to include in its draft NEPA document. USEPA requested inclusion of the results from geotechnical investigations and plans for the disposal of contaminated materials. Specifically, USEPA recommended considering other projects in the area that may need fill material such as old mines, roads, and superfund sites.

LRPS held a Joint Agency and Public Meeting and Site Visit on January 25, 2023. Existing geological and soil resources information from the PAD was presented at the Joint Agency and Public Meeting. During the meeting, discussion occurred with Kentucky DNR regarding deep mining that has occurred in the area and conducting a breakthrough analysis.

LRPS is conducting extensive geotechnical studies, including test pits, geophysical seismic refraction surveys, and geophysical seismic MASW surveys, to assess and provide information to support design of geotechnical measures to address stability at the Lewis Ridge Project. Summaries of key findings from geological reconnaissance, geophysical investigations, and ongoing geotechnical investigations are included in Sections 5.8.1.3 and 5.8.1.4.3.

The Kentucky DEP submitted comments on April 6, 2023 (following the Joint Agency and Public Meeting) and on July 9, 2024 (following the distribution of the Draft Study Plan). In the comments, the Kentucky DEP provided state permitting information. In the April 6, 2023 comments, the Kentucky DEP attached comments from the Kentucky DNR related to implementation of the SMCRA through KRS 350.020. Kentucky DNR provided details on three permits bonded under Kentucky DNR jurisdiction providing additional information on underground operations beneath the upper and lower reservoirs. Kentucky DNR expressed concern with the potential of breakthrough due to underground mine works, specifically with the approximate elevations of the Harlan Coal Seam in the location of the proposed upper reservoir and the Mason Coal Seam in the location of the proposed lower reservoir.

LRPS filed its DLA on September 30, 2024. USEPA provided comments on the DLA related to geological and soil resources, specifically on differential settlement calculations. As appropriate, LRPS addressed comments in the FLA and in the accompanying Summary Response Table to Comments provided in Appendix A.

5.8.3.2 Applicant Recommendations

LRPS proposes to implement the following studies and PM&E measures to minimize impacts on geological and soil resources:

- **Erosion and Sediment Control Plan:**
    - LRPS proposes to develop and implement an Erosion and Sediment Control Plan with the purpose of limiting potential for impacts from soil erosion and sedimentation during Lewis Ridge Project construction. The Erosion and Sediment Control Plan will be filed with the Commission after license issuance and implemented immediately prior to construction. The Erosion and Sediment Control Plan will include:
        - Specific erosion prevention and control measures based on state recommended BMPs to be implemented prior to permanent stabilization of the site. Measures to avoid or minimize sediment transport may include silt fences, hay bales, etc.
        - Provisions to limit the amount of disturbed ground to the extent possible. The Vegetation Management Plan (Appendix D, described in Section 5.5.3) will be followed.
- **Slope Stability Analysis:**
    - Slope instability at or near Lewis Ridge Project features will be assessed as part of a future design phase. The assessment will be based on published geologic mapping, prior geologic reconnaissance (Schnabel 2023, 2025a), Statewide (Kentucky Geography Network. 2024) and project specific (AECOM 2025) LiDAR, and the ongoing Geotechnical Investigation (AECOM

2025a). The stability of rock excavation slopes within the reservoir area will primarily depend on the slope geometry relative to natural rock discontinuities. Discontinuity characteristics will be assessed through ongoing geotechnical investigations. Geotechnical data from the ongoing investigations will support stability analyses to estimate safety factors and recommend stabilization measures if needed. Similar analyses will be conducted for existing slopes outside and below the reservoir, as appropriate.

  - Potential slope stabilization measures will include:
    - Special procedures and BMPs to be implemented during the construction and post-construction periods to mitigate landslide occurrence and slope instability.
    - Basic mitigation strategy areas to protect against landslides and slope instability during construction such as appropriate grading controls, natural and/or cut slope stabilization, drainage improvement, and erosion and runoff control.
    - Review of landslide susceptibility of geologic soils and rock units in the Study Area.
    - A summary of slope maintenance and monitoring procedures.

- **Breakthrough Analysis:**
  - Based upon the provided dimensions of both reservoirs, the Kentucky DNR has concerns related to the potential of breakthrough via the underground mine works. The Kentucky DNR requested that a breakthrough analysis be conducted. The breakthrough analysis will be performed in general accordance with Section 8.4.4 of the Engineering and Design Manual - Coal Refuse Disposal Facilities (MSHA 2010). This manual defines a mine breakthrough as an area where the load imposed by the overburden and impoundment or deterioration due to weathering, degradation or seepage forces causes collapse of overburden strata and uncontrolled release of fluid fine coal refuse and water into mine workings and beyond. This analysis is meant to calculate a factor of safety for mine breakthrough potential for a coal seam with mine working extending beneath all or a portion of an impoundment pool.
  - Vertical breakthrough analysis of the upper reservoir into the underlying Harlan seam mine workings and lateral breakthrough into Mason seam mine workings adjacent to the lower reservoir impoundment will be performed as part of a future design phase (AECOM 2025a).

- **Subsidence Analysis:**
    - A preliminary subsidence analysis was performed at the upper reservoir by Schnabel in 2023 to characterize potential subsidence and strain beneath and at the subgrade of the upper dam and reservoir. The Surface Deformation Prediction System software (developed by researchers at Virginia Tech) was used to evaluate the range of possible subsidence and strain in the foundation of the upper reservoir and dam. A summary of this analysis and results are included in Section 5.8.2.
    - An analysis of potential surface subsidence due to collapse of inactive coal mines below the upper reservoir will be performed as part of a future design phase. This analysis will update the intentionally conservative preliminary analysis documented in Schnabel (2023). The subsidence analyses will be coordinated with the breakthrough analyses.
    - Subsidence of mine workings below the conveyance alignment will also be assessed as part of a future design phase (AECOM 2025a).

5.8.4 References

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5.9 Recreational Resources (18 CFR § 4.41 (f)(7))

5.9.1 Existing Environment

5.9.1.1 Recreation at the Project

There are no existing recreation sites in the Project Study Area, and there are no public recreation sites in the Project Vicinity. The Project Study Area and much of the Project Vicinity includes land with active and reclaimed mining operations. Due to industrial use of the land at the proposed Lewis Ridge Project site, public access on this privately owned property is restricted for public safety and recreation is not permitted.

5.9.1.2 Protected River Segments, National Trails System, and Wilderness Areas

There are no river segments in the Project Vicinity that have been designated for inclusion in the National Wild and Scenic River System (NPS 2025a). Kentucky has a Wild Rivers Program, which was established by the Kentucky Wild Rivers Act of 1972 and is administered by the Office of Kentucky Nature Preserves. A 16.1-mile-long segment of the Cumberland River from Summer Shoals to the backwaters of Lake Cumberland, located approximately 84 river miles downstream from the Project Vicinity, is designated by Kentucky as a Wild River. Martins Fork from Kentucky Highway 987 to the eastern boundary of Cumberland Gap National Park is a state designated Wild River; this reach is approximately 8 miles from the proposed Lewis Ridge Project. There are no state-protected river segments in the Project Vicinity. (Kentucky EEC 2025a).

There are no lands included in the National Trails System, nor are there lands designated as, or under study for inclusion as, a Wilderness Area in the Project Vicinity (NPS 2025b, Southern Appalachian Wilderness Stewards 2025).

5.9.1.3 Recreation in the Region

The Upper Cumberland River supports recreational water activities including fishing, canoeing, and kayaking. There is an Upper Cumberland River public access site called the Varilla Ramp located downstream from the Project Vicinity, approximately 3 miles from the Lewis Ridge Project. The Varilla Ramp includes a boat ramp and a small, gravel parking area for approximately eight vehicles. The Varilla Ramp is used for bank anglers, wade fishing, and as a put-in for canoes and kayaks. The Kentucky DFWR manages the Varilla Ramp and lists a river mile stretch of 13.8 miles of the Upper Cumberland River with the

Varilla Ramp as the put-in access point and the 4 Mile Ramp located just north of Pineville as the take-out location. The Kentucky DFWR does not list any boating sections on the Upper Cumberland River further upstream of the Project Vicinity. The Varilla Ramp is shown in Figure 5-43 (Kentucky DFWR 2025).

Figure 5-43: Varilla Ramp

Source: Kentucky DFWR 2025

There are numerous recreational opportunities in Eastern Kentucky in the region surrounding the proposed Lewis Ridge Project. Regional parks include Cumberland Gap National Historic Park, Pine Mountain State Resort Park, Kentucky Ridge State Forest and Wildlife Management Area, Daniel Boone National Forest, and Cumberland Falls State Resort Park.

Cumberland Gap National Historic Park is located approximately 10 miles south of the proposed Lewis Ridge Project. The park is located at the borders of Kentucky, Tennessee, and Virginia, consists of approximately 14,000 acres, and offers 85 miles of hiking trails, camping, scenic views, unique geologic sandstone formations, and underground caverns (NPS 2025c). Cumberland Gap National Historic Park is managed by the National Park Service (NPS 2025c). The Pine Mountain State Scenic Trail is currently being developed and, once completed, will traverse 120 miles from the Breaks Interstate Park to the Cumberland Gap National Historical Park (Kentucky State Parks 2025b).

Pine Mountain State Resort Park is located approximately 10 miles west of the Lewis Ridge Project site. The Pine Mountain State Resort Park overlooks the Kentucky Ridge State Forest and offers lodging, hiking trails, and golf. The state manages the park, and it was Kentucky’s first state park. (Kentucky State Parks 2025c).

Kentucky Ridge State Forest, located approximately 15 miles west of the Lewis Ridge Project site, consists of over 15,000 acres and contains the Pine Mountain State Resort Park. Kentucky Ridge State Forest is located on the south side of Pine Mountain and the north side of Log Mountain, encompassing Little Clear Creek Valley as well as Chenoa Lake. The forest is open to public hunting fishing, primitive camping, and hiking, and is managed by the state. (Kentucky EEC 2025b).

Daniel Boone National Forest, located approximately 40 miles west and northwest of the Lewis Ridge Project site, consists of more than 708,000 acres of national forest system lands across 21 counties in eastern Kentucky. Daniel Boone National Forest has over 600 miles of trails and is home to two federally recognized wilderness sites and more than 250 recreation sites. Recreation activities include hiking, hunting, camping, picnicking, off-highway vehicle riding, and fishing. The U.S. Forest Service (USFS) manages the Daniel Boone National Forest. (USFS 2025).

Cumberland Falls State Resort Park is located approximately 45 miles west of the Lewis Ridge Project site, and Kentucky State Parks manages the park. Within the park is Cumberland Falls, a 125-foot-wide waterfall on the Cumberland River. In addition to camping, there is lodging available at the park. The park provides opportunities for recreation including hiking, fishing, canoeing, and picnicking. (Kentucky State Parks 2025a).

Boone’s Ridge is a tourism center currently under development approximately 3 miles southwest of the Lewis Ridge Project site. Boone’s Ridge will include an 81,000-square-foot complex called Trailblazer's Hall, which will include a restaurant, theater, gift shop, and a museum exhibit hall. Additional recreation features such as nature trails, playground, zoo, and gondola are proposed. (Boone's Ridge 2025). Beginning in 2017, the Kentucky DFWR has relocated elk from other elk populations in southeastern Kentucky to Boone's Ridge for herd restoration efforts and wildlife viewing (Kentucky Living 2018; Kentucky DFWR n.d.).

5.9.2 Potential Impacts of the Proposed Lewis Ridge Project

The Applicant does not anticipate impacts to recreation resources as a result of the construction or operation of the Lewis Ridge Project. Recreation does not occur in the Lewis Ridge Project Study Area, nor is it expected in the future, as the property is privately owned and public access is restricted for public safety. There are no public recreation sites in the Project Vicinity. For these reasons, LRPS does not anticipate the Lewis Ridge Project to impact existing or potential recreation in the Lewis Ridge Project Study Area.

5.9.3 Agency Consultation and Applicant Recommendations

5.9.3.1 Agency Consultation

Documentation of consultation appears in Appendix A. No comments or requests specific to recreational resources have been received. No studies related to recreation were requested.

5.9.3.2 Applicant Recommendations

Recreation is not permitted within the proposed Lewis Ridge Project area, as the property is privately owned and public access is restricted for public safety due to the industrial use of the land, including active and reclaimed mining operations. As such, LRPS is not proposing PM&E measures related to recreation resources.

5.9.4 References

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5.10 Aesthetic Resources (18 CFR § 4.41 (f)(8))

5.10.1 Existing Environment

Bell County, Kentucky, includes two scenic Appalachian Mountain ridges, the Pine and Cumberland Mountains, which are densely forested with streams flowing through deep valleys (Commonwealth of Kentucky 2017). The Pine Mountain ridge extends southwest/northeast from Jellico, Tennessee, to Elkhorn City, Kentucky, and runs through the northwest corner of the Project Vicinity (Commonwealth of Kentucky 2022). The Cumberland Mountain ridge extends west/east and is approximately 6 miles south of the Project Vicinity. Bell County is home to Kentucky's first state park (Pine Mountain State Resort Park) and the country's largest national historical park (Cumberland Gap National Historical Park). Chained Rock on Pine Mountain provides views of the city of Pineville and its surrounding mountain forests (Kentucky Department of Tourism 2022).

The Lewis Ridge Project Study Area is an industrial site. The viewshed is comprised of active mine works, disturbed revegetated lands used for mining, and surrounding forests. Due to mining in the Study Area, a network of existing access roads runs throughout the landscape, which was originally constructed to support mining operations. The area is characterized by a variety of visible remnants of industrial mining use, including graded slopes, highwalls, and cleared staging areas. Vegetation in these areas is in various stages of regrowth. Deciduous forest, mixed evergreen deciduous forest, disturbed shrublands, and disturbed herbaceous vegetation are present within the Study Area.

Photos taken within the Study Area, which show the current visual character of the area, are provided below. Figure 5-44 shows the location of the proposed upper reservoir, while Figure 5-45 shows a northwestern view from the upper reservoir site. Figure 5-46 is a photo taken from the location of the proposed lower reservoir. Figure 5-47 is a photo of Tom Fork downstream of the lower reservoir location. Figure 5-48 shows a view of Tom Fork at the proposed lower reservoir location. Figure 5-49 shows a view of the pond near Tom Fork at the proposed lower reservoir location. Figure 5-50 is a photo of a closed high wall mining operation in the Study Area. Figure 5-51 shows an existing permanent access road in the Study Area. Figure 5-52 shows the Cumberland River at the proposed interconnection line crossing, viewed from the north side facing south. Figure 5-53 depicts the road on the north side of the Cumberland River near the interconnection line crossing. Figure 5-54 presents a view of the intake area from the west side of the Cumberland River, facing east. Figure 5-55 shows the railroad crossing near the proposed intake. Figure 5-56 and Figure 5-57 show the land adjacent to the initial fill and recharge water intake location on the Cumberland River.

Figure 5-44: Upper Reservoir Site

Figure 5-45: Northwest View from the Upper Reservoir Site

Figure 5-46: Lower Reservoir Site

Figure 5-47: View of Tom Fork Downstream of Lower Reservoir Site

Figure 5-48: View of Tom Fork at Proposed Lower Reservoir

Figure 5-49: Pond Near Tom Fork at the Proposed Lower Reservoir

Figure 5-50: Closed High Wall Mining Operation in Project Vicinity

Figure 5-51: Existing Permanent Access Road

Figure 5-52: Cumberland River at the Proposed Interconnection Line Crossing, on North Side of River Facing South

Figure 5-53: Road on North Side of Cumberland River Near the Cumberland River Interconnection Line Crossing

Figure 5-54: View of General Intake Area, on West Side of Cumberland River Facing East

Figure 5-55: Railroad Crossing Near the Proposed Intake

Figure 5-56: Area Near Intake on the Cumberland River, View 1

Figure 5-57: Area Near Intake on the Cumberland River, View 2

5.10.2 Potential Impacts of the Proposed Lewis Ridge Project

The Lewis Ridge Project will involve the development of an upper reservoir, water conveyance system, lower reservoir, powerhouse, interconnection line, intake structure on the Cumberland River, access roads, and various ancillary facilities. Both the upper and lower reservoirs will be located on lands that have been previously used for mining activities, and the visual appearance of these areas reflects the industrial use. The terrain is marked by altered landforms such as highwalls, terraced slopes, and large, graded clearings that were once used for equipment staging and material extraction. Vegetation in these areas is in various stages of regrowth. Although the Lewis Ridge Project will introduce new infrastructure into the landscape, it is not anticipated it to result in substantial alterations to the overall visual context or character of the area, which is already shaped by industrial use. Additionally, the existing topography and vegetative cover provide a natural buffer that is anticipated to screen much of the proposed development from public view. The reuse of existing access roads where feasible further minimizes the need for new land disturbance and visible changes.

At the proposed intake location on the Cumberland River, certain project components, including the intake and associated initial fill and recharge water supply pipes, may be visible from nearby residences located across the river. These elements are most likely to be noticeable during the winter months, when deciduous vegetation is not in leaf. For the remainder of the year, the presence of foliage is expected to provide substantial visual screening, thereby reducing the visibility of these features in the landscape (as shown in Figure 5-54).

Renderings of the Lewis Ridge Project provide a visual representation of the proposed key features, including the upper and lower reservoir. These renderings help illustrate what the Lewis Ridge Project will look like once constructed and the relationship within the existing landscape. Figure 5-58 shows a simulated view of the Lewis Ridge Project from a location across from the intake, taken at coordinates 36.763387, -83.558270, at a height of 2 meters above ground level (at approximately elevation 1,083 ft). Figure 5-59 presents a view from a point near the interconnection line, located at 36.795681, -83.524886, also at 2 meters above ground level at approximately elevation 1,109.0 ft. As illustrated in both figures, the project features are expected to be minimally visible due to the viewing distance and surrounding topography.

Figure 5-60 presents a bare earth analysis identifying areas within 3 miles of the Lewis Ridge Project that could potentially have views of the project features, based solely on topography. This analysis does not account for vegetation, which is likely to obstruct or limit views of the Lewis Ridge Project in many locations. Therefore, areas identified as having potential visibility may not actually have a clear line of sight, particularly when vegetation is leafed out. As illustrated, the Lewis Ridge Project is generally not expected to be visible north of Pine Ridge. However, to the south of Pine Ridge, as well as to the northeast and southwest, there are areas where the Lewis Ridge Project may fall within the viewshed. Visibility is less likely from the southeastern side of the Lewis Ridge Project. Some portions of Boone’s Ridge (described in Section 5.9), located southwest of the Lewis Ridge Project, may have potential views of the project features.

Figure 5-58: Rendering of View of Lewis Ridge Project, at 36.763387, -83.558270, Across From Intake (Balkan Brownings Creek Road and Hen Wilder Branch Road)

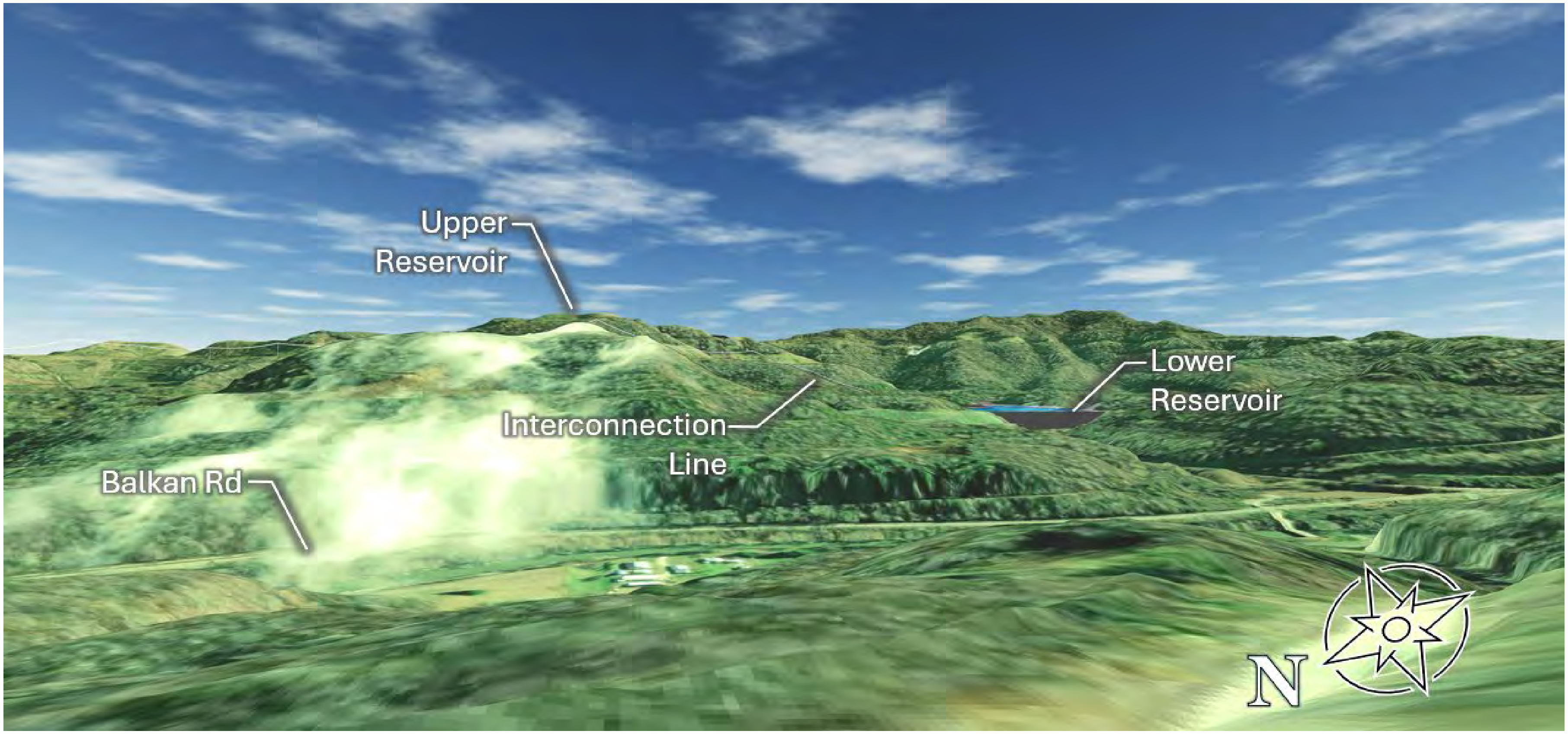


Figure 5-59: Rendering of View of Lewis Ridge Project, at 36.795681, -83.524886, Near Interconnection Line (US-119, Hwy-72 Intersection)

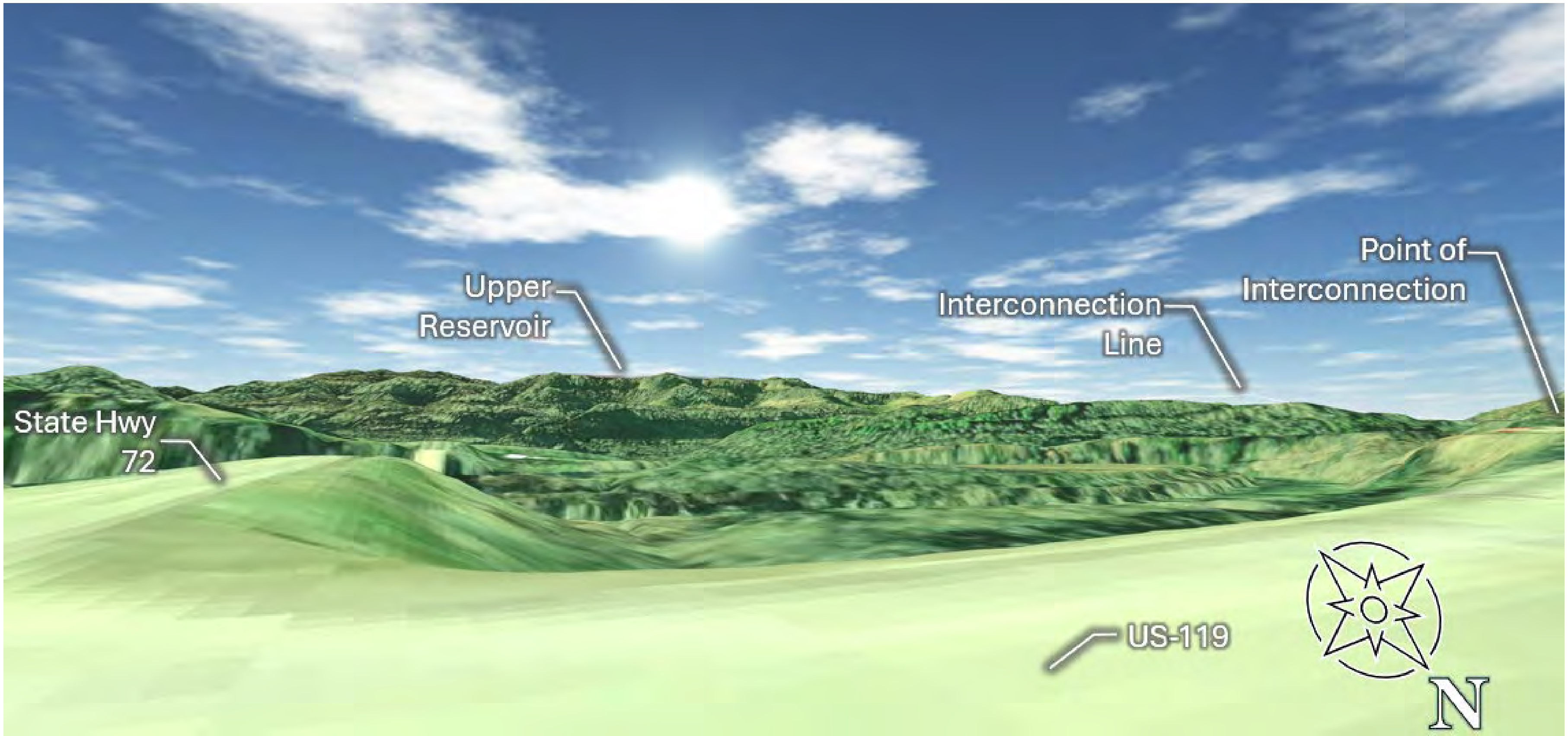
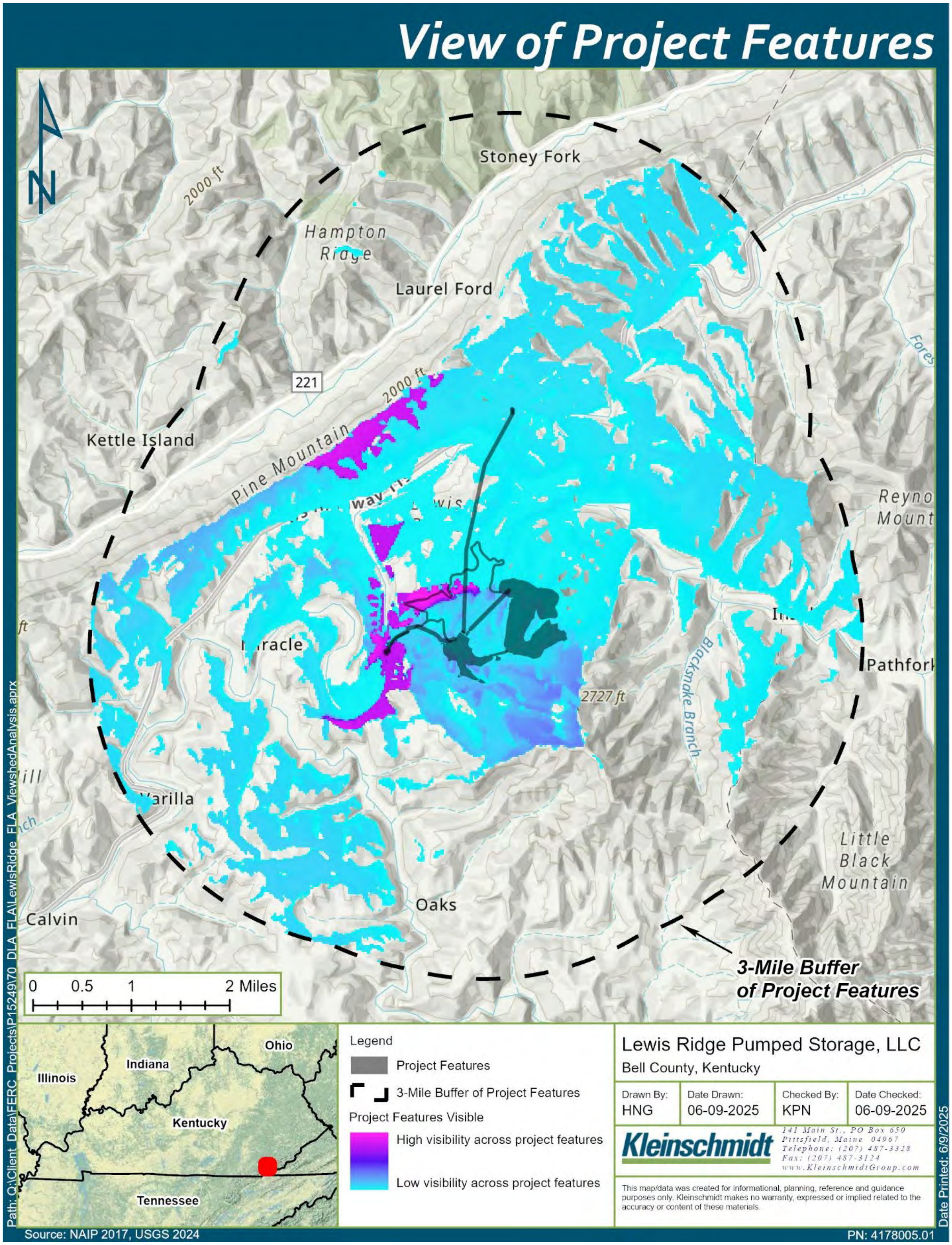


Figure 5-60: Bare Earth Analysis of Potential View of Project Features



5.10.3 Agency Consultation and Applicant Recommendations

5.10.3.1 Agency Consultation

Documentation of consultation is provided in Appendix A. LRPS filed its DLA on September 30, 2024. USEPA provided comments on the DLA related to aesthetic resources, requesting clarification on the visibility of the Lewis Ridge Project within the region. LRPS addressed this comment in the Summary Response Table to Comments provided in Appendix A.

5.10.3.2 Applicant Recommendations

The Lewis Ridge Project will be situated in an area that has been used for mining activities, and as the visual landscape is already characterized by industrial mining activity, the transition to a pumped storage facility does not substantially alter the area's aesthetic character. As such, LRPS is not proposing PM&E measures related to aesthetic resources.

5.10.4 References

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5.11 Land Use (18 CFR § 4.41 (f)(9))

5.11.1 Existing Environment

The Project Vicinity includes lands generally considered to be rural. The Project Vicinity includes lands which have been used for mining as well as forested lands and low-density residential areas. Major land cover categories as mapped by the National Land Cover Database (NLCD) for the Lewis Ridge Project Study Area and Project Vicinity are presented in Table 5-38 and depicted on Figure 5-61:. The major land cover identified in the NLCD is undeveloped land, largely consisting of deciduous forest, shrub/scrub, and herbaceous land. Although the NLCD can be helpful in understanding regional land cover patterns, and in this case, is helpful for understanding the land cover in the Project Vicinity, actual land use in the Study Area differs substantially from what is represented in the NLCD data. The following section provides a description of land use within the Study Area.

The existing primary land use in the Study Area is industrial. The Lewis Ridge Project features will be primarily located at a site owned by Asher Land and Mineral, LLLP and will largely occupy areas previously disturbed for mining activities, or along existing access roads. Current land use in the Study Area is industrial, with forest, scrub/shrub, and grassland vegetation covering mine lands in various stages of reclamation. Figure 5-62 illustrates the extent of historical mining activities within and around the Study Area. As shown, various types of mining operations, including surface, underground, and highwall mining, are present across a substantial portion of the Study Area, including in the locations of key project features such as the upper reservoir and lower reservoir.

As discussed in Section 5.8.1.4.3, there are currently six mining permits in the Study Area that are bonded under Kentucky DNR jurisdiction (Permit Nos. 807-0339, 807-0345, 807-0347, 807-0353, 807-0372, and 807-5220). As outlined in Table 5-39 and as the locations are depicted on Figure 5-42, three of the existing mining permits (807-0339, 807-0347, and 807-0353) are classified as A-1, indicating they are authorized for active mining operations. Of note, one of the active mining permits, 807-0353, is in the location of the lower reservoir. Two permits, 807-0345 and 807-5220, are in bonded Phase 1 status, while one permit, 807-0372, is in bonded Phase 2. Further explanation of the incremental bonding status is provided in Section 5.8.1.4.3.

Kentucky DNR mining permits specify post-mining land use types and restoration requirements following the completion of mining activities. The locations of approved post mining land uses are depicted in Figure 5-. The approved post mining land uses under Kentucky DNR Permit No. 807-0345 and Kentucky DNR Permit No. 807-0347 are “pastureland” and “forestland”. The approved post mining land use under Kentucky DNR Permit No. 807-0353 and Kentucky DNR Permit No. 807-0372 is “fish and wildlife.” The approved post mining land use under Kentucky DNR Permit No. 807-0339 is “forestland”. The approved post mining land use under Kentucky DNR Permit No. 807-5220 is “pastureland”. 30 CFR § 701.5 defines the post mining land use types. Pastureland is defined as “*Land used primarily for the long-term production of adapted, domesticated forage plants to be grazed by livestock or occasionally cut and cured for livestock feed.*” Forestland is defined as “*Land used or managed for the long-term production of wood, wood fiber, or wood-derived products.*” Fish and wildlife post mining land use is defined as "*land dedicated wholly or partially to the production, protection, or management of species of fish or wildlife*." Examples of species used for revegetation of fish and wildlife post-mining land use types as outlined in existing mining permits include the following: permanent grass (redtop, perennial ryegrass, timothy, orchard grass), legumes (Korean or kobe lespedeza, birdsfoot trefoil, ladino clover, red clover), trees (southern red oak, pignut hickory, redbud, sugar maple, locust, short leafed pine), and temporary plants (foxtail millet, annual ryegrass, balboa rye, annual rye).

Table 5-38: NLCD Land Cover Categories in the Project Study Area and Project Vicinity

Major Land Use	Project Study Area Acres	Project Vicinity Acres
Deciduous Forest	1,108.9	7,047.8
Shrub/Scrub	221.3	677.3
Herbaceous	95.0	351.5
Mixed Forest	88.4	651.2
Evergreen Forest	37.1	127.2
Developed, Open Space	24.0	231.4
Developed, Low Intensity	19.6	172.0
Hay/Pasture	11.2	320.0
Barren Land	10.2	93.4
Developed, Medium Intensity	9.7	78.1
Open Water	8.0	91.0
Developed, High Intensity	1.6	12.1
Emergent Herbaceous Wetlands	0.4	45.0
Woody Wetlands	0	1.3
Total*	**1,635.2**	**9,899.3**

Source: USGS 2023

* Due to rounding, the sum of the addends may not equal the total.

Figure 5-61: NLCD Mapped Land Cover in the Project Vicinity

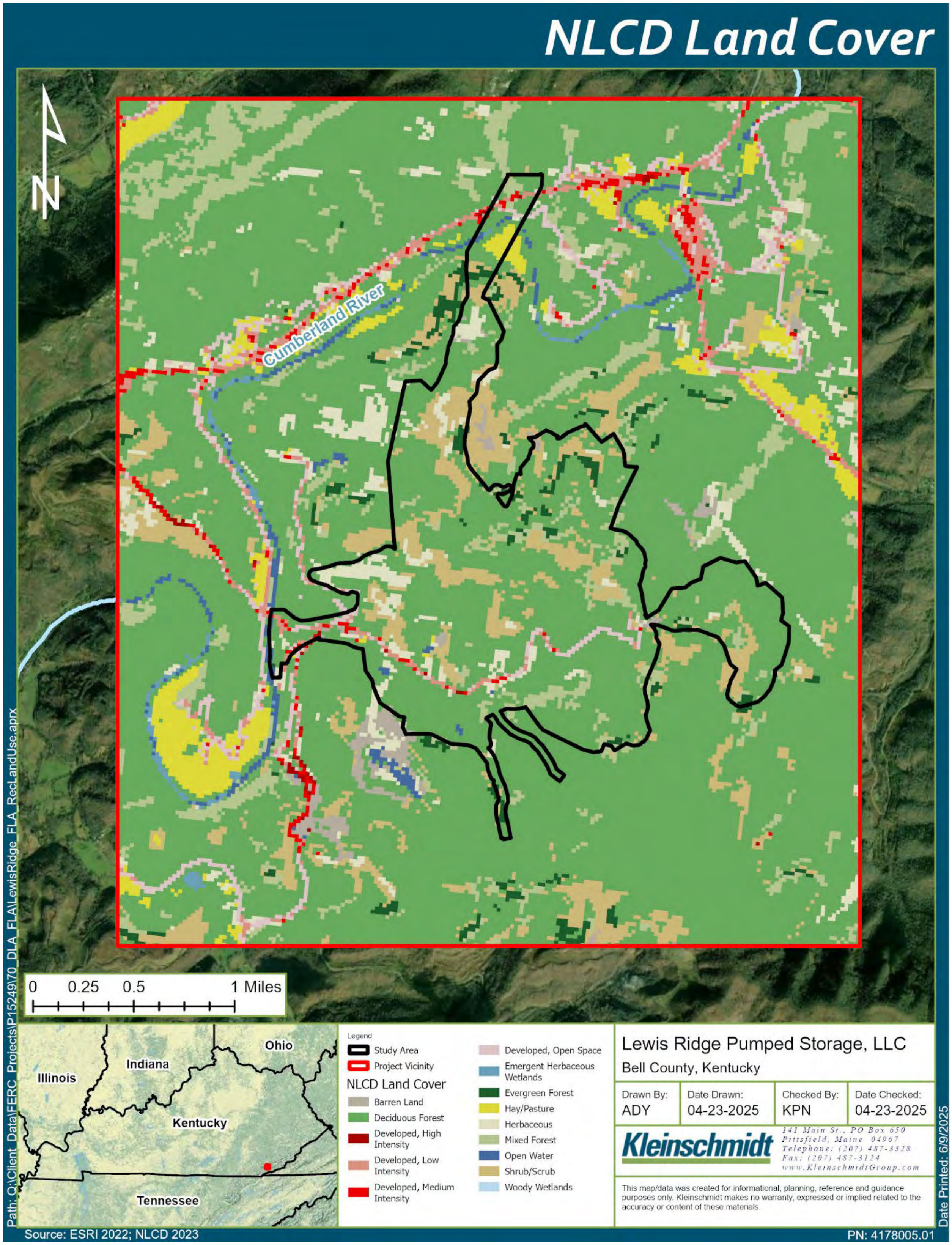


Figure 5-62: Mined Areas Near the Lewis Ridge Project Study Area

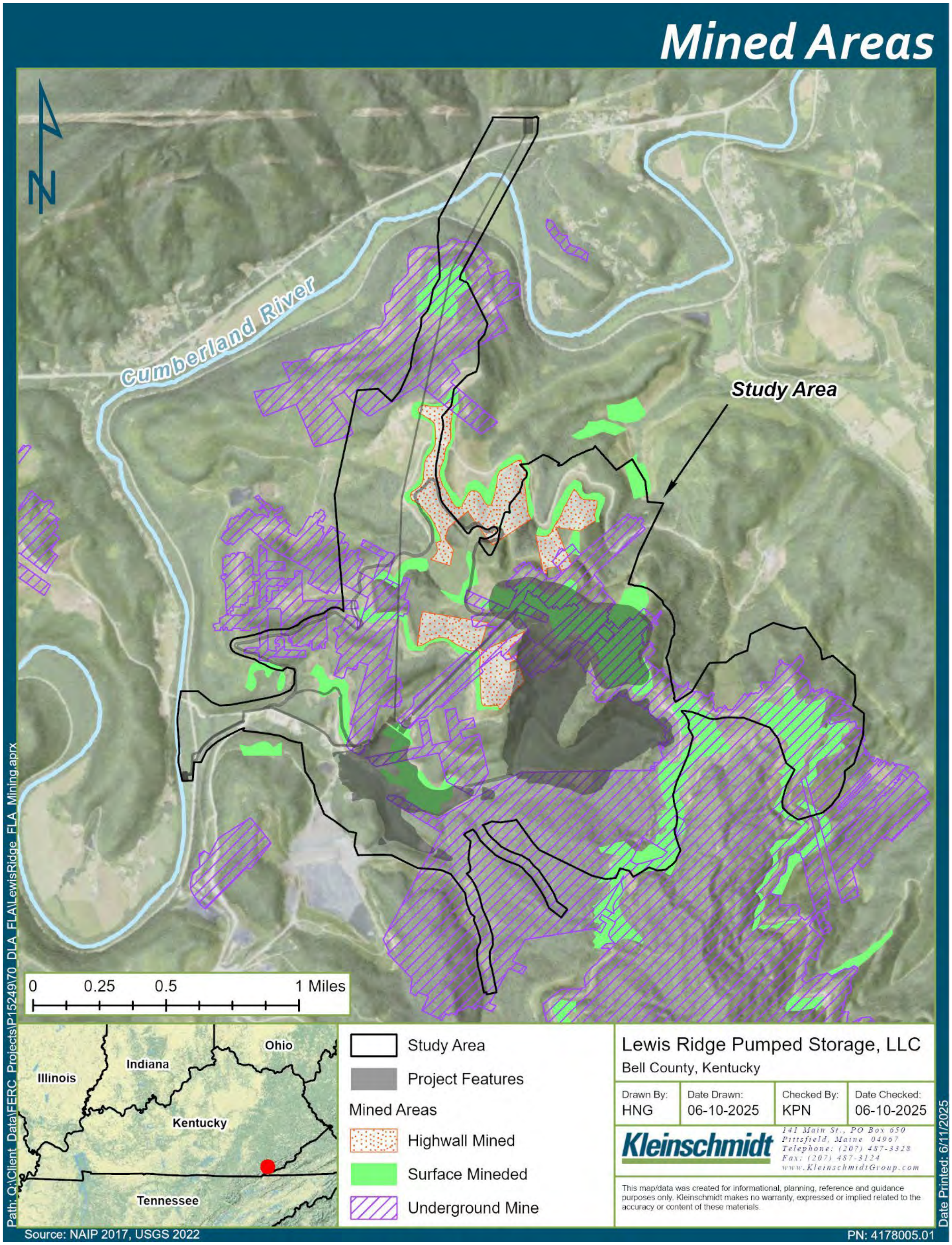
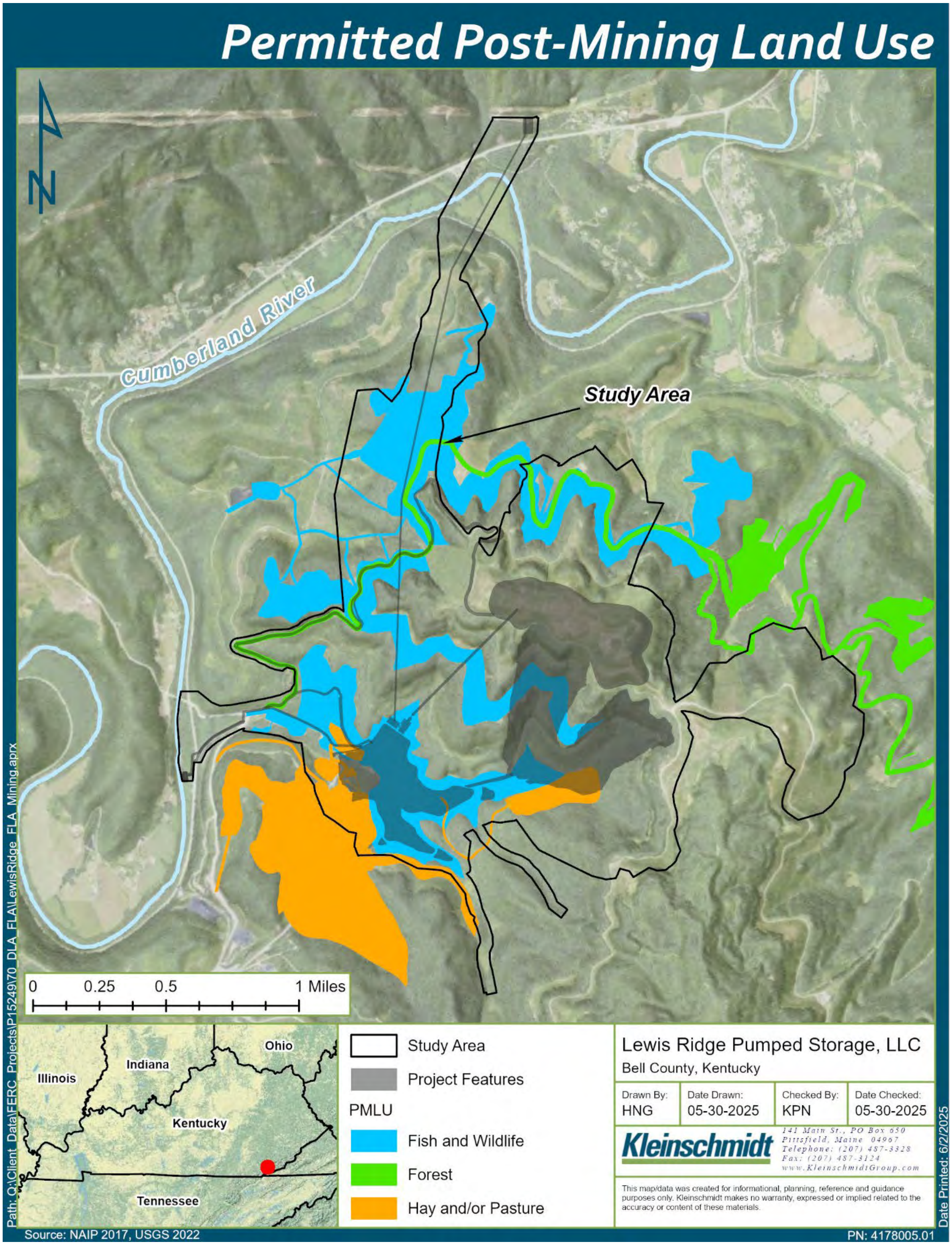


Table 5-39: Permitted Post-Mining Land Use Types within the Proposed Project Boundary

Post-Mining Land Use Types	Area within Proposed Project Boundary (Acres)
Fish and Wildlife	135.9
Forest	7.7
Hay and/or Pasture	16.1

Figure 5-63: Impacts to the Permitted Post-Mining Land Use Requirements



5.11.2 Potential Impacts of the Proposed Lewis Ridge Project

The Lewis Ridge Project is proposed to be developed on land currently designated and used for industrial purposes, primarily associated with mining. A key advantage of this location is its alignment with existing land uses, which supports a responsible and efficient use of previously disturbed land. The largely industrial Study Area features land cover that includes forest, scrub/shrub, and grassland vegetation covering active and mine lands in various stages of reclamation. The proposed Lewis Ridge Project will transition the site from its current industrial use in mining to another industrial application focused on energy generation through a pumped storage facility. This compatibility between existing and proposed land uses reduces the need for potential greenfield development, minimizes disruption to undisturbed areas, and represents a positive reuse of post-mining landscapes. Because much of the Lewis Ridge Project area is already characterized by industrial activity and existing access roads will be used, the overall impact on land use is expected to be minimal.

Permanent impacts to land cover will include the conversion of existing land cover to inundated areas at the upper reservoir and lower reservoir, diversion of Tom Fork through the lower reservoir, tree clearing and ground disturbance for installation of the water conveyance, interconnection line, powerhouse, access roads, and ancillary facilities, and placement of fill generated from ground excavation. Existing mining roads will be utilized to the extent feasible to minimize ground disturbance and clearing.

Areas within the Study Area have post-mining land use requirements as stipulated in the associated Kentucky DNR mining permits. Amendments to the post-mining land use requirements may be required for areas under the existing Kentucky DNR mining permits impacted by the Lewis Ridge Project. The Applicant will continue to consult with Kentucky DNR regarding existing permits at the project site under Kentucky DNR jurisdiction. The Applicant will comply with the permits or seek permit amendments for the Lewis Ridge Project, construction materials and associated permitting needs, and post-mining land use commitments (mine reclamation requirements, protection enhancement plans) associated with existing permits.

Temporary construction impacts will include vegetation clearing, ground disturbance, and the establishment of staging and laydown areas, as well as temporary access roads. Revegetation of these areas will follow the guidelines outlined in the Vegetation Management Plan (Appendix D).

5.11.3 Agency Consultation and Applicant Recommendations

5.11.3.1 Agency Consultation

Documentation of consultation is provided in Appendix A. Consultation specific to land use is summarized below.

LRPS held a Joint Agency and Public Meeting and Site Visit on January 25, 2023. Existing land use information from the PAD was presented at the Joint Agency and Public Meeting. Discussion occurred with Kentucky DNR regarding post-mining land use commitments/ mine reclamation requirements associated with existing permits at the Lewis Ridge Project site under Kentucky DNR jurisdiction.

The Kentucky DEP submitted comments on April 6, 2023, following the Joint Agency and Public Meeting. In their comments, the Kentucky DEP attached comments from the Kentucky DNR related to implementation of the SMCRA through KRS 350.020. Kentucky DNR provided details on three permits bonded under Kentucky DNR jurisdiction highlighting potential conflicts related to sediment control, elimination of highwall to approximate original contour, and implementation of the approved post mining land use. In addition, the Kentucky DEP identified an underground storage tank and state superfund site within the area. The Kentucky DEP Superfund Branch manages sites with known or suspected releases of hazardous substances, petroleum pollutants, or contaminants into the environment that are not specifically regulated by other branches. The identified state superfund site resulted from a diesel fuel and waste oil spill on March 8, 2007. The site was documented and brought into compliance, successfully meeting Option A (No Further Action) cleanup requirements in December 2007. The identified underground storage tank is outside of the Study Area, and the Applicant does not expect it to be impacted by the Lewis Ridge Project. LRPS met with Kentucky DNR on July 24, 2024, and discussed obtaining a SMCRA permit exemption related to the potential for exposure of small amounts of coal during construction, construction materials and associated permitting needs, and post-mining land use commitments/mine reclamation requirements/protection enhancement plans associated with existing permits at the Lewis Ridge Project site.

LRPS filed its DLA on September 30, 2024. FERC provided comments on the DLA related to land use, requesting additional information on the current operational status, historic use, and mining reclamation measures of the coal mine lands at the Lewis Ridge Project.

LRPS addressed these comments, as appropriate, through additional information added to Section 5.8.1.4.3.

5.11.3.2 Applicant Recommendations

The development of the Lewis Ridge Project will allow for use of previously disturbed lands. The selection of the Lewis Ridge Project site as configured minimizes permanent impacts to undisturbed lands as much of the land has been used for mining. Existing access roads will be used to the extent feasible. To minimize temporary impacts on land use, LRPS proposes to continue consultation with Kentucky DNR regarding post-mining land use designations and will implement a Vegetation Management Plan (Appendix D), along with BMPs outlined in future construction plans.

5.11.4 References

United States Geological Survey (USGS). 2023. National Land Cover Database (NLCD) 2021 Land Cover Change Index Conterminous United States.

5.12 Tribal Resources (18 CFR § 4.38)

5.12.1 Existing Environment

Tribal consultation is required for all federal undertakings, regardless of whether the APE includes federal, tribal, state, or private lands so long as the undertaking may affect historic properties of religious and cultural significance to a Native American tribe (Advisory Council on Historic Preservation [ACHP] 2021). There are no tribal lands at the Lewis Ridge Project. Although no specific tribal interest has been identified at the Lewis Ridge Project, the Tribes listed in Table 5-40 are included in LRPS's distribution list for the Lewis Ridge Project's licensing process.

Table 5-40: Tribes Included in Lewis Ridge Project's Distribution List

Tribe
Cherokee Nation
Delaware Nation
Eastern Band of Cherokee Indians
Miami Tribe of Oklahoma
Muscogee (Creek) Nation
Peoria Tribe of Indians of Oklahoma
Southern Cherokee Nation of Kentucky
United Keetoowah Band of Cherokee Indians in Oklahoma

5.12.2 Potential Impacts of the Proposed Lewis Ridge Project

Construction activities have the potential to disturb historic properties of religious and cultural significance to a Native American tribe within the APE, if those properties exist. Although no specific tribal interest has been identified at the Lewis Ridge Project, construction could result in the unanticipated discovery of previously unknown historic properties that may be of religious and cultural significance to Native American tribes.

5.12.3 Agency Consultation and Applicant Recommendations

5.12.3.1 Agency Consultation

Documentation of consultation appears in Appendix A. Consultation specific to tribal resources is summarized below.

Many different statutes, regulations, executive orders, and federal policies direct federal agencies to consult with Native American tribes including the NHPA as amended. Section 106 of the NHPA, 54 U.S.C. 306108 and its implementing regulations at 36 CFR part 800, requires federal agencies to take into account the effects of projects they carry out, license, or financially assist (undertakings) on historic properties and provide the ACHP a reasonable opportunity to comment on those undertakings. The NHPA also requires that, in carrying out its responsibilities under the Section 106 review process, a federal agency must consult with any Native American tribe that attaches religious and cultural significance to historic properties that may be affected by the agency's undertakings. (ACHP 2021).

In August 2022, LRPS sent outreach emails to 20 entities providing an information sheet on the Lewis Ridge Project and requesting meetings to learn about available resource information and discuss potential resource concerns, information gaps, and proposed studies. This email outreach included the Delaware Nation, Peoria Tribe of Indians in Oklahoma, Eastern Band of Cherokee Indians, Southern Cherokee Nation of Kentucky, and the Miami Tribe of Oklahoma. No responses were received from the Tribes. LRPS invited representatives from the five aforementioned Tribes to attend the Joint Agency and Public Meeting and Site Visit. No comments were received specific to tribal resources during the Joint Agency and Public Meeting or in comments following the Joint Agency and Public Meeting.

By letter dated February 14, 2023, FERC invited the Eastern Band of Cherokee Indians, United Keetoowah Band of Cherokee Indians in Oklahoma, Muscogee (Creek) Nation, and Cherokee Nation (Nation) to participate in the licensing process for the Lewis Ridge Project. FERC requested responses from the Tribes stating their interest in participating. In its comments provided to FERC on March 20, 2023, the Nation stated it maintains databases and records of cultural, historic, and pre-historic resources in the area. The Nation confirmed it had not found any instances where the Lewis Ridge Project intersects or adjoins such resources. The Nation did not foresee the proposed Lewis Ridge Project impacting Cherokee cultural resources at that time, and requested that, if items of cultural significance are discovered, FERC should halt all project activities immediately and conduct further consultation.

LRPS filed its DLA on September 30, 2024, and the DLA was distributed to Tribes listed in Table 5-40. No comments pertaining to tribal resources were received.

On April 17, 2025, LRPS sent a request for information on Traditional Cultural Properties (TCPs) within the Study Area to the Tribes listed in Table 5-40. At the time of filing this FLA, no responses have been received.

5.12.3.2 Applicant Recommendations

LRPS proposes to continue consultation with Native American Tribes throughout the licensing process and implement the following PM&E measures to minimize impacts on tribal resources:

- **Historic Properties Management Plan:**
    - As discussed further in Section 5.6.3.2, LRPS has developed an HPMP, which specifies how historic properties will be managed within the APE. The HPMP includes an inadvertent discovery protocol. The HPMP is filed as Appendix E, Historic Properties Management Plan (Privileged), and includes inadvertent discovery protocol.

5.12.4 References

Advisory Council on Historic Preservation (ACHP). 2021. Consultation with Indian Tribes in the Section 106 Review Process: The Handbook. Available online: https://www.achp.gov/sites/default/files/2021-06/ConsultationwithIndianTribesHandbook6-11-21Final_0.pdf. Accessed July 2024.

6.0 CONSISTENCY WITH COMPREHENSIVE PLANS (18 CFR § 5.18 (B)(5)(F))

Section 10(a)(2)(A) of the Federal Power Act (FPA), 16 U.S.C § 803(a)(2)(A), requires FERC to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways potentially affected by the proposed project. On April 27, 1988, FERC issued Order No. 481-A revising order No. 481, issued October 26, 1987, establishing that FERC will accord FPA Section 10(a)(2)(A) comprehensive plan status to any federal or state plan that:

- Is a comprehensive study of one or more of the beneficial uses of a waterway or waterways;
- Specifies the standards, the data, and the methodology used; and
- Is filed with the Secretary of the Commission.

FERC currently lists 18 comprehensive plans for the Commonwealth of Kentucky (FERC 2025). Of these listed plans, LRPS identified seven as potentially relevant to the Lewis Ridge Project. Table 6-1 lists the plans considered and provides a summary of the plan and its consistency with the proposed Lewis Ridge Project, if applicable.

Table 6-1: Relevant Comprehensive Plans and Consistency with the Project

Resource	Comprehensive Plan	Consistency of the Project with Plan
Recreation Resources	Kentucky Department for Local Government. Kentucky Statewide Comprehensive Outdoor Recreation Plan (SCORP). Frankfort, Kentucky. October 2019.	The SCORP outlines strategies and recommendations for addressing outdoor recreation to promote healthy lifestyles and increase outdoor recreational activities and tourism. There are no recreation sites at the proposed in the Lewis Ridge Project Study Area, and there are no public recreation sites in the Project Vicinity. Due to public safety restrictions, no recreation sites are proposed at the Lewis Ridge Project. The Lewis Ridge Project will have no impact to recreation resources, and the SCORP is not applicable.
Water Resources	Kentucky Department for Natural Resources and Environmental Protection. 1979. Kentucky wild rivers statewide management plan. Frankfort, Kentucky. June 1979.	In 1972, portions of the Red, Rockcastle, Cumberland, Green, and Big South Fork of the Cumberland River were designated as Wild Rivers. In 1974, portions of Martins Fork and the Little South Fork of the Cumberland River were added to the Wild River system. The statewide plan provides recommendations for management of Kentucky's Wild Rivers. The nearest Kentucky Wild River designation of the Cumberland River is a 16.1-mile-long segment of the Cumberland River from Summer Shoals to the backwaters of Lake Cumberland (Kentucky EEC 20245). The segment is located approximately 84 river miles downstream from the Lewis Ridge Project; therefore, the plan is not applicable. However, LRPS has consulted with Kentucky DNR throughout the licensing process.

Resource	Comprehensive Plan	Consistency of the Project with Plan
Water Resources	Kentucky Department for Natural Resources and Environmental Protection. 1980. Kentucky wild rivers: Cumberland River management plan. Frankfort, Kentucky. June 1980.	In 1972, portions of the Cumberland River were designated as Wild Rivers. In 1974, portions of the Little South Fork of the Cumberland River were added to the Wild River system. The plan provides recommendations for management of the portions of the Cumberland River eligible for Kentucky's Wild River system. The nearest Kentucky Wild River designation of the Cumberland River is a 16.1-mile-long segment of the Cumberland River from Summer Shoals to the backwaters of Lake Cumberland (Kentucky EEC 20245). The segment is located approximately 84 river miles downstream from the Lewis Ridge Project; therefore, the plan is not applicable. However, LRPS has consulted with Kentucky DNR throughout the licensing process.
Water Resources	Kentucky Department for Natural Resources and Environmental Protection. 1980. Kentucky wild rivers: Martins Fork management plan. Frankfort, Kentucky. June 1980.	In 1974, portions of Martins Fork and the Little South Fork of the Cumberland River were added to Kentucky's Wild River system. The plan provides recommendations for management of the portions of Martins Fork eligible for Kentucky's Wild River system. The nearest Kentucky Wild River designation of the Cumberland River is a 16.1-mile-long segment of the Cumberland River from Summer Shoals to the backwaters of Lake Cumberland (Kentucky EEC 20245). The segment is located approximately 84 river miles downstream from the Lewis Ridge Project; therefore, the plan is not applicable. However, LRPS has consulted with Kentucky DNR throughout the licensing process.

Resource	Comprehensive Plan	Consistency of the Project with Plan
Water Resources	Kentucky DEP Division of Water. National Park Service. 1992. Kentucky rivers assessment. Department of the Interior, Atlanta, Georgia.	The Kentucky Rivers Assessment presents the findings of a comprehensive statewide evaluation of resources associated with the state’s most significant rivers. Ten categories of resource values were assessed: agricultural lands, botanical resources, corridor character, cultural resources, fish resources, geologic and scenic features, recreational boating, water quality, water resources, and wildlife resources. A total of 551 rivers were evaluated, including 1,363 individual study segments. The Cumberland River was found significant in every resource category. The Exhibit E considers Lewis Ridge Project impacts on the Cumberland River using similar resource values, and the Lewis Ridge Project does not adversely affect the Cumberland River; therefore, the Lewis Ridge Project is consistent with the plan. LRPS has consulted with relevant agencies, including Kentucky DEP, NPS, and USACE throughout the licensing process and will continue working with the appropriate agencies to secure the necessary permits related to waterway impacts, therefore it is anticipated that the Lewis Ridge Project will be consistent with the Kentucky Rivers Assessment.
Water Resources	National Park Service. 1993. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C.	The Nationwide Rivers Inventory (NRI) is a listing of more than 3,200 free-flowing river segments in the United States that are believed to possess one or more “outstandingly remarkable” natural or cultural values judged to be at least regionally significant. Under the Wild and Scenic Rivers Act section 5(d)(1) and related guidance, all federal agencies must seek to avoid or mitigate actions that would adversely affect NRI river segments. The NRI is potentially applicable to the proposed Lewis Ridge Project as it is located adjacent to waters of Kentucky (Cumberland River). There are no rivers within the Project Vicinity that have been designated for inclusion in the National Wild and Scenic River System (NPS 20254); therefore, the Lewis Ridge Project will be consistent with the plan and avoids effects to NRI segments.

Resource	Comprehensive Plan	Consistency of the Project with Plan
Fish and Aquatic Resources	U.S. Fish and Wildlife Service. n.d. Fisheries USA: The recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.	The recreational fisheries policy of the USFWS directs federal agencies to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased resources for recreational fishing opportunities. This policy encourages federal actions that support the sustainable productivity, function, and distribution of aquatic resources to enhance recreational fishing opportunities, while also promoting compatibility with other environmental regulations, such as the Endangered Species Act. The Applicant has consulted with the USFWS as discussed in Section 5.3. It is not anticipated that the Lewis Ridge Project will have substantial impact to recreational fisheries, and therefore, it is anticipated that the Lewis Ridge Project will be consistent with USFWS's recreational fisheries policy.

Source: FERC 2025

6.1 References

Federal Energy Regulatory Commission (FERC). 2025. List of Comprehensive Plans. Office of Energy Projects, 20426. Washington, D.C. Available online: https://www.ferc.gov/media/comprehensive-plans. Accessed May 2025.

Kentucky Energy and Environment Cabinet (Kentucky EEC). 2025. Kentucky Wild Rivers Program. Available online: https://eec.ky.gov/Nature-Preserves/conserving_natural_areas/wild-rivers/Pages/default.aspx Accessed: May 2025.

National Park Service (NPS). 2024. Nationwide Rivers Inventory Interactive Map. Available online: https://www.nps.gov/maps/full.html?mapId=8adbe798-0d7e-40fb-bd48-225513d64977 Accessed: May 2025.

National Park Service (NPS). 2025. National Wild and Scenic Rivers System. Available online: https://www.rivers.gov/kentucky Accessed: May 2025.

APPENDIX A

SUMMARY RESPONSE TABLE TO DLA COMMENTS, DLA COMMENTS, AND DOCUMENTATION OF CONSULTATION

Table 1: Responses to Comments Received on the Draft License Application

No.	Topic	Comment	Response
Federal Energy Regulatory Commission, December 27, 2024 (Accession No. 20241227-3009)			
1	Exhibits A and B	Section 2.0, *Proposed Project Structures*, the proposed project features include a 3.6-mile-long, 161 Kilovolt (kV), overhead interconnection line, and shows the location of the point of interconnection in Figure 2-1 (*also see* Exhibit F-1 labeled as Point of Connection Pineville+Harlan #1 161 KV Line). Please clarify whether the point of interconnection for the transmission line occurs at a substation, and if yes, who owns and operates the substation, and whether the substation would be within the project boundary.	The location of the switching stations and point of interconnection (POI) are depicted in Exhibit F and described in Section 2.6 of Exhibit A. The project has two switching stations, one outside of the powerhouse and the other at the POI. The switching station is anticipated to be to be jointly managed by the project company and the connecting utility. The switching stations and POI are located within the proposed FERC Project Boundary, as outlined in Section 3.2.1 of Exhibit E and Exhibit G.
2	Exhibits A and B	Section 2.4, *Powerhouse and Generating Equipment*, proposes two turbine options for the Lewis Ridge Project as using either Francis-type fixed or variable-speed pump-turbine units. In the FLA, please provide a detailed description to include the number, type and rated capacity of any proposed turbines and generators as well as the pumping capacities of the devises.	Detailed descriptions of the generating equipment have been included in Section 2.5 of Exhibit A, Section 3.5 of Exhibit B, and Section 2.8 of the Preliminary Supporting Design Report (SDR) in Exhibit F.
3	Exhibits A and B	Section 2.1, *Upper Reservoir and Dam*, states that, "The upper reservoir's integrated overflow emergency spillway along the hardfill dam crest would be designed to provide protection from overtopping the dam during extreme floods or a potential over-pumping event." The DLA does not provide details about the operations of the upper reservoir's emergency spillway. As described in section 2.5, *Project Operation during Adverse, Mean, and High-Water Years*, it is unclear how the emergency spillway will be operated, and what water will flow into as it exits the spillway. For example, does water exiting the spillway enter an intermittent stream that conveys water back down to the lower reservoir or the Tom Fork River downstream of the lower reservoir? Please include in the FLA a complete description of the spillway's operation and water conveyance. Please also provide similar details for the lower reservoir's emergency spillway in the FLA.	Detailed descriptions of the spillways have been included in Section 2.1 of Exhibit A, Section 2.5.2 of Exhibit B, and Section 2.5.6 of the Preliminary SDR in Exhibit F.
4	Exhibits A and B, and Exhibit E	We note that some studies appear to be ongoing. Pursuant to Section 4.38 (c)(1)(i), please be sure to include the study results and study reports in the final license application (FLA) along with a schedule for completing any outstanding studies and filing the results with the Commission.	Study results and schedule for outstanding studies have been included in Exhibit E. Completed study reports are included in the Exhibit E Appendices.
5	Exhibits A and B, and Exhibit E	For the coal mine lands to be occupied by the project, the current operational status, historic use of land, and necessary mining reclamation measures should be fully described in the FLA.	Additional information on the mining activities at the site have been included in Sections 5.8.1.4 and 5.11.1 of Exhibit E.
6	Exhibits A and B	The DLA presents two alternatives for the proposal, alternative A, initially presented in the PAD and carried into DLA, and Alternative B, presented only in the DLA. To avoid confusion in the FLA please delete all references to Alternative A which, it appears, you no longer intend to pursue.	As requested, references to Alternatives A and B have been removed from the FLA. A description of project design alternatives, as required in 18 CFR Section 4.41 (c)(2), is outlined in Section 1.2 of Exhibit B.
7	Exhibits A and B	Section 4.41(b) of the Commission's regulations requires that the FLA identify all facilities that are necessary for operation and maintenance, including those needed to convey water for reservoir filling and maintenance flows. This information is not in the DLA. Please include in the FLA a description of all water conveyance facilities and structures that would be used to convey water from the Tom Fork River to the lower reservoir as proposed in the DLA.	A detailed description of the initial fill and recharge water supply pipeline and associated facilities has been included in Section 2.4 of Exhibit A, Section 2 of Exhibit B, Section 2.9 of the Preliminary SDR in Exhibit F, and Attachment 5 titled *Initial Fill and Recharge Technical Memorandum* in the Preliminary SDR.
8	Exhibits A and B	Section 4.41(c) of the Commission's regulations identifies requirements for Exhibit B, Project Operation and Resource Utilization. The DLA states that fill flows and maintenance flows are still being evaluated. The DLA indicates that the source of initial fill flows and maintenance flows would be the Tom Fork River, but the DLA also states that well water and the Cumberland River would be considered for operation flows. Please provide a clear, detailed proposal for the water sources, in the FLA. Please include supporting information for initial and maintenance fill estimates, as well as methodology used to determine these estimates, including both evaporation and leakage losses. Also, include a complete copy of a report conducted by Kleinschmidt (Kleinschmidt 2022) as identified in the list of references.	A detailed description of the water supply for the initial fill and recharge water has been included in Section 2.4 of Exhibit A, Section 2 of Exhibit B, Section 2.9 of the Preliminary SDR in Exhibit F, and Attachment 5 titled *Initial Fill and Recharge Technical Memorandum* in the Preliminary SDR. As updated hydrology data are presented in the aforementioned technical memorandum, the 2022 Kleinschmidt memo is excluded to prevent potential confusion arising from outdated information.
9	Exhibits A and B	The draft application provides insufficient information for staff to evaluate the estimates for initial fill flows, maintenance flows, source flow (in the Tom Fork River), and evaporation and leakage losses. In the FLA, please provide supporting information for initial fill flows,	A detailed description of the water supply for the initial fill and recharge water has been included in Section 2.4 of Exhibit A, Section 2 of Exhibit B, Section 2.9 of the Preliminary

No.	Topic	Comment	Response
		maintenance fill flows, source flow (in the Tom Fork River), and evaporation and leakage loss estimates, as well as methodology and supporting documents used to make these estimates.	SDR in Exhibit F, and Attachment 5, *Initial Fill and Recharge Technical Memorandum*, included in the Preliminary SDR.
10	Exhibits A and B	Section 4.41(c)(4)(i) of the Commission's Regulations requires monthly flow duration curves, as well as minimum, maximum, and mean recorded flows in cubic feet per second. In the DLA this information was provided for the Cumberland River, but not for the Tom Fork River which is proposed for water withdraws. A monthly evaluation of Tom Fork River flows is particularly important since the Tom Fork River, upstream of the project, is an intermittent stream, which largely relies on rainfall events for flows. Given the small drainage area for the Tom Fork (2.6 square miles), flows are expected to be flashy. Please include monthly flow duration curves for the Tom Fork River in the FLA.	Monthly flow duration curves for Tom Fork are provided in Section 3.1 of Exhibit B and Section 5.2 of Exhibit E. Since there is no historical gaged streamflow data for Tom Fork, minimum, maximum, and mean flows were estimated by scaling the mean annual flow rate by monthly precipitation data utilizing the USGS StreamStats program. Additionally, stream flow data for Tom Fork at the location of the proposed lower dam will be collected for a duration of 12 months. The collected flow data will support the hydrologic and hydraulic modeling of the current and anticipated flows from Tom Fork.
11	Exhibits A and B	Given the potential for low flows in the system, and their potential to affect generation, the FLA should include a low flow or drought management plan, or the outlines of such a plan that staff can consider in its analysis.	The proposed operation of the Lewis Ridge Project, including under adverse (low-water) scenarios, has been included in Section 2.5 of Exhibit B. Low flow scenarios are also addressed in the Preliminary SDR in Exhibit F and Attachment 5 titled *Initial Fill and Recharge Technical Memorandum* in the Preliminary SDR. Low flows are not anticipated to impact generation and detailed information on adverse scenarios are included in the FLA, thus a standalone low flow or drought management plan is not necessary for FERC's analysis.
12	Exhibit D	Section 4.41(e) of the Commission's regulations requires filing with the Commission a statement of project costs and financing (i.e., Exhibit D) that includes, in general, construction costs for major project works and personnel, estimates of taxes, annual operation and maintenance costs, and the capital and annual cost for all environmental measures. The Exhibit D filed with the DLA included only a few costs. In accordance with section 4.41(e) (sections 1 through 9), please include a complete Exhibit D in the FLA.	Exhibit D has been updated to include the contents as required in Section 4.41(e) of the Commission's regulations.
13	Exhibit E	The DLA and supporting study reports include various maps showing georeferenced datasets (geographic information system (GIS) shapefiles). To facilitate Commission staff's review of the existing environmental conditions at the project, concurrent with the FLA, please file the following GIS shapefiles: (1) the project study area shown in figure 1-1 in Exhibit A; (2) proposed project features (i.e., interconnection line, penstock, fill area, permanent access road [new], permanent access road [existing], temporary construction road [new], temporary construction road [existing], point of interconnection, project reservoirs, powerhouse, spillway, construction laydown and parking), and river mile points, shown in figure 2-1 of Exhibit A, and/or figure 1-3 of Exhibit B; (3) proposed project boundary shown in figure 1-2 of Exhibit B and figure 3-1, Exhibit E; (4) Cumberland River Basin and sub-basins shown in figure 4-1, Exhibit E; (5) drainage area of the lower reservoir shown in figure 5-2, Exhibit E; (6) jurisdictional wetlands and streams mapped in the study area shown in figure 5-14, Exhibit E; (7) FEMA flood hazard classifications shown in figure 5-15, Exhibit E; (8) geologic formations shown in figure 5-18, Exhibit E; (9) mapped soil types shown in figure 5-19, Exhibit E; (10) mined areas (surface and subsurface) shown in figure 5-22, Exhibit E; (11) land use classifications shown in figure 5-24 (Existing Mining Permits Bonded under Kentucky DNR Jurisdiction), Exhibit E; and (12) Land use classifications shown in figure 5-33, Exhibit E.	The GIS shapefiles pertaining to the figures included in this FLA are attached to the FERC filing. The shapefiles from the DLA figures have been excluded to prevent potential confusion arising from outdated information.

No.	Topic	Comment	Response
14	Exhibit E	If the Cumberland River is to be used as a fill or make-up water source, the effects on water volume, water quality, aquatic habitat, and fish entrainment of the withdrawal from the river should be estimated in the FLA.	Initial fill water will primarily be sourced from the Cumberland River and supplemented from storm runoff from Tom Fork. Reservoir recharge water will be sourced from the Cumberland River with supplemental water from Tom Fork during storm events. Sections 5.2 and 5.3 of Exhibit E detail the potential impacts on water resources and on fish and aquatic resources, respectively.
15	Exhibit E	Section 5.2.1.8, *Wetlands, Riparian, and Littoral Habitat*, Figure 5-13 shows U.S. Fish and Wildlife Service, National Wetlands Inventory wetlands within the project vicinity. However, the colors used for the wetland types are very similar to the background color of the base map used, making it hard to discern some of the smaller areas that contain wetlands. In the FLA, it is recommended to either lighten the base map color (as done in Figure 5-14) or use fill colors for the wetland type polygons that are higher in contrast to the base map used, so that wetlands can be easily identified. This recommendation applies for all similar figures. Additionally, for Figure 5-13 and Figure 5-14, please include a polygon, or polygons, showing the location(s) where excavated material will be disposed of for the construction of the reservoirs so that staff may fully understand what, if any, wetland, streams and/or riparian habitat would be impacted by the fill area(s).	Updated wetland and waterway figures have been included in Section 5.2 of Exhibit E. The Figure previously number 5-13 is updated with polygon fill colors that have higher contrast with the base map background in the FLA. Proposed project features, including disposal areas, have been added to the figure outlining jurisdictional wetlands and waterways within the Study Area.
16	Exhibit E	Section 5.2.1.8, *Wetlands, Riparian, and Littoral Habitat*, Figure 5-14 shows a bright blue dashed line within the transmission corridor. However, the symbology in the legend does not show a dashed bright blue line, it only shows a solid blue line. Therefore, it is unclear what the dashed blue line represents. In the FLA, please correct this error in Figure 5-14.	Updated wetland and waterway figures have been included in Section 5.2 of Exhibit E. The legend of the Figure previously numbered 5-14 is updated in the FLA.
17	Exhibit E	Section 5.3.1.3, *Invasive and Nonindigenous Fish and Aquatic Species*, contains Table 5-11 which has confusing, and incorrect data listed for some species. The title of the table is, "Nonindigenous Aquatic Species Known to Occur in the Upper Cumberland River Basin". However, some species listed in the table do not occur in the upper Cumberland River (e.g., coho salmon). Additionally, there are other species that have been found in the upper Cumberland River but are listed with an incorrect "Species Origin" status. For example, yellow perch are listed as native in the upper Cumberland River, and, although this species has been found in the upper river, their status in the Cumberland River should be listed as Exotic (aka nonindigenous). Only species found in the upper Cumberland River (indicated as such in the title) should be reported, and their origin status (e.g., native, exotic, etc.) should be based on whether the given species is considered native or exotic within the Cumberland River and adjacent waterbodies.	The terms "native" and "exotic" have been removed from the table. "Native" was used to identify species indigenous to the U.S. Species included in this table have been observed in the Cumberland River Basin. Some unexpected species (such as American alligator), have one or few occurrences in the basin. This list includes species associated with past fish stocking efforts in Tennessee, as well as the likely escape of non-native species.
18	Exhibit E	The project would use nearly all flow from the Tom Fork River for annual maintenance flows. The FLA should address how flows in the Cumberland River could be affected by loss of tributary inflow from the Tom Fork River.	Water resources are discussed in Section 5.2 of Exhibit E, including anticipated impacts to Tom Fork and the Cumberland River. LRPS proposes to source recharge water from Tom Fork during storm events, with supplemental flow, if needed, from the Cumberland River. Base flows in Tom Fork will be maintained.
19	Exhibit E	The DLA indicates that dissolved oxygen (DO) concentrations in the Tom Fork River are slightly higher than DO concentrations in the Cumberland River. The FLA should evaluate how a loss of inflow to the Cumberland River from the Tom Fork River could affect DO concentrations in the Cumberland River.	Water resources are discussed in Section 5.2 of Exhibit E, including anticipated impacts to Tom Fork and the Cumberland River. Recharge water from Tom Fork will only be stored during storm events; thus, changes to DO concentrations in the Cumberland River are not anticipated. Proposed water quality monitoring methods and reporting are provided in the Water Quality Monitoring Plan appended to Exhibit E.
20	Exhibit E	Section 5.4, *Wildlife Resources*, provides information regarding wildlife species that are known to occur, or may occur, within the project study area, including native species, non-native invasive species, and rare, threatened, or endangered species. This section states that Bell County, Kentucky, is within the Kentucky Elk Restoration Zone, a 16-county area in the Cumberland Plateau physiographic ecoregion, and that initial research following the elk reintroduction in Kentucky demonstrated that elk favored the food resources on recently established grassland at mine sites and used the adjacent forests for cover and refuge. Although section 5.5, Botanical Resources, describes grassy, previously mined areas and adjacent forests, the DLA does not describe whether elk currently use the proposed project area. In the FLA, please include the following information regarding the status of elk at the project: (1) a description and map of the current range of the reintroduced elk; (2) a description and map of the locations of any areas within the proposed project study area that are currently used by elk; (3) any existing programs or activities conducted by resource agencies to manage the	Elk are known to occur in the Lewis Ridge Project Vicinity. Section 5.4 of Exhibit E has been updated to include a description of range extent and habitat use of elk in the Lewis Ridge Project Vicinity, a description of management activities being implemented by the Kentucky DFWR, and a summary of the Wildlife Management Plan that includes elk habitat enhancement activities.

No.	Topic	Comment	Response
		elk population at, or near, the project; and (4) any proposed measures to protect elk during project construction, operation, and maintenance, and/or enhance elk habitat.	
21	Exhibit E	Section 5.4, *Wildlife Resources*, also describes an avian hotspot called Boone's Ridge within 2 miles of the project area where over 150 bird species have been reported since 2018. Exhibit A of the DLA includes brief, general descriptions of the transmission equipment (e.g., substation at the proposed powerhouse, and 3.6-mile-long overhead 161-kV transmission line). Section 5.4.3.2, *Applicant Recommendations*, includes the following proposed measures to reduce the potential for avian collisions: install a chain link fence marked with vinyl strips and/or reflective tape would be installed around the lower reservoir, and (if recommended), install flight diverters on the interconnection line to reduce avian collision. It is not clear what, if any avian protection measures are proposed for the project transmission line and substation. It is also not clear why Lewis Ridge anticipates that birds could experience a collision at the lower reservoir (except with the proposed fence) or if the applicant proposes to exclude or deter birds from using the lower reservoir. So that Commission staff can analyze the design, configuration, and maintenance of the project transmission line(s) and substation as they relate to avian protection, please provide with the FLA (i.e., under the *Wildlife Resources* section of Exhibit E) the following information: (1) any available data regarding observed or documented avian interactions with existing transmission line(s) and substation(s) within the project study area, such as nest building, perching, electrocutions, collisions, and any outages related to such interactions; (2) a detailed description of the proposed chain link fence around the lower reservoir, including: (a) the fence dimensions and features; (b) the purpose of, and need for the fence; and (c) any bird or other wildlife species it is intended to exclude or deter from the lower reservoir, if applicable; (3) whether the proposed project transmission lines, substation, and associated equipment would be designed and built to be consistent with the Avian Power Line Interaction Committee (APLIC) and FWS guidelines to minimize adverse avian interactions (i.e., potential avian electrocutions and collisions) (APLIC, 2006 and 2012; and APLIC and FWS, 2005); (4) detailed descriptions, figures, and diagrams of any proposed project transmission line and substation, and the specifications and locations of any proposed avian protection devices that would be consistent with APLIC guidelines, if applicable; and (5) a description of any other proposed avian protections measures and/or proposed Avian Protection Plan for the project, if applicable.	Wildlife resources are described in Section 5.4 of Exhibit E and the Wildlife Management Plan appended to Exhibit E. The Wildlife Management Plan outlines measures proposed for the protection of local wildlife, including avian species.
22	Exhibit E	Although the bat survey provided information about bat use during and immediately after the maternity season for the aforementioned bat species, it is not clear in section 5.4 of the DLA whether Lewis Ridge's bat surveys included an assessment of any mine cavities within the proposed project study area for bat use. Both surface and sub-surface mining occurred previously at the proposed project site and so staff will need additional information regarding any existing sub-surface mine cavities to evaluate potential project effects on listed bat species. Lewis Ridge's proposal to consult with FWS to identify construction windows that provide for bat and wildlife protection as well as feasible construction timelines for completing the project is vague. Without additional information regarding potential roost trees and mine cavities that may serve as bat roost/hibernation sites, it is not clear how this measure would minimize the effects of proposed project construction on federally listed bat species at the project. To facilitate staff review of the potential effects of project construction on federally listed bat species, please include the following information in the FLA: (1) detailed descriptions of known existing subsurface mine cavities, including locations within the proposed project boundary, dimensions, and any openings that could serve as bat access points; (2) the species and number of potentially suitable summer roost trees, including any maternity roost trees, that would be permanently removed or temporarily disturbed during project construction; (3) a detailed description of proposed bat protection measures based on the information collected for items 1 and 2 above, including time-of-year restrictions on excavation near subsurface mine cavities and/or tree removal activities, to include cutting down, harvesting, destroying, trimming, or manipulating in any other way the trees, saplings, snags, or any other form of woody vegetation	A bat portal survey and additional bat mist netting were completed within an updated Study Area in 2025. The results are summarized in Section 5.4 of Exhibit E, and the reports are appended to Exhibit E. Environmental measures to protect bats are described in the Wildlife Management Plan. This plan outlines measures proposed for the protection of local wildlife, including bat species. The Wildlife Management Plan has been appended to Exhibit E of the FLA.

No.	Topic	Comment	Response
		likely to be used by Indiana, northern long-eared, or tricolored bats within the proposed project boundary. Please note that suitable northern long-eared bats roosts include live or dead trees that are typically greater than or equal to 3 inches in diameter at breast height and have cavities, peeling bark, crevices, or hollows. Tricolored bats primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees, and they have also been observed roosting in lichens with pendant growth forms and among pine and eastern red cedar needles.	
23	Exhibit E	Section 5.5, *Botanical Resources*, provides some general background information regarding the existing composition of forest, shrub, and herbaceous communities within the proposed Lewis Ridge Project study area. This section states that there is a diversity in the age of trees at the project, with a tree diameter range of 5 to 40 inches at breast height, and the dominant vegetation includes: (1) cool season grasses, lespedeza, and some shrubs at the (previously mined) proposed upper reservoir location; (2) mixed deciduous forest with adjacent wetland and stream habitats at the proposed penstock and lower reservoir locations; (3) forested land and mining access roads along the proposed transmission line corridor. Section 5.5.2, *Potential Impacts of the Proposed Lewis Ridge Project*, states that construction and operation of the proposed project would permanently alter habitat and is anticipated to displace vegetation, including forested habitat and areas disturbed from previous mining operations, as well as an area which hasn't been disturbed and vegetation clearing would be required for the interconnection line corridor. However, the DLA does not provide a detailed description of the specific vegetation that would be permanently removed or vegetation that would be temporarily disturbed during construction. In the FLA, please include the following information: (1) detailed descriptions of the locations, acreages, and types of each vegetation, or specific vegetation community types, that would be permanently removed during project construction, distinguishing among: (a) areas that were previously disturbed during mining operations, (b) areas that have not been previously disturbed, and (c) areas dominated by non-native, invasive vegetation; (2) detailed descriptions of the locations, acreages, types of each vegetation, or specific vegetation community types, and nature of temporary disturbance proposed during project construction, distinguishing among: (a) areas that were previously disturbed during mining operations, (b) areas that have not been previously disturbed, and (c) areas dominated by non-native, invasive vegetation; (3) maps/figures showing the vegetation community types in relation to the proposed project facilities and the areas of permanent vegetation removal and temporary vegetation disturbance; and (4) the procedures, including any time of year restrictions, for removing or disturbing vegetation in sensitive habitats such as wetlands, riparian habitat, and suitable habitat for rare, threatened, or endangered species.	The Applicant conducted a vegetation assessment for the Lewis Ridge Project in 2025 to address FERC's questions. Section 5.5 of Exhibit E has been modified to include additional information regarding vegetation type and proposed disturbance. The Vegetation Assessment Report has been appended to Exhibit E of the FLA.
24	Exhibit E	Section 5.5.3.2, *Applicant Recommendations*, includes a proposal to implement a Vegetation Management Plan to mitigate the effects of construction on botanical resources through revegetation and the use of invasive species management protocols, given the presence of 12 non-native, invasive plants within the proposed project area. However, this section does not provide sufficient information for Commission staff to evaluate the proposed plan. In the FLA, please provide detailed descriptions of the areas that would be revegetated including: (1) the locations, acreages, topography, soil/substrate type(s), existing vegetation, and types of vegetation that would be used to stabilize soils during and after project construction; (2) a proposed plant species list for revegetation efforts; (3) a description of techniques and best management practices to be used to promote revegetation and to control the establishment and spread of non-native invasive plants, until disturbed areas are successfully revegetated; (4) any provisions for monitoring with descriptions of the criteria for measuring the success of revegetation efforts, and the procedures to be followed to update the plan if monitoring shows that revegetation is not successful; and (5) schedules for revegetation as well as any monitoring and/or maintenance (e.g., fertilization or irrigation requirements) of revegetated areas until revegetation is successful.	A Vegetation Management Plan was drafted and is appended to Exhibit E. This plan includes details on areas to be revegetated, as requested.

No.	Topic	Comment	Response
25	Exhibit E	The DLA does not include a description of any proposed regular vegetation management practices that would be implemented after project construction and revegetation is complete. In the FLA, please provide a detailed description of any proposed regular vegetation management practices that would be implemented within the project boundary after project construction, including: (1) the goals of vegetation management and any target species; (2) the types of vegetation management (e.g., forest management practices such as silviculture; and regular vegetation maintenance such as tree trimming and removal, mowing, herbicide applications, etc.); If herbicides would be used to control vegetation, please include the method/location of application (e.g., foliar, stump, stem, and/or vine). (3) the locations where each vegetation management technique would occur within the project boundary (e.g., proposed project facilities, access roads, parking areas, recreation areas, wildlife management areas, etc.); (4) the procedures, including any time of year restrictions, for managing vegetation in sensitive habitats such as wetlands, riparian habitat, and suitable habitat for rare, threatened, or endangered species; and (5) a schedule for conducting regular vegetation management (i.e., activities performed annually, seasonally, as-needed, etc.).	A Vegetation Management Plan was drafted and is appended to Exhibit E. This plan includes detailed descriptions of proposed regular vegetation management practices that will be implemented within the proposed Lewis Ridge Project Boundary, following construction, as requested.
26	Exhibit E	FWS considers official species lists generated in its Information for Planning and Conservation (IPaC) system to be valid for 90 days. The list included in the DLA was generated on July 19, 2024, and therefore it is now expired. In addition to including the tricolored bat, FWS may have other updates to the species list for the proposed Lewis Ridge Project. To facilitate Commission staff's review of the licensing proposal, please update the species list in IPaC and ensure that all current federally listed, proposed, and candidate species that may occur at, or be affected by the proposed project are covered in the FLA. Please provide detailed discussions of the potential project-related effects (i.e., construction, operation, maintenance, including vegetation management, and any proposed project-related recreation) on all the federally listed, proposed, and candidate species, and their habitats that may occur at the project.	A new USFWS Information for Planning and Consultation (IPaC) report of the Lewis Ridge Project Study Area was generated on May 9, 2025. The report is appended to Exhibit E of the FLA (Rare Species Reports [Privileged]), and the information is summarized in Section 5.4 of Exhibit E. The updated IPaC report included the species that were identified previously in the 2024 IPaC report. Additionally, the eastern hellbender was identified to be potentially occurring in the Study Area in the 2025 IPaC report. Section 5.4 of Exhibit E has been updated to reflect this addition, and discussion on potential project-related effects on rare, threatened, and endangered (RTE) species is provided.
27	Exhibit E	Section 4.41(f)(4) of the Commission's regulations, requires that an FLA include a description of adverse effects to cultural resources and any proposed mitigation measures. The cultural resources section of the Lewis Ridge study plan discusses possible project effects and notes avoidance of site 15BI57 in a general sense. The DLA, however, does not specify how each cultural site would be affected or propose specific protective or mitigation measures (i.e., avoidance, data recovery, etc). Therefore, please include the following in the FLA: (1) the results of National Register eligibility determinations for all archaeological sites that cannot be avoided during project construction, operation, or maintenance activities, (2) a description of specific project impacts on these sites; (3) proposed mitigation measures; and (4) documentation of Kentucky State Historic Preservation Officer (SHPO) concurrence on the eligibility determinations and finding of effects.	Section 5.6 of Exhibit E of the FLA provides additional detail pertaining to this topic.
28	Exhibit E	Although historic properties appear to be present within the proposed project boundary, neither the DLA nor the study plan mentions that a historic properties management plan (HPMP) will be developed. In the FLA, please either include a draft HPMP or provide an explanation for why one is not needed under section 106 of the National Historic Preservation Act.	A draft Historic Properties Management Plan (HPMP) has been appended to Exhibit E.
29	Exhibit E	If there are additional resources within the project area of potential effects that have not been addressed in the study, the FLA and the draft HPMP should include: (1) a description of these resources; (2) the results of any National Register evaluation of these resources; (3) a description of potential impacts and any proposed mitigation, as required by section 4.41(f)(4) of the Commission's regulations; and (4) documentation of all consultation with Lewis Ridge.	The Study Area outlined in the FLA is the same area as the proposed Area of Potential Effects (APE) for the design and construction phase of the Lewis Ridge Project. Cultural resources evaluations were conducted in the Study Area, except for some private parcels where landowner access has not yet been granted. The draft HPMP, which has been appended to Exhibit E, includes the elements requested in subparts (1) and (2) of this comment. Section 5.6 of Exhibit E discusses the potential impacts of the proposed Lewis Ridge Project as well as documentation of consultation pertaining to cultural resources at the Lewis Ridge Project.
30	Exhibit F	Sections 4.41(g) (sections 1 through 4) of the Commission's regulations describe what must be included in Exhibit F. The DLA includes conceptual design drawings for the proposed project. However, it does not contain drawings for the facilities involved with the initial fill water and long-term refill systems. Please provide conceptual design drawings for these facilities in the FLA. The DLA does not	The water supply for the initial fill and recharge water has been included in Exhibit F, sheets F-15 and F-16, and in the Preliminary SDR Section 2.9 and Attachment 5, *Initial Fill and Recharge Technical Memorandum*, included in Exhibit F.

No.	Topic	Comment	Response
		include a Supporting Design Report. Please provide a Supporting Design Report as required by section 4.41(g)(3) of the Commission's regulations in the FLA.	
31	Exhibit G	Sections 4.41(h) (sections 1 through 2) of the Commission's regulations describe what must be included in Exhibit G, Project Boundary. The DLA includes an Exhibit G, project boundary drawing, which needs additional labels. Exhibit G should label all major project features, including but not limited to, access roads, the penstock, sub-stations if present, and the connecting transmission line.	A revised Exhibit G is included in this FLA. Exhibit G includes labels for all major project features.
Kentucky State Historic Preservation Office (SHPO) – Comments on Study Reports, December 19, 2024			
1	Archaeology Report	Please submit the report as a single PDF.	Editorial corrections were made to the report, and the revised report was filed with the Kentucky SHPO on February 14, 2025.
2	Archaeology Report	For appendix A, please complete the rest of the KY Cemetery Supplemental Site Form, available here: https://heritage.ky.gov/historic-places/resources-survey/Documents/FieldworkCRspecs.pdf	This has been completed. The revised report was filed with the Kentucky SHPO on February 14, 2025.
3	Cultural Historic Report	Please submit the cultural historic report as one pdf.	Editorial corrections were made to the report, and the revised report was filed with the Kentucky SHPO on February 14, 2025.
4	Cultural Historic Report	p. 13/Project Description, 2nd paragraph, 1st sentence (see below), typo "reservation" should be "reservoir." *The proposed location for the upper reservation is atop Chestnut Flats, approximately 3,980 ft northeast of the location of the non-extant town of Balkan (Figure 4).*	Editorial corrections were made to the report, and the revised report was filed with the Kentucky SHPO on February 14, 2025.
5	Cultural Historic Report	p. 28, first paragraph, last sentence, word(s) missing (see below), possibly "part of" *In the following decades Balkan's population rapidly declined, and a review of topographic quadrangles of the area from 1954 and 1974 indicates that very little of the town remained by the early the 1970s (USGS 1954, 1974).*	Editorial corrections were made to the report, and the revised report was filed with the Kentucky SHPO on February 14, 2025.
6	Cultural Historic Report	p. 29, Table 1, for Sites 2 and 3, either list address as that listed on survey form or insert lat./long.	Editorial corrections were made to the report, and the revised report was filed with the Kentucky SHPO on February 14, 2025.
7	Cultural Historic Report	p. 29, Table 1, Site 1, location is Brownies Creek not Brownies Creeks. Please revise.	Editorial corrections were made to the report, and the revised report was filed with the Kentucky SHPO on February 14, 2025.
8	Cultural Historic Report	p. 29, Table 1, Site 2, resource listed as L & N Rail Line, survey form it is listed as CSX Railroad-Likely best to give a combination so that the historical reference is captured as well as current ownership so L & N/CSX Railroad. Please revise table and survey form.	Editorial corrections were made to the report, and the revised report was filed with the Kentucky SHPO on February 14, 2025.
9	Cultural Historic Report	p. 39, paragraph 5, last sentence (see below), presumably a typo-check year dates and revise if applicable, or flip January and July if this construction all occurred in 1935. *Between July 1935 and January 1935, the WPA had constructed 310 schools across Kentucky, including the Balkan School (Figures 58 and 59) (Kennedy and Johnson 2005:48).*	Editorial corrections were made to the report, and the revised report was filed with the Kentucky SHPO on February 14, 2025.
10	Survey Forms	Please submit each survey form as an individual pdf.	The revised report was filed with the Kentucky SHPO on February 14, 2025, following Kentucky SHPO submittal requirements, with the survey forms submitted as individual files.
11	Survey Forms	Please check page 1 of all survey forms. Make sure that #8 the report reference is filled in correctly and that the numbers which follow in the left column are 9-15. Almost all of these have the numbering messed up.	Editorial corrections were made to the report, and the revised report was filed with the Kentucky SHPO on February 14, 2025.

No.	Topic	Comment	Response
Environmental Protection Agency (EPA), December 11 and December 21, 2024			
1	Diversion of Flow and Initial Fill	On Page A-7 of the Draft License Agreement (DLA) and at various other points in the project documents, the plans for the impoundment of Tom Fork to construct and fill the lower reservoir are discussed. As with EPA's previous review of the PAD, it is unclear if there would be ongoing releases from the lower reservoir to maintain base flow in Tom Fork, if a diversion of Tom Fork around the reservoir would maintain baseflow, or if the permanent and complete impoundment of waters from Tom Fork and its tributaries is proposed. The DLA, in Section 5.2.1, Page E-24, indicates that Tom Fork would pass through the lower reservoir but the plans for this passage of flow is not adequately described. The extent to which upstream and downstream waters will be impacted, both directly and indirectly, will inform discussions regarding avoidance, minimization, and compensatory mitigation requirements for the project. <u>Recommendations</u>: EPA continues to recommend the consideration of Water Quality Standards for The Commonwealth of Kentucky, summarized in our previous comments, which include limitations regarding the alteration of flow among other parameters.	During construction, Tom Fork will be rerouted around the lower reservoir. LRPS will monitor flows to verify that base flows are maintained. During operation, flow from Tom Fork and its drainage area will be routed through the lower reservoir. LRPS will monitor inflow to the lower reservoir and at the low-level outlet to verify and maintain base flows. Management of flows is described in Section 2.3 of Exhibit A and Section 2 of Exhibit B.
2	Diversion of Flow and Initial Fill	Page B-8, Section 2.1 the DLA discusses the initial fill of the lower impoundment but does not provide clear information on the duration of the initial fill and the potential impacts associated with that fill. <u>Recommendations</u>: EPA recommends the applicant engage with EPA and other regulatory agencies prior to the submission of the FLA, where coordination could support a timely project review as well as ensure the project's adherence to the various applicable regulations (CWA Sections 404, 401 etc.). EPA recommends detailed studies to collect data on Tom Fork for a period of at least one year (the proposed period of initial fill), which should include water quality data as well as flow data to support hydrologic/hydraulic modeling of the current and anticipated future flows from Tom Fork. Kentucky Division of Water might be able to provide some baseline data for Tom Fork. This information is critical to inform decisions regarding the source(s) of initial fill for the impoundments. Because there is no information regarding historic, current, and predicted future flows of Tom Fork, it is difficult to support the general statements throughout the documents regarding Tom Fork's ability to sustain the project for initial fill, and throughout project operations for refill.	A detailed description of the initial fill and recharge water supply pipeline and associated facilities has been included in Section 2.4 of Exhibit A, Section 2 of Exhibit B, Section 2.9 of the Preliminary SDR in Exhibit F, and Attachment 5 titled *Initial Fill and Recharge Technical Memorandum* in the Preliminary SDR.
3	Diversion of Flow and Initial Fill	Section 5.2.2 Discusses potential impacts of the project. Some of the statements in this section appear to conflict with each other, need additional clarification, or both. For example: 1. "The percent of flow from Tom Fork that would be used for the initial fill is currently unknown; however, the initial fill would temporarily affect water quantity in Tom Fork." • Additional information on these temporary effects is necessary to inform future discussion of project impacts. 2. "Approximately the same amount of natural inflow to the lower reservoir would be released back to Tom Fork; however, this amount of flow is currently unknown and will be included in the FLA." • It is unclear if Tom Fork will be diverted around the lower reservoir, entirely captured by the lower reservoir with releases through a spillway, or some other alternative. • See previous comments regarding data needs on alterations to flow in Tom Fork, and the value of continued early engagement with EPA and other agencies to discuss any potential permitting issues at the time of FLA submittal. 3. "Rerouting Tom Fork during construction would not impact the quantity of water entering the Cumberland River. Changes in the quantity of water in Tom Fork during the initial fill or recharge would have a minor, temporary effect on water quantity entering the Cumberland River." • The information in the above sentences should be clarified with supporting information to indicate the true extent of impacts to water quantity in Tom Fork and downstream waters.	A detailed description of the initial fill and recharge water supply pipeline and associated facilities has been included in Section 2.4 of Exhibit A, Section 2 of Exhibit B, Section 2.9 of the Preliminary SDR in Exhibit F, and Attachment 5 titled *Initial Fill and Recharge Technical Memorandum* in the Preliminary SDR. Anticipated impacts to water resources have been added to Section 5.2 of Exhibit E.
4	Clean Water Act Section 404	At various points in the DLA, including Exhibit E Page E-7, the applicant indicates that they will continue conversations with Kentucky Division of Natural Resources (KDNR) regarding the possibility of SMCRA permit exemptions for permits which are currently active on the lands being considered for the LRPS project. EPA is requesting detailed information on the outstanding permit obligations related	Regulatory requirements pertaining to the Surface Mining Control and Reclamation Act (SMCRA) and 404 of the Clean Water Act are outlined in the Initial Statement and Section 2 of Exhibit E. Proposed impacts to water resources and existing permits on mine

No.	Topic	Comment	Response
		to aquatic resource restoration and compensatory mitigation to satisfy previous permits under Section 404 of the Clean Water Act, which cannot be waived or exempted. All previous permit requirements related to section 404 of the Clean Water Act, such as compensatory mitigation for previous impacts to aquatic resources, must still be met. Additionally, once the impacts associated with the new LRPS project (direct, secondary, and cumulative) are adequately understood and have been avoided and minimized to the maximum extent practicable [40 CFR 230.10(d)], the applicant will need to provide compensatory mitigation for any unavoidable impacts to aquatic resources…Any new compensatory mitigation requirements should be considered separately from previous requirements associated with historic mining activities on the property….Any newly proposed impacts to those resources may be considered cumulative impacts or may come directly into conflict with existing permit mitigation requirements. Finally, any potential costs associated with required compensatory mitigation for impacts should be considered by the applicant and potentially included as estimated project construction costs which are outlined in Table 1-1, Pages D-1 and D-2, of the DLA. Recommendations: EPA respectfully requests involvement in future project planning discussions with U.S. Army Corps of Engineers – Nashville District (USACE) and other agencies regarding impacts to aquatic resources.	lands are discussed in Sections 5.2, 5.8, and 5.11 of Exhibit E. Cumulative effects are discussed in Section 5.1 of Exhibit A, and construction costs are included in Exhibit D.
5	Clean Water Act Section 404	The currently available information with respect to project site alternatives that were considered is insufficient to determine if the selected project site is the Least Environmentally Damaging Practicable Alternative, or LEDPA. Specifically, the DLA states on pages B-1 and E-14 that no alternative sites were investigated for the project proposal. Additionally, the DLA states on Page B-2 that since the time of submitting the Pre-Application Document (PAD), project area footprints and impacts increased, rather than decreased, throughout the course of examining on-site alternatives. Increases to project impacts throughout the assessment of alternatives may not represent an appropriate application of the 404(b)(1) guidelines, which require avoidance and minimization of impacts before beginning to consider compensatory mitigation to offset unavoidable impacts. Furthermore, while the proposed property may represent a unique opportunity to repurpose a historic mining site, that aspect of the site's history also leads to additional environmental and safety concerns which have been raised with the applicant throughout the course of their agency correspondence. Recommendations: EPA recommends an alternatives analysis for the project, in accordance with 40 CFR 230.10(a)(4). The alternatives analysis should include other properties whose selection may result in lesser impacts to the aquatic environment. 40 CFR 230.10(a)(2) describes the practicability of alternatives in light of the overall project purpose, including the evaluation of alternative properties even if they are not presently owned by the applicant. The alternatives analysis should provide clear and quantifiable information on the aquatic resource impacts associated with each alternative.	The Applicant understands that the requirements of the Clean Water Act, including those outlined in 40 CFR Part 230, will be addressed during the permitting phase of the project with the appropriate regulatory lead agency. For the purposes of this license application, the appropriate discussion of alternatives considered for the Lewis Ridge Project is provided in Exhibit B of the FLA, consistent with the requirements of 18 CFR § 4.41(c). This analysis includes both design alternatives within the proposed site and a detailed description of the site selection process. As described in Section 1 of Exhibit B, the siting of a pumped storage project includes review of locations with suitable topography, factors of accessibility for infrastructure development, proximity to the electrical grid, regional energy needs, land availability, access to existing water sources, and the potential to minimize environmental impacts. The selected site for the Lewis Ridge Project was determined to be favorable based on these criteria and presents a unique opportunity to repurpose a previously mined area for energy storage.
6	Clean Water Act Section 404	The most current information on project construction and operations indicates that Tom Fork and potentially other aquatic resources will be wholly converted from natural systems to an industrial facility. The impoundments will be industrial in nature, lined with hydraulic asphalt concrete (HAC), and will experience significant drawdowns and additions within a 24-hour period (100' water surface elevation change in the lower reservoir and a 71' water surface elevation change in the upper reservoir). Unlike other impoundment projects, these do not appear to have the ability to naturalize and create new aquatic ecosystems which may provide functions and services to the surrounding ecological communities. Such a conversion of natural resources to an industrial facility creates concerns with respect to potential secondary or cumulative impacts resulting from the project. Section 5.2.1.8 of the DLA discusses Wetland, Riparian and Littoral Plant and Animal species but the extent of potential impacts to those resources are not discussed in any detail. LRPS proposes to install and maintain fish exclusion bar racks at the lower reservoir inlet and outlet. Exclusion upstream and downstream of the impoundment in Tom Fork implies that fish would no longer be able to pass from above the reservoir to below, and vice versa. EPA acknowledges that during the course of a single habitat study in which no fish sampling occurred, that fish were only observed in the lowest, low gradient reaches of Tom Fork. However, this anecdotal data does not confirm whether fish may move throughout other stream reaches during certain times of year. If fish passage will be eliminated for Tom Fork, what about passage for other aquatic and semi-aquatic organisms? How will the inlets and outlets of the impoundment of Tom Fork be situated relative to the existing and constructed channels? How much of the stream channel up- and downstream of the Tom Fork impoundment will need to be channelized, armored, or otherwise constructed? CWA Section 404 regulations 40 CFR 230.32 discuss the possible loss of values for other wildlife associated with the discharge of dredged or fill material into Waters of the US, and 40 CFR Part 230 Subpart H discusses means to avoid and minimize the loss of	The Applicant acknowledges the EPA's recommendation to consider indirect, secondary, and cumulative impacts in the development of protection, mitigation, and enhancement (PM&E) measures. These considerations have been addressed in Exhibit E of the FLA, which includes a comprehensive evaluation of the Lewis Ridge Project's potential environmental effects. The analysis in Exhibit E is consistent with the content requirements outlined in 18 CFR § 4.41. The Applicant believes that the FLA provides a sufficient basis for evaluating the Lewis Ridge Project's environmental implications and for informing the development of appropriate PM&E measures.

No.	Topic	Comment	Response
		values. 40 CFR 230.75 specifically discusses actions affecting plant and animal communities, while 40 CFR 230.77(b) addresses specific actions associated with the construction of dams. Finally, 40 CFR 230.77(d) states that "[w]hen a significant ecological change in the aquatic environment is proposed by the discharge of dredged or fill material, the permitting authority should consider the ecosystem that will be lost as well as the environmental benefits of the new system." As currently proposed, the new system will be wholly industrial in nature and thus it may be appropriate to consider a complete loss of the existing ecosystem once it has been replaced by the infrastructure for the proposed project. Recommendations: EPA Recommends that Protection, Mitigation and Enhancement Measures (PM&E) discussed in the DLA also consider ways to account for indirect, secondary, and cumulative impacts resulting from the project.	
7	Cumulative Effects Analysis	Section 5.1, Page E-23, discusses the applicant's cumulative effects analysis and recognizes that cumulative impacts would occur to water, geological and soil resources as a result of the project. The applicant did not identify any other resources that would be cumulatively affected by the proposed project. Recommendations: EPA is requesting detailed results from the cumulative effects analysis, if available. EPA additionally recommends outlining what methods or tools were used to identify any potential cumulative impacts to other resources which were examined, but for which there were no findings of cumulative effects. For example, how were potential cumulative effects to flora, fauna, and aesthetics considered during the cumulative effects analysis?	The Applicant acknowledges the EPA's request for additional details on the methodology related to the cumulative effects analysis. As described in Exhibit E of the FLA, cumulative impacts were appropriately considered during the evaluation of project effects on environmental resources. Cumulative effects were assessed throughout the preparation of the Exhibit E, which meets the content requirements set forth in 18 CFR § 4.41.
8	Aesthetic Resources	The impoundments for the LRPS project have been described as "crowns on the mountaintop." Will the final project design be largely visible throughout the region, having a potential cumulative impact on regional aesthetics when considered alongside the extensive mining impacts in the region? Would the project be visible from Cumberland Gap National Historic Park or other scenic overlooks which may be in the surrounding areas? 40 CFR 230.53 discusses aesthetics in the context of Subpart F - Potential Effects on Human Use Characteristics (40 CFR Part 230 Subpart F). Recommendations: Address aesthetics and human use characteristics and/or impacts.	Potential impacts to aesthetic resources are described in Section 5.10 of Exhibit E. As described, the Lewis Ridge Project will be situated in an area that has been used for mining activities, and as the visual landscape is already characterized by industrial mining activity, the transition to a pumped storage facility does not substantially alter the area's aesthetic character. No key observation points or concerns about changes to visual resources have been raised in public meetings or comments. A bare earth viewshed analysis was run, and it was determined that the project features have the potential to be visible from certain areas of the Cumberland Gap National Historic Park and Boone's Ridge.
9	Water Quality	As water is exchanged between the proposed project reservoirs, there is potential for the concentration of water constituents, including Total Dissolved Solids (TDS), nutrients and chemical contaminants. According to information in the DLA, historic mining has occurred on the project site from the 1940's to as recently as 2020, and that as a result large portions of the site are indiscriminately covered with mine spoils (DLA Page E-128). Thus, the potential for accretion of contaminants in the impounded water may be high. Additionally, because the project plans have been modified to include a hydraulic asphalt concrete (HAC) liner in both reservoirs, information should be provided regarding the potential leaching of any contaminants from the asphalt liners before those waters are released into Tom Fork. Recommendations: EPA continues to recommend sediment testing of areas in the site which are proposed to be disturbed by the project. Additionally, we recommend that water quality of any proposed releases from the impoundment into Tom Fork should be further analyzed. 40 CFR 230.5(i) states: "If there is a reasonable probability of chemical contamination, conduct the appropriate tests according to the section on Evaluation and Testing (§ 230.61)."	A Water Quality Monitoring Plan, which includes monitoring of water quality conditions in Tom Fork, has been developed for the Lewis Ridge Project and is being filed as an appendix to Exhibit E.
10	Water Quality Standards	Table 5-3, Page E-31, lists water quality standards (WQS) that are applicable to the project vicinity. Many or all these parameters can be directly affected through the impoundment of waters and these effects can be influenced through various aspects of project design and management. For example, the surface temperature of impounded waters can become elevated above the surrounding natural water temperatures. Conversely, the water temperatures at the bottom of impoundments can be greatly reduced as compared to the surrounding environmental temperatures. Where waters are released from an impoundment into the downstream ecosystem (hyper- or hypolimnetic) can influence the effect on water temperatures in the ecosystem. Information on page E-51 of the DLA indicates that water released from the lower reservoir to Tom Fork would be at the same elevation as the reservoir floor, a hypolimnetic release, and thus that the water quality being released to Tom Fork would reflect the conditions at the bottom of the reservoir. Hypolimnetic	A Water Quality Monitoring Plan has been developed for the Lewis Ridge Project and is being filed as an appendix to Exhibit E.

No.	Topic	Comment	Response
		releases are known to result in reductions to water temperature and dissolved oxygen. EPA acknowledges the supposition in the DLA that water in the upper and lower impoundments will be well mixed because of the pump and generation cycle, and that additional clarification on this matter may be provided from the proposed Water Quality Monitoring Plan. Page E-39 and Table 5-6 of the DLA provide information on recently acquired water quality parameters monitored in the mainstem of Tom Fork. However, it appears that water quality for Tom Fork was only collected during a single day's sampling event. Recommendations: EPA recommends continued long-term monitoring of water quality in Tom Fork to determine if there are any trends in the data which could indicate that water quality in Tom Fork is decreasing, increasing, or remaining stable over time. These data would also establish the baseline which would allow for meaningful comparisons to future water quality. It is important to document whether this ecosystem is currently trending towards recovery of some of the ecological functions and services which may have been directly affected by previous mining activities, and whether the LRPS project would limit the capacity of the resource to recover from past impacts. Additionally, while moving forward with project planning, EPA recommends careful consideration of whether proposed releases back into Tom Fork will be able to maintain the required WQS. The temperature and dissolved oxygen WQS, among others, can be equally influenced by the source location and amounts of releases from impounded waters. For example, the Flow WQS, requiring that alterations to flow shall not be to a degree that would adversely affect the aquatic community, can be directly controlled through the careful planning of releases from an impoundment. Currently there is not enough information available to support the idea that the proposed project will not alter flows to a degree that would adversely affect the aquatic community.	
11	Water Quality Standards	Section 5.2.1.5 discusses deficiencies in meeting WQS for certain stretches of the Cumberland River downstream of the project. Some of those deficiencies are apparently considered as secondary impacts from surface mining activities in the area. Any additional impacts to water quality in these reaches of the river may be considered cumulative and should be accounted for in any future analysis of cumulative effects. Additionally, future TMDLs written to manage cumulative affects for downstream segments of the Cumberland River may the project. Recommendations: As above, EPA recommends continued collection of baseline water quality data for Tom Fork in order to document current trends in water quality. Currently there only appears to be water quality data on Tom Fork from a single day's sampling event, which is not sufficient to characterize the baseline conditions of the resource for future comparison. EPA requests involvement in future meetings where water resources will be discussed.	Water quality monitoring was initiated in Tom Fork and the Cumberland River, and the results are summarized in Section 5.2 of Exhibit E. Additionally, a Water Quality Monitoring Plan has been developed for the Lewis Ridge Project and is being filed as an appendix to Exhibit E.
12	Dam Safety, Longevity, and Operations	Page B-2 of the DLA provides information regarding the modification of project plans to utilize a hardfill dam for the upper reservoir and an earthfill dam for the lower reservoir, as opposed to the original plans to use roller compacted concrete for project construction. Recommendations: EPA is requesting additional information as to the reasons for this modification and whether the new project design includes any potential impacts on the project's longevity, safety, or both.	The upper reservoir dam type has been revised to a rocky earthfill embankment dam, allowing excavated materials to be used to construct the embankment. The maximum height of the dam was reduced to 50 feet.
13	Dam Safety, Longevity, and Operations	Page D-3, Section 4.3, assumes a useful life of the project to be 50 years. What are the typical actions associated with the decommissioning of a pumped storage facility at the end of its useful life, and what implications does that have for future impacts, restoration, or both, to aquatic resources within the project area? Recommendations: EPA requests information about the longevity of the dam and the proposed life of the project regarding aquatic impacts.	The FERC license term that is being requested is 50 years for this new construction project. With proper ongoing inspection, maintenance, and rehabilitation, it is anticipated that the Lewis Ridge Project will be able to operate far longer than the license term.
14	Dam Safety, Longevity, and Operations	Appendix E, page E-1 indicates that minimal recharge water would be required to maintain water levels for the impoundments, but there is no definitive information in the DLA on the amounts of recharge water that would be required throughout the life of the project to maintain operations. Recommendations: EPA recommends detailed studies to provide the best available information on predicted amounts and frequencies of withdrawal of recharge water that will be required after the initial fill. Ideally, the necessary amounts of recharge water would be compared to data on the predicted future average flows of Tom Fork to determine whether future sources of recharge water will have the capacity to maintain the project.	A detailed description of the water supply for the initial fill and recharge water has been included in Section 2.4 of Exhibit A, Section 2 of Exhibit B, Section 2.9 of the Preliminary SDR in Exhibit F, and Attachment 5 titled *Initial Fill and Recharge Technical Memorandum* in the Preliminary SDR.

No.	Topic	Comment	Response
15	Dam Safety, Longevity, and Operations	The timing of reservoir filling was not specified. Filling reservoirs has been found to cause impairments to the receiving downstream waters, therefore, optimal timing of reservoir filling may reduce potential impacts to downstream waters and aquatic life. For example, seasonal timing during wet vs. dry times of year, or in consideration of different life stages for aquatic life. A flow analysis could also determine how to balance future water withdrawals, impoundment operations, and help minimize water quality and aquatic life impacts both in the managed impoundment and downstream. Recommendations: Provide a plan for the timing of reservoir filling, any ongoing withdrawals, and reservoir operations that includes temporal and aquatic life considerations and potential impacts.	A detailed description of the water supply for the initial fill and recharge water has been included in Section 2.4 of Exhibit A and Section 2 of Exhibit B.
16	Issues of Concern	Please include the results from the differential settlement calculations. In addition, please include how much settlement would be acceptable, why, and potential unsafe scenarios after a few decades. We hope you would be able to produce this after your geotechnical borings.	An analysis of potential surface subsidence due to degradation (collapse) of no longer active coal mines below the upper reservoir will be performed as part of the next phase of design. A description of the approach to the subsidence analysis is provided in Attachment 1 of the Preliminary SDR in Exhibit F titled *Preliminary Engineering Geology Technical Memorandum*.
17	Issues of Concern	Would the site need ground improvement to control settlement? If yes or no, please explain.	An analysis of potential surface subsidence due to degradation (collapse) of no longer active coal mines below the upper reservoir will be performed as part of the next phase of design. A description of the approach to the subsidence analysis is provided in Attachment 1 of the Preliminary SDR in Exhibit F titled *Preliminary Engineering Geology Technical Memorandum*.
18	Issues of Concern	To avoid catastrophes such as the Taum Sauk Dam, we suggest investigating the option to include a natural overflow system to prevent overflow in case of equipment malfunction.	Detailed descriptions of the spillways have been included in Section 2 of Exhibit A, Section 2 of Exhibit B, and Section 2.5 of the Preliminary SDR in Exhibit F.
19	Issues of Concern	Recharge Water (section 2.2): the draft application estimates an 8% of the active storage volume (274 acre-feet) annually lost in part to evaporation, and therefore the need to be replenish. Due to the constant and permanent water withdrawal from Tom Fork the environmental evaluation and mitigation of this impact needs to be addressed. Priorly, we have suggested to investigate floating solar arrays to mitigate evaporation and the use of other energy resources. Please consider those comments.	The anticipated total evaporation loss of both reservoirs is described in Section 2.2 of Exhibit B. Overall, total annual evaporation losses from the reservoirs are anticipated to be minimal, and potential impacts associated with recharge water withdrawals are addressed in Section 5.2 of Exhibit E. The Applicant will continue to evaluate options such as floating solar arrays to minimize evaporation.
20	Issues of Concern	We recommend a back-up system to assure the successful emergency stop of the equipment in case of emergency.	In the case of an emergency where the pump-turbines need to be shut down, the following features will be included in the Lewis Ridge Project: a. The wicket gates that are at the entrance to the turbine can close to shut off flow and allow the turbine to stop. b. The main inlet valve upstream of the turbine can close to shut off flow and allow the turbine to stop. c. The intake gate at the upper reservoir inlet/outlet structure can close to shut off flow and allow the turbine to stop.
21	Editorial Correction	Page 2 of the Distribution List – Jeaneanne Gettle is not the Regional Administrator. If you need a contact, you can add the Project Officer Maria R. Clark.	The Applicant's Distribution List for the Lewis Ridge Project licensing has been updated to include Maria R. Clark in lieu of Jeaneanne Gettle for the U.S. Environmental Protection Agency.

No.	Topic	Comment	Response
Kentucky Department of Environmental Protection, October 28, 2024			
1	General	The Kentucky Division of Enforcement endorses this project.	Comment acknowledged.
2	Water Resources	Division of Water: The Director's Office has no comments. The Water Quality Branch has no comments on this project. Field Operations Branch has no comments. The proposed project could require multiple Water Withdrawal Applications depending on what proposed sources are used for the initial filling and recharge. Applications for permits or authorizations should be made four to six months prior to requested withdrawal initiation. The proposed project is within the Knox County Utility Commission source water protection area, zone 3. Questions should be directed to Allan Shingleton at 502-782-6907 or Allan.Shingleton@ky.gov. The proposed work is endorsed by the Groundwater Section of the Watershed Management Branch. However, it is our recommendation that site be made aware of the requirements of 401 KAR 5:037 and the need to develop a Groundwater Protection Plan (GPP) for the protection of groundwater resources within that area. The Engineering Section of the Division of Water's Water Infrastructure Branch has no comments on the proposed project.	The Applicant will work with the Kentucky Department of Environmental Protection to obtain the required permits for the Lewis Ridge Project. Additional discussion on water resource permitting is provided in Section 2.1 and 5.2 of Exhibit E.
3	Wildlife Resources	Kentucky Nature Preserves Your project might have the potential of impacting federally or state listed species and natural communities. Go to the Kentucky Biological Assessment Tool (kynaturepreserves.org) to obtain a Standard Occurrence Report for information regarding listed species known within your project area. The report will also provide information on public and private conservation lands, areas of biodiversity significance, and other natural resources in your project area for which the Office of Kentucky Nature Preserves maintains data. This review is based upon the information that was provided by the applicant. An endorsement of this project does not satisfy, or imply, the acceptance or issuance of any permits, certifications or approvals that may be required from this agency under Kentucky Revised Statutes or Kentucky Administrative Regulations. Such endorsement means this agency has found no major concerns from the review of the proposed project as presented other than those stated as conditions or comments. If you should have any questions, please contact me at (502) 782-0863 or e-mail Louanna.Aldridge@ky.gov.	An updated Standard Occurrence Report from the Kentucky Biological Assessment Tool was obtained for the Study Area, and the results are summarized in Section 5.4 of Exhibit E.

APPENDIX A-2

DLA COMMENTS

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426
December 27, 2024

OFFICE OF ENERGY PROJECTS

Project No. 15249-001– Kentucky
Lewis Ridge Pumped Storage Project
Lewis Ridge Pumped Storage, LLC

VIA FERC Service

Sandy Slayton
Lewis Ridge Pumped Storage, LLC
830 NE Holladay Street
Portland, OR 97232

Subject: Staff Comments on the Draft License Application for the Lewis Ridge Pumped Storage Project

Dear Ms. Slayton:

On September 30, 2024, Lewis Ridge Pumped Storage Project, LLC (Lewis Ridge) filed a draft license application (DLA) with the Federal Energy Regulatory Commission for the Lewis Ridge Pumped Storage Project No. 15249-001. We provide our comments in the attached Appendix A. When you prepare your final license application, please provide the information we request in Appendix A.

If you have any questions regarding this letter or the contents of the final license application, please contact Monte TerHaar at (202) 502-6035, or via email at monte.terhaar@ferc.gov.

Sincerely,

Stephen Bowler, Chief
South Branch
Division of Hydropower Licensing

Attachment: Appendix A – Comments on the Draft License Application for the Lewis Ridge Pumped Storage Project No. 15249-001

APPENDIX A

COMMENTS ON THE DRAFT LICENSE APPLICATION FOR THE LEWIS RIDGE PUMPED STORAGE PROJECT NO. 15249-001

Exhibits A and B

1. Section 2.0, *Proposed Project Structures*, the proposed project features include a 3.6-mile-long, 161 Kilovolt (kV), overhead interconnection line, and shows the location of the point of interconnection in Figure 2-1 (*also see* Exhibit F-1 labeled as Point of Connection Pineville+Harlan #1 161 KV Line). Please clarify whether the point of interconnection for the transmission line occurs at a substation, and if yes, who owns and operates the substation, and whether the substation would be within the project boundary.

2. Section 2.4, *Powerhouse and Generating Equipment*, proposes two turbine options for the Lewis Ridge Project as using either Francis-type fixed or variable-speed pump-turbine units. In the FLA, please provide a detailed description to include the number, type and rated capacity of any proposed turbines and generators as well as the pumping capacities of the devises.

3. Section 2.1, *Upper Reservoir and Dam*, states that, “The upper reservoir’s integrated overflow emergency spillway along the hardfill dam crest would be designed to provide protection from overtopping the dam during extreme floods or a potential over-pumping event.” The DLA does not provide details about the operations of the upper reservoir’s emergency spillway. As described in section 2.5, *Project Operation during Adverse, Mean, and High-Water Years*, it is unclear how the emergency spillway will be operated, and what water will flow into as it exits the spillway. For example, does water exiting the spillway enter an intermittent stream that conveys water back down to the lower reservoir or the Tom Fork River downstream of the lower reservoir? Please include in the FLA a complete description of the spillway’s operation and water conveyance. Please also provide similar details for the lower reservoir’s emergency spillway in the FLA.

4. We note that some studies appear to be ongoing. Pursuant to Section 4.38 (c)(1)(i), please be sure to include the study results and study reports in the final license application (FLA) along with a schedule for completing any outstanding studies and filing the results with the Commission.

5. For the coal mine lands to be occupied by the project, the current operational status, historic use of land, and necessary mining reclamation measures should be fully described in the FLA.

6. The DLA presents two alternatives for the proposal, alternative A, initially presented in the PAD and carried into DLA, and Alternative B, presented only in the DLA. To avoid confusion in the FLA please delete all references to Alternative A which, it appears, you no longer intend to pursue.

7. Section 4.41(b) of the Commission's regulations requires that the FLA identify all facilities that are necessary for operation and maintenance, including those needed to convey water for reservoir filling and maintenance flows. This information is not in the DLA. Please include in the FLA a description of all water conveyance facilities and structures that would be used to convey water from the Tom Fork River to the lower reservoir as proposed in the DLA.

8. Section 4.41(c) of the Commission's regulations identifies requirements for Exhibit B, Project Operation and Resource Utilization. The DLA states that fill flows and maintenance flows are still being evaluated. The DLA indicates that the source of initial fill flows and maintenance flows would be the Tom Fork River, but the DLA also states that well water and the Cumberland River would be considered for operation flows. Please provide a clear, detailed proposal for the water sources, in the FLA. Please include supporting information for initial and maintenance fill estimates, as well as methodology used to determine these estimates, including both evaporation and leakage losses. Also, include a complete copy of a report conducted by Kleinschmidt (Kleinschmidt 2022) as identified in the list of references.

9. The draft application provides insufficient information for staff to evaluate the estimates for initial fill flows, maintenance flows, source flow (in the Tom Fork River), and evaporation and leakage losses. In the FLA, please provide supporting information for initial fill flows, maintenance fill flows, source flow (in the Tom Fork River), and evaporation and leakage loss estimates, as well as methodology and supporting documents used to make these estimates.

10. Section 4.41(c)(4)(i) of the Commission's Regulations requires monthly flow duration curves, as well as minimum, maximum, and mean recorded flows in cubic feet per second. In the DLA this information was provided for the Cumberland River, but not for the Tom Fork River which is proposed for water withdraws. A monthly evaluation of Tom Fork River flows is particularly important since the Tom Fork River, upstream of the project, is an intermittent stream, which largely relies on rainfall events for flows. Given the small drainage area for the Tom Fork (2.6 square miles), flows are expected to be flashy. Please include monthly flow duration curves for the Tom Fork River in the FLA.

11. Given the potential for low flows in the system, and their potential to affect generation, the FLA should include a low flow or drought management plan, or the outlines of such a plan that staff can consider in its analysis.

Exhibit D

12. Section 4.41(e) of the Commission's regulations requires filing with the Commission a statement of project costs and financing (i.e., Exhibit D) that includes, in general, construction costs for major project works and personnel, estimates of taxes, annual operation and maintenance costs, and the capital and annual cost for all environmental measures. The Exhibit D filed with the DLA included only a few costs. In accordance with section 4.41(e) (sections 1 through 9), please include a complete Exhibit D in the FLA.

Exhibit E

13. The DLA and supporting study reports include various maps showing georeferenced datasets (geographic information system (GIS) shapefiles). To facilitate Commission staff's review of the existing environmental conditions at the project, concurrent with the FLA, please file the following GIS shapefiles:

    (1) the project study area shown in figure 1-1 in Exhibit A;
    (2) proposed project features (i.e., interconnection line, penstock, fill area, permanent access road [new], permanent access road [existing], temporary construction road [new], temporary construction road [existing], point of interconnection, project reservoirs, powerhouse, spillway, construction laydown and parking), and river mile points, shown in figure 2-1 of Exhibit A, and/or figure 1-3 of Exhibit B;
    (3) proposed project boundary shown in figure 1-2 of Exhibit B and figure 3-1, Exhibit E;
    (4) Cumberland River Basin and sub-basins shown in figure 4-1, Exhibit E;
    (5) drainage area of the lower reservoir shown in figure 5-2, Exhibit E;
    (6) jurisdictional wetlands and streams mapped in the study area shown in figure 5-14, Exhibit E;
    (7) FEMA flood hazard classifications shown in figure 5-15, Exhibit E;
    (8) geologic formations shown in figure 5-18, Exhibit E;
    (9) mapped soil types shown in figure 5-19, Exhibit E;
    (10) mined areas (surface and subsurface) shown in figure 5-22, Exhibit E;
    (11) land use classifications shown in figure 5-24 (Existing Mining Permits Bonded under Kentucky DNR Jurisdiction), Exhibit E; and
    (12) Land use classifications shown in figure 5-33, Exhibit E.

14. If the Cumberland River is to be used as a fill or make-up water source, the effects on water volume, water quality, aquatic habitat, and fish entrainment of the withdrawal from the river should be estimated in the FLA.

15. Section 5.2.1.8, *Wetlands, Riparian, and Littoral Habitat*, Figure 5-13 shows U.S. Fish and Wildlife Service, National Wetlands Inventory wetlands within the project vicinity. However, the colors used for the wetland types are very similar to the background color of the base map used, making it hard to discern some of the smaller areas that contain wetlands. In the FLA, it is recommended to either lighten the base map color (as done in Figure 5-14) or use fill colors for the wetland type polygons that are higher in contrast to the base map used, so that wetlands can be easily identified. This recommendation applies for all similar figures. Additionally, for Figure 5-13 and Figure 5-14, please include a polygon, or polygons, showing the location(s) where excavated material will be disposed of for the construction of the reservoirs so that staff may fully understand what, if any, wetland, streams and/or riparian habitat would be impacted by the fill area(s).

16. Section 5.2.1.8, *Wetlands, Riparian, and Littoral Habitat*, Figure 5-14 shows a bright blue dashed line within the transmission corridor. However, the symbology in the legend does not show a dashed bright blue line, it only shows a solid blue line. Therefore, it is unclear what the dashed blue line represents. In the FLA, please correct this error in Figure 5-14.

17. Section 5.3.1.3, *Invasive and Nonindigenous Fish and Aquatic Species*, contains Table 5-11 which has confusing, and incorrect data listed for some species. The title of the table is, "Nonindigenous Aquatic Species Known to Occur in the Upper Cumberland River Basin". However, some species listed in the table do not occur in the upper Cumberland River (e.g., coho salmon). Additionally, there are other species that have been found in the upper Cumberland River but are listed with an incorrect "Species Origin" status. For example, yellow perch are listed as native in the upper Cumberland River, and, although this species has been found in the upper river, their status in the Cumberland River should be listed as Exotic (aka nonindigenous). Only species found in the upper Cumberland River (indicated as such in the title) should be reported, and their origin status (e.g., native, exotic, etc.) should be based on whether the given species is considered native or exotic within the Cumberland River and adjacent waterbodies.

18. The project would use nearly all flow from the Tom Fork River for annual maintenance flows. The FLA should address how flows in the Cumberland River could be affected by loss of tributary inflow from the Tom Fork River.

19. The DLA indicates that dissolved oxygen (DO) concentrations in the Tom Fork River are slightly higher than DO concentrations in the Cumberland River. The FLA should evaluate how a loss of inflow to the Cumberland River from the Tom Fork River could affect DO concentrations in the Cumberland River.

20. Section 5.4, *Wildlife Resources*, provides information regarding wildlife species that are known to occur, or may occur, within the project study area, including native species, non-native invasive species, and rare, threatened, or endangered species. This section states that Bell County, Kentucky, is within the Kentucky Elk Restoration Zone, a 16-county area in the Cumberland Plateau physiographic ecoregion, and that initial research following the elk reintroduction in Kentucky demonstrated that elk favored the food resources on recently established grassland at mine sites and used the adjacent forests for cover and refuge. Although section 5.5, Botanical Resources, describes grassy, previously mined areas and adjacent forests, the DLA does not describe whether elk currently use the proposed project area. In the FLA, please include the following information regarding the status of elk at the project: (1) a description and map of the current range of the reintroduced elk; (2) a description and map of the locations of any areas within the proposed project study area that are currently used by elk; (3) any existing programs or activities conducted by resource agencies to manage the elk population at, or near, the project; and (4) any proposed measures to protect elk during project construction, operation, and maintenance, and/or enhance elk habitat.

21. Section 5.4, *Wildlife Resources*, also describes an avian hotspot called Boone's Ridge within 2 miles of the project area where over 150 bird species have been reported since 2018. Exhibit A of the DLA includes brief, general descriptions of the transmission equipment (e.g., substation at the proposed powerhouse, and 3.6-mile-long overhead 161-kV transmission line). Section 5.4.3.2, *Applicant Recommendations*, includes the following proposed measures to reduce the potential for avian collisions: install a chain link fence marked with vinyl strips and/or reflective tape would be installed around the lower reservoir, and (if recommended), install flight diverters on the interconnection line to reduce avian collision. It is not clear what, if any avian protection measures are proposed for the project transmission line and substation. It is also not clear why Lewis Ridge anticipates that birds could experience a collision at the lower reservoir (except with the proposed fence) or if the applicant proposes to exclude or deter birds from using the lower reservoir. So that Commission staff can analyze the design, configuration, and maintenance of the project transmission line(s) and substation as they relate to avian protection, please provide with the FLA (i.e., under the *Wildlife Resources* section of Exhibit E) the following information:

(1) any available data regarding observed or documented avian interactions with existing transmission line(s) and substation(s) within the project study area, such as nest building, perching, electrocutions, collisions, and any outages related to such interactions;

(2) a detailed description of the proposed chain link fence around the lower reservoir, including: (a) the fence dimensions and features; (b) the purpose of, and need for the fence; and (c) any bird or other wildlife species it is intended to exclude or deter from the lower reservoir, if applicable;

(3) whether the proposed project transmission lines, substation, and associated equipment would be designed and built to be consistent with the Avian Power Line Interaction Committee (APLIC) and FWS guidelines to minimize adverse avian interactions (i.e., potential avian electrocutions and collisions) (APLIC, 2006 and 2012; and APLIC and FWS, 2005);

(4) detailed descriptions, figures, and diagrams of any proposed project transmission line and substation, and the specifications and locations of any proposed avian protection devices that would be consistent with APLIC guidelines, if applicable; and

(5) a description of any other proposed avian protections measures and/or proposed Avian Protection Plan for the project, if applicable.

22. Section 5.4.1.1, *Rare, Threatened, and Endangered Wildlife Resources*, table 5-15, provides the federally listed, proposed, and candidate wildlife species that may occur in the study area or be affected by the proposed project. The list of species includes the endangered gray bat, Indiana bat, and northern long-eared bat, as well as the proposed endangered tricolored bat. Gray bats roost in caves or mines year-round while Indiana, northern long-eared, and tricolored bats hibernate in caves or mines during the winter and roost in trees in the summer. In July and August of 2024, Lewis Ridge used the U.S. Fish and Wildlife Service's (FWS) Range-wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines (April 2024) to conduct a presence/absence bat survey. In total, 22 individual bats of 5 species were captured including 1 gray bat and 1 adult male tricolored bat.

Although the bat survey provided information about bat use during and immediately after the maternity season for the aforementioned bat species, it is not clear in section 5.4 of the DLA whether Lewis Ridge's bat surveys included an assessment of any mine cavities within the proposed project study area for bat use. Both surface and sub-surface mining occurred previously at the proposed project site and so staff will need additional information regarding any existing sub-surface mine cavities to evaluate potential project effects on listed bat species. Lewis Ridge's proposal to consult with FWS to identify construction windows that provide for bat and wildlife protection as well as feasible construction timelines for completing the project is vague. Without additional information regarding potential roost trees and mine cavities that may serve as bat roost/hibernation sites, it is not clear how this measure would minimize the effects of proposed project construction on federally listed bat species at the project. To facilitate staff review of the potential effects of project construction on federally listed bat species, please include the following information in the FLA:

(1) detailed descriptions of known existing subsurface mine cavities, including locations within the proposed project boundary, dimensions, and any openings that could serve as bat access points;
(2) the species and number of potentially suitable summer roost trees, including any maternity roost trees, that would be permanently removed or temporarily disturbed during project construction;
(3) a detailed description of proposed bat protection measures based on the information collected for items 1 and 2 above, including time-of-year restrictions on excavation near subsurface mine cavities and/or tree removal activities, to include cutting down, harvesting, destroying, trimming, or manipulating in any other way the trees, saplings, snags, or any other form of woody vegetation likely to be used by Indiana, northern long-eared, or tricolored bats within the proposed project boundary. Please note that suitable northern long-eared bats roosts include live or dead trees that are typically greater than or equal to 3 inches in diameter at breast height and have cavities, peeling bark, crevices, or hollows. Tricolored bats primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees, and they have also been observed roosting in lichens with pendant growth forms and among pine and eastern red cedar needles.

23. Section 5.5, *Botanical Resources*, provides some general background information regarding the existing composition of forest, shrub, and herbaceous communities within the proposed Lewis Ridge Project study area. This section states that there is a diversity in the age of trees at the project, with a tree diameter range of 5 to 40 inches at breast height, and the dominant vegetation includes: (1) cool season grasses, lespedeza, and some shrubs at the (previously mined) proposed upper reservoir location; (2) mixed deciduous forest with adjacent wetland and stream habitats at the proposed penstock and lower reservoir locations; (3) forested land and mining access roads along the proposed transmission line corridor. Section 5.5.2, *Potential Impacts of the Proposed Lewis Ridge Project*, states that construction and operation of the proposed project would permanently alter habitat and is anticipated to displace vegetation, including forested habitat and areas disturbed from previous mining operations, as well as an area which hasn't been

disturbed and vegetation clearing would be required for the interconnection line corridor. However, the DLA does not provide a detailed description of the specific vegetation that would be permanently removed or vegetation that would be temporarily disturbed during construction. In the FLA, please include the following information:

(1) detailed descriptions of the locations, acreages, and types of each vegetation, or specific vegetation community types, that would be permanently removed during project construction, distinguishing among: (a) areas that were previously disturbed during mining operations, (b) areas that have not been previously disturbed, and (c) areas dominated by non-native, invasive vegetation;
(2) detailed descriptions of the locations, acreages, types of each vegetation, or specific vegetation community types, and nature of temporary disturbance proposed during project construction, distinguishing among: (a) areas that were previously disturbed during mining operations, (b) areas that have not been previously disturbed, and (c) areas dominated by non-native, invasive vegetation;
(3) maps/figures showing the vegetation community types in relation to the proposed project facilities and the areas of permanent vegetation removal and temporary vegetation disturbance; and
(4) the procedures, including any time of year restrictions, for removing or disturbing vegetation in sensitive habitats such as wetlands, riparian habitat, and suitable habitat for rare, threatened, or endangered species.

24. Section 5.5.3.2, *Applicant Recommendations*, includes a proposal to implement a Vegetation Management Plan to mitigate the effects of construction on botanical resources through revegetation and the use of invasive species management protocols, given the presence of 12 non-native, invasive plants within the proposed project area. However, this section does not provide sufficient information for Commission staff to evaluate the proposed plan. In the FLA, please provide detailed descriptions of the areas that would be revegetated including:

(1) the locations, acreages, topography, soil/substrate type(s), existing vegetation, and types of vegetation that would be used to stabilize soils during and after project construction;
(2) a proposed plant species list for revegetation efforts;
(3) a description of techniques and best management practices to be used to promote revegetation and to control the establishment and spread of non-native invasive plants, until disturbed areas are successfully revegetated;

(4) any provisions for monitoring with descriptions of the criteria for measuring the success of revegetation efforts, and the procedures to be followed to update the plan if monitoring shows that revegetation is not successful; and

(5) schedules for revegetation as well as any monitoring and/or maintenance (e.g., fertilization or irrigation requirements) of revegetated areas until revegetation is successful.

25. The DLA does not include a description of any proposed regular vegetation management practices that would be implemented after project construction and revegetation is complete. In the FLA, please provide a detailed description of any proposed regular vegetation management practices that would be implemented within the project boundary after project construction, including:

(1) the goals of vegetation management and any target species;

(2) the types of vegetation management (e.g., forest management practices such as silviculture; and regular vegetation maintenance such as tree trimming and removal, mowing, herbicide applications, etc.); If herbicides would be used to control vegetation, please include the method/location of application (e.g., foliar, stump, stem, and/or vine).

(3) the locations where each vegetation management technique would occur within the project boundary (e.g., proposed project facilities, access roads, parking areas, recreation areas, wildlife management areas, etc.);

(4) the procedures, including any time of year restrictions, for managing vegetation in sensitive habitats such as wetlands, riparian habitat, and suitable habitat for rare, threatened, or endangered species; and

(5) a schedule for conducting regular vegetation management (i.e., activities performed annually, seasonally, as-needed, etc.).

26. FWS considers official species lists generated in its Information for Planning and Conservation (IPaC) system to be valid for 90 days. The list included in the DLA was generated on July 19, 2024, and therefore it is now expired. In addition to including the tricolored bat, FWS may have other updates to the species list for the proposed Lewis Ridge Project. To facilitate Commission staff’s review of the licensing proposal, please update the species list in IPaC and ensure that all current federally listed, proposed, and candidate species that may occur at, or be affected by the proposed project are covered in the FLA. Please provide detailed discussions of the potential project-related effects (i.e., construction, operation, maintenance, including vegetation management, and any proposed project-related recreation) on all the federally listed, proposed, and candidate species, and their habitats that may occur at the project.

27. Section 4.41(f)(4) of the Commission's regulations, requires that an FLA include a description of adverse effects to cultural resources and any proposed mitigation measures. The cultural resources section of the Lewis Ridge study plan discusses possible project effects and notes avoidance of site 15BI57 in a general sense. The DLA, however, does not specify how each cultural site would be affected or propose specific protective or mitigation measures (i.e., avoidance, data recovery, etc). Therefore, please include the following in the FLA: (1) the results of National Register eligibility determinations for all archaeological sites that cannot be avoided during project construction, operation, or maintenance activities, (2) a description of specific project impacts on these sites; (3) proposed mitigation measures; and (4) documentation of Kentucky State Historic Preservation Officer (SHPO) concurrence on the eligibility determinations and finding of effects.

28. Although historic properties appear to be present within the proposed project boundary, neither the DLA nor the study plan mentions that a historic properties management plan (HPMP) will be developed. In the FLA, please either include a draft HPMP or provide an explanation for why one is not needed under section 106 of the National Historic Preservation Act.

29. If there are additional resources within the project area of potential effects that have not been addressed in the study, the FLA and the draft HPMP should include: (1) a description of these resources; (2) the results of any National Register evaluation of these resources; (3) a description of potential impacts and any proposed mitigation, as required by section 4.41(f)(4) of the Commission's regulations; and (4) documentation of all consultation with Lewis Ridge.

Exhibit F

30. Sections 4.41(g) (sections 1 through 4) of the Commission's regulations describe what must be included in Exhibit F. The DLA includes conceptual design drawings for the proposed project. However, it does not contain drawings for the facilities involved with the initial fill water and long-term refill systems. Please provide conceptual design drawings for these facilities in the FLA. The DLA does not include a Supporting Design Report. Please provide a Supporting Design Report as required by section 4.41(g)(3) of the Commission's regulations in the FLA.

Exhibit G

31. Sections 4.41(h) (sections 1 through 2) of the Commission's regulations describe what must be included in Exhibit G, Project Boundary. The DLA includes an

Exhibit G, project boundary drawing, which needs additional labels. Exhibit G should label all major project features, including but not limited to, access roads, the penstock, sub-stations if present, and the connecting transmission line.

Subject: FW: Lew is Ridge Pumped Storage, LLC
Attachments: Comments - KHC 242438_FERC_Pumped Water Storage System_Bell.docx

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From: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Sent: Thursday, December 19, 2024 1:10 PM
To: Elizabeth Krchnavek <Elizabeth.Krchnavek@kleinschmidtgroup.com>
Subject: Lew is Ridge Pumped Storage, LLC

From: Hutchins, Patricia (Heritage Council) <patricia.hutchins@ky.gov>
Sent: Thursday, December 19, 2024 6:43 AM
To: Sandy Slayton <sandy@ryedevelopment.com>
Subject: Lew is Ridge Pumped Storage, LLC

Dear Ms. Slayton,

Thank you for your submission of an archaeology report, cultural historic, and survey forms for the Lewis Ridge Pumped Storage Project, KHC # 24238. We have found that each requires revisions. Attached are our comments. Please let us know if you have any questions.

Sincerely,
Patti

Patricia E. Hutchins
Archaeology Review Coordinator
Kentucky Heritage Council
410 High Street
Frankfort, Kentucky 40601
Email: patricia.hutchins@ky.gov

Coming Soon!!!
January 1, 2025 please visit our webpage to submit your Section 106 documentation via the new **INHERIT** portal.

For the remainder of 2024:
Email your complete Section 106 submission to: khc.section106@ky.gov.

Preliminary Records Review for Above Ground Resources: https://heritage.ky.gov/historic-places/resources-survey/prelim/Pages/default.aspx

Preliminary Records Review for Archaeological Resources: https://anthropology.as.uky.edu/recorded-archaeological-sites

Notes on KHC# 242438-Pumped Water Storage System in
Bell County, KY

Please address the following.

Regarding the archaeology report:

Please submit the report as a single PDF.

For appendix A, please complete the rest of the KY Cemetery Supplemental Site Form, available here: https://heritage.ky.gov/historic-places/resources-survey/Documents/FieldworkCRspecs.pdf

Regarding the cultural historic:

Please submit the cultural historic report as one pdf.

p. 13/Project Description, 2nd paragraph, 1st sentence (see below), typo “reservation” should be “reservoir.”

The proposed location for the upper reservation is atop Chestnut Flats, approximately 3,980 ft northeast of the location of the non-extant town of Balkan (Figure 4).

p. 28, first paragraph, last sentence, word(s) missing (see below), possibly “part of”

In the following decades Balkan’s population rapidly declined, and a review of topographic quadrangles of the area from 1954 and 1974 indicates that very little of the town remained by the early the 1970s (USGS 1954, 1974).

p. 29, Table 1, for Sites 2 and 3, either list address as that listed on survey form or insert lat./long.

p. 29, Table 1, Site 1, location is Brownies Creek not Brownies Creeks. Please revise.

p. 29, Table 1, Site 2, resource listed as L & N Rail Line, survey form it is listed as CSX Railroad-Likely best to give a combination so that the historical reference is captured as well as current ownership so L & N/CSX Railroad. Please revise table and survey form.

p. 39, paragraph 5, last sentence (see below), presumably a typo-check year dates and revise if applicable, or flip January and July if this construction all occurred in 1935.

Between July 1935 and January 1935, the WPA had constructed 310 schools across Kentucky, including the Balkan School (Figures 58 and 59) (Kennedy and Johnson 2005:48).

Regarding the Survey Forms:

Please submit each survey form as an individual pdf.

Please check page 1 of all survey forms. Make sure that #8 the report reference is filled in correctly and that the numbers which follow in the left column are 9-15. Almost all of these have the numbering messed up.

From: Clark, Maria
To: Sandy Slayton
Cc: Lesley Brotkowski
Subject: EPA comments for the meeting: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Date: Wednesday, December 11, 2024 7:52:14 AM
Attachments: image001.png
Rye Development - Lewis Ridge Pumped Storage - Draft license comments (003).docx

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Good morning Sandy – I wanted to send you an agenda, but my colleagues from the Water Program worked hard at their concerns and to be fair to them I decided to forward you the draft list they put together. In addition, I hope that this information helps you all to feel better prepare for our meeting. We understand that you might don't have all the answers, but this is a great opportunity to hear from you if these concerns are not totally clear.

Please let me know if you have any questions.

We are looking forward to this meeting! Thank you.
Maria

Diversion of Flow and Initial Fill:

On Page A-7 of the Draft License Agreement (DLA) and at various other points in the project documents, the plans for the impoundment of Tom Fork to construct and fill the lower reservoir are discussed. As with EPA's previous review of the PAD, it is unclear if there would be ongoing releases from the lower reservoir to maintain base flow in Tom Fork, if a diversion of Tom Fork around the reservoir would maintain baseflow, or if the permanent and complete impoundment of waters from Tom Fork and its tributaries is proposed. The DLA, in Section 5.2.1, Page E-24, indicates that Tom Fork would pass through the lower reservoir but the plans for this passage of flow is not adequately described. The extent to which upstream and downstream waters will be impacted, both directly and indirectly, will inform discussions regarding avoidance, minimization, and compensatory mitigation requirements for the project.

Recommendations: EPA continues to recommend the consideration of Water Quality Standards for The Commonwealth of Kentucky, summarized in our previous comments, which include limitations regarding the alteration of flow among other parameters.

Page B-8, Section 2.1 the DLA discusses the initial fill of the lower impoundment but does not provide clear information on the duration of the initial fill and the potential impacts associated with that fill. The DLA does state that the initial fill, as currently proposed, would be completed over a period of one year. However, it is not clear whether any downstream flows of Tom Fork would be maintained during this fill period or if Tom Fork downstream of the project would experience an extended dry period. Because there is no information regarding historic, current, and predicted future flows of Tom Fork, it is difficult to support the general statements throughout the documents regarding Tom Fork's ability to sustain the project for initial fill and throughout project operations for refill. Page B-10 of the DLA indicates that project operations would not be affected by low- or high-water years, but there is no flow data to support this statement. Section 5.2.1.1, Page E-28, states that streamflow "…would not affect the dependable capacity of the Lewis Ridge Project because it would be a pumped storage facility." Information in this same section provides estimated averages of flows for Tom Fork (between 3.3 - 4.0 CFS), but it is not clear if these estimated averages can support the project alone, or only in combination with other water sources. Page E-69 of the DLA indicates that Tom Fork experiences low summertime flow rates, but these reduced rates are not quantified nor put into context for the project proposal. How low are summertime flow rates compared to wintertime flow rates, and does this difference represent a potential issue for project sustainability during low flow periods? Because there is no historical flow data, only recently acquired average estimates, it is not possible to understand whether streamflow will affect the dependable capacity of the project. Accordingly, detailed scientific studies of the capacity for Tom Fork to sustain the project will be necessary to assess direct impacts to Tom Fork and its tributaries as well as potential direct, secondary, or cumulative impacts to other resources which may be needed to support the project, such as the Cumberland River. EPA understands that LRPS intends to include information relating to flows in Tom's Fork in their Final License Application (FLA).

Recommendations: EPA recommends the applicant engage with EPA and other regulatory agencies prior to the submission of the FLA, where coordination could support a timely project review as well as ensure the project’s adherence to the various applicable regulations (CWA Sections 404, 401 etc.)
EPA recommends detailed studies to collect data on Tom Fork for a period of at least one year (the proposed period of initial fill), which should include water quality data as well as flow data to support hydrologic/hydraulic modeling of the current and anticipated future flows from Tom Fork. Kentucky

Division of Water might be able to provide some baseline data for Tom Fork. This information is critical to inform decisions regarding the source(s) of initial fill for the impoundments. Because there is no information regarding historic, current, and predicted future flows of Tom Fork, it is difficult to support the general statements throughout the documents regarding Tom Fork's ability to sustain the project for initial fill, and throughout project operations for refill.

Section 5.2.2 Discusses potential impacts of the project. Some of the statements in this section appear to conflict with each other, need additional clarification, or both. For example:

1. "The percent of flow from Tom Fork that would be used for the initial fill is currently unknown; however, the initial fill would temporarily affect water quantity in Tom Fork."
    - Additional information on these temporary effects is necessary to inform future discussion of project impacts.
2. "Approximately the same amount of natural inflow to the lower reservoir would be released back to Tom Fork; however, this amount of flow is currently unknown and will be included in the FLA."
    - It is unclear if Tom Fork will be diverted around the lower reservoir, entirely captured by the lower reservoir with releases through a spillway, or some other alternative.
    - See previous comments regarding data needs on alterations to flow in Tom Fork, and the value of continued early engagement with EPA and other agencies to discuss any potential permitting issues at the time of FLA submittal.
3. "Rerouting Tom Fork during construction would not impact the quantity of water entering the Cumberland River. Changes in the quantity of water in Tom Fork during the initial fill or recharge would have a minor, temporary effect on water quantity entering the Cumberland River."
    - The information in the above sentences should be clarified with supporting information to indicate the true extent of impacts to water quantity in Tom Fork and downstream waters.

Clean Water Act Section 404:

At various points in the DLA, including Exhibit E Page E-7, the applicant indicates that they will continue conversations with Kentucky Division of Natural Resources (KDNR) regarding the possibility of SMCRA permit exemptions for permits which are currently active on the lands being considered for the LRPS project. EPA is requesting detailed information on the outstanding permit obligations related to aquatic resource restoration and compensatory mitigation to satisfy previous permits under Section 404 of the Clean Water Act, which cannot be waived or exempted. All previous permit requirements related to section 404 of the Clean Water Act, such as compensatory mitigation for previous impacts to aquatic resources, must still be met. Additionally, once the impacts associated with the new LRPS project (direct, secondary, and cumulative) are adequately understood and have been avoided and minimized to the maximum extent practicable [40 CFR 230.10(d)], the applicant will need to provide compensatory mitigation for any unavoidable impacts to aquatic resources. Section 5.2.1.8 of the DLA discusses wetland and streams habitat in the project area as well as the applicant's Jurisdictional Streams and Wetlands Determination assessment which was conducted in 2022 and 2024. Information obtained in this assessment will inform future discussion of avoidance, minimization, and compensatory mitigation of impacts to Waters of the US (WOTUS). Any new compensatory mitigation requirements should be considered separately from previous requirements associated with historic mining activities on the property. It will also be necessary to understand what steps to avoid, minimize and compensate for impacts to aquatic resources were undertaken for previous permits associated with mining in the project area. It is possible that some of the resources which may be impacted by the LRPS project are tied to the previous applicant's avoidance, minimization and compensation measures which were required for the issuance of their permit. Thus, any newly proposed impacts to those resources may be considered cumulative impacts or may come directly into conflict with existing permit mitigation requirements. Finally, any potential costs associated with required compensatory mitigation for impacts should be considered by the applicant and potentially included as estimated project construction costs which are outlined in Table 1-1, Pages D-1 and D-2, of the DLA.

Recommendations: EPA respectfully requests involvement in future project planning discussions with U.S. Army Corps of Engineers – Nashville District (USACE) and other agencies regarding impacts to aquatic resources.

The currently available information with respect to project site alternatives that were considered is insufficient to determine if the selected project site is the Least Environmentally Damaging Practicable Alternative, or LEDPA. Specifically, the DLA states on pages B-1 and E-14 that no alternative sites were investigated for the project proposal. Additionally, the DLA states on Page B-2 that since the time of submitting the Pre-Application Document (PAD), project area footprints and impacts increased, rather than decreased, throughout the course of examining on-site alternatives. Increases to project impacts throughout the assessment of alternatives may not represent an appropriate application of the 404(b)(1) guidelines, which require avoidance and minimization of impacts before beginning to consider compensatory mitigation to offset unavoidable impacts. Furthermore, while the proposed property may represent a unique opportunity to repurpose a historic mining site, that aspect of the site's history also leads to additional environmental and safety concerns which have been raised with the applicant throughout the course of their agency correspondence.

Recommendations: EPA recommends an alternatives analysis for the project, in accordance with 40 CFR 230.10(a)(4). The alternatives analysis should include other properties whose selection may result in lesser impacts to the aquatic environment. 40 CFR 230.10(a)(2) describes the practicability of alternatives in light of the overall project purpose, including the evaluation of alternative properties even if they are not presently owned by the applicant. The alternatives analysis should provide clear and quantifiable information on the aquatic resource impacts associated with each alternative.

The most current information on project construction and operations indicates that Tom Fork and potentially other aquatic resources will be wholly converted from natural systems to an industrial facility. The impoundments will be industrial in nature, lined with hydraulic asphalt concrete (HAC), and will experience significant drawdowns and additions within a 24-hour period (100' water surface elevation change in the lower reservoir and a 71' water surface elevation change in the upper reservoir). Unlike other impoundment projects, these do not appear to have the ability to naturalize and create new aquatic ecosystems which may provide functions and services to the surrounding ecological communities. Such a conversion of natural resources to an industrial facility creates concerns with respect to potential secondary or cumulative impacts resulting from the project. Section 5.2.1.8 of the DLA discusses Wetland, Riparian and Littoral Plant and Animal species but the extent of potential impacts to those resources are not discussed in any detail. LRPS proposes to install and maintain fish exclusion bar racks at the lower reservoir inlet and outlet. Exclusion upstream and downstream of the impoundment in Tom Fork implies that fish would no longer be able to pass from above the reservoir to below, and vice versa. EPA acknowledges that during the course of a single habitat study in which no fish sampling occurred, that fish were only observed in the lowest, low gradient reaches of Tom Fork. However, this anecdotal data does not confirm whether fish may move throughout other stream reaches during certain times of year. If fish passage will be eliminated for Tom Fork, what about passage for other aquatic and semi-aquatic organisms? How will the inlets and outlets of the impoundment of Tom Fork be situated relative to the existing and constructed channels? How much of the stream channel up- and downstream of the Tom Fork impoundment will need to be channelized, armored, or otherwise constructed?

CWA Section 404 regulations 40 CFR 230.32 discuss the possible loss of values for other wildlife associated with the discharge of dredged or fill material into Waters of the US, and 40 CFR Part 230 Subpart H discusses means to avoid and minimize the loss of values. 40 CFR 230.75 specifically discusses actions affecting plant and animal communities, while 40 CFR 230.77(b) addresses specific actions associated with the construction of dams. Finally, 40 CFR 230.77(d) states that "[w]hen a significant ecological change in the aquatic environment is proposed by the discharge of dredged or fill material, the permitting authority should consider the ecosystem that will be lost as well as the environmental benefits of the new system." As currently proposed, the new system will be wholly industrial in nature and thus it may be appropriate to consider a complete loss of the existing ecosystem once it has been replaced by the infrastructure for the proposed project.

<u>Recommendations</u>: EPA Recommends that Protection, Mitigation and Enhancement Measures (PM&E) discussed in the DLA also consider ways to account for indirect, secondary, and cumulative impacts resulting from the project.

Section 5.1, Page E-23, discusses the applicant's cumulative effects analysis and recognizes that cumulative impacts would occur to water, geological and soil resources as a result of the project. The applicant did not identify any other resources that would be cumulatively affected by the proposed project.

<u>Recommendations</u>: EPA is requesting detailed results from the cumulative effects analysis, if available. EPA additionally recommends outlining what methods or tools were used to identify any potential cumulative impacts to other resources which were examined, but for which there were no findings of cumulative effects. For example, how were potential cumulative effects to flora, fauna, and aesthetics considered during the cumulative effects analysis?

The impoundments for the LRPS project have been described as "crowns on the mountaintop." Will the final project design be largely visible throughout the region, having a potential cumulative impact on regional aesthetics when considered alongside the extensive mining impacts in the region? Would the project be visible from Cumberland Gap National Historic Park or other scenic overlooks which may be in the surrounding areas? 40 CFR 230.53 discusses aesthetics in the context of Subpart F - Potential Effects on Human Use Characteristics (40 CFR Part 230 Subpart F).

<u>Recommendations:</u> Address aesthetics and human use characteristics and/or impacts.

Water Quality:

As water is exchanged between the proposed project reservoirs, there is potential for the concentration of water constituents, including Total Dissolved Solids (TDS), nutrients and chemical contaminants. According to information in the DLA, historic mining has occurred on the project site from the 1940's to as recently as 2020, and that as a result large portions of the site are indiscriminately covered with mine spoils (DLA Page E-128). Thus, the potential for accretion of contaminants in the impounded water may be high. Additionally, because the project plans have been modified to include a hydraulic asphalt concrete (HAC) liner in both reservoirs, information should be provided regarding the potential leaching of any contaminants from the asphalt liners before those waters are released into Tom Fork.

Recommendations: EPA continues to recommend sediment testing of areas in the site which are proposed to be disturbed by the project. Additionally, we recommend that water quality of any proposed releases from the impoundment into Tom Fork should be further analyzed. 40 CFR 230.5(i) states: "If there is a reasonable probability of chemical contamination, conduct the appropriate tests according to the section on Evaluation and Testing (§ 230.61)."

Water Quality Standards:

Table 5-3, Page E-31, lists water quality standards (WQS) that are applicable to the project vicinity. Many or all these parameters can be directly affected through the impoundment of waters and these effects can be influenced through various aspects of project design and management. For example, the surface temperature of impounded waters can become elevated above the surrounding natural water temperatures. Conversely, the water temperatures at the bottom of impoundments can be greatly reduced as compared to the surrounding environmental temperatures. Where waters are released from an impoundment into the downstream ecosystem (hyper- or hypolimnetic) can influence the effect on water temperatures in the ecosystem. Information on page E-51 of the DLA indicates that water released from the lower reservoir to Tom Fork would be at the same elevation as the reservoir floor, a hypolimnetic release, and thus that the water quality being released to Tom Fork would reflect the conditions at the bottom of the reservoir. Hypolimnetic releases are known to result in reductions to water temperature and dissolved oxygen. EPA acknowledges the supposition in the DLA that water in the upper and lower impoundments will be well mixed because of the pump and generation cycle, and that additional clarification on this matter may be provided from the proposed Water Quality Monitoring Plan. Page E-39 and Table 5-6 of the DLA provide information on recently acquired water quality parameters monitored in the mainstem of Tom Fork. However, it appears that water quality for Tom Fork was only collected during a single day's sampling event.

Recommendations: EPA recommends continued long-term monitoring of water quality in Tom Fork to determine if there are any trends in the data which could indicate that water quality in Tom Fork is decreasing, increasing, or remaining stable over time. These data would also establish the baseline which would allow for meaningful comparisons to future water quality. It is important to document whether this ecosystem is currently trending towards recovery of some of the ecological functions and services which may have been directly affected by previous mining activities, and whether the LRPS project would limit the capacity of the resource to recover from past impacts. Additionally, while moving forward with project planning, EPA recommends careful consideration of whether proposed releases back into Tom Fork will be able to maintain the required WQS. The temperature and dissolved oxygen

WQS, among others, can be equally influenced by the source location and amounts of releases from impounded waters. For example, the Flow WQS, requiring that alterations to flow shall not be to a degree that would adversely affect the aquatic community, can be directly controlled through the careful planning of releases from an impoundment. Currently there is not enough information available to support the idea that the proposed project will not alter flows to a degree that would adversely affect the aquatic community.

Section 5.2.1.5 discusses deficiencies in meeting WQS for certain stretches of the Cumberland River downstream of the project. Some of those deficiencies are apparently considered as secondary impacts from surface mining activities in the area. Any additional impacts to water quality in these reaches of the river may be considered cumulative and should be accounted for in any future analysis of cumulative effects. Additionally, future TMDLs written to manage cumulative affects for downstream segments of the Cumberland River may the project.

Recommendations: As above, EPA recommends continued collection of baseline water quality data for Tom Fork in order to document current trends in water quality. Currently there only appears to be water quality data on Tom Fork from a single day's sampling event, which is not sufficient to characterize the baseline conditions of the resource for future comparison. EPA requests involvement in future meetings where water resources will be discussed.

Dam Safety, Longevity and Operations:

Page B-2 of the DLA provides information regarding the modification of project plans to utilize a hardfill dam for the upper reservoir and an earthfill dam for the lower reservoir, as opposed to the original plans to use roller compacted concrete for project construction.

Recommendations: EPA is requesting additional information as to the reasons for this modification and whether the new project design includes any potential impacts on the project's longevity, safety, or both.

Page D-3, Section 4.3, assumes a useful life of the project to be 50 years. What are the typical actions associated with the decommissioning of a pumped storage facility at the end of its useful life, and what implications does that have for future impacts, restoration, or both, to aquatic resources within the project area?

Recommendations: EPA requests information about the longevity of the dam and the proposed life of the project regarding aquatic impacts.

Appendix E, page E-1 indicates that minimal recharge water would be required to maintain water levels for the impoundments, but there is no definitive information in the DLA on the amounts of recharge water that would be required throughout the life of the project to maintain operations.

Recommendations: EPA recommends detailed studies to provide the best available information on predicted amounts and frequencies of withdrawal of recharge water that will be required after the initial fill. Ideally, the necessary amounts of recharge water would be compared to data on the predicted future average flows of Tom Fork to determine whether future sources of recharge water will have the capacity to maintain the project.

The timing of reservoir filling was not specified. Filling reservoirs has been found to cause impairments to the receiving downstream waters, therefore, optimal timing of reservoir filling may reduce potential impacts to downstream waters and aquatic life. For example, seasonal timing during wet vs. dry times of year, or in consideration of different life stages for aquatic life. A flow analysis could also determine how to balance future water withdrawals, impoundment operations, and help minimize water quality and aquatic life impacts both in the managed impoundment and downstream.

Recommendations: Provide a plan for the timing of reservoir filling, any ongoing withdrawals, and reservoir operations that includes temporal and aquatic life considerations and potential impacts.

From: Clark, Maria
To: Sandy Slayton
Cc: Lesley Brotkowski; Kajumba, Ntale
Subject: EPA comments: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Date: Saturday, December 21, 2024 2:49:53 AM
Attachments: image001.png
Rye Development - Lewis Ridge Pumped Storage - Draft license comments.docx

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Dear Sandy – I hope to find you well. Below please see additional comments from EPA. I'm also attaching our earlier water comments. Merry Christmas and a Prosperous 2025 to you and your family.

===

Issues Of Concern:

1. *Please include the results from the differential settlement calculations. In addition, please include how much settlement would be acceptable, why, and potential unsafe scenarios after a few decades. We hope you would be able to produce this after your geotechnical borings.*
2. *Would the site need ground improvement to control settlement? If yes or no, please explain.*
3. *To avoid catastrophes such as the Taum Sauk Dam, we suggest investigating the option to include a natural overflow system to prevent overflow in case of equipment malfunction.*
4. *Recharge Water (section 2.2): the draft application estimates an 8% of the active storage volume (274 acre-feet) annually lost in part to evaporation, and therefore the need to be replenish. Due to the constant and permanent water withdrawal from Tom Fork the environmental evaluation and mitigation of this impact needs to be addressed. Priorly we have suggested to investigate floating solar arrays to mitigate evaporation and the use of other energy resources. Please consider those comments.*
5. *We recommend a back-up system to assure the successful emergency stop of the equipment in case of emergency.*
6. *Thank you for responding to some of our past comments, and we understand you are addressing the rest of those comments.*

Editorial corrections:

1. *Page 2 of the Distribution List – Jeaneanne Gettle* ***is not*** *the Regional Administrator. If you need a contact, you can add the Project Officer Maria R. Clark.*

==

Maria R. Clark

NEPA Section – Region 4
U.S. Environmental Protection Agency
61 Forsyth Street, SW
Atlanta, GA 30303
Phone# 404-562-9513

From: Sandy Slayton
To: Clark, Maria
Cc: Lesley Brotkowski; Kajumba, Ntale
Subject: RE: EPA comments: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Date: Monday, January 6, 2025 8:38:20 PM
Attachments: image001.png

Happy New Year Maria! Thank you for these comments. I realized I hadn't replied when you sent them, and wanted to be sure you knew they were received.

Sandy

ANDY BESHEAR
GOVERNOR

REBECCA W. GOODMAN
SECRETARY

ANTHONY R. HATTON
COMMISSIONER

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION

300 SOWER BOULEVARD
FRANKFORT, KENTUCKY 40601
TELEPHONE: 502-564-2150 TELEFAX: 502-564-4245

October 28, 2024

Rye Development
1100 S Olive St, ,
West Palm Beach, Florida 33401

Re: Lewis Ridge Pumped Storage Project – NEPA 2024-0083

Dear Sir or Madam,

The Energy and Environment Cabinet serves as the state clearinghouse for review of environmental documents generated pursuant to the National Environmental Policy Act (NEPA). Within the Cabinet, the Commissioner's Office in the Department for Environmental Protection coordinates the review for Kentucky state agencies. We received your letter requesting an environmental review for this project. We have reviewed the document and provided comments below.

Division of Enforcement:

On September 30, 2024, Lewis Ridge Pumped Storage, LLC (LRPS) filed the Draft License Application (DLA) for an original license for the Lewis Ridge Pumped Storage Project (Lewis Ridge Project) with the Federal Energy Regulatory Commission (FERC No. 15249). The Lewis Ridge Project is a proposed pumped storage project in Bell County, Kentucky with an anticipated total installed capacity of 287 megawatts (MW) of renewable energy storage. The electronic files can be downloaded through FERC's eLibrary at elibrary.ferc.gov by searching on the project number P-15249 or the project website: https://lewisridgeproject.com. The unconstructed Project is located in the Upper Cumberland River Basin in Bell County, Kentucky near the borders of Tennessee and Virginia. The Project would be a closed loop pumped storage hydroelectric generating facility located at a site historically used for mining. The Project is anticipated to provide 287 megawatts (MW) of generation capacity.
The Kentucky Division of Enforcement endorses this project.

Division of Water:

The Director's Office has no comments.

The Water Quality Branch has no comments on this project.

Field Operations Branch has no comments.

The proposed project could require multiple Water Withdrawal Applications depending on what proposed sources are used for the initial filling and recharge. Applications for permits or authorizations should be made four to six months prior to requested withdrawal initiation. The proposed project is within the Knox County Utility Commission source water protection area, zone 3. Questions should be directed to Allan Shingleton at 502-782-6907 or Allan.Shingleton@ky.gov.

The proposed work is endorsed by the Groundwater Section of the Watershed Management Branch. However, it is our recommendation that site be made aware of the requirements of 401 KAR 5:037 and the need to develop a Groundwater Protection Plan (GPP) for the protection of groundwater resources within that area.

The Engineering Section of the Division of Water's Water Infrastructure Branch has no comments on the proposed project.

Division of Waste Management:

Division for Air Quality:

Kentucky Nature Preserves

Your project might have the potential of impacting federally or state listed species and natural communities. Go to the Kentucky Biological Assessment Tool (kynaturepreserves.org) to obtain a Standard Occurrence Report for information regarding listed species known within your project area. The report will also provide information on public and private conservation lands, areas of biodiversity significance, and other natural resources in your project area for which the Office of Kentucky Nature Preserves maintains data.

This review is based upon the information that was provided by the applicant. An endorsement of this project does not satisfy, or imply, the acceptance or issuance of any permits, certifications or approvals that may be required from this agency under Kentucky Revised Statutes or Kentucky Administrative Regulations. Such endorsement means this agency has found no major concerns from the review of the proposed project as presented other than those stated as conditions or comments. If you should have any questions, please contact me at (502) 782-0863 or e-mail Louanna.Aldridge@ky.gov.

Sincerely,

Louanna C. Aldridge

Louanna Aldridge
Environmental Scientist Consultant
Office of the Commissioner
Department for Environmental Protection
Energy and Environment Cabinet

APPENDIX A-3

DOCUMENTATION OF CONSULTATION (PUBLIC)

From: Sandy Slayton

To: Johnnie.Turner@lrc.ky.gov; Adam.Bowling@lrc.ky.gov; Darryl.lacounte@bia.gov; Kim.Amendola@noaa.gov; NashvilleRegulatory@usace.army.mil; casey.h.ehorn@usace.army.mil; cara.c.beverly@usace.army.mil; Marian.R.Rubin@usace.army.mil; Joseph.oloriz@hq.doe.gov; andrew_raddant@ios.doi.gov; Gettle.Jeaneanne@epa.gov; Michael_Oetker@fws.gov; john_faustini@fws.gov; lee_andrews@fws.gov; KentuckyES@fws.gov; Mike_floyd@fws.gov; Karah_jaffe@fws.gov; jeff_duncan@nps.gov; chuck-hoskin@cherokee.org; elizabeth-toombs@cherokee.org; ddotson@delawarenation-nsn.gov; rsneed@nc-cherokee.com; syerka@nc-cherokee.com; dlankford@miamination.com; dhill@muscogeenation.com; thunt@mcn-nsn.gov; chiefharper@peoriatribe.com; rdbrock@charter.net; jbunch@ukb-nsn.gov; rcain@ukb-nsn.gov; Louanna.Aldridge@ky.gov; shawn.hokanson@ky.gov; samantha.vogeler@ky.gov; Beth.trent@ky.gov; glen.alexander@ky.gov; allan.shingleton@ky.gov; gordonr.slone@ky.gov; Jay.cunningham@ky.gov; Barry.butcher@ky.gov; Lonis.Morgan@ky.gov; thomas.barbour@ky.gov; matt.catron@ky.gov; craig.potts@ky.gov; mona.juett@ky.gov; Kenya.Stump@ky.gov; info@kychamber.com; econdev@ky.gov; Linda.bridwell@ky.gov; Debbie.Gambrel@ky.gov; brock@bcje.com; swilson@middlesborokentucky.net; pinevillemayor@gmail.com; ashley@kyrc.org; fitzkrc@aol.com; cacclement@gmail.com; josh@mtassociation.org; Asherlandandmineral.mg@gmail.com

Cc: Erik Steimle; Lesley Brotkowski

Subject: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application

Date: Monday, September 30, 2024 2:59:21 PM

Attachments: image001.png

Good Afternoon,

On September 30, 2024, Lewis Ridge Pumped Storage, LLC (LRPS) filed the Draft License Application (DLA) for an original license for the Lewis Ridge Pumped Storage Project (Lewis Ridge Project) with the Federal Energy Regulatory Commission (FERC No. 15249).

The Lewis Ridge Project is a proposed pumped storage project in Bell County, Kentucky with an anticipated total installed capacity of 287 megawatts (MW) of renewable energy storage.

The electronic files can be downloaded through FERC’s eLibrary at elibrary.ferc.gov by searching on the project number P-15249 or the project website: https://lewisridgeproject.com.

LRPS is requesting review and comment on the DLA. Comments are due within 90 days of this distribution, or by December 29, 2024. If you have questions concerning this filing please contact me at sandy@ryedevelopment.com.

Thank you,

Sandy

Rye Development
Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From: Sandy Slayton
To: KHC Section106
Cc: Lesley Brotkowski
Subject: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Date: Monday, September 30, 2024 2:59:31 PM
Attachments: image001.png
LRPS Kentucky SHPO Section 106 Form 2024_09_25.pdf

Good Morning,

Lewis Ridge Pumped Storage, LLC (LRPS) has filed the Draft License Application (DLA) for an original license for the Lewis Ridge Pumped Storage Project (Lewis Ridge Project) with the Federal Energy Regulatory Commission (FERC No. 15249).

The Lewis Ridge Project is a proposed pumped storage project in Bell County, Kentucky with an anticipated total installed capacity of 287 megawatts (MW) of renewable energy storage.

The electronic files can be downloaded through FERC's eLibrary elibrary.ferc.gov or the Project website: https://lewisridgeproject.com/resources.html

The Section 106 Review and Compliance cover sheet for the DLA submittal is attached.

LRPS is requesting review and comment on the DLA. Comments are due within 90 days of this distribution, or by December 29, 2024.

Sandy

Rye Development
Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

KENTUCKY HERITAGE COUNCIL COVER SHEET
FOR SECTION 106 REVIEW AND COMPLIANCE

When federal (and some state) funds, permits or approvals are needed for a project, regulations such as 36 CFR Part 800 require these agencies or their delegates to consult with the Kentucky Heritage Council/State Historic Preservation Office regarding the project's potential effects on historic properties. To facilitate our review, please provide the following information and applicable attachments. Our office will generate a response within 30 days of receipt. Incomplete submissions may be returned for more information.

SECTION 1: APPLICANT INFORMATION

Project Sponsor or Applicant: Lewis Ridge Pumped Storage, LLC

Contact Person (name & position)**:** Sandy Slayton

Return Address: 1455 SW Broadway Street, Suite 290, Portland, Oregon 97201

Telephone: (206) 919-3976 **E-mail:** sandy@ryedevelopment.com

Project Title: Lewis Ridge Pumped Storage Project, FERC P-15249

SECTION 2: AGENCY INFORMATION

Funding/Permitting Agency: Federal Energy Regulatory Commission

Agency Contact Person (name & position)**:** Michael Spencer

Telephone: (202) 502-6093 **E-mail:** michael.spencer@ferc.gov

SECTION 3: PROJECT LOCATION

E911 Street Address (or other description)**:** Please see coordinates

City/Township: near Blackmont, Tejay, Balkan, and Callaway **County:** Bell County, KY

Latitude: 36.761074 **Longitude:** -83.548854

SECTION 4: PROJECT TYPE (please check all that apply)

Proposed Activity: ☐ Demolition ☐ Rehabilitation ☐ Structural Relocation ☐ Trails

☒ New Construction ☐ Land and/or Building Acquisition ☐ Sewer/Water Lines ☐ Roads/Bridges

☐ Non-Construction Planning/Refinancing ☐ Other (describe):

SECTION 5: IDENTIFICATION OF KNOWN HISTORIC PROPERTIES

KHC Preliminary Site Check #: 84717726 **OSA Preliminary Site Check #:** P45988

If your project involves ground disturbance, has the site been previously disturbed?

☒ Yes (describe in detail below) ☐ No

The majority of the Project Area is located at a mining area. Please see the Draft License Application for more details.

Is there anything over 50 years of age in or visible from the project location? ☒ **Yes** ☐ **No**

SECTION 6: ATTACHMENTS - Attach all as applicable

All documentation should be labeled with the project name or site address.

- ☒ Clear, current photographs of the project site and anything over 50 years of age in or visible from it.
- ☒ Site map/plan indicating the exact location and boundaries of the project area.
- ☒ Detailed description of the project (may include plans, scope of work, and other available information.)
- ☒ Documentation of prior ground disturbance (e.g. maps, photographs, underground utility plans, etc.)
- ▣ Any known information about the history/use of the property and local significance.

NOTE: Submit all information to Craig Potts, Executive Director/SHPO Via E-mail to: khc.section106@ky.gov PAPER SUBMISSIONS WILL NOT BE ACCEPTED

We are no longer accepting paper documents for above or below ground review. Please submit all electronic documents for Section 106 Review to khc.section106@ky.gov. DO NOT SUBMIT ANY INITIAL SECTION 106 REVIEW MATERIALS TO AN INDEPENDENT REVIEWER. Failure to submit documents to the dedicated Section 106 email address will result in our staff not eceiving these documents for review.

From:	Clark, Maria
To:	Sandy Slayton
Cc:	Lesley Brotkowski; Kajumba, Ntale
Subject:	RE: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Date:	Wednesday, October 2, 2024 2:03:59 PM
Attachments:	image001.png

You don't often get email from clark.maria@epa.gov. Learn why this is important

Hello Sandy – thank you so much for your response. I'll be talking to our team and see if they need a call. I truly appreciate our communications; I know that we can get so much done this way.

For now, we need time to refresh our memories and dust-off our files for this time around.

Thank you again for your valuable feedback.

Maria

From: Sandy Slayton <sandy@ryedevelopment.com>
Sent: Wednesday, October 2, 2024 10:06 AM
To: Clark, Maria <Clark.Maria@epa.gov>
Cc: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Subject: RE: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application

Caution: This email originated from outside EPA, please exercise additional caution when deciding whether to open attachments or click on provided links.

Good Morning Maria,

I really appreciate your email and I'm glad you reached out. I apologize that we somehow let your email drop off our distribution list, but it is back on now, and we look forward to working with you on this project.

In response to your questions below:

1. Is FERC going to publish an official request to comments for this DLA? FERC does not typically publish an official request for comments for the Draft License Application (DLA) under the Traditional Licensing Process.
2. Is this request for comments only from LRPS? Yes. Per 18 CFR § 4.38 (c)(4) the applicant distributes the DLA to resource agencies and tribes with a written request for review and comment within 90 days from the date of the letter requesting comments.
3. Do you have an updated schedule from LRPS? The construction schedule is included in Exhibit D. We did not specify the date of the Final License Application (FLA) filing in the DLA, but I would anticipate it would not be less than 6 months from the date of the DLA.
4. Do you have an updated schedule from FERC? FERC does not issue a pre-filing schedule under

the Traditional Licensing Process.

If this brings up any additional questions or comments, please let me know. If you would like a call soon, or any time, to discuss anything about the project or the process we can get that scheduled.

Sandy

From: Clark, Maria <Clark.Maria@epa.gov>
Sent: Tuesday, October 1, 2024 7:51 AM
To: Sandy Slayton <sandy@ryedevelopment.com>
Cc: Clark, Maria <Clark.Maria@epa.gov>
Subject: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Importance: High

Good morning Sandy,

I hope this email finds you well.

I have been in contact with you re this project since 2022 (see attachment), and we had a great introductory meeting back then.

I'm writing you to request to please keep me inform and up to date about this project. The email you sent below was sent only to our acting regional administrator. I would truly appreciate if you kept the communications as we started a few years ago so we can process your request the best way for everyone without avoidable delays.

A few questions:

1. Is FERC going to publish an official request to comments for this DLA?
2. Is this request for comments only from LRPS?
3. Do you have an updated schedule from LRPS?
4. Do you have an updated schedule from FERC?

Please reach out to me anytime if you have questions. Have a wonderful day!
Best,

Maria R. Clark

NEPA Section – Region 4
U.S. Environmental Protection Agency
61 Forsyth Street, SW
Atlanta, GA 30303
Phone# 404-562-9513

Kleinschmidt Associates
141 Main Street, P.O. Box 650
Pittsfield, ME 04967

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Roger "Bear" Brock
Chief
Southern Cherokee Nation of Kentucky
P.O. Box 481
Allen

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Kleinschmidt

From: Lee Jr Warren <forms@lewisridgeproject.com>
Sent: Sunday, October 13, 2024 11:22 AM
To: info@lewisridgeproject.com
Subject: Inquiry from Lewis Ridge website

From: Lee Jr Warren
Email: [redacted]
Message: Yes I am interested in the Lewis Ridge Project. I'm an adjacent property owner. I'm interested in the opportunity to work with you on this project in whatever capacity that I can. We are so glad to have the work for our community as well. Please feel welcome to contact me anytime.

Appreciatively,
Lee Warren Jr.
[redacted]

From: Earlene Giglierano <[redacted]>
Sent: Tuesday, October 15, 2024 12:55 PM
To: Sandy Slayton <sandy@ryedevelopment.com>
Subject: info on Lewis Ridge Pumped Storage Project

I am writing on behalf of my mother and grandfather, Thelma Davison and James Rector. They received your certified letter today and I am asking for information regarding specifically what effect this will have on their land. Will you wish to purchase, condemn, or rent property? The letter she received was lacking in pertinent information. I tried calling the number on the letter and did not reach you. You may reply here or call me at [redacted].

Earlene Giglierano

-----Original Message-----
From: Fran Campbell [redacted]
Sent: Wednesday, October 16, 2024 10:12 PM
To: Sandy Slayton <sandy@ryedevelopment.com>
Subject: Lewis Ridge Pumped Storage Project, FERC P-15249

Hello Ms. Slayton-

We received a letter from Rye Development about the Lewis Ridge Project FERC P-15249. I am the great grandson of I. N. Creech and am responsible for the property that our family owns in Bell County, Kentucky.

We have gone to the elibrary site and downloaded the 762 page document and map. It looks like our property is involved in this Pump Storage Project.

What do I need to do to follow and be updated on the proposed project?

Looking forward to hearing from you.

Sincerely,

Jackie (Jack) Campbell
Represenitive for
I.N. Creech Heirs

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	10/16/2024
Person documenting conversation	Sandy Slayton (Lewis Ridge Pumped Storage, LLC)
Discussion participants	Sandy Slayton, Earlene Giglierano
Subject of conversation	Project overview

Summary of Conversation

Sandy Slayton contacted Earlene Giglierano to provide a project overview and answer any questions in response to the online inquiry from October 15, 2024 submitted on behalf of Thelma Davison and James Rector. Ms. Slayton explained that their private property is not anticipated to be needed for the purposes of the proposed Lewis Ridge Project. Ms. Slayton also explained that if they have any further questions, that Lewis Ridge Pumped Storage, LLC would be happy to set up a call or meeting to discuss any concerns or questions.

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	10/16/2024
Person documenting conversation	Sandy Slayton (Lewis Ridge Pumped Storage, LLC)
Discussion participants	Sandy Slayton, Lee Warren Jr.
Subject of conversation	Project Overview

Summary of Conversation

Sandy Slayton contacted Lee Warren Jr. to provide a project overview and answer any questions in response to the online inquiry from October 13, 2024. Mr. Warren expressed interest in future communication and collaboration. Ms. Slayton explained that Lewis Ridge Pumped Storage, LLC would be happy to set up a call or meeting if Mr. Warren have any further questions.

From: Aldridge, Louanna C (EEC) <Louanna.Aldridge@ky.gov>
Sent: Monday, October 28, 2024 10:55 AM
To: Sandy Slayton <sandy@ryedevelopment.com>
Subject: FW: Lewis Ridge Pumped Storage Project - NEPA 2024-0083 Final Review Complete

Hello,

Final review for Lewis Ridge Pumped Storage Project - NEPA 2024-0083 received on 10/2/2024 12:00:00 AM has been COMPLETED.
eForm Submitter email address : sandy@ryedevelopment.com.
Louanna Aldridge

TEAM KENTUCKY
ENERGY AND
ENVIRONMENT CABINET

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	11/7/2024
Person documenting conversation	Chris Douglas
Discussion participants	Chris Douglas and Maria Warren
Subject of conversation	Initial Contact

Summary of Conversation

Provided an overview of the Lewis Ridge Pumped Storage Project. It was noted that updates will be provided moving forward and that discussions regarding right-of-way or easement agreements will take place at a later stage. She mentioned that Lee would follow up with any questions.

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	11/8/2024
Person documenting conversation	Chris Douglas
Discussion participants	Chris Douglas and Andrew Ramaglia
Subject of conversation	Project overview

Summary of Conversation

Provided an overview of the Lewis Ridge Pumped Storage Project. Andrew Ramaglia expressed concern regarding potential safety risks related to flooding.

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	11/8/2024
Person documenting conversation	Chris Douglas
Discussion participants	No discussion. Henry Gray wasn’t home
Subject of conversation	Location of interconnection line

Summary of Conversation

Chris Douglas spoke to the wife of Henry Gray. She said she didn't think he had any concerns (she didn't) and said she would have him call Mr. Douglas if he did.

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	11/8/2024
Person documenting conversation	Chris Douglas
Discussion participants	Chris Douglas & Nora Lawson
Subject of conversation	Location of interconnection line

Summary of Conversation

Provided an overview of the Lewis Ridge Pumped Storage Project. Nora Lawson asked whether the proposed line would cross her property and Chris Douglas explained the location in relation to the property. Nora Lawson also inquired whether the project would involve a full property purchase or a right-of-way agreement. It was explained that a right-of-way agreement is more likely. She expressed no additional concerns and was encouraged to reach out with any further questions.

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	11/12/2024
Person documenting conversation	Chris Douglas
Discussion participants	Chris Douglas and Jack Campbell
Subject of conversation	Initial Contact – Project overview

Summary of Conversation

Provided an overview of the Lewis Ridge Pumped Storage Project. Jack Campbell stated that he had no concerns or questions at the time and expressed appreciation for the call. He was encouraged to reach out at any time with any questions.

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	11/13/2024
Person documenting conversation	Chris Douglas
Discussion participants	Chris Douglas and Jessie Collins
Subject of conversation	Initial Contact – Project overview

Summary of Conversation

Provided an overview of the Lewis Ridge Pumped Storage Project. Collins inquired about potential compensation and whether the arrangement would involve a purchase or an easement. It was explained that it is too early in the process to discuss specific terms. When asked about her concerns, she expressed a desire for assurance that any future interconnection line would not pose risks to children or animals.

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	11/15/2024
Person documenting conversation	Chris Douglas
Discussion participants	Chris Douglas and Brenda Ramsey Brock
Subject of conversation	Initial Contact – Project overview

Summary of Conversation

Provided an overview of the Lewis Ridge Pumped Storage Project. She wanted to know if her property would be surveyed to see where the lines are. Chris Douglas explained that survey may have to happen in situations where the line is close to a property line/corner. Explained that the location is not final, and she indicated a preference to postpone further discussion until the final location is confirmed.

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	11/21/2024
Person documenting conversation	Chris Douglas
Discussion participants	Chris Douglas and Jim Franks
Subject of conversation	Initial Contact – Project overview

Summary of Conversation

Discussed Project. Mr. Franks only concern at the present time is the location of the transmission line. He said he didn't think that this would affect his property. I explained that this may be the case and arranged to meet with him in person to go over the proposed location (explaining that this location is only proposed and is not final yet).

Lewis Ridge Pumped Storage Project, FERC P-15249

Meeting Summary

Date/Time: 12/2/2024 2:00PM – 3:00PM ET

Meeting Type: Virtual meeting via Teams

Attendees:

Samantha Vogeler, Kentucky Department for Environmental Protection (Kentucky DEP) Division of Water
Allan Shingleton, Kentucky DEP Division of Water
Joanna Ashford, Kentucky DEP Division of Water
Shawn Hokanson, Kentucky DEP Division of Water
Sandy Slayton, Lewis Ridge Pumped Storage, LLC (LRPS)
Dylan Stankus, LRPS
Patrick Willis, AECOM
Michael Ricci, RESPEC
Lesley Brotkowski, Kleinschmidt Associates (Kleinschmidt)
Elizabeth Krchnavek, Kleinschmidt

Purpose:

Meeting to discuss the Lewis Ridge Pumped Storage Project, FERC P-15249 (Lewis Ridge Project) design and permitting needs for water withdrawal and Clean Water Act (CWA) Section 401 Water Quality Certification (WQC).

Agenda:

- Design overview, focus on lower reservoir
- Design considerations
- Water withdrawal permitting
  - Process
    - Initial fill
    - Makeup water
  - Timing
  - Limitations
  - Design and/or study requests for permitting
  - Water withdrawal considerations
- 401 permitting
  - Process
  - Timing
  - Limitations
  - Design and/or study requests for permitting

Summary:

- Patrick Willis (AECOM)
  - Provided an overview of Lewis Ridge Project. He explained that the Draft License Application was submitted to the Federal Energy Regulatory Commission (FERC) on

  - September 30, 2024, and the engineering design of the Lewis Ridge Project is being refined.
  - Described the Lewis Ridge Project location in Bell County, Kentucky as well as the general arrangement.
  - Described the project features including the upper and lower reservoirs, penstocks, and powerhouse.
  - Described that initial fill and annual makeup water will be required for the Lewis Ridge Project.
    - Explained that approximately 3,275 acre-feet is currently anticipated to be needed for the initial fill. Annual make-up water due to evaporation and seepage losses is estimated to be 274 acre-feet.
    - Currently it is anticipated that some of the initial fill will be from Tom Fork. Supplementary water may be required from Cumberland River.
    - Explained that the annual recharge water is anticipated to be from natural inflows of Tom Fork. A lower level outlet will be used to discharge excess Tom Fork flow.
- Sandy Slayton (LRPS) described where the project is in the FERC licensing process. Explained that the Draft License Application was filed with FERC on September 30, 2024, and comments on the DLA are due December 29, 2024. The FERC license is not anticipated to be received for approximately 2.5 years.
- Allan Shingleton (Kentucky DEP Division of Water) asked for clarification on the source of the recharge water.
  - Sandy Slayton confirmed that recharge water is anticipated to be from Tom Fork only, and that the Cumberland River withdrawal would be one time for the initial fill of the project.
  - Patrick Willis further explained that Tom Fork is approximately 5 cfs, so annually provides approximately 3,600 acre-feet of water. Annual make-up water is estimated to be a fraction of this amount at approximately 274 acre-feet.
- Samantha Vogeler (Kentucky DEP Division of Water) explained that initial data would be important to inform the 401 WQC. She explained that downstream effects from the proposed action to aquatic life would need to be determined. Biological sampling would be anticipated, including macroinvertebrate sampling, as well as a mussel and fish survey. Samantha Vogeler explained that because of the proposed alteration of the water system, the U.S. Army Corps of Engineers would likely require compensatory mitigation. She stated that there are no wetland mitigation credits currently available in Bell County. Credits should not be purchased from Tennessee, they should be from Kentucky, if needed, to be considered applicable for the Kentucky DEP.
- Lesley Brotkowski (Kleinschmidt) provided an overview of studies completed pertaining to water resources and aquatic habitat. She explained that a wetland and waterway delineation and blackside dace survey were completed. The blackside dace survey includes habitat information for Tom Fork. She explained that studies have not been completed in the Cumberland River and asked if there are certain thresholds or restrictions that LRPS should be aware of regarding the anticipated Cumberland River withdrawal.
- Joanna Ashford (Kentucky DEP Division of Water) stated that there is no fee associated with the one time withdrawal. She stated that the permitting process involves review and conversation with Kentucky DEP to understand specific project needs and a comparison of water models, to determine what rate of withdrawal may be acceptable. Joanna Ashford asked Patrick Willis to

provide the presentation with the basic project information, to jumpstart review of the project. Joanna Ashford explained that no determination can be made at this time, but that early consultation prior to the permitting process is helpful to continue to understand the project and to ensure that more complete applications are prepared.

- Sandy Slayton asked about timelines for the water withdrawal permit and the 401 WQC.
    - Allan Shingleton stated that the water withdrawal permit is issued within 120 days once the application is deemed complete.
    - Samantha Vogeler stated that the 401 WQC process is longer and can be up to 365 days. The review process is a minimum of 120 days following the receipt of a complete WQC application. Based on the scale of the project, she estimated that the review period may be around 180 days but added it could be up to 365 days. This time period includes a 30-day public notice. The time period is also dependent on the applicant's response time.
    - Samantha explained that a Pre-Filing Meeting request is required for the 401 WQC.
    - The withdrawal permit application will review water quantity and the 401 WQC will review water quality. KY DEP Water Resources staff will work closely together to review the overall project.
- Lesley Brotkowski asked if Kentucky DEP has a preference on when the WQC application is submitted relative to the FERC license application.
    - Samantha Vogeler stated that they prefer the NEPA analysis be completed prior to receiving the WQC application.
        - Lesley explained that FERC's NEPA analysis won't be completed prior to the WQC application, as FERC's regulations require the WQC Application be submitted within 60 days from FERC's issuance of Ready for Environmental Analysis (REA). Lesley Brotkowski noted that an environmental report (Exhibit E) is include in the FERC license application, which includes information FERC will use for the NEPA analysis.
- Sandy Slayton offered that if a site visit is helpful, this can be arranged.
- Samantha Vogeler asked when the Pre-Filing Meeting request and WQC application are anticipated to be submitted.
    - Lesley explained that the WQC application timing is not determined at this time but will be no later than 60 days from FERC's REA.
- Sandy Slayton asked if there is a complete WQC application example available. Samantha Vogeler suggested that LRPS could submit an open information request to obtain a complete application for similar projects.
    -
- Samantha Vogeler stated that if there are any public drinking water system users downstream within 5 miles, that they would be notified of the pending permit applications.
- Joanna Ashford asked if a latitude/longitude could be sent of the project location.
    - Sandy stated that this could be provided as well as a KMZ.
- Sandy thanked everyone for their participation.

AECOM

Design Update

Lewis Ridge Pumped Storage Project

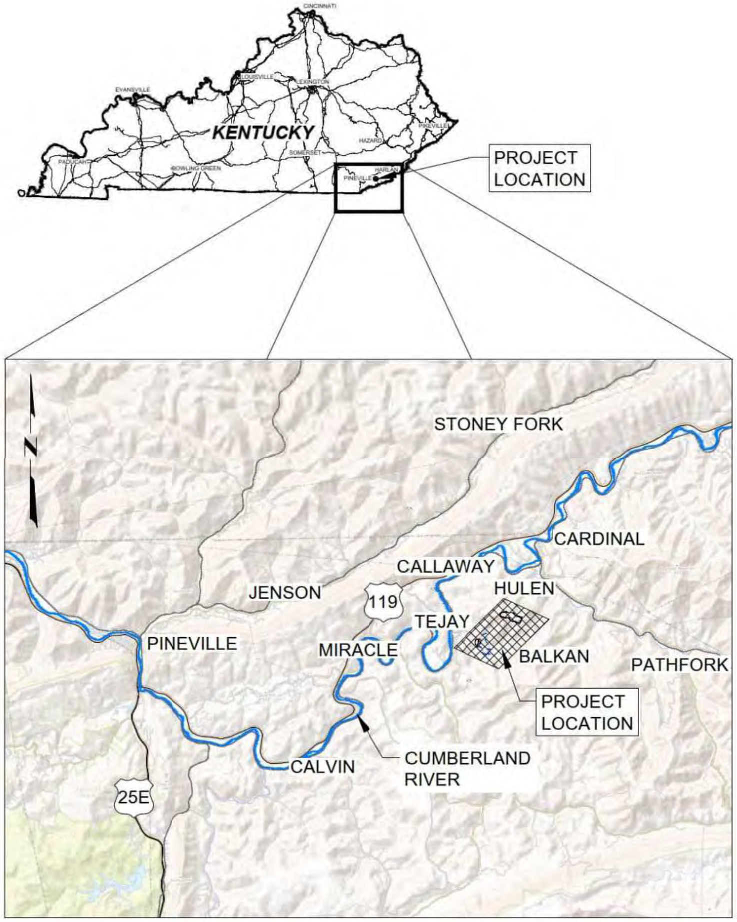
December 2, 2024

Delivering a better world

*CEII Design drawings have been redacted.

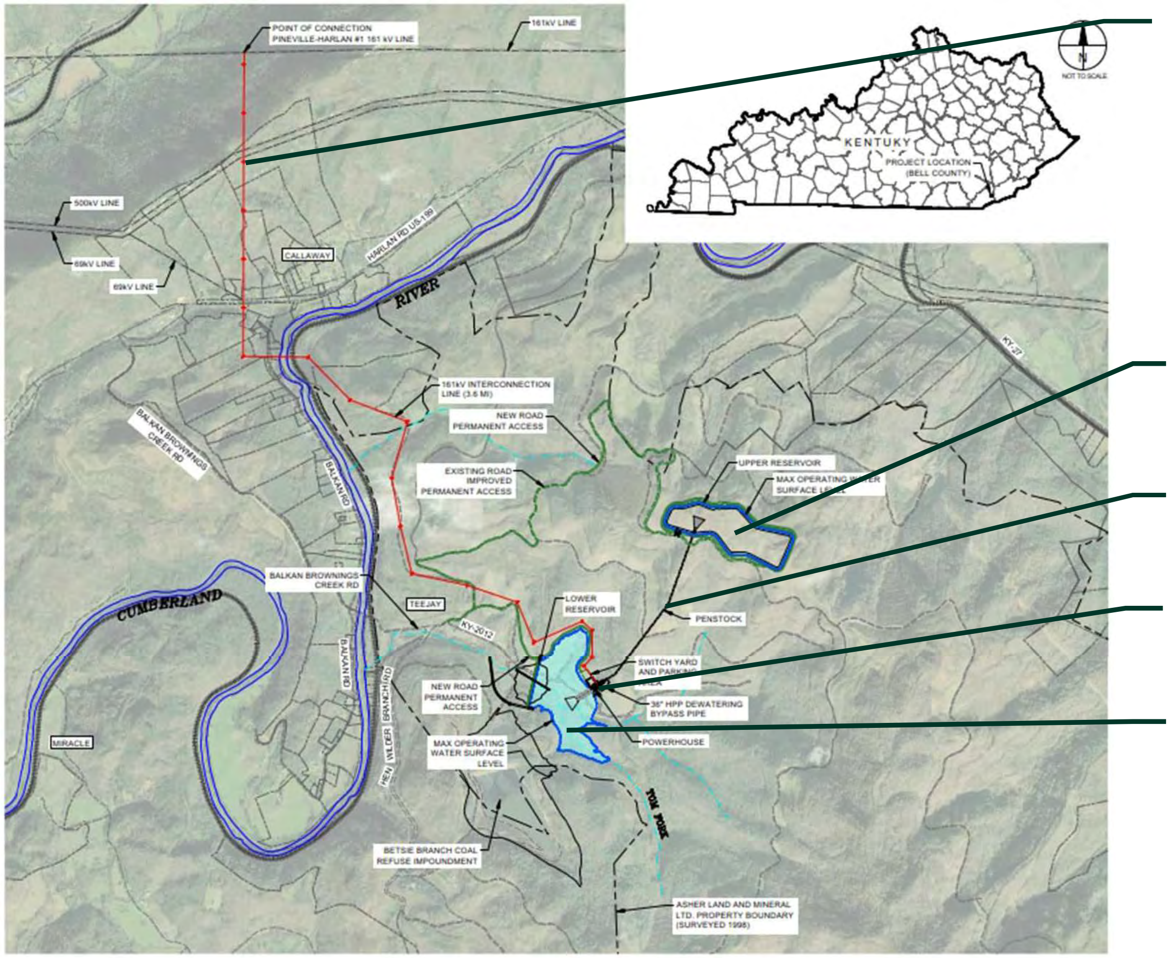
aecom.com

Project Location



- Project is located in Bell County, Kentucky
- Upper Cumberland River Basin within the Tom Fork Creek drainage basin
- Approximately 10 miles east of Pineville, Kentucky

Project General Arrangement



PROJECT GENERAL ARRANGEMENT

161 kV Overhead Transmission Line (3.2 miles)

Upper Reservoir

Surface Penstock

Powerhouse (287MW)

Lower Reservoir

Upper Reservoir

- 5,450-foot-long ring dike hardfill / RCC dam
- 135 feet high
- Surface area of 40 acres
- Active storage capacity of 2,600 acre-feet
- Integrated overflow spillway and low-level outlet works
- Floor of the reservoir will be lined with Hydraulic Asphalt Concrete

Lower Reservoir

- 830-foot-long cross valley embankment dam
- 120 feet high
- Surface area of 48 acres
- Active storage capacity of 2,600 acre-feet
- Concrete lined emergency spillway in left abutment
- Low-level outlet works
- Upstream face of the dam and reservoir footprint will be lined with Hydraulic Asphalt Concrete

Photos of Tom Fork Creek in Proposed Lower Reservoir Location

- Area of drainage basin above Lower Reservoir site is 1.8 square miles

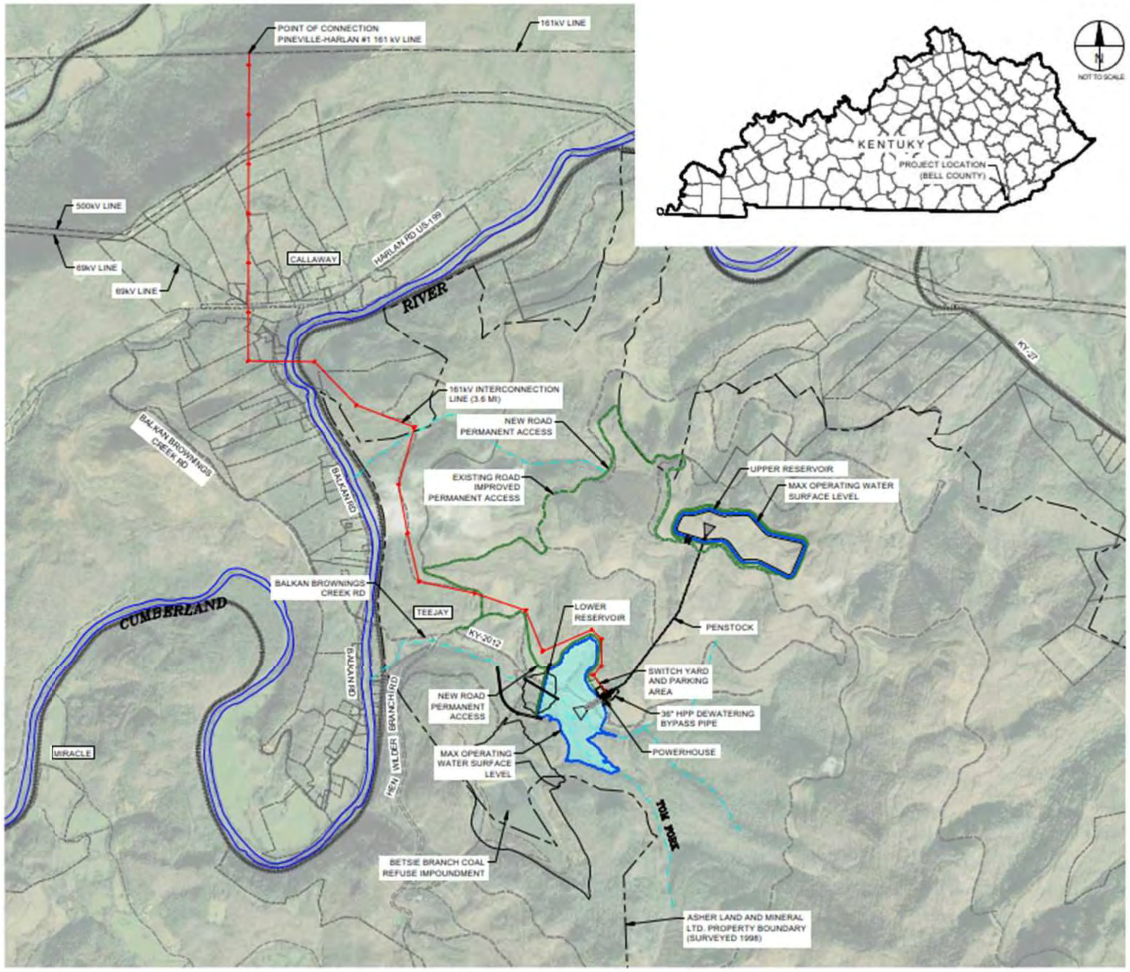
Penstock Plan and Profile

- 4,757-foot-long steel surface penstock (pipeline)
- Penstock will be 16 feet in diameter

Powerhouse

- Shaft-type powerhouse
- 150-foot-diameter circular shaft 250 feet below ground surface
- Two 143.5 MW reversible Francis pump-turbines (total installed capacity of 287 MW)
- Short tunnel sections of penstocks on upstream side and tailrace tunnels on downstream side

Initial Fill and Annual Makeup Water



PROJECT GENERAL ARRANGEMENT

- Volume of water required for initial fill is 3,275 acre-feet
- Annual make-up water due to evaporation and seepage losses is 274 acre-feet
- Source of initial fill is anticipated to be from natural inflows to the Lower Reservoir from the Tom Fork Creek Drainage; supplementary water may be required from the Cumberland River and / or groundwater wells
- Source of annual make-up water is anticipated to be from natural inflows from the Tom Fork Creek Drainage

AECOM

Thank you.

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aecom.com

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	12/3/2024
Person documenting conversation	Chris Douglas
Discussion participants	Chris Douglas and Kenneth McGeorge
Subject of conversation	Project overview

Summary of Conversation

Provided overview of Lewis Ridge Pumped Storage Project. He wanted to know where the line would go. Chris Douglas explained the current anticipated location in relation to his property. Chris Douglas explained that an easement would be needed for the overhead interconnection line.

From: Sandy Slayton
To: Ashford, Joanna B (EEC); Vogeler, Samantha N (EEC); Shingleton, Allan D (EEC); Hokanson, Shawn M (EEC)
Cc: Brianne Wilson; Lesley Brotkowski; Michael Ricci; Willis, Patrick; Dylan Stankus
Subject: Lewis Ridge Project Water Withdrawal and 401 Permitting
Date: Tuesday, December 3, 2024 5:33:46 PM
Attachments:

Joanna, Samantha, Allan, Shawn,

Thank you for joining us to discuss the Lewis Ridge Project yesterday. The discussion was very helpful on our end. Attached are the documents we discussed: the powerpoint we shared on the call and a KMZ of the preliminary project boundary. The lat long of the general area of the reservoir outlet (not exact) is below. Please let us know if we can provide any additional clarifications or information. We look forward to continued collaboration.

Lat: 36°45'39.99"N
Long: 83°33'2.59"W

Sandy

Rye Development
Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From: Clark, Maria
To: Sandy Slayton
Cc: Lesley Brotkowski
Subject: RE: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Date: Thursday, December 5, 2024 2:27:00 PM
Attachments: image001.png

Excellent. Let me check with my colleagues and I'll send you a few days. Thank you!

From: Sandy Slayton <sandy@ryedevelopment.com>
Sent: Thursday, December 5, 2024 1:41 PM
To: Clark, Maria <Clark.Maria@epa.gov>
Cc: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Subject: RE: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application

Hi Maria,

Yes, of course, we would be happy to.

Next week is best, at least on my end. Could you give me some dates that might work for you and we can find a time?

Sandy

From: Clark, Maria <Clark.Maria@epa.gov>
Sent: Thursday, December 5, 2024 1:40 PM
To: Sandy Slayton <sandy@ryedevelopment.com>
Cc: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Subject: RE: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Importance: High

Dear Sandy,

I hope this email finds you well.

A few colleagues in our water program have several questions about this project, and I thought to ask you if you think is possible to have a Teams meeting with your group before the 12/29 date. I could send you their concerns before the meeting so we can have a fruitful conversation. What do you think?

FYI – I haven't mention this to my colleagues because I want to know from your side first.

Thank you – Maria.

From:	Clark, Maria
To:	Sandy Slayton
Cc:	Lesley Brotkowski
Subject:	EPA comments for the meeting: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Date:	Wednesday, December 11, 2024 7:52:14 AM
Attachments:	image001.png Rye Development - Lewis Ridge Pumped Storage - Draft license comments (003).docx

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Good morning Sandy – I wanted to send you an agenda, but my colleagues from the Water Program worked hard at their concerns and to be fair to them I decided to forward you the draft list they put together. In addition, I hope that this information helps you all to feel better prepare for our meeting. We understand that you might don't have all the answers, but this is a great opportunity to hear from you if these concerns are not totally clear.

Please let me know if you have any questions.

We are looking forward to this meeting! Thank you.
Maria

From: Sandy Slayton <sandy@ryedevelopment.com>
Sent: Monday, December 9, 2024 10:18 AM
To: Clark, Maria <Clark.Maria@epa.gov>
Cc: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Subject: Re: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application

Caution: This email originated from outside EPA, please exercise additional caution when deciding whether to open attachments or click on provided links.

Good Morning Maria,

Yes, this works for us. Do you want to pick the time in there that is best and send us an invitation?

Sandy

From: Clark, Maria <Clark.Maria@epa.gov>
Sent: Friday, December 6, 2024 2:10 PM
To: Sandy Slayton <sandy@ryedevelopment.com>
Cc: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Subject: RE: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application

Dear Sandy – most of my colleagues are available to meet this Wednesday, Dec 11 in the afternoon. Would you guys be available between 2pm and 4pm?

I hope this works for all of you.

Thank you!
Maria

From: Sandy Slayton <sandy@ryedevelopment.com>
Sent: Thursday, December 5, 2024 1:41 PM
To: Clark, Maria <Clark.Maria@epa.gov>
Cc: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Subject: RE: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application

Caution: This email originated from outside EPA, please exercise additional caution when deciding whether to open attachments or click on provided links.

Hi Maria,

Yes, of course, we would be happy to.

Next week is best, at least on my end. Could you give me some dates that might work for you and we can find a time?

Sandy

From: Clark, Maria <Clark.Maria@epa.gov>
Sent: Thursday, December 5, 2024 1:40 PM
To: Sandy Slayton <sandy@ryedevelopment.com>
Cc: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Subject: RE: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Importance: High

Dear Sandy,

I hope this email finds you well.

A few colleagues in our water program have several questions about this project, and I thought to ask you if you think is possible to have a Teams meeting with your group before the 12/29 date. I could send you their concerns before the meeting so we can have a fruitful conversation. What do you think?

FYI – I haven’t mention this to my colleagues because I want to know from your side first.

Thank you – Maria.

From: Sandy Slayton <sandy@ryedevelopment.com>
Sent: Wednesday, October 2, 2024 10:06 AM
To: Clark, Maria <Clark.Maria@epa.gov>
Cc: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Subject: RE: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application

Caution: This email originated from outside EPA, please exercise additional caution when deciding whether to open attachments or click on provided links.

Good Morning Maria,

I really appreciate your email and I'm glad you reached out. I apologize that we somehow let your email drop off our distribution list, but it is back on now, and we look forward to working with you on this project.

In response to your questions below:

1. Is FERC going to publish an official request to comments for this DLA? FERC does not typically publish an official request for comments for the Draft License Application (DLA) under the Traditional Licensing Process.
2. Is this request for comments only from LRPS? Yes. Per 18 CFR § 4.38 (c)(4) the applicant distributes the DLA to resource agencies and tribes with a written request for review and comment within 90 days from the date of the letter requesting comments.
3. Do you have an updated schedule from LRPS? The construction schedule is included in Exhibit D. We did not specify the date of the Final License Application (FLA) filing in the DLA, but I would anticipate it would not be less than 6 months from the date of the DLA.
4. Do you have an updated schedule from FERC? FERC does not issue a pre-filing schedule under the Traditional Licensing Process.

If this brings up any additional questions or comments, please let me know. If you would like a call soon, or any time, to discuss anything about the project or the process we can get that scheduled.

Sandy

From: Clark, Maria <Clark.Maria@epa.gov>
Sent: Tuesday, October 1, 2024 7:51 AM
To: Sandy Slayton <sandy@ryedevelopment.com>
Cc: Clark, Maria <Clark.Maria@epa.gov>
Subject: PLEASE UPDATE: Lewis Ridge Pumped Storage Project, FERC P-15249 Draft License Application
Importance: High

Good morning Sandy,

I hope this email finds you well.

I have been in contact with you re this project since 2022 (see attachment), and we had a great introductory meeting back then.

I'm writing you to request to please keep me inform and up to date about this project. The email you sent below was sent only to our acting regional administrator. I would truly appreciate if you kept the communications as we started a few years ago so we can process your request the best way for everyone without avoidable delays.

A few questions:

1. Is FERC going to publish an official request to comments for this DLA?
2. Is this request for comments only from LRPS?
3. Do you have an updated schedule from LRPS?
4. Do you have an updated schedule from FERC?

Please reach out to me anytime if you have questions. Have a wonderful day!
Best,

Maria R. Clark

NEPA Section – Region 4
U.S. Environmental Protection Agency
61 Forsyth Street, SW
Atlanta, GA 30303
Phone# 404-562-9513

Lewis Ridge Pumped Storage Project, FERC P-15249

Meeting Summary

Date/Time: 12/11/2024 3:00PM – 4:00PM ET

Meeting Type: Virtual meeting via Teams

Attendees:

Maria Clark, U.S. Environmental Protection Agency (EPA)
Ashley Monroe, EPA
Austin Fitzgerald, EPA
Matt Rebel, EPA
Lydia Mayo, EPA
Sandy Slayton, Lewis Ridge Pumped Storage, LLC (LRPS)
Ushakar Jha, LRPS
Dylan Stankus, LRPS
Michael Ricci, RESPEC
Lesley Brotkowski, Kleinschmidt Associates (Kleinschmidt)
Elizabeth Krchnavek, Kleinschmidt

Purpose:

Meeting to discuss EPA comments on Lewis Ridge Pumped Storage Project, Federal Energy Regulatory Commission (FERC) P-15249 (Lewis Ridge Project).

Summary:

- Introductions were made among meeting participants.
- Sandy Slayton (LRPS) thanked the EPA for their participation and asked if they had a preference on how to run the meeting and topics discussed. Draft comments from EPA were provided earlier that morning.
- Maria Clark (EPA) suggested that Sandy Slayton first provide a brief overview of recent state agency meetings and then walk through the draft comments provided from EPA.
- Sandy described prior meetings that have occurred with resource agencies to discuss aquatic resources. On December 12, 2024 a meeting was held with Kentucky Department for Environmental Protection (Kentucky DEP) Division of Water to discuss design and permitting needs for water withdrawal and Clean Water Act (CWA) Section 401 Water Quality Certification (WQC). On August 12, 2024 a meeting was held with U.S. Army Corps of Engineers (USACE), Kentucky DEP, and Kentucky Department for Natural Resources (Kentucky DNR) to discuss water resources as it pertains to the project. The Joint Agency and Public Meeting was held on January 25, 2023. On November 9, 2022, an introductory meeting was held with EPA.
- Austin Fitzgerald (EPA) suggested a review of the EPA comments. He noted that additional background information is needed to fully understand the project and potential impacts. He asked if water quality monitoring has been conducted and what the impacts to Tom Fork will be. Sandy explained that LRPS will be initiating water quality monitoring in end of 2024 or early 2025. Sandy explained that impacts to Tom Fork are still being evaluated and will be described further in the Final License Application (FLA).

- Ashley Monroe (EPA) asked how many years of studies are anticipated.
    - Lesley Brotkowski (Kleinschmidt) described the FERC licensing process. She explained that the Draft License Application (DLA) was filed 9/30/2024 and that certain studies have already been completed, including a wetland and waterway evaluation and blackside dace habitat evaluation. The FLA is anticipated to be filed in late Q1 or early Q2 of 2025. She explained that FERC will issue a notice of acceptance and ready for environmental analysis (REA) and then typically 8 months to a year later, FERC issue Draft Environmental Analysis (EA) or Environmental Impact Statement (EIS). Lesley explained that Clean Water Act (CWA) Section 401 Water Quality Certificate (WQC) Application would be filed no later than 60 days after the REA notice. Water resource data collection will likely include approximately one year of data prior to the WQC Application.
- Austin explained that the EPA typically works with the USACE on Section 404 permitting process.
- Ashley asked if the 2011 Memorandum of Understanding (MOU) between U.S. Army Corps of Engineers (USACE) and FERC is still active. Ms. Brotkowski stated that the FERC would be the lead agency in the FERC licensing process but indicated that there may be cooperating agencies throughout the process. Ushakar Jha (LRPS) stated that there is an updated 2016 MOU between USACE and FERC.
- Austin explained that he reached out to USACE to discuss the 404 process. He explained that their understanding is that the FERC licensing process is first, followed by the 404 process. Sandy explained that LRPS is happy to assist with early and frequent correspondence with the agencies. Early consultation is preferred.
- Lydia Mayo (EPA) asked if the Louisville District USACE was involved. Austin responded that it is Nashville District.
- Sandy reviewed some of the draft EPA comments. She provided clarification on the water source (initial fill likely Tom Fork, with supplementation from Cumberland), and refill is still being determined. Regarding evaluation of alternative site locations, Sandy explained that the nature of pumped storage limits sites that are particularly appropriate. She explained that LRPS analyzed other configurations within the site once this particular location was selected. Sandy clarified that LRPS is not the owner of the site. Austin explained that it may be helpful to expand on the site selection process in the FLA.
- Austin explained that there are different Surface Mining Control and Reclamation Act (SMCRA) permits in the area. He explained that the EPA will want to understand what those permits and compensatory requirements may be, as exemption of these requirements may not be possible. Mike Ricci (RESPEC) stated that Nally and Hamilton is aware of the 404 permit obligations and they understand that this does not conflict with them. Mike clarified that the only exemption that could be requested is if material to be mined is identified and a SMCRA permit is appropriate.
- Austin asked Mike what coordination has been done related to potential issues with underground mining. Mike explained that this a critical part of the design that LRPS is working through. Sandy further explained that Schnabel Engineering is the geotechnical expert on the team and that they are continuing to evaluate information related to these topics.
- Lesley Brotkowski asked for addition detail regarding EPA's TMDL comment. Matt Rebel (EPA) clarified that the TMDL is copper listing and EPA is concerned about metals moving downstream.

- Maria stated that she will send information to Sandy about six mining permits in the area she may have questions about.
- Maria explained that additional comments will be provided to Rye in written form, such as consideration for solar panels on the upper reservoir.
- Maria asked about the U.S. Department of Energy (DOE) grant process.
    - Sandy explained that LRPS was awarded about $81 million for the project that will be issued in phases. Currently, LRPS is in the first phase. Sandy explained the NEPA process in association with the DOE grant process.
- Maria stated that if additional questions arise, to please contact EPA at any time.
- Sandy thanked everyone for their time and participation.

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	12/14/2024
Person documenting conversation	Chris Douglas
Discussion participants	Irene Rhymer & Chris Douglas
Subject of conversation	Location of interconnection line

Summary of Conversation

Provided an overview of Lewis Ridge Pumped Storage Project and described the anticipated location of the interconnection line. No questions or concerns noted at this time by Irene Rhymer.

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	12/30/2024
Person documenting conversation	Chris Douglas
Discussion participants	William Johnson & Chris Douglas
Subject of conversation	Location of interconnection line

Summary of Conversation

Provided an overview of Lewis Ridge Pumped Storage Project and described the anticipated location of the interconnection line. William Johnson wanted to know when right of way offers would be made. Chris Douglas explained that exact location of the interconnection line has not been set yet. William Johnson asked that for a call back when the line location is finalized. Expressed no concerns with the project.

Subject: FW: Open records request related to WQCs
Attachments: Open Records Request Form - DEP_Rye Development.pdf

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From: Michael Ricci <Michael.Ricci@respec.com>
Sent: Thursday, January 2, 2025 2:56 PM
To: KY EEC Open Records <eec.kora@ky.gov>
Cc: Sandy Slayton <sandy@ryedevelopment.com>; Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Subject: Open records request related to WQCs

Find attached an open records request for information related to WQC applications for hydropower, dam and/or infrastructure projects that capture and release water from a natural stream. This request is submitted in response to a meeting on 12/02/24 between DOE representatives and representatives of Rye Development.

Please let me know if you have any questions or require any additional information.

Thanks,
Mike

RESPEC

Michael Ricci
Principal Engineer

✉ Michael.Ricci@respec.com
☎ 859-361-4540

📍 146 East Third St.
Lexington, KY 40508

55 Years

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COMMONWEALTH OF KENTUCKY

REQUEST TO INSPECT PUBLIC RECORDS
RE: KRS CH.61

REQUEST

DATE: 01/02/2025

TO: Kentucky Division of Water
Name of State Agency

Public files in Regional Offices are not necessarily complete. Complete public files may be examined at the appropriate central office in Frankfort, Ky.

1. I request to inspect the following document(s): WQC applications submitted & approved for hydropower, dam, and/or infrastructure projects that capture and release water from a natural stream. An item of focus will be the potential effects to the stream immediately downstream of the dam.

2. Number of copies of each document requested @ 10¢ a page: ______

3. Enclosed $______ Check ☐ Money Order ☐ Cash ☐

4. ______
Signature

RESPEC
Company

146 E 3rd St, Lexington, KY 40508 859-361-4540
Address Phone

---

5. Is requested information from a database or geographic information system: Yes ☐ No ☒

6. For commercial use: Yes ☐ No ☒

7. If the answer to questions 5 & 6 is yes, the commercial purpose for which the requested information shall be used to: ______
We are requesting the data in digital format, if possible.

I hereby certify that the information set forth in item 7 is true and correct to the best of my knowledge

______
Signature

DISPOSITION

8. The following disposition was made of the above request: ______

9. ______ Signature of Custodian ______ Amount Received

______ Agency ______ Date

DEP-0049

Lewis Ridge Pumped Storage Project (FERC No. 15249)

Consultation Documentation

Date	1/6/2025
Person documenting conversation	Sandy Slayton (Lewis Ridge Pumped Storage, LLC)
Discussion participants	Sandy Slayton, Sonya Sutton
Subject of conversation	Project Overview

Summary of Conversation

Sandy Slayton contacted Sonya Sutton to provide a project overview and answer questions in response to the online inquiry. Sonya Sutton expressed concern about potential impacts to the Green Cemetery. Sandy Slayton confirmed that the cemetery would not be impacted by the Lewis Ridge Project. Sandy Slayton provided information on how project documents can be obtained on the FERC eLibrary and let her know that if she has any further questions to email or call her and she is happy to discuss.

From: Sonya Sutton <forms@lewisridgeproject.com>
Sent: Monday, January 6, 2025 2:17 PM
To: info@lewisridgeproject.com
Subject: Inquiry from Lewis Ridge website

From: Sonya Sutton
Email: [redacted]
Message: I am contacting you regarding the Lewis Ridge project. My mother is still a resident in Tejay spur (better known as Balkan Road) and sadly my dad passed April 26, 2024 and was laid too rest in our family cemetery which is located within your project vicinity. My great grandparents, grandparents, aunts, uncles, cousin, my dad and when the time comes for my mom passing as well as my own plan and many more family members plan on being laid too rest in the same cemetery. The cemetery is located beside highway 119 across from where the road enters to Tajay Spur Road.

My mother never received a letter in the past concerning the Lewis Ridge project and my mother has lived there since she was sixteen years old and will soon turn 70. I have some questions concerning the cemetery and the location of my parents home that are located within the project vicinity. I will grateful if you could give me a call at [redacted]. Thank you for your time.

Sonya Sutton

From: Hutchins, Patricia (Heritage Council) <patricia.hutchins@ky.gov>
Sent: Thursday, March 27, 2025 6:55 AM
To: Sandy Slayton <sandy@ryedevelopment.com>
Subject: FERC P-15249; Lewis Ridge Pumped Storage

Dear Ms. Slayton,

Attached are our comments for the proposed project, KHC # 250195. Please let us know if you have any questions.

Sincerely,
Patti

Patricia E. Hutchins
Archaeology Review Coordinator
Kentucky Heritage Council
410 High Street
Frankfort, Kentucky 40601
Email: patricia.hutchins@ky.gov

Moving forward please submit all Section 106 documentation to our online portal, INHERIT that is live on our webpage now. **Beginning February 1, 2025, the KHC.Section106@ky.gov email address will no longer be monitored.**

Preliminary Records Review for Above Ground Resources: https://heritage.ky.gov/historic-places/resources-survey/prelim/Pages/default.aspx

Preliminary Records Review for Archaeological Resources: https://anthropology.as.uky.edu/recorded-archaeological-sites

Please note that we are short staffed and some reviews may take longer than 30 days.

Andy Beshear
Governor

Jacqueline Coleman
Lt. Governor

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL
THE STATE HISTORIC PRESERVATION OFFICE
410 High Street
Frankfort, Kentucky 40601
(502) 564-7005
www.heritage.ky.gov

Lindy Casebier
Secretary

Craig A. Potts
Executive Director &
State Historic Preservation Officer

March 14, 2025

Sandy Slayton
Lewis Ridge Pumped Storage, LLC
1455 SW Broadway Street, Suite 290
Portland, Oregon 97201
Via email: sandy@ryedevelopment.com

RE: FERC; FERC P-15249; Lewis Ridge Pumped Storage, LLC; Bell County, KY

Cultural Historic, Resource Forms, and

An Archaeological Survey for the Asher Land and Mineral Ltd. Property on the Lewis Ridge Pumped Storage Project in Bell County, Kentucky by Clara R. Hoefer and Tanya Faberson Hurst

Dear Ms. Slayton,

Thank you for your submittal of the cultural historic letter report, historic resource forms, and an archaeology report regarding the above-referenced undertaking.

Regarding above-ground resources, we accept the cultural historic report and the resource forms. Fourteen new sites, BL375-BL388, were documented, and two previously documented sites, BL306 and BL89, were revisited. We concur that Sites BL 306 and BL 375 are eligible for listing on the National Register of Historic Places (NRHP). We concur that Sites BL 376 and BL 388 are undetermined for the NRHP. We concur that all other resources are ineligible for listing on the NRHP.

Cultural Resource Analysts, Inc. (CRA) conducted an archaeological survey of the 300.4-acre area of potential effect (APE) in July and August of 2024. We understand methods included pedestrian survey and shovel testing. Two new archaeological sites (15Bl157 and 15Bl158) were documented as a result of this survey. Additionally, previously recorded sites 15Bl128 and 15Bl133 were revisited.

CRA recommends that Site 15Bl158 is not eligible for listing in the NRHP. We concur with this recommendation.

CRA recommends Site 15Bl157, a historic cemetery, is unassessed for the NRHP. We concur with this recommendation, and with the recommendation that the site and a 30-foot buffer be avoided by ground-disturbing project activities.

Sites 15Bl128 and 15Bl133 were originally documented in 2007 and 2008, respectively, and each was recommended ineligible for listing in the NRHP. CRA recommends no change to this status for either, and we concur with these recommendations.

We accept the archaeology report without revision.

Should you have any questions or concerns, please contact Patti Hutchins of my staff at Patricia.Hutchins@ky.gov.

Sincerely,

Craig Potts
Executive Director and
State Historic Preservation Officer

KHC# 250195
CP: peh, mr

From: Microsoft Outlook <MicrosoftExchange329e71ec88ae4615bbc36ab6ce41109e@ryedevelopment.com>
Sent: Thursday, April 17, 2025 4:49 PM
To: Sandy Slayton
Subject: Undeliverable: Lewis Ridge Project TCP Information Request (Bell County, KY)

Your message to mountainspirit67@yahoo.com couldn't be delivered.

When Office 365 tried to send your message, the receiving email server outside Office 365 reported an error.

sandy Sender	**Office 365**	**mountainspirit67** **Action Required**
		Policy violation or system error

How to Fix It

Check the "Reported Error" from the "Error Details" section shown below for more information about the problem. The error might tell you what went wrong and how to fix it. For example, if the error states that the message was blocked due to a potential virus or because the message was too large, try sending the message again without attachments.

If you're not able to fix the problem, it's likely that only the recipient's email admin can fix it. Contact the recipient by some other means (by phone, for example) and ask them to tell their email admin about the problem. Give them the "Reported Error" from the "Error Details" section below.

Was this helpful? Send feedback to Microsoft.

More Info for Email Admins

From:	Sandy Slayton
To:	elizabeth-toombs@cherokee.org
Cc:	Elizabeth Krchnavek; Dylan Stankus; Lesley Brotkowski
Subject:	Lewis Ridge Project TCP Information Request (Bell County, KY)
Date:	Thursday, April 17, 2025 7:51:42 PM
Attachments:	image001.png 20250417 Lewis Ridge Pumped Storage TCP Information Request.pdf

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Good Afternoon,

Lewis Ridge Pumped Storage, LLC is conducting a cultural resources evaluation in support of a Federal Energy Regulatory Commission license application for the proposed Lewis Ridge Pumped Storage Project located in southeastern Kentucky. We'd like to request information related to Traditional Cultural Properties that may be located in the study area as outlined in the attached letter. We greatly appreciate any information you can share regarding the presence or absence of Traditional Cultural Properties and respectfully request your response by May 19, 2025. Please reach out to me with any questions or if you would like to discuss our request in more detail.

Sincerely,

Sandy Slayton

Rye
Development
Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From: Sandy Slayton
To: ddotson@delawarenation-nsn.gov
Cc: Elizabeth Krchnavek; Dylan Stankus; Lesley Brotkowski
Subject: Lewis Ridge Project TCP Information Request (Bell County, KY)
Date: Thursday, April 17, 2025 7:50:20 PM
Attachments: image001.png
20250417 Lewis Ridge Pumped Storage TCP Information Request.pdf

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Good Afternoon,

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Sincerely,

Sandy Slayton

Rye Development

Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From: Sandy Slayton
To: russtown@ebci-nsn.gov
Cc: Elizabeth Krchnavek; Dylan Stankus; Lesley Brotkowski
Subject: Lewis Ridge Project TCP Information Request (Bell County, KY)
Date: Thursday, April 17, 2025 7:49:35 PM
Attachments: image001.png
20250417 Lewis Ridge Pumped Storage TCP Information Request.pdf

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Good Afternoon,

Lewis Ridge Pumped Storage, LLC is conducting a cultural resources evaluation in support of a Federal Energy Regulatory Commission license application for the proposed Lewis Ridge Pumped Storage Project located in southeastern Kentucky. We'd like to request information related to Traditional Cultural Properties that may be located in the study area as outlined in the attached letter. We greatly appreciate any information you can share regarding the presence or absence of Traditional Cultural Properties and respectfully request your response by May 19, 2025. Please reach out to me with any questions or if you would like to discuss our request in more detail.

Sincerely,

Sandy Slayton

Rye Development
Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From: Sandy Slayton
To: dlankford@miamination.com
Cc: Elizabeth Krchnavek; Dylan Stankus; Lesley Brotkowski
Subject: Lewis Ridge Project TCP Information Request (Bell County, KY)
Date: Thursday, April 17, 2025 7:50:49 PM
Attachments: image001.png
20250417 Lewis Ridge Pumped Storage TCP Information Request.pdf

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Good Afternoon,

Lewis Ridge Pumped Storage, LLC is conducting a cultural resources evaluation in support of a Federal Energy Regulatory Commission license application for the proposed Lewis Ridge Pumped Storage Project located in southeastern Kentucky. We'd like to request information related to Traditional Cultural Properties that may be located in the study area as outlined in the attached letter. We greatly appreciate any information you can share regarding the presence or absence of Traditional Cultural Properties and respectfully request your response by May 19, 2025. Please reach out to me with any questions or if you would like to discuss our request in more detail.

Sincerely,

Sandy Slayton

Rye Development
Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From: Sandy Slayton
To: swaters@muscogeenation.com
Cc: Elizabeth Krchnavek; Dylan Stankus; Lesley Brotkowski
Subject: Lewis Ridge Project TCP Information Request (Bell County, KY)
Date: Thursday, April 17, 2025 7:50:38 PM
Attachments: image001.png
20250417 Lewis Ridge Pumped Storage TCP Information Request.pdf

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Good Afternoon,

Lewis Ridge Pumped Storage, LLC is conducting a cultural resources evaluation in support of a Federal Energy Regulatory Commission license application for the proposed Lewis Ridge Pumped Storage Project located in southeastern Kentucky. We'd like to request information related to Traditional Cultural Properties that may be located in the study area as outlined in the attached letter. We greatly appreciate any information you can share regarding the presence or absence of Traditional Cultural Properties and respectfully request your response by May 19, 2025. Please reach out to me with any questions or if you would like to discuss our request in more detail.

Sincerely,

Sandy Slayton

Rye
Development

Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From:	Sandy Slayton
To:	chiefharper@peoriatribe.com
Cc:	Elizabeth Krchnavek; Dylan Stankus; Lesley Brotkowski
Subject:	Lewis Ridge Project TCP Information Request (Bell County, KY)
Date:	Thursday, April 17, 2025 7:49:36 PM
Attachments:	image001.png 20250417 Lewis Ridge Pumped Storage TCP Information Request.pdf

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Good Afternoon,

Lewis Ridge Pumped Storage, LLC is conducting a cultural resources evaluation in support of a Federal Energy Regulatory Commission license application for the proposed Lewis Ridge Pumped Storage Project located in southeastern Kentucky. We'd like to request information related to Traditional Cultural Properties that may be located in the study area as outlined in the attached letter. We greatly appreciate any information you can share regarding the presence or absence of Traditional Cultural Properties and respectfully request your response by May 19, 2025. Please reach out to me with any questions or if you would like to discuss our request in more detail.

Sincerely,

Sandy Slayton

Rye Development
Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From: Sandy Slayton
To: mountainspirit67@yahoo.com
Cc: Elizabeth Krchnavek; Dylan Stankus; Lesley Brotkowski
Subject: Lewis Ridge Project TCP Information Request (Bell County, KY)
Date: Thursday, April 17, 2025 7:49:34 PM
Attachments: image001.png
20250417 Lewis Ridge Pumped Storage TCP Information Request.pdf

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Good Afternoon,

Lewis Ridge Pumped Storage, LLC is conducting a cultural resources evaluation in support of a Federal Energy Regulatory Commission license application for the proposed Lewis Ridge Pumped Storage Project located in southeastern Kentucky. We'd like to request information related to Traditional Cultural Properties that may be located in the study area as outlined in the attached letter. We greatly appreciate any information you can share regarding the presence or absence of Traditional Cultural Properties and respectfully request your response by May 19, 2025. Please reach out to me with any questions or if you would like to discuss our request in more detail.

Sincerely,

Sandy Slayton

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Development
Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From: Sandy Slayton
To: rcain@ukb-nsn.gov
Cc: Elizabeth Krchnavek; Lesley Brotkowski; Dylan Stankus
Subject: Lewis Ridge Project TCP Information Request (Bell County, KY)
Date: Thursday, April 17, 2025 7:49:34 PM
Attachments: image001.png
20250417 Lewis Ridge Pumped Storage TCP Information Request.pdf

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Lewis Ridge Pumped Storage, LLC is conducting a cultural resources evaluation in support of a Federal Energy Regulatory Commission license application for the proposed Lewis Ridge Pumped Storage Project located in southeastern Kentucky. We'd like to request information related to Traditional Cultural Properties that may be located in the study area as outlined in the attached letter. We greatly appreciate any information you can share regarding the presence or absence of Traditional Cultural Properties and respectfully request your response by May 19, 2025. Please reach out to me with any questions or if you would like to discuss our request in more detail.

Sincerely,

Sandy Slayton

Rye Development
Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

Rye Development

100 South Olive Ave., West Palm Beach, Florida 33401

April 17, 2025

VIA Email

Re: ***Request for Information on Traditional Cultural Properties within the Lewis Ridge Pumped Storage Project (FERC Project No. 15249) Study Area***

Dear Sir or Madam,

Lewis Ridge Pumped Storage, LLC (LRPS or Applicant) is the applicant for an original Federal Energy Regulatory Commission (FERC or Commission) license for the Lewis Ridge Pumped Storage Project (Lewis Ridge Project) (FERC No. 15249). The Lewis Ridge Project is a proposed pumped storage project in Bell County, Kentucky. LRPS filed a Pre-Application Document (PAD) and Notice of Intent (NOI) with FERC to seek an original license for the Lewis Ridge Project on October 21, 2022, and a Draft License Application (DLA) on September 30, 2024. A cultural resources evaluation is being conducted in the Lewis Ridge Project Study Area (Study Area) in 2025 to gather additional information for the Final License Application (FLA).

This letter is to request information related to Traditional Cultural Properties (TCPs) that may be located within the Study Area. The Study Area is shown in the attached figure . LRPS understands that resources identified during conventional archaeological surveys are not inclusive of those for which Native American Tribes have unique and special knowledge. Therefore, LRPS is requesting information to determine potential presence of TCPs located within the Study Area. While locations of TCPs are helpful for site evaluations, specific locations of TCPs will remain confidential as appropriate. Specific locations of TCPs, if provided, will be provided to FERC as Privileged information and excluded from public documents.

Please provide confirmation of the presence or absence of TCPs and number or locations of TCPs within the Study Area. We respectively request your response by May 19, 2025. If you would prefer to discuss any sensitive information in a phone call or meeting, please contact me by phone at (503) 341-1425 or email at sandy@ryedevelopment.com. Please also feel free to contact me directly with any comments or questions about this request. Thank you for your time and consideration of this information request.

Sincerely,

Sandra J Slayton

Sandy Slayton
Vice President
Rye Development

cc: TCP Distribution List
Lesley Brotkowski, Kleinschmidt Associates

Attachments:
TCP Distribution List
Figure – Lewis Ridge Project Study Area

TCP Distribution List

Elizabeth Toombs
Tribal Historic Preservation Officer
Cherokee Nation
P.O. Box 948
Tahlequah, Oklahoma 74465

Deborah Dotson
President
Delaware Nation
P.O. Box 825
Anadarko, Oklahoma 73005

Russell Townsend
Tribal Historic Preservation Officer
Eastern Band of Cherokee Indians
P.O. Box 455
Cherokee, North Carolina 28719

Douglas Lankford
Chief
Miami Tribe of Oklahoma
P.O. Box 1326
Miami, Oklahoma 74355-1326

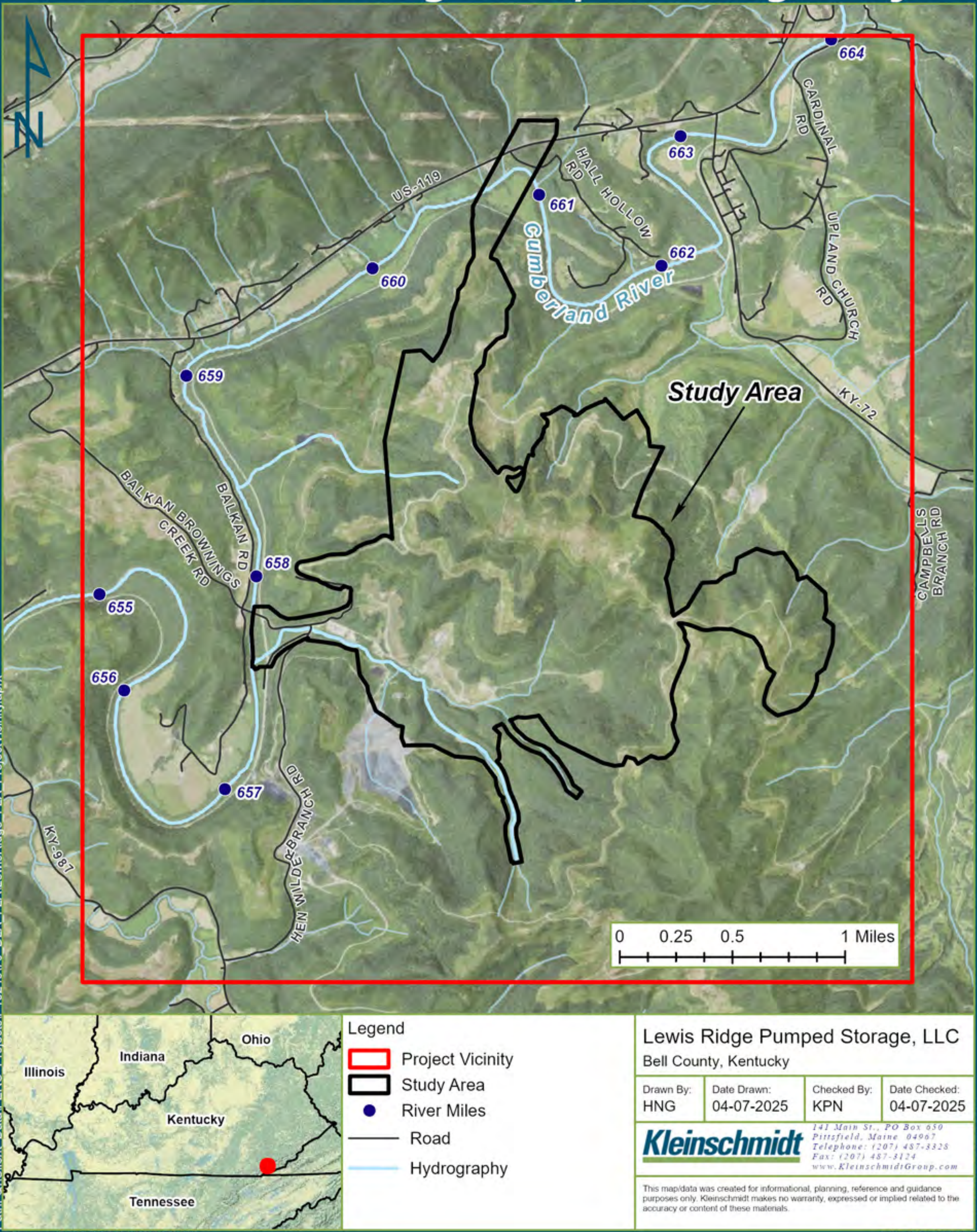
Savannah Waters
Tribal Historic Preservation Officer
Muscogee (Creek) Nation
P.O. Box 580
Okmulgee, Oklahoma 74447

Craig Harper
Chief
Peoria Tribe of Indians of Oklahoma
118 South Eight Tribes Trail
Miami, Oklahoma 74355

Doug Mountain Spirit
Chief
Southern Cherokee Nation of Kentucky

Roger Cain
Tribal Historic Preservation Officer
United Keetoowah Band of Cherokee
Indians in Oklahoma
P.O. Box 1425
Tahlequah, Oklahoma 74465

Lewis Ridge Pumped Storage Project



Lewis Ridge Pumped Storage, LLC

Bell County, Kentucky

Drawn By:	Date Drawn:	Checked By:	Date Checked:
HNG	04-07-2025	KPN	04-07-2025

Kleinschmidt

141 Main St., PO Box 650
Pittsfield, Maine 04967
Telephone: (207) 487-3328
Fax: (207) 487-3124
www.KleinschmidtGroup.com

This map/data was created for informational, planning, reference and guidance purposes only. Kleinschmidt makes no warranty, expressed or implied related to the accuracy or content of these materials.

Path: Q:\Client Data\FERC_Projects\P15249170_DLA_FLA\LewisRidge_FLA_ProjectVicinity.aprx

Date Printed: 4/8/2025

Source: NAIP 2017, USGS 2022

PN: 4178005.01

From:	Elizabeth Krchnavek
To:	scnkregistrar@gmail.com
Cc:	Sandy Slayton; Dylan Stankus; Lesley Brotkowski
Subject:	Lewis Ridge Project TCP Information Request (Bell County, KY)
Date:	Friday, April 18, 2025 3:19:00 PM
Attachments:	20250417 Lewis Ridge Pumped Storage TCP Information Request.pdf

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Good Afternoon,

Lewis Ridge Pumped Storage, LLC is conducting a cultural resources evaluation in support of a Federal Energy Regulatory Commission license application for the proposed Lewis Ridge Pumped Storage Project located in southeastern Kentucky. We'd like to request information related to Traditional Cultural Properties that may be located in the study area as outlined in the attached letter. We greatly appreciate any information you can share regarding the presence or absence of Traditional Cultural Properties and respectfully request your response by May 19, 2025. Please reach out with any questions or if you would like to discuss our request in more detail.

Additionally, could you please provide a current mailing address? It looks like the one we have on file (PO Box 481, Allen, KY 41601) is no longer active.

Thank you,

Elizabeth Krchnavek
Licensing Coordinator
Kleinschmidt
Cell: 571-230-6830
Office: 984-389-1086
www.KleinschmidtGroup.com

Lewis Ridge Pumped Storage Project, FERC P-15249

Meeting Summary

Date/Time: 4/25/2025 11:00 AM – 11:45 AM ET

Meeting Type: Virtual meeting via Teams

Attendees:

John Hast, Kentucky Department of Fish and Wildlife Resources (KYDFW)
Sandy Slayton, Lewis Ridge Pumped Storage, LLC (LRPS)
Randy Lamutt, AECOM
Lesley Brotkowski, Kleinschmidt Associates (Kleinschmidt)
Jared Porter, Kleinschmidt

Purpose:

Meeting to discuss elk and wildlife habitat considerations for the proposed Lewis Ridge Pumped Storage Project, FERC P-15249 (Lewis Ridge Project).

Project Overview:

- Sandy led introductions and provided an overview of the Lewis Ridge Project.
- The current design layout and renderings were reviewed. Randy noted that the penstock is proposed to be above ground level, extending from the upper reservoir to the lower reservoir.
- Lesley noted that revegetation of lands disturbed during construction and wildlife management would be described in the FERC license application and we wanted to work collaboratively to ensure our proposed measures were in line with KYDFW elk management goals.

Elk and Wildlife Habitat Considerations

- John stated that he's familiar with the Lewis Ridge Project property and has done a lot of work in mine country as the bear and elk program coordinator.
- KYDFW monitors collared elk present in the Lewis Ridge Project area and surrounding lands. Most of the collared elk in this area are females. Elk in Kentucky are not migratory but do move across large areas, sometimes in groups up to 100 to 150 individuals. Elk typically prefer grasslands but are also found in forested areas. Creation and management of grassland habitat at the Lewis Ridge Project may help to keep the elk out of the river bottoms, where they can sometimes congregate around pastures and alfalfa fields when forage is limited.
- John noted that elk are a good umbrella species, as grasslands created for elk provide habitat benefits for a variety of wildlife, including short eared owl, northern bobwhite, and other grassland obligate species. John has had good luck using hydroseeded warm season grass mixes, including Indian grass, big bluestem, side oats gramma, and little bluestem, but cool season grass mixes with fescue and weeping lovegrass also provide good forage for elk. Hydroseeding of warm season grasses has a higher cost than use of other seed

mixes, but warm season grasses seem to do a better job keeping out invasive species than the cool season grasses. He noted that autumn olive and lespedeza often invade grasslands and are a management challenge.

- KYDFW manages grasslands with a combination of prescribed burning and herbicide (including triclopyr) applications. Burns help to manage invasive species, but do not eliminate them entirely. Mowing during seed establishment and every 3 to 5 years thereafter is also a good grassland management tool. Burns in areas planted with warm season grasses have resulted in expansion of warm season grasses into surrounding area.
- John stated that elk are behaviorally plastic and able to adapt to human activity from mine and construction activities, and noise during construction is not a concern for elk. Given the mobility of elk and bears, he did not see a need for installation of wildlife crossings at the Lewis Ridge Project. He noted that these animals cover large areas, and the penstock would not be an impediment to movement as they would be able to go around the project facilities.
- Potential use of a wildlife exclusion fence around the lower reservoir was discussed. An AC liner is proposed along the bottom of the reservoir, with the normal water line 20’-30’ below the ground surface. John noted that water is not a limiting factor in Kentucky, as wildlife are able to access water from nearby rivers, creeks, and ponds. Given the availability of water and unnatural surface and distance between the shoreline and water, it was noted that animals are unlikely to be attracted to the lower reservoir and exclusion fencing may not be needed.

Next Steps

- Lesley requested John provide information on elk distribution near the Lewis Ridge Project, potential seed mixes, and management recommendations.
- LRPS will incorporate elk and wildlife recommendations into the FERC License Application to be filed in June 2025 and include John on the distribution list.

KENTUCKY HERITAGE COUNCIL COVER SHEET FOR SECTION 106 SUBMISSIONS

If you are applying for federal funds or permits, **we want to help you with your project** as early in the process as possible. Our reviewers need up to 30 days to review and provide comments on our submission. DON'T WAIT! Visit our webpage and submit your documentation to the INHERIT portal: https://heritage.ky.gov/compliance/Pages/overview.aspx.

Contact Nicole via email with questions or concerns: Nicole.Konkol@ky.gov.

SECTION 1: APPLICANT INFORMATION

Project Applicant: Lewis Ridge Pumped Storage, LLC

Contact Person (name & position)**:** Sandy Slayton

Return Address: 1455 SW Broadway Street, Suite 290, Portland, Oregon 97201

Telephone: (206) 919-3976 **E-mail:** sandy@ryedevelopment.com

Project Title: Lewis Ridge Pumped Storage Project, FERC P-15249

SECTION 2: AGENCY INFORMATION

Funding/Permitting Agency: Federal Energy Regulatory Commission

Agency Contact Person (name & position)**:** Michael Spencer

Telephone: (202) 502-6093 **E-mail:** michael.spencer@ferc.gov

SECTION 3: PROJECT LOCATION

Street Address (or other location)**:** Please see coordinates

City: near Blackmont, Tejay, Balkan, and Callaway **County:** Bell County, KY

Lat (Dec/Deg): 36.761074 **Long (Dec/Deg):** -83.548854

SECTION 4: PROJECT TYPE (please check all that apply)

Proposed Activity: ☐ Demolition ☐ Rehabilitation ☐ Structural Relocation ☐ Trails

☒ New Construction ☐ Land and/or Building Acquisition ☐ Sewer/Water Lines ☐ Roads/Bridges

☐ Non-Construction Planning/Refinancing ☐ Other (describe):

SECTION 5: IDENTIFICATION OF KNOWN HISTORIC PROPERTIES

OSA Preliminary Site Check #: P45988

Provide a detailed description of your project. If necessary, include it in your pdf attachments.

This is a supplemental submittal is related to a proposed unconstructed pumped storage facility, Lewis Ridge Pumped Storage Project (FERC P-15249), requesting formal review and concurrence of proposed APE. Previous associated submittals include the information as required in Section 6.

Is there anything over 50 years of age in or visible from the project location? ☒ **Yes** ☐ **No**

SECTION 6: ATTACHMENTS - Attach All.

All documentation should be labeled with the project name or site address.

- ☒ Clear, current photographs of the project site and anything over 50 years of age in or visible from it.
- ☒ Site map/plan indicating the exact location and boundaries of the project area.
- ☒ Detailed description of the project (may include plans, scope of work, and other available information.)
- ☒ Documentation of prior ground disturbance (e.g. maps, photographs, underground utility plans, etc.)
- ☒ Any known information about the history/use of the property and local significance.
- ☑ Results of your Preliminary Records Review from the Site Identification web portal.

Submit all information via the INHERIT portal. Submission of initial Section 106 documentation to any individual reviewer will delay distribution and review.

Rye Development

100 South Olive Ave., West Palm Beach, Florida 33401

May 9, 2025

Craig Potts
Executive Director and State Historic Preservation Officer
Kentucky Heritage Council
The Barstow House
410 High Street
Frankfort, Kentucky 40601

Patricia E. Hutchins
Archaeology Review Coordinator
Kentucky Heritage Council
410 High Street
Frankfort, Kentucky 40601

Re: Request for Review and Concurrence of Area of Potential Effects (APE) for the Proposed Lewis Ridge Pumped Storage Project, FERC Project No. 15249

Dear Sir or Madam:

This letter is to request review and concurrence of the proposed Area of Potential Effects (APE) for the Lewis Ridge Pumped Storage Project (Lewis Ridge Project) (FERC No. 15249). Lewis Ridge Pumped Storage, LLC (LRPS or Applicant) is the Applicant for the Lewis Ridge Project. The Lewis Ridge Project is a proposed, unconstructed pumped storage project in Bell County, Kentucky with an anticipated power output capacity of 266 megawatts (MW) of renewable energy storage. The Lewis Ridge Project would involve the construction of new water storage, water conveyance, and electric generation facilities. The land on which the Lewis Ridge Project reservoirs are proposed is land that has been used for both underground and surface mining. The Applicant is using the Federal Energy Regulatory Commission's (FERC) Traditional Licensing Process (TLP) as established in FERC regulations, Title 18 of the US CFR, Part 4, to apply for an original license.

On November 19, 2021, LRPS applied to FERC for a preliminary permit for the Lewis Ridge Project, and on March 3, 2022, the FERC issued a preliminary permit. LRPS filed a Pre-Application Document (PAD) and Notice of Intent (NOI) to seek an original license for the Lewis Ridge Project on October 21, 2022. LRPS distributed a Draft Study Plan to FERC, resource agencies, Tribes, and stakeholders on June 13, 2024, which included a cultural resources evaluation. LRPS filed a Revised Study Plan with FERC on August 16, 2024. LRPS filed its Draft

License Application (DLA) on September 30, 2024. The Environmental Report (Exhibit E) of the DLA included the archaeological survey and cultural historic survey reports.

Since filing the DLA, engineering design has advanced, and some project features have shifted. As such, additional archaeological and cultural historic surveys have been conducted in a revised 2025 Study Area. A Final License Application (FLA) for an original license for the Lewis Ridge Project is being prepared and is anticipated to include the results of the updated archaeological and cultural historic surveys. Design specifications associated with the Lewis Ridge Project will continue to advance and should be considered preliminary.

This letter formally requests the SHPO review and concurrence of the proposed two phased APE for the Lewis Ridge Project: 1) design and construction; and 2) operations. During Phase 1 - design and construction, the proposed APE is the 2025 Study Area, as defined on Figure 1 (Attachment 1). The 2025 Study Area includes the anticipated limits of disturbance during construction and additional lands that were studied during the cultural resource evaluations due to the potential for project features to shift as engineering design advances. When construction is complete, LRPS proposes that the Phase 2 operations APE would be defined as the FERC Project Boundary, as approved in the FERC license, for the duration of the license term. The FERC Project Boundary as currently proposed is outlined in Figure 2 (Attachment 2). The FERC Project Boundary is the geographic extent of the hydropower project that FERC determines a licensee must control on behalf of its licensed hydropower project.

We respectfully request your review and concurrence of the proposed APE (Phase 1 and Phase 2) for the Lewis Ridge Project by June 9, 2025. If you have any questions regarding this request, please contact me by phone at (503) 341-1425 or email at sandy@ryedevelopment.com.

Sincerely,

Sandra J Slayton

Sandy Slayton
Vice President
Rye Development

Attachments: Figure 1 –Lewis Ridge Project Design and Construction APE – Phase 1
Figure 2 –Lewis Ridge Project Operation APE – Phase 2

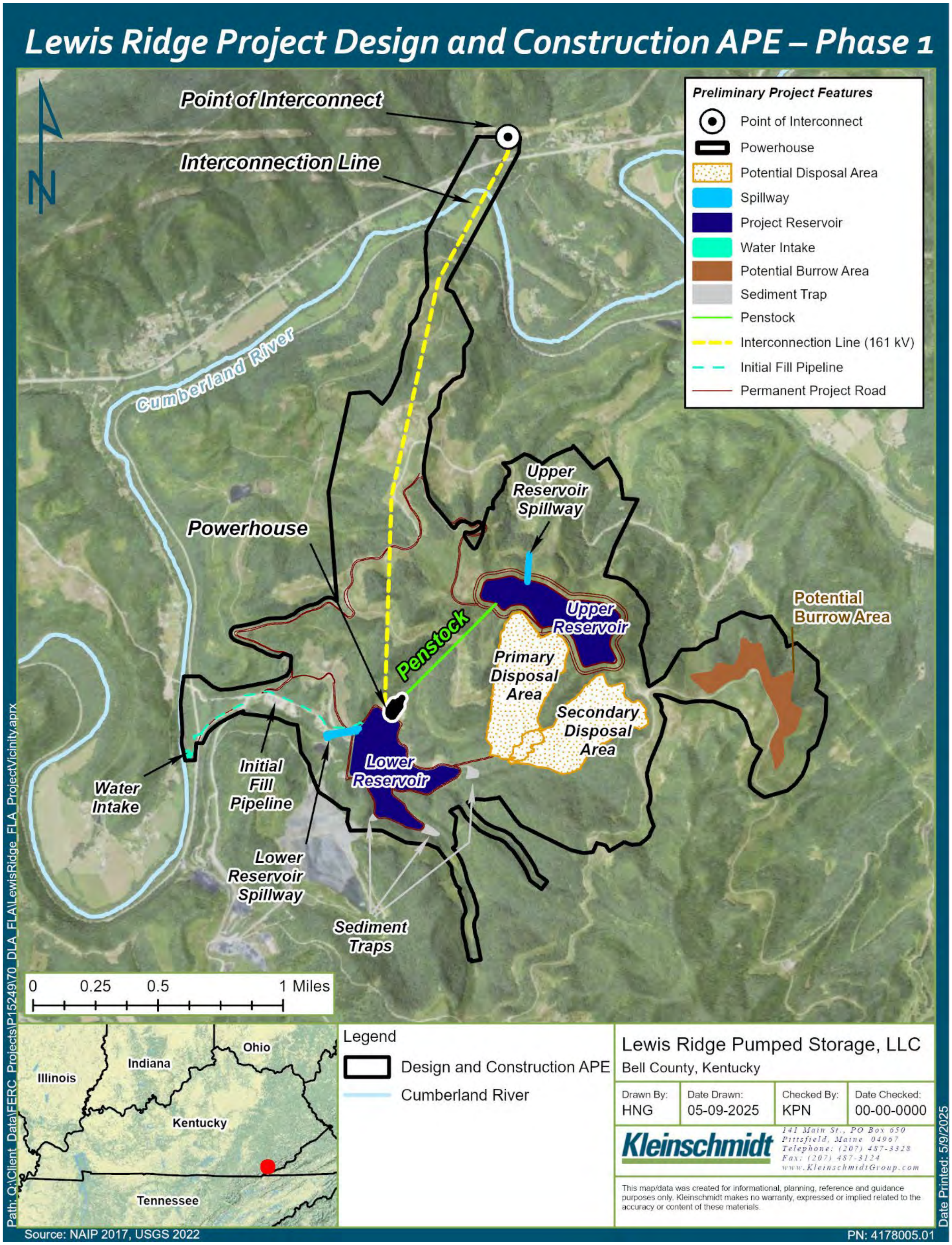
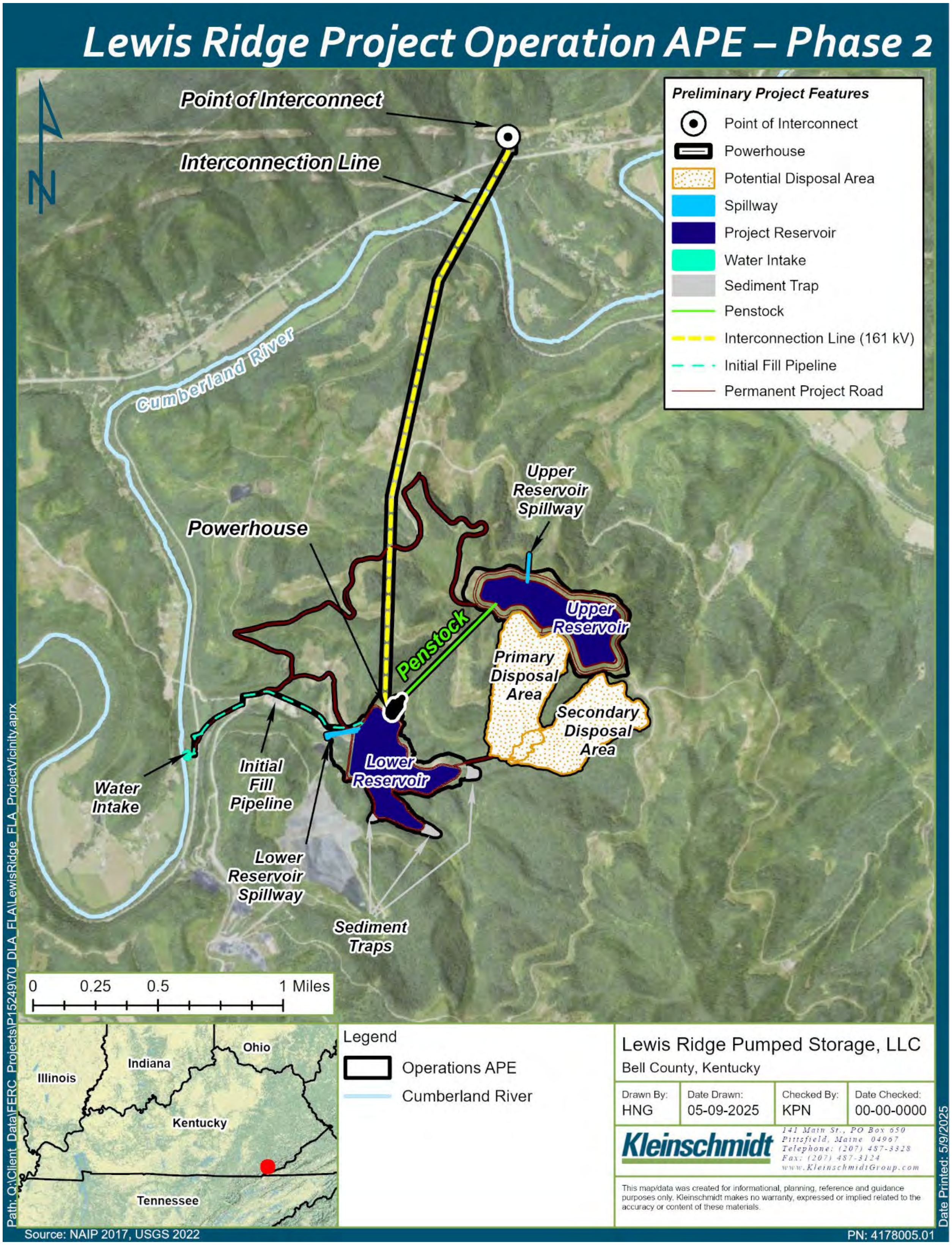


Figure 1 –Lewis Ridge Project Design and Construction APE – Phase 1



Source: NAIP 2017, USGS 2022

Figure 2 –Lewis Ridge Project Operation APE – Phase 2

From: Lesley Brotkowski
To: Hast, John T (FW)
Subject: RE: Lewis Ridge Pumped Storage Project - Elk Habitat Considerations
Date: Tuesday, May 20, 2025 11:52:00 AM
Attachments: image001.jpg
image004.jpg
image005.gif

Thank you, John. This information is very helpful since you have first-hand experience as to what has worked well on the landscape.

Have a nice week,
Lesley

From: Hast, John T (FW) <John.Hast@ky.gov>
Sent: Tuesday, May 20, 2025 10:37 AM
To: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Subject: RE: Lewis Ridge Pumped Storage Project - Elk Habitat Considerations

Lesley,

My apologizes for the delay!

I have attached a map of six years of locations from the Balkan elk herd that resides on and near the Lewis Ridge Project site. This herd uses a large area and will not likely be impacted by any construction in the area as they have plenty of great habitat just to the south of the project area. This map also points out the importance of the early successional areas created by mining practices. As we discussed, reseeding of disturbed areas will certainly attract elk back to the project area.

I have recently been exploring a seed mix to promote native grass and forbes on the mine land we are impacting with prescribed fire and have had some good discussion with Roundstone seed company, a leading native seed producer in our region.

The link below goes directly to a seed mix they have produced for mine and gas well sites. We intend to try this mix later this summer on some areas that we burn down to prepare for planting.
https://roundstoneseed.com/erosion-control-mixes/1553-mix-201-native-strip-mine-gas-production-site-mix.html

For maintenance with herbicide, I have tested and recommend the following:

Using ground spray equipment (i.e., UTV with boomless sprayer in my case):

1. Pasturegaurd at a 1% tank mix, applied with 10 gallons was water per acre with a non-ionic surfactant mixed per the label applied in May or June.
2. Pasturegaurd at a 1.5% tank mix, applied with 10 gallons of water per acre with a non-ionic

surfactant mixed per the label applied July to September.

3. Remedy Ultra at a 1.5% tank mix, applied with 10 gallons was water per acre with a non-ionic surfactant mixed per the label applied May to September.

Using an aerial application:

1. Remedy Ultra at 32oz per acre applied with 5 gallons of water per acre (low volume, high concentration seems to work best).

Thanks,
J. Hast

John Hast, Ph.D.
Bear and Elk Program Coordinator
Kentucky Department of Fish and Wildlife Resources
1 Sportsman's Lane, Frankfort, KY 40601
502-892-4533 (office) │ John.Hast@ky.gov

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From: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Sent: Thursday, May 8, 2025 11:44 AM
To: Hast, John T (FW) <John.Hast@ky.gov>
Cc: Sandy Slayton <sandy@ryedevelopment.com>; Jared Porter <Jared.Porter@KleinschmidtGroup.com>; Catron, Matt (FW) <Matt.Catron@ky.gov>
Subject: RE: Lewis Ridge Pumped Storage Project - Elk Habitat Considerations

Good morning, John,

We're working on finalizing documents for our upcoming FERC License Application. Could you please provide us with your recommended elk habitat seed mix, management recommendations, and elk habitat distribution information?

Thank you!
Lesley

From: Lesley Brotkowski
Sent: Friday, April 25, 2025 11:56 AM
To: Hast, John T (FW) <John.Hast@ky.gov>
Cc: Sandy Slayton <sandy@ryedevelopment.com>; Lamutt, Randy <randy.lamutt@aecom.com>; Jared Porter <Jared.Porter@KleinschmidtGroup.com>; Dylan Stankus <dylan@ryedevelopment.com>; Catron, Matt (FW) <Matt.Catron@ky.gov>
Subject: RE: Lewis Ridge Pumped Storage Project - Elk Habitat Considerations

John,

Thank you for taking the time to meet with us this morning to discuss elk and wildlife considerations for the Lewis Ridge Project. We appreciate your insights and offer to provide elk distribution information, seed mix, and management recommendations. This information will be useful for development of enhancement measures in the FERC license application.

Have a nice weekend,
Lesley

From: Catron, Matt (FW) <Matt.Catron@ky.gov>
Sent: Tuesday, April 22, 2025 1:04 PM
To: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>; Hast, John T (FW) <John.Hast@ky.gov>
Cc: Sandy Slayton <sandy@ryedevelopment.com>; Lamutt, Randy <randy.lamutt@aecom.com>; Jared Porter <Jared.Porter@KleinschmidtGroup.com>; Dylan Stankus <dylan@ryedevelopment.com>
Subject: Re: Lewis Ridge Pumped Storage Project - Elk Habitat Considerations

Hello Lesley,

I have talked to John Hast, and he would be available all day tomorrow, Thursday evening, and Friday. I have also added him on this email.

Thanks,

Matt

Matt Catron
Regional Wildlife Biologist III
Department of Fish and Wildlife Resources
135 Realty Lane Somerset, Ky 42501
606-677-1098 or 606-416-9550 | matt.catron@ky.gov

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From: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>
Sent: Tuesday, April 22, 2025 10:14 AM
To: Catron, Matt (FW) <Matt.Catron@ky.gov>
Cc: Sandy Slayton <sandy@ryedevelopment.com>; Lamutt, Randy <randy.lamutt@aecom.com>; Jared Porter <Jared.Porter@KleinschmidtGroup.com>; Dylan Stankus <dylan@ryedevelopment.com>
Subject: RE: Lewis Ridge Pumped Storage Project - Elk Habitat Considerations

This Message Originated from Outside the Organization
You have not previously corresponded with this sender.

Report Suspicious

Good morning, Matt,

We're following up on our request for a meeting to discuss elk habitat considerations for the proposed Lewis Ridge Pumped Storage Project. Would you prefer we reach out to one of your elk specialists directly? We see John Hast and Dan Crank listed on some of the available elk resources online, so could reach out to one of them directly unless you recommend a specific individual.

Thank you!
Lesley

From: Lesley Brotkowski
Sent: Thursday, April 10, 2025 4:39 PM
To: matt.catron@ky.gov
Cc: Sandy Slayton <sandy@ryedevelopment.com>; Lamutt, Randy <randy.lamutt@aecom.com>; Jared Porter <Jared.Porter@KleinschmidtGroup.com>; Dylan Stankus <dylan@ryedevelopment.com>

Subject: Lewis Ridge Pumped Storage Project - Elk Habitat Considerations

Hi Matt,

Lewis Ridge Pumped Storage, LLC is in the process of developing a Final License Application for the proposed Lewis Ridge Pumped Storage Project in Bell County, KY. The project is in the Kentucky Elk Restoration Zone and elk are known to occur at this site. We are considering options to enhance elk habitat in our vegetation management plan and wildlife management plan.

We would appreciate consultation with elk specialists within your agency to discuss elk habitat and potential wildlife crossing recommendations. Please let me know your availability for a virtual meeting during the week of April 14th or 21st and I'll coordinate a meeting with our team.

Thank you,

Lesley Brotkowski
Senior Regulatory Advisor
Kleinschmidt
Office: 715-318-3729
www.KleinschmidtGroup.com

From: Elizabeth Krchnavek
To: russell@willard-oh.com
Subject: Request for updated mailing address for the Southern Cherokee Nation of Kentucky
Date: Thursday, May 22, 2025 2:32:00 PM

Good Afternoon,

I am reaching out to request an updated mailing address for the Southern Cherokee Nation of Kentucky for inclusion on the distribution list associated with the licensing of the proposed Lewis Ridge Pumped Storage Project (FERC Project No. 15249). The Lewis Ridge Project is a proposed, unconstructed pumped storage hydroelectric generating facility located in Bell County, Kentucky. It appears that the mailing address currently on file—P.O. Box 481, Allen, KY 41601—is no longer active. We would appreciate it if you could confirm the correct and current mailing address at your earliest convenience.

Thank you for your assistance.

Best regards,

Elizabeth Krchnavek
Licensing Coordinator
Kleinschmidt
Cell: 571-230-6830
Office: 984-389-1086
www.KleinschmidtGroup.com

ANDY BESHEAR
GOVERNOR

JACQUELINE COLEMAN
LT. GOVERNOR

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL
THE STATE HISTORIC PRESERVATION OFFICE
410 HIGH STREET
FRANKFORT, KENTUCKY 40601
(502) 564-7005
www.heritage.ky.gov

LINDY CASEBIER
SECRETARY

CRAIG A. POTTS
EXECUTIVE DIRECTOR &
STATE HISTORIC PRESERVATION OFFICER

June 4, 2025

Sandy Slayton
Vice President, Rye Development
100 South Olive Ave.
West Palm Beach, Florida 33401
Via email: sandy@ryedevelopment.com

RE: FERC; FERC P-15249; Lewis Ridge Pumped Storage, LLC; Bell County, KY

Dear Ms. Slayton,

Thank you for your submission of documents related to the above-referenced project. We understand that in September of 2024, Lewis Ridge Pumped Storage, LLC (LRPS) filed a Draft License Application with FERC for the construction of a closed loop pumped storage hydroelectric generating facility in Bell County, near Blackmont, Tejay, Balkan, and Callaway and near River Mile 659 of the Cumberland River. Since that time, project plans have changed, and an altered area of potential effect (APE) is proposed.

LRPS proposes a Phase 1 APE for the construction area and a Phase 2 APE for operations. The Phase 1 APE includes the full limits of disturbance during construction as well as a buffer. The Phase 2 APE includes the geographic extent of the hydropower project that FERC determines a licensee must control on behalf of its licensed hydropower project and will apply after construction is complete and through the duration of the license term. Our office has reviewed the proposed revisions and **concurs** with the delineation of the updated areas of potential effect.

We look forward to continued consultation regarding this proposed undertaking, including an opportunity to comment on the archaeological and cultural historic surveys conducted for the revised APEs. Please contact Patti Hutchins or Sarah Jackson of my staff with any questions or concerns at Patricia.Hutchins@ky.gov or Sarah.McCarttJackson@ky.gov.

Sincerely,

Craig Potts
Executive Director and
State Historic Preservation Officer

KHC# 250891, prev. 66139,
220208, 220598, 250195
CP: peh, smj

From: McCartt-Jackson, Sarah (Heritage Council) <sarah.mccarttjackson@ky.gov>
Sent: Wednesday, June 11, 2025 4:58 AM
To: Sandy Slayton <sandy@ryedevelopment.com>
Cc: Hutchins, Patricia (Heritage Council) <patricia.hutchins@ky.gov>
Subject: RE: FERC; FERC P-15249; Lewis Ridge Pumped Storage, LLC; Bell County, KY

You don't often get email from sarah.mccarttjackson@ky.gov. Learn why this is important

Ms. Slayton,

Please see the attached transmittal letter regarding the above-referenced undertaking.

Thank you,
Sarah

Sarah Jackson
Historic Preservation Coordinator
Kentucky Heritage Council
410 High Street
Frankfort, Kentucky 40601

Moving forward please submit all Section 106 documentation to our online portal, INHERIT that is live on our webpage now. **Beginning February 1, 2025, the KHC.Section106@ky.gov email address will no longer be monitored.**

Useful links for preliminary records reviews are provided below:
Preliminary Records Review for Above Ground Resources: https://heritage.ky.gov/historic-places/resources-survey/prelim/Pages/default.aspx

Preliminary Records Review for Archaeological Resources:
https://anthropology.as.uky.edu/recorded-archaeological-sites

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Secretary

Craig A. Potts
Executive Director &
State Historic Preservation Officer

June 4, 2025

Sandy Slayton
Vice President, Rye Development
100 South Olive Ave.
West Palm Beach, Florida 33401
Via email: sandy@ryedevelopment.com

RE: FERC; FERC P-15249; Lewis Ridge Pumped Storage, LLC; Bell County, KY

Dear Ms. Slayton,

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Sincerely,

Craig Potts
Executive Director and
State Historic Preservation Officer

KHC# 250891, prev. 66139,
220208, 220598, 250195
CP: peh, smj

APPENDIX B

WATER QUALITY MONITORING PLAN

WATER QUALITY MONITORING PLAN

LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

Prepared for:
Lewis Ridge Pumped Storage, LLC

Prepared by:
Kleinschmidt Associates

June 2025

Kleinschmidt

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DEFINITIONS OF TERMS, ACRONYMS, AND ABBREVIATIONS

Applicant	Lewis Ridge Pumped Storage, LLC
BMP	best management practice
°C	degrees Celsius
CFR	Code of Federal Regulations
cfs	cubic feet per second
CDS	Cumberland Downstream
CUS	Cumberland Upstream
DO	dissolved oxygen
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
KAR	Kentucky Administrative Code
Lewis Ridge Project	Lewis Ridge Pumped Storage Project, FERC P-15249
LRPS	Lewis Ridge Pumped Storage, LLC
mg/L	milligrams per liter
ml	milliliter(s)
PM&E	protection, mitigation, and enhancement measures
Project Vicinity	The general geographic area in which the proposed Lewis Ridge Project will be located, as indicated on the Project Vicinity figures.
RM	river mile
TDS	total dissolved solids
TF1	Tom Fork 1
TF2	Tom Fork 2
TSS	total suspended solids
WQMP	Water Quality Monitoring Plan

1.0 INTRODUCTION

Lewis Ridge Pumped Storage, LLC (Applicant or LRPS) is filing with the Federal Energy Regulatory Commission (FERC) a Water Quality Monitoring Plan (WQMP) for the Lewis Ridge Pumped Storage Project (FERC No. 15249) (Lewis Ridge Project). The Lewis Ridge Project is a proposed, unconstructed pumped storage hydroelectric generating facility located in Bell County, Kentucky, on land that has been used for both underground and surface coal mining. Development of the Lewis Ridge Project will involve construction of new water storage, water conveyance, and electric generation facilities.

This WQMP has been developed for submittal to FERC with the Lewis Ridge Project's Final License Application (FLA). The purpose of this WQMP is to present monitoring methods for evaluating water quality and compliance with standards before and during construction and during operation of the Lewis Ridge Project.

2.0 BACKGROUND INFORMATION

The Lewis Ridge Project site is located in Bell County, Kentucky, which is in southeast Kentucky, near the borders of Tennessee and Virginia, near river mile (RM) 657.5 of the Cumberland River (Figure 2-1). Construction of the Lewis Ridge Project will consist of: a rocky earthfill dam and associated upper reservoir with an integrated overflow emergency spillway; a steel penstock; a powerhouse; an earthfill embankment dam and associated lower reservoir with an integrated overflow emergency spillway; an overhead interconnection line; and an intake and water supply pipeline to the lower reservoir for initial fill and periodic recharge. Proposed Lewis Ridge Project features are shown on Figure 2-1.

The proposed lower reservoir will be located within a valley that contains Tom Fork, a tributary to the Cumberland River. Tom Fork is an approximately 9,300-foot (1.8 river mile) perennial stream. Tom Fork flows to the northwest and west to its confluence with the Cumberland River and has a drainage area of approximately 2.6 square miles (U.S. Geological Survey 2024). The drainage area of the Cumberland River at the confluence with Tom Fork is approximately 472 square miles (AECOM 2025).

The designated uses applicable to the Cumberland River and Tom Fork are warm water aquatic habitat, primary contact recreation, secondary contact recreation, domestic water supply, and fish consumption (Kentucky Administrative Code [KAR] 2022). Applicable water quality standards for the Cumberland River and Tom Fork are summarized in Table 2-1.

Table 2-1: Water Quality Standards Applicable to the Project Vicinity

Parameter	Standard
pH	6.0-9.0; shall not fluctuate by more than 1.0 pH unit over a 24-hour period
Temperature	<31.7 degrees Celsius (°C) (<89.0° Fahrenheit)
Dissolved Oxygen (DO) milligrams per liter (mg/L)	Minimum 5.0 mg/L daily average; Instantaneous minimum 4.0 mg/L
Alkalinity	As $CaCO_3$, shall not be reduced by more than 25 percent
Total Dissolved Solids (TDS), Total Suspended Solids, or Specific Conductance	Shall not be changed to the extent that the indigenous aquatic community is adversely affected Human Health (domestic water supply): TDS 250,000 µg/L (250 mg/L)
Iron[a]	Human Health (domestic water supply): 300 µg/L (0.3 mg/L); Warm Water Aquatic Habitat: Acute – 4,000 µg/L (4 mg/L), Chronic – 1,000 µg/L (1 mg/L)
Sulfate	Human Health (domestic water supply): 250,000 (µg/L) (250 mg/L)
Copper[b,c,d]	Human Health (domestic water supply): 1,300 (µg/L) (1.3 mg/L); Warm Water Aquatic Habitat: Acute – 14 µg/L; Chronic – 9.3 µg/L
Lead[b,c,d]	Human Health (domestic water supply): 15 (µg/L) (0.015 mg/L); Warm Water Aquatic Habitat: Acute – 65 µg/L, Chronic – 2.5 µg/L
Manganese (secondary standard)[e]	50 µg/L (0.05 mg/L)

Source: 40 CFR Part 141, KAR 2022; USEPA 2024a, 2024b

[a] The chronic criterion for iron shall not exceed three and five tenths (3.5) mg/L (thirty-five hundred µg/L) if aquatic life has not been shown.

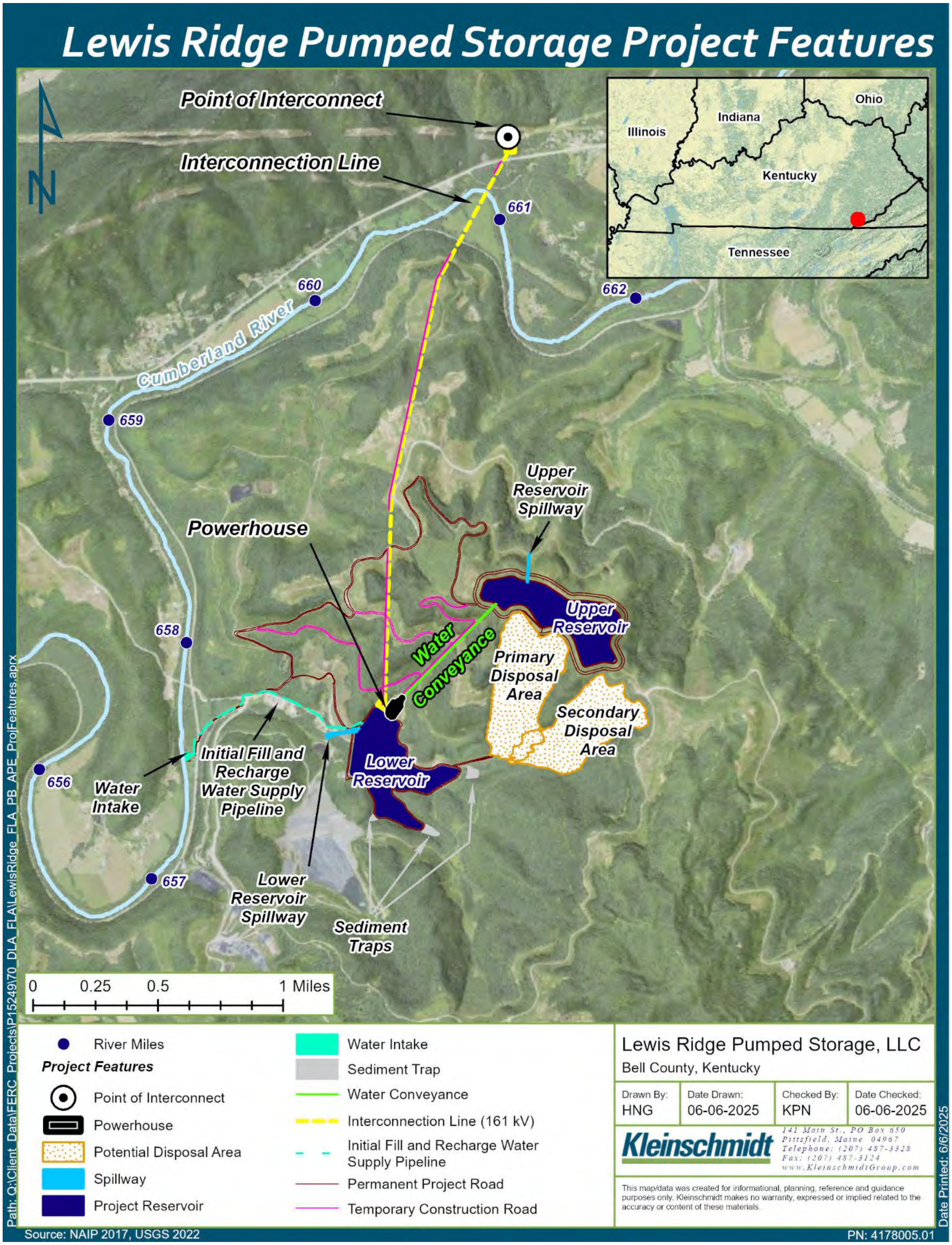
[b] Acute criteria = protective of aquatic life based on one (1) hour exposure that does not exceed the criterion for a given pollutant.

[c] Chronic = protective of aquatic life based on ninety-six (96) hour exposure that does not exceed the criterion of a given pollutant more than once every three (3) years on average.

[d] The acute and chronic criteria are based on a hardness (as carbonate) level of 100 mg/L.

[e] Secondary drinking water standards are guidelines for aesthetic purposes and are not enforceable.

Figure 2-1: Lewis Ridge Project Features



Source: NAIP 2017, USGS 2022

3.0 GOALS AND OBJECTIVES

The goal of this WQMP is to describe the proposed methods for characterizing baseline water quality conditions and for monitoring water quality during operation in the Project reservoirs and receiving streams (i.e., Tom Fork and Cumberland River). Water quality data will be collected and evaluated to characterize baseline conditions and to verify compliance with applicable water quality standards. Specific objectives of the WQMP include:

- Characterize baseline water quality conditions in the Cumberland River and Tom Fork by collecting data for multiple parameters (e.g., water temperature, dissolved oxygen [DO], pH, metals, specific conductance); and
- Verify compliance with water quality standards in the Tom Fork, the Cumberland River, and the reservoirs during normal operations.

LRPS will develop and implement best management practices (BMPs) and several protection, mitigation, and enhancement (PM&E) measures (i.e., stream buffers, Erosion and Sediment Control Plan, Stormwater Pollution Protection Plan) to minimize and avoid effects from construction activities on the quality of water in Tom Fork and the Cumberland River. The control plans will be developed prior to initiation of construction. LRPS will conduct water quality monitoring during construction in accordance with permit requirements.

4.0 METHODS

4.1 Parameters, Sampling Locations, and Frequency

4.2 Baseline

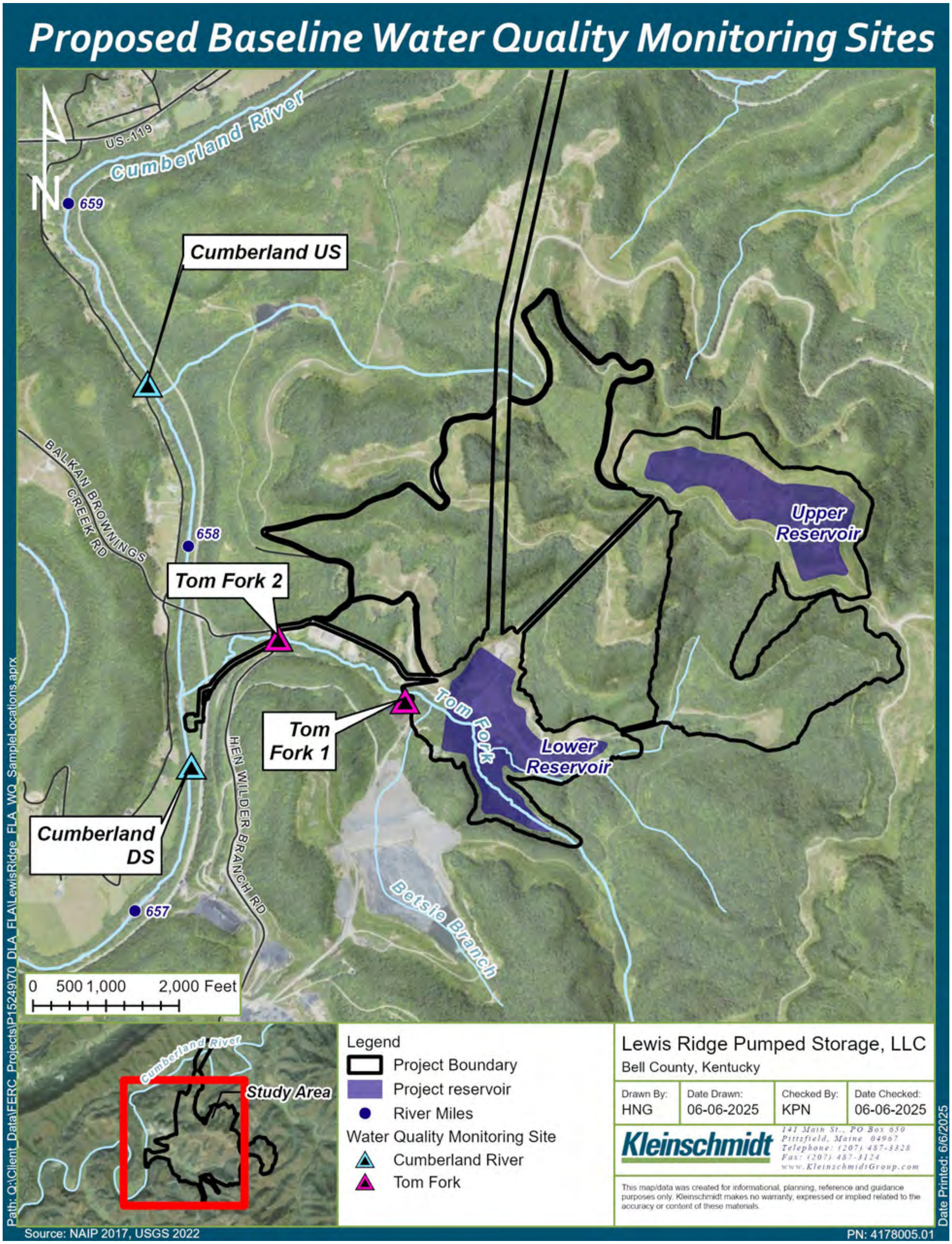
There is limited water quality information currently available for Tom Fork and the reach of the Cumberland River near the confluence with Tom Fork. LRPS proposes to collect data for several water quality parameters to characterize the typical levels and concentrations that currently exist in Tom Fork and the Cumberland River for a period of 12 months prior to initiation of Project construction.

LRPS initiated water quality monitoring at two sites in Tom Fork and two sites in the Cumberland River in March 2025 to establish baseline conditions of water temperature, DO, pH, and several parameters that may be present due to previous mining activities (Figure 4-1). Tom Fork 1 (TF1) is approximately 0.63 river miles (3,330 feet) upstream of the confluence with the Cumberland River at a culvert crossing under an access road. This site is located approximately where the proposed lower reservoir spillway and low level outlet will discharge into Tom Fork. Tom Fork 2 (TF2) is approximately 0.28 river miles (1,470 feet) upstream of the confluence with the Cumberland River where Hen Wilder Road crosses Tom Fork at a bridge. This monitoring site corresponds to the approximate location where the initial fill and recharge water supply pipeline will cross Tom Fork.

Cumberland Upstream (CUS) is on the Cumberland River approximately 0.82 river miles (4,345 feet) upstream of the confluence with Tom Fork and approximately 300 feet upstream of the confluence with Dry Branch. Cumberland Downstream (CDS) is approximately 0.2 river miles (1,070 feet) downstream of the confluence of Tom Fork with the Cumberland River and approximately 600 feet downstream of the proposed intake location. The two monitoring sites in the Cumberland River (CUS and CDS) will represent the water quality before and after Tom Fork enters the Cumberland River, respectively.

Once per month, LRPS proposes to collect a measurement of water temperature (degrees Celsius) and DO, and to collect water samples for analysis of pH, total alkalinity, acidity, total and dissolved iron, total and dissolved manganese, lead, copper, specific conductance, total sulfate, total suspended solids (TSS), and total dissolved solids (TDS) at each of the four monitoring sites.

Figure 4-1: Water Quality Monitoring Sites



4.3 Operation

After the Lewis Ridge Project is operational, LRPS proposes to perform short term and long-term water quality monitoring to assess potential effects of project operation on water quality in the reservoirs, in Tom Fork, and in the Cumberland River. The short-term monitoring will be completed during the first year of normal project operations (i.e., typical 24-hour operating cycle). Once per month, LRPS proposes to record water temperature, DO, and pH and to collect water samples from TF1, TF2, CUS, CDS, and a tap off the penstock in the powerhouse for analysis of alkalinity, acidity, specific conductance, TDS, TSS, sulfate, and metals (e.g., iron, lead, copper, manganese). The results will be compared to the baseline conditions to evaluate any changes that may be associated with project operation.

LRPS will initiate long-term monitoring during the second year of normal project operations. Long-term monitoring will continue throughout project operations. The long-term monitoring parameters include water temperature, DO, and pH. Once per month, LRPS will collect a measurement of the long-term parameters from the penstock tap. The penstock monitoring location is considered representative of water within both the upper and lower reservoirs because the water will be cycled between the reservoirs daily. Sampling will be completed in accordance with Kentucky Department for Environmental Protection Division of Water standard operating procedures (i.e., *Water Quality Sampling in Lakes and Reservoirs* [Kentucky Energy and Environment Cabinet {Kentucky EEC} 2016], *Sampling Surface Water Quality in Lotic and Wetland Systems* [Kentucky EEC 2022]).

4.4 Measurement Methods

4.4.1 Field Parameters

Water temperature, DO, and pH will be measured with a calibrated handheld meter.

4.4.2 Laboratory Methods

Samples for laboratory analysis will be collected and analyzed by an accredited local laboratory. The laboratory methods, detection limits, and reporting limits are shown in Table 5-1.

Table 5-1: Laboratory Analytical Methods

Parameter	Method Detection Limit	Method Reporting Limit	Method
pH	NA	NA	SM 4500 H+-B
Total Dissolved Iron (mg/L)	0.002	0.025	EPA 200.7 Rev 4.4-1994
Total Recoverable Iron (mg/L)	0.002	0.025	EPA 200.7 Rev 4.4-1994
Total Dissolved Manganese (mg/L)	0.002	0.025	EPA 200.7 Rev 4.4-1994
Total Recoverable Manganese (mg/L)	0.002	0.025	EPA 200.7 Rev 4.4-1994
Total Recoverable Copper (µg/L)	0.1	5.0	EPA 200.8 Rev 4.4-1994
Total Recoverable Lead (µg/L)	0.3	2.0	EPA 200.8 Rev 4.4-1994
Acidity (mg/L)	NA	5	SM 2310 B-2011
Alkalinity (mg/L)	6	10	EPA 310.2 Rev 1974
Specific Conductance (µS/cm)	1	1	SM 2510 B-2011
Total Sulfate (as SO_4) (mg/L)	2	10	ASTM D516-16
TDS (mg/L)	7	10	SM 2540 C-2015
TSS (mg/L)	3	5	SM 2540 C-2015

4.4.3 Quality Control

Each laboratory used (if more than one) is required to operate a formal quality control program. The requirements of this program will consist of an initial demonstration of performance; analysis of a laboratory reagent blank, laboratory fortified blank, instrument performance check standard, calibration check standards, and laboratory fortified sample matrices; and either field, laboratory, or laboratory fortified sample matrices duplicate sample analyses. The laboratory will be required to maintain performance records that define the quality of the data that is generated.

5.0 MANAGEMENT AND REPORTING

5.1 Reporting and Schedule

Activities conducted under the WQMP will be documented in annual summary reports to be submitted to the Kentucky Division of Water. The reports will include an update on the status of water quality monitoring activities, a summary of water quality monitoring results for the previous year, comparison with water quality standards, and any proposed modifications to the WQMP.

5.2 Water Quality Adaptive Management

If the monitoring report indicates that a water quality sample taken from the penstock tap location is not in compliance with the standard, the following actions will be taken:

- LRPS will contact staff at the Kentucky Division of Water and request a conference call to discuss the parameter(s) not in compliance and possible causes.
- LRPS will propose appropriate measures to confirm nature of the non-compliance (resampling, adaptive measures, mitigation, etc.).
- LRPS will submit the response report to Kentucky Division of Water for review and approval.
- LRPS will implement adaptive management measures, as agreed upon with Kentucky Division of Water.

6.0 REFERENCES

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APPENDIX C

WILDLIFE MANAGEMENT PLAN

WILDLIFE MANAGEMENT PLAN

LEWIS RIDGE PUMPED STORAGE PROJECT

FERC NO. 15249

Prepared for:

Lewis Ridge Pumped Storage, LLC

Prepared by:

Kleinschmidt Associates

June 2025

Kleinschmidt

TABLE OF CONTENTS

LIST OF FIGURES

DEFINITIONS OF TERMS, ACRONYMS, AND ABBREVIATIONS

APLIC	Avian Power Line Interaction Committee
Applicant	Lewis Ridge Pumped Storage, LLC
Commission	Federal Energy Regulatory Commission
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
Kentucky DFWR	Kentucky Department of Fish and Wildlife Resources
Lewis Ridge Project	Lewis Ridge Pumped Storage Project, FERC P-15249
LRPS	Lewis Ridge Pumped Storage, LLC
Project Vicinity	The general geographic area in which the proposed Lewis Ridge Project will be located, as indicated on the Project Vicinity figures.
USFWS	U.S. Fish and Wildlife Service
VMP	Vegetation Management Plan
WMP	Wildlife Management Plan

1.0 INTRODUCTION

Lewis Ridge Pumped Storage, LLC (Applicant or LRPS) is filing with the Federal Energy Regulatory Commission (FERC or Commission) its Wildlife Management Plan (WMP) for the Lewis Ridge Pumped Storage Project (FERC No. 15249) (Lewis Ridge Project). The Lewis Ridge Project is a proposed, unconstructed pumped storage hydroelectric generating facility located in Bell County, Kentucky, on land that has been used for both underground and surface coal mining. Development of the Lewis Ridge Project will involve construction of new water storage, water conveyance, and electric generation facilities.

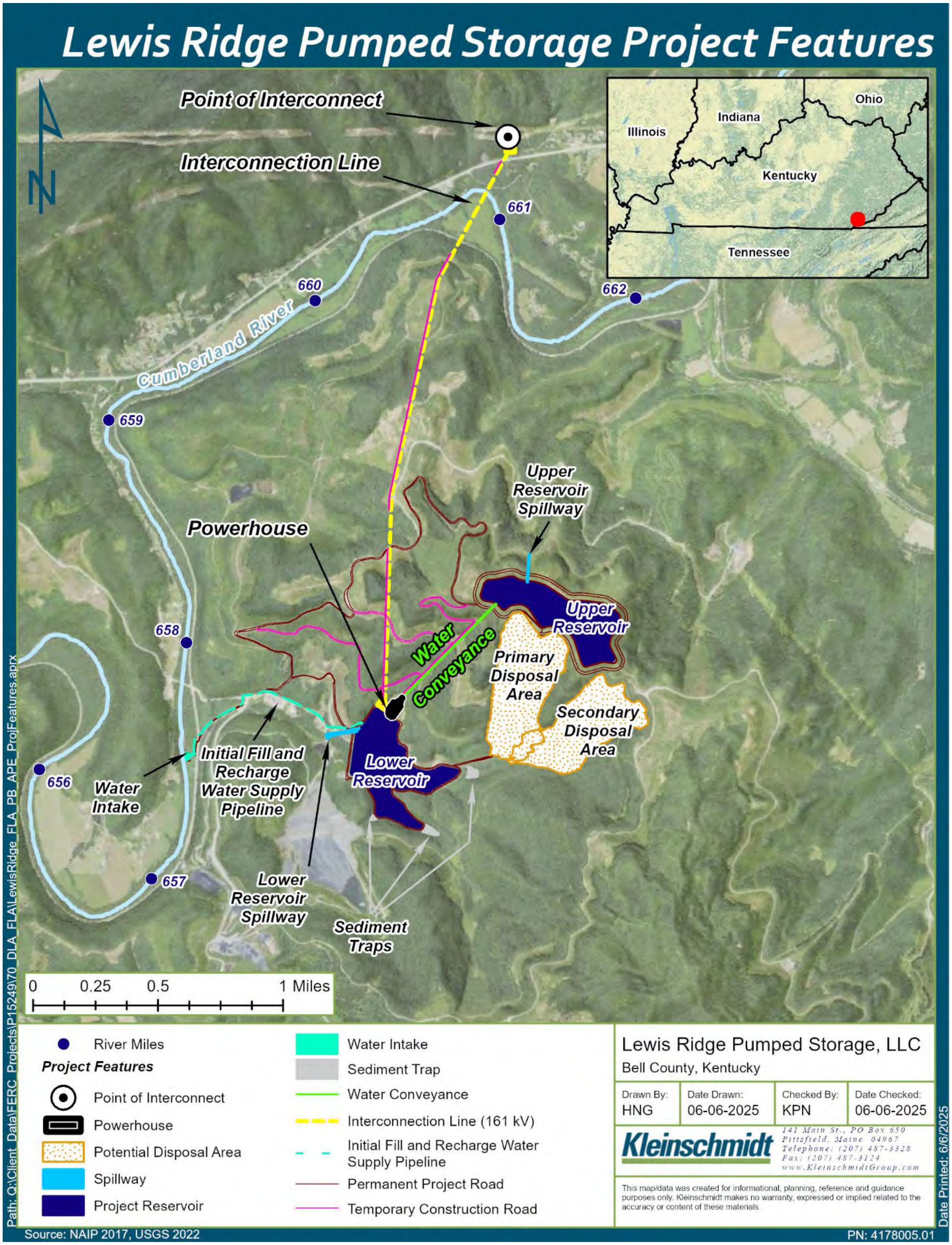
The purpose of this WMP is to develop voluntary guidelines that LRPS will adopt to reduce potential impacts to wildlife associated with the construction and operation of the Lewis Ridge Project. This WMP establishes goals for managing wildlife resources at the Lewis Ridge Project and identifies measures for existing and proposed wildlife habitat management and improvement.

2.0 BACKGROUND INFORMATION

The Lewis Ridge Project is located in Bell County, Kentucky, in southeastern Kentucky near the borders of Tennessee and Virginia. Construction of the Lewis Ridge Project will consist of a rocky earthfill dam and associated upper reservoir with an integrated overflow emergency spillway; steel water conveyance; powerhouse; earthfill embankment dam and associated lower reservoir with an integrated overflow emergency spillway; overhead interconnection line; and intake and water supply pipelines to the lower reservoir for initial fill and periodic recharge. Proposed Lewis Ridge features are shown on Figure 2-1.

The Lewis Ridge Project features will primarily be located within areas previously disturbed during coal mining activities. Both native and non-native vegetation typical of the region are present at the Lewis Ridge Project. Wildlife habitat includes mature deciduous forest, mixed evergreen deciduous forest, disturbed shrubland, disturbed herbaceous vegetation, ponds, and creeks. These habitats support a variety of mammals, birds, reptiles, amphibians, and insect species. Existing wildlife resources at the Lewis Ridge Project site are described in Exhibit E of the FLA, Section 5.4.

Figure 2-1: Proposed Lewis Ridge Project Features



3.0 GOALS

The goal of this WMP is to avoid or reduce potential impacts to wildlife resources during construction and operation of the Lewis Ridge Project. Specific objectives of this WMP are described below.

- Avoid and minimize or impacts to wildlife during construction of the Lewis Ridge Project.
- Revegetate, maintain, and enhance wildlife species' habitats on Lewis Ridge Project lands.
    - Areas of emphasis include establishing and maintaining habitat quality for elk, bat species, and migratory birds, as well as general guidelines to protect terrestrial and aquatic habitat.
- Avoid and minimize impacts to wildlife during operation of the Lewis Ridge Project.

4.0 MANAGEMENT MEASURES

This section identifies management measures for wildlife in consultation with resource agencies, with a focus on regional restoration goals, sensitive species, and general wildlife considerations.

4.1 Elk Management Measures

Elk (*Cervus canadensis*) occur at the Lewis Ridge Project. The Lewis Ridge Project area is located within the Kentucky Elk Restoration Zone. The Kentucky Elk Restoration Zone encompasses 16 counties and supports a free ranging herd of approximately 1,550 wild elk (Kentucky Department of Fish and Wildlife Resources [Kentucky DFWR] 2015).

Elk in the region have been documented transversing large areas over short timeframes, and the presence of the project facilities are not expected to limit mobility or reduce access to habitat for elk and other species that inhabit the area. The Kentucky Department of Fish and Wildlife Resources (DFWR) has been consulted regarding the need for wildlife crossings for native species, specifically local elk populations. Given the mobility of elk and common wildlife in the area, Kentucky DFWR did not recommend wildlife crossings along the water conveyance at the Lewis Ridge Project, as these animals cover large areas and can go around the project facilities. Kentucky DFWR noted that elk are behaviorally plastic and can adapt to human activity, including mining and construction activities.

Elk habitat establishment and management activities at the Lewis Ridge Project will be implemented in conjunction with the Vegetation Management Plan (VMP) (Appendix D of Exhibit E of the FLA). Elk utilize forests and grasslands for cover, refuge, and forage. The goal of revegetation of disturbed areas after construction will be to establish and maintain grassland habitat to be utilized as forage by elk and other species. Seeding of plant species that provide elk forage will occur across disturbed areas below the interconnection line, within the disposal areas, and adjacent to the water conveyance. Species to be established include native warm season grasses and forbs. Monitoring and management of the established grasslands will be conducted to manage invasive species and maintain forage quality for elk. Detailed vegetation establishment and management measures are included in the VMP.

4.2 Bat Species Management Measures

Bat surveys were conducted at the Lewis Ridge Project during 2024 and 2025. Surveys included mine portal surveys and mist-netting surveys during the maternity season and were conducted as presence/probable absence surveys for federal listed bat species, including federal endangered gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalist)*, and northern long-eared bat (*Myotis septentrionalis*), and proposed threatened tricolored bat (*Perimyotis subflavus*). Bat species documented at the Lewis Ridge Project include big-eared bat (*Corynorhinus townsendii*), big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), red bat *(Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), gray bat, small-footed bat (*Myotis lebelii*), little brown bat (*Myotis lucifugus),* tricolored bat, and evening bat (*Nycticeius humeralis*).

There are no known summer or winter occurrences of federal endangered northern long-eared bat or Indiana bat, and no occupied maternity roost trees or hibernacula have been identified at the Lewis Ridge Project. No northern long-eared bats or Indiana bats were collected or detected with acoustic monitors during presence/probable absence surveys, indicating the species are not likely present at the Lewis Ridge Project during the maternity season, or are present in numbers too low to be detected by approved U.S. Fish and Wildlife Service (USFWS) protocols. The capture of a tricolored bat, which are proposed for listing, indicates that the Lewis Ridge Project may affect summer populations of the species but is not likely to jeopardize the survival of the species. Gray bats were not documented in mine portal surveys, and the presence of a gray bat on the property during 2024 mist-netting surveys and 2025 acoustic surveys indicates that the species forages there. Forested acreage removal associated with the Lewis Ridge Project will not impact roosting habitat for this species, as the species does not utilize trees as summer roost habitat. Following confirmation that bats were not using the only known mine portal at the Lewis Ridge Project, the entrance was closed off to exclude future use by bats.

Minimal impacts to bat species are expected through construction and operation of the Lewis Ridge Project. No federal listed bat species that use maternity roost trees were documented at the Lewis Ridge Project; as such, seasonal restrictions for tree clearing are not proposed. If an occupied roost tree or hibernacula for any federal listed bat species is identified prior to, during, or after construction, LRPS will notify the Kentucky DFWR and USFWS within 72 hours of discovery and will follow guidance on best management practices to avoid impacts. This may include avoidance of tree clearing activity within 150 feet of known roost trees during the pup rearing season of June 1-July 31. Established grasslands following construction will provide open forage habitat for bats.

4.3 Bald Eagle and Migratory Bird Management Measures

There are no known bald eagle nest sites located at the Lewis Ridge Project. If bald eagle nesting activity is documented prior to or during construction activities, LRPS will notify the Kentucky DFWR and USFWS within 72 hours with location and observed activity. Additionally, if bald eagle nesting activity is established, buffer zones will be maintained around the nest site in accordance with USFWS bald eagle management guidelines, including maintaining overstory trees within 330 feet of the nest, and avoiding construction and tree clearing activities within 660 feet of the nest during the breeding season (December-June).

The interconnection line will be constructed according to existing standards and guidelines to minimize risk of electrocution and collision by raptors (Avian Power Line Interaction Committee [APLIC] and USFWS 2005; APLIC 2012). Specifically, conductors will be spaced to reduce the likelihood of electrocution. This includes construction of power poles that maintain 40 inches or more of vertical clearance and 60 inches or more of horizontal clearance between energized conductors or energized conductors and grounded hardware. Visibility enhancement devices (e.g., marker balls, bird diverters) will also be installed on lines to reduce collision risk.

Mowing in managed grassland habitats will be conducted prior to April 15 or after August 15 for the protection of nesting birds and ground nesting wildlife to avoid expected time periods of nestbuilding, egg laying, and rearing.

4.4 Mussel Relocation

A mussel reconnaissance and removal effort will occur within the footprint of the proposed Cumberland River water intake prior to installation of concrete pads and intake screens. A certified malacologist will perform a spot check of the area for the presence of mussel species. If mussel presence is documented, individuals will be removed and placed in suitable habitat outside of the intake area.

4.5 General Construction and Operational Guidelines

During construction, appropriate speed limits will be set for all construction roads to reduce the risk of collisions with wildlife. Any open pits will be closed, temporarily fenced, or covered each evening. Inspections of open pits will occur daily to ensure animal safety.

Where practicable, construction activities, infrastructure, and man-made structures (e.g., roads, parking lots, staging areas) will be concentrated on lands that are already altered to conserve area-sensitive species and avoid habitat fragmentation.

5.0 IMPLEMENTATION

Activities conducted under the WMP will be implemented during the construction and operation of the Lewis Ridge Project. The WMP will be reviewed and updated if needed during the license term.

6.0 REFERENCES

Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service (APLIC and USFWS). 2005. Avian Protection Plan Guidelines. April 2005. Available online: https://www.aplic.org/uploads/files/2634/APPguidelines_final-draft_Aprl2005.pdf.

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APPENDIX D

VEGETATION MANAGEMENT PLAN

VEGETATION MANAGEMENT PLAN

LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

Prepared for:
Lewis Ridge Pumped Storage, LLC

Prepared by:
Kleinschmidt Associates

June 2025

Kleinschmidt

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

DFWR	Department of Fish and Wildlife Resources
FLA	Final License Application
LRPS	Lewis Ridge Pumped Storage, LLC
NRCS	Natural Resources Conservation Service
USDA	United States Department of Agriculture
UTV	Utility Task Vehicle
VMP	Vegetation Management Plan

1.0 INTRODUCTION

Lewis Ridge Pumped Storage, LLC (Applicant or LRPS) is filing with the Federal Energy Regulatory Commission (FERC or Commission) its Vegetation Management Plan (VMP) for the Lewis Ridge Pumped Storage Project (FERC No. 15249) (Lewis Ridge Project). The Lewis Ridge Project is a proposed, unconstructed pumped storage hydroelectric generating facility located in Bell County, Kentucky on land that has been used for both underground and surface coal mining. The Lewis Ridge Project will involve the construction of new water storage, water conveyance, and electric generation facilities.

The purpose of this VMP is to develop voluntary guidelines that LRPS will adopt to manage and improve terrestrial habitat during construction and operation of the Lewis Ridge Project. This VMP establishes goals for establishing, monitoring, and maintaining vegetation at the Lewis Ridge Project.

2.0 BACKGROUND INFORMATION

The Lewis Ridge Project site is located in Bell County, Kentucky, in southeastern Kentucky near the borders of Tennessee and Virginia. Construction of the Lewis Ridge Project will consist of a rocky earthfill dam and associated upper reservoir with an integrated overflow emergency spillway; a steel water conveyance; powerhouse; earthfill embankment dam and associated lower reservoir with an integrated overflow emergency spillway; an overhead interconnection line; and an intake and water supply pipelines to the lower reservoir for initial fill and periodic recharge. Proposed Lewis Ridge features are shown on Figure 2-1.

The Lewis Ridge Project features will primarily be located within areas previously disturbed during coal mining activities. Both native and non-native invasive vegetation typical of the region are present at the Lewis Ridge Project. Terrestrial habitat includes mature and young deciduous forest, mature and young mixed evergreen deciduous forest, disturbed shrubland, and disturbed herbaceous vegetation. Common invasive species at the Lewis Ridge Project include kudzu (*Pueraria montana*), autumn olive (*Elaeagnus umbellata*), European privet (*Ligustrum vulgare*), tree of heaven *(Ailanthus altissima*), and royal paulownia (*Paulownia tomentosa*), sericea lespedeza (*Lespedeza cuneata*), honeysuckles

(*Lonicera* spp.), Japanese knotweed (*Reynoutria japonica*), and multiflora rose *(Rosa multiflora*). Existing botanical resources at the Lewis Ridge Project site are described in Exhibit E of the Final License Application (FLA), Section 5.5.

The proposed construction and operation of the Lewis Ridge Project will permanently alter current vegetation communities (Figure 2-2). Vegetation disruption will primarily occur over areas that have been historically logged and more recently disturbed from mining operations. The project footprint encompasses vegetation communities that are characterized by previous anthropogenic disturbances associated with logging, surface mining, highwall mining, and construction of mining access roads. Implementation of this VMP will reduce impacts to local plant communities, establish grasslands that will provide beneficial forage habitat for elk and other species that utilize grasslands, and manage invasive species.

Figure 2-1: Proposed Lewis Ridge Project Features

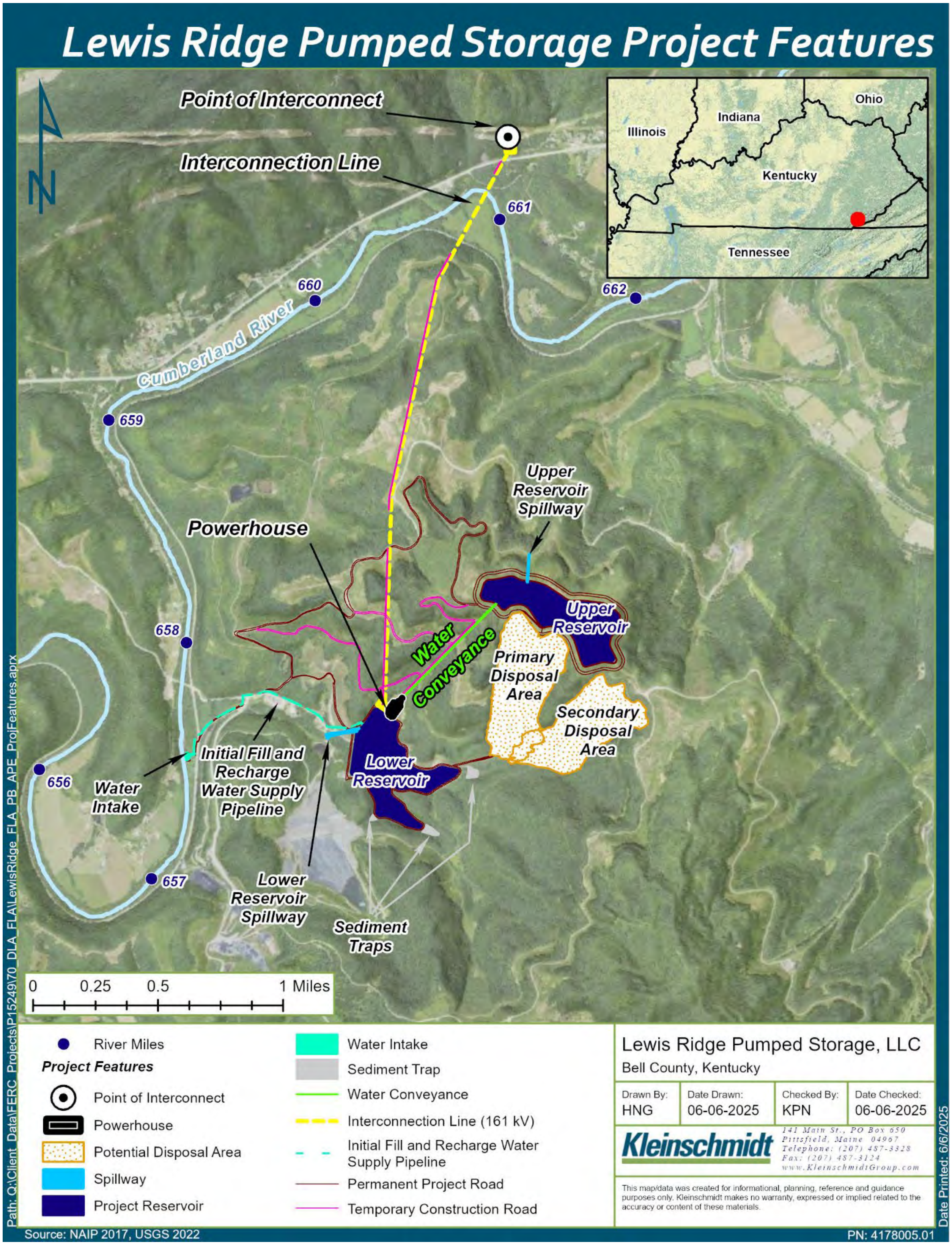
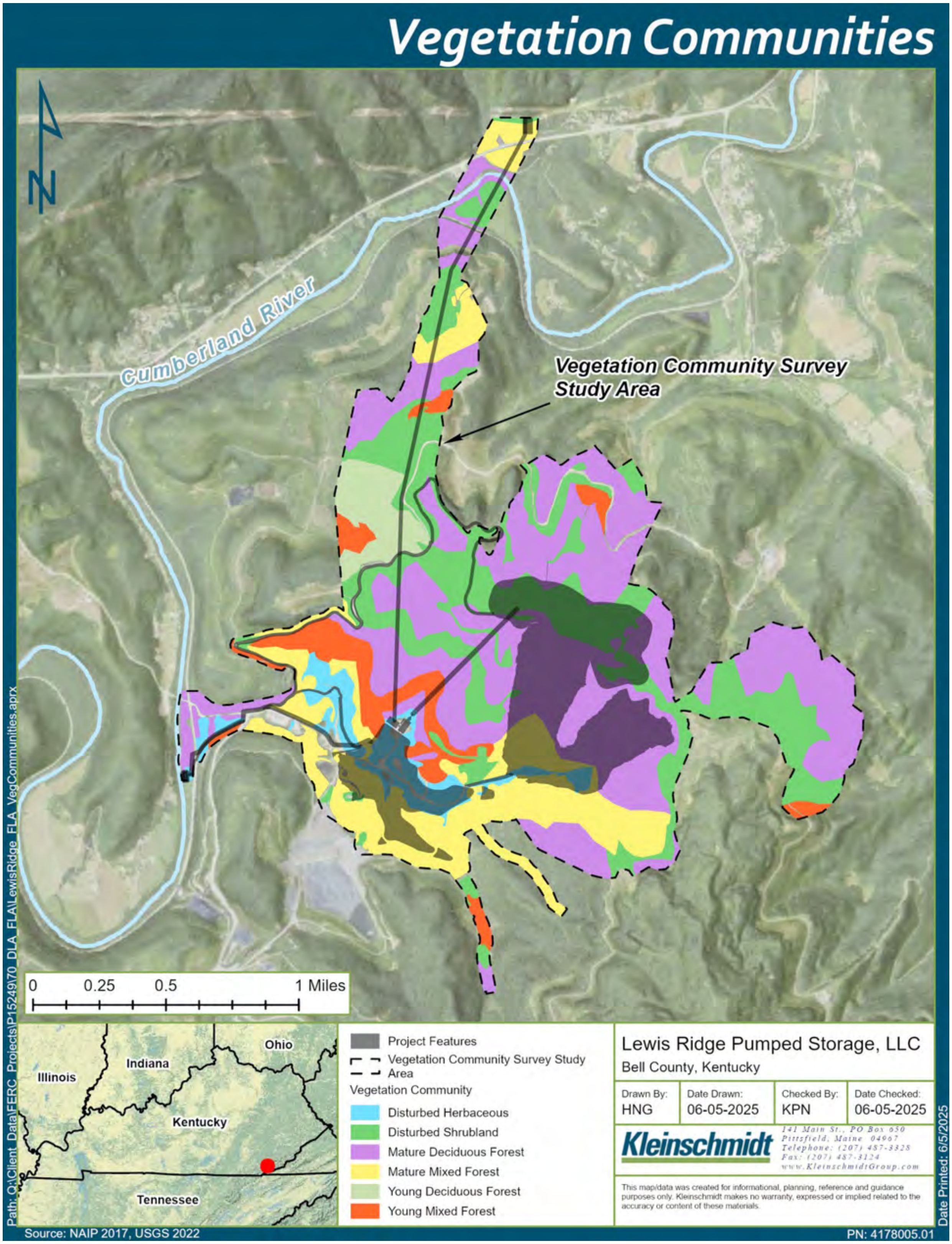


Figure 2-2: Pre-Construction Vegetation Communities at the Lewis Ridge Project



3.0 GOALS

The goal of this VMP is to establish, monitor, and manage vegetation during the construction and operation of the Lewis Ridge Project. Specific objectives of this VMP are described below.

- Re-establish vegetation in areas that are disturbed during construction.
    - Promote plant growth to secure the soil and establish vegetation communities in areas of disturbance during construction through seeding and land management activities.
- Monitor and maintain re-planted vegetation during Project operation.
    - Monitor and maintain revegetated plant communities during Lewis Ridge Project operation.
    - Monitor and manage the establishment and spread of and invasive species.

4.0 VEGETATION ESTABLISHMENT MEASURES

Previous coal mining activities affected plant species composition throughout much of the Lewis Ridge Project area. Vegetation will be disturbed during Project construction. Spoil material and excavated rock will be reused on-site or deposited in the designated primary and secondary disposal areas.

Site-specific revegetation methods will focus on establishment of grasslands and maintained turf grass areas around project facilities. Grasslands will include native warm season grasses and herbaceous plants, with an emphasis on improving and maintaining elk habitat quality in reseeded areas. Managed turf grass areas will be established in the immediate vicinity of the Lewis Ridge Project facilities and will be mowed and maintained for safe access and operation. Additional goals of planting will include protection of soils and maintained or improved aesthetic quality.

Revegetation measures described below have been developed with the goal of creating sites with the following characteristics:

- Grasslands provide wildlife habitat benefit, with an emphasis on improved habitat quality for elk and grassland obligate species.

- Revegetated areas that are capable of self-sustaining, reproducing plant populations with some maintenance.
- Revegetated areas that are resilient and able to endure normal periodic stress events in the local environment (e.g., drought or heavy rains).

Revegetation measures at disturbed areas and human use areas are described below.

4.1 Temporary Construction Seeding

Bare soil in excavated or disposal areas will be seeded after 14 days if no work is planned in that area during the following 7 days, according to standards described in the Kentucky Erosion Prevention and Sediment Control Guide (Kentucky Energy and Environment Cabinet 2025). On slopes steeper than 4:1, bulldozers or other tracked vehicles will be run to create tread-track depressions for catching and holding seed. Oats, perennial ryegrass, white, and/or annual rye will be seeded between March 1 to October 31, and annual rye, wheat, and/or perennial ryegrass will be planted between November 1 and February 28 (Kentucky Transportation Center 2009).

4.2 Grassland

Disturbed areas to be revegetated with a native grassland seed mix will include disposal areas, adjacent to the water conveyance, within the interconnection line corridor, adjacent to existing and temporary roads, along the initial fill and recharge water intake pipelines, and disturbed areas around the reservoirs.

Grassland seeding will occur between February 15 and May 15 or between August 15 and September 15 in the year following completion of construction. A native seed mix, as outlined in Table 4-1, or similar, will be utilized. This plant list is based on Mix 201-Native Strip Mine and Gas Production Site Mix, sold by Roundstone Native Seed, LLC. Consideration of this seed mix has been developed based on communication with the Kentucky Department of Fish and Wildlife Resources (DFWR) wildlife biologists and may be adjusted pending future consultation.

If germination and establishment of seeds is not successful during the spring and summer months, reseeding will occur between February 15 and May 15 or August 15 and September 15 of the year following construction.

Table 4-1: Grassland Seed Mix for Revegetating Disturbed Areas

Common Name	Species Name	Percentage of Mix (based on weight)
switchgrass	*Panicum virgatum*	9
deer tongue grass	*Panicum clandestinum*	5
little bluestem	*Schizachyrium scoparium*	8
side oats grama	*Bouteloua curtipendula*	12
big bluestem	*Andropogon gerardii*	12
fall panicum	*Panicum anceps*	9
Indian grass	*Sorghastrum nutans*	12
yarrow	*Achillea millefolium*	1
blackeyed Susan	*Rudbeckia hirta*	2
partridge pea	*Cassia fasciculata*	10
lupine	*Lupinus perennis*	7
showy tickseed	*Bidens aristosa*	6
showy tick trefoil	*Desmodium canadense*	7
gray goldenrod	*Solidago nemoralis*	2

4.3 Maintained Turf Grass

Areas designed for human use, such as the immediate vicinity of the powerhouse, administration and maintenance building, switching stations, reservoir access areas, and parking lots will be seeded with a suitable turf mix in the spring or early-fall following construction. Examples of suitable turfgrass species include Kentucky bluegrass, perennial ryegrass, and tall fescue.

5.0 MONITORING AND MAINTENANCE

5.1 Monitoring

5.1.1 Performance Standards

Monitoring will be conducted by a vegetation specialist familiar with the species and vegetation types found at the Lewis Ridge Project. Revegetated areas will be monitored annually for a minimum of 5 years following construction, or until performance standards are met. If performance standards are not met within 5 years, monitoring and maintenance activities will continue to be evaluated in consultation with Kentucky DFWR. Once performance standards are met, monitoring will be conducted at 5-year intervals.

Specific performance standards are described in Table 5-1.

Table 5-1: Revegetation Performance Standards

Objective	Performance Standard
Vegetation Cover – Revegetate disturbed sites with appropriate cover of target species	By year 5, total percent cover of desired target species on disturbed areas will be >70% of total area. Target species will be defined as plant species from the seed mix, or plant species in adjacent areas not disturbed by construction.
Species Composition – Establish a species composition that is representative of seed mix	By year 5, at least 70% of total target plant species will be either from the seed mix and/or consist of plant species in adjacent areas not disturbed by construction.
Invasive Plants – Percent cover of invasive species	Percent cover of invasive species will not exceed the percent cover of invasive species in adjacent areas not disturbed by construction.

5.1.2 Post-Construction

Seeded areas will initially be monitored for germination success. Germination success at seeded areas will be assessed qualitatively at the start of the first growing season after seeding to determine whether seeds are germinating, and whether additional seeding or other corrective actions should be implemented.

Seeded areas will continue to be monitored after the first growing season to document establishment success based on the performance standards described in Table 5-1. General documentation and monitoring will occur throughout each of the disturbed areas, with continued documentation of vegetation cover, composition of target and invasive species, and percent bare ground. Erosion extent (e.g., gullying) in steep areas will also be documented during the annual revegetation monitoring efforts.

5.2 Maintenance

5.2.1 Grassland

Mowing of seeded areas will be implemented in the first growing season following construction, if needed, to manage invasive species and aid in establishment of the native seed mix. Once established, periodic mowing (estimated to occur every three to five years) will be conducted to reduce establishment of woody vegetation. Mowing will be conducted prior to April 15 or after August 15 for the protection of nesting birds and ground nesting wildlife.

In addition to mowing, periodic herbicide applications will be applied to seeded areas. Broadleaf-specific herbicides will be used in consultation with the Kentucky DFWR. Current applications that are used by the Kentucky DFWR on lands managed for elk include:

- Pastureguard - 1% tank mix, applied with 10 gallons of water per acre with a non-ionic surfactant, applied in May- June.
- Pastureguard - 1.5% tank mix, applied with 10 gallons of water per acre with a non-ionic surfactant, applied in July-September.
- Remey Ultra - 1.5% tank mix, applied with 10 gallons of water per acre with a non-ionic surfactant, applied May-September.

Herbicide application may be conducted over larger areas with a vehicle (e.g., utility task vehicle [UTV] and boomless sprayer). Spot spraying may be utilized in areas where higher native forb density is observed.

Prescribed burning may also be implemented in managed grasslands. The Kentucky DFWR currently utilizes prescribed fire as a management tool on reclaimed mine lands in the region, and details regarding burning extent and methodologies, if recommended, would be developed in consultation Kentucky DFWR personnel.

5.2.2 Maintained Turf Grass

Mowing and turfgrass maintenance practices will be implemented around human use areas to minimize weed and invasive species growth, facilitate routine operations and facility maintenance, and ensure safe access. Regular mowing will occur around the perimeter areas of Lewis Ridge Project facilities, such as the powerhouse, switchyard, upper and lower reservoir access roads, and along service pathways. Mowing frequency will occur at a rate dependent on plant growth rate and weather conditions, and will be maintained to balance erosion control, weed suppression, and ease of maintenance.

5.3 Invasive Plant Management

A total of 19 invasive plant species are documented at the Lewis Ridge Project site based on the vegetation surveys conducted in 2025 (Table 5-2) (Appendix K of Exhibit E, FLA). Mowing and herbicide application may be used to manage invasive plant species before, during, and after construction. Herbicides will be selected in based on target species and following available herbicide label specifications.

Herbicide application will be applied to kudzu and Japanese knotweed prior to construction in the southern portion of the Lewis Ridge Project. The herbicide application period for kudzu varies depending on the herbicide that is used, but the application period for most herbicides generally falls within the summer months between June and September. Certain kudzu herbicides require moderate rainfall shortly after application to initiate the soil-activation component of the herbicide (USDA 1996). Herbicide treatment for Japanese knotweed should occur in the late summer, ideally when the plants are 3-6 feet tall (NRCS 2011).

Woody species and sericea lespedeza readily colonize seeded grasslands. Specific management activities targeting invasive species in revegetated grasslands will be implemented, as outlined in Section 5.2.

Table 5-2: Invasive Plant Species Documented at the Lewis Ridge Project

Common Name	Species Name
tree of heaven	*Ailanthus altissima*
Japanese barberry	*Berberis thunbergii*
Queen Anne’s lace	*Daucus carota*
autumn olive	*Elaeagnus umbellata*
winter creeper	*Euonymus fortune*
ground ivy	*Glechoma hederacea*
purple dead nettle	*Lamium purpureum*
sericea lespedeza	*Lespedeza cuneata*
privet	*Ligustrum vulgare*
tall fescue	*Lolium arundinaceum*
Japanese honeysuckle	*Lonicera japonica*
Amur honeysuckle	*Lonicera mackii*
Japanese stiltgrass	*Microstegium vimineum*
royal paulownia	*Paulownia tomentosa*
kudzu	*Pueraria montana var. lobatta*
bulbous buttercup	*Ranunculus bulbosus*
Japanese knotweed	*Reynoutria japonica*
multiflora rose	*Rosa multiflora*
common chickweed	*Stellaria media*

Source: Copperhead 2025

6.0 IMPLEMENTATION AND COORDINATION

Activities conducted under the VMP will be documented in a summary report submitted to the Kentucky DFWR annually following Lewis Ridge Project construction until the vegetation performance standards outlined in Section 5.1 are met. The report will include a summary of vegetation cover, composition of target and invasive species, percent bare ground, and management actions implemented. Reports will cover a period of January-December and will be submitted no later than February 28 of the following year.

Following construction, the VMP will be reviewed and updated every 10 years during the license term. A draft of the revised VMP will be shared with the Kentucky DFWR and for a 30-day review prior to finalization.

7.0 REFERENCES

Copperhead Environmental Consulting (Copperhead). 2025. Vegetation Assessment Report for the Proposed Lewis Ridge Pumped Storage Project, Bell County, Kentucky.

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APPENDIX E

HISTORIC PROPERTIES MANAGEMENT PLAN
(PRIVILEGED)

APPENDIX F

JURISDICTIONAL STREAMS AND WETLANDS DETERMINATIONS REPORT

Lewis Ridge Pumped Storage LLC
Bell County, Kentucky

Jurisdictional Streams and Wetlands Determinations
May 2025

EcoSource, Inc. 120 Marketplace Circle, Ste C-163, Georgetown, Kentucky 40324 Telephone (502) 868-5200

Lewis Ridge Pumped Storage, LLC.
Bell County, Kentucky

Jurisdictional Streams and Wetlands Determinations

May 2025

Prepared for

Lewis Ridge Pumped Storage, LLC.
100 S. Olive Street
West Palm Beach, FL 33401

EcoSource, Inc.
120 Marketplace Circle, C-163, Georgetown, Kentucky 40324 Telephone (502) 868-5200

I. PURPOSE

EcoSource, Inc. performed a review of jurisdictional waters for the proposed Lewis Ridge Pumped Storage LLC project in Bell County, Kentucky. A level of review was provided that would determine if jurisdictional waters were present within the proposed project area. The ground reconnaissance for the proposed project was performed on the following dates:

- October 12, 2022
- November 14, 2022
- August 22, 2024
- September 3, 2024
- September 12, 2024
- April 16, 2025
- April 29, 2025

All information concerning the delineation of streams and wetlands that is presented in this report is subject to verification and approval by the US Army Corps of Engineers prior to any site disturbance.

II. PROJECT AREA DESCRIPTION

The proposed project is located on the Balkan, Kentucky 7.5' USGS topographic quadrangle at the following coordinates: 36.760895°, -83.551033°. From the intersection of US 25E and US 119 south of Pineville, Kentucky, travel north on US 119 for a distance of 11.4 miles. Turn right or south onto Balkan Road, travel for a distance of 1.4 miles. Turn right or east onto KY 2012, travel for a distance of 0.5 mile to the project area.

III. BACKGROUND INFORMATION

Several data sources were used to provide background information for this review including the Bell County Soil Survey as represented by the US Department of Agriculture (USDA) Web Soil Survey[1], the National Wetlands Inventory (NWI) Map[2], Balkan, Kentucky 7.5' US Geological Survey (USGS) topographic quadrangle, and Google Earth. These information sources were used only for preliminary review and were followed by field investigations. Reference the Jurisdictional Determination (JD) map provided with this report.

The following information was gleaned from these sources:

- USDA web soil survey – the following soil series were mapped within the proposed project area.
  - Alticrest-Totz-Helechawa complex, rocky, 20-55%
  - Craigsville-Philo Complex, occasionally flooded (possible hydric components)
  - Fairpoint and Bethesda Soils, 2-70%, stony

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[1] Mapping can be found at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
[2] Mapping can be found at https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/

  - Gilpin-Shelocta silt loams, 12-20%
  - Gilpin-Rayne-Sequoia Complex, 25-55%, very stony
  - Highsplint-Cloverlick-Guyandotte Complex, very rocky 35-75%
  - Pope fine sandy loam, occasionally flooded (possible hydric components)
  - Shelbiana loam, occasionally flooded (possible hydric components)
  - Shelocta –Gilpin silt loams, 20-35%
  - Shelocta-Highsplint-Gilpin Complex, 20-70%, very stony
  - Shelocta-Kimper-Cloverlick Complex, 20-80%, very stony
  - Udorthents-Urban Land Complex, occasionally flooded
  - Udorthents-Urban Land Complex, 15-35%
  - Water

- NWI mapping – streams and wetland features (ponds) were mapped within the project area.
  - R2UBH – riverine, lower perennial, unconsolidated bottom, permanently flooded
  - R4SBC – riverine, intermittent, streambed, seasonally flooded
  - R5UBH – riverine, unknown perennial, unconsolidated bottom, permanently flooded
  - PUBHh – palustrine, unconsolidated bottom, permanently flooded, diked/impounded
  - PUBHx – palustrine, unconsolidated bottom, permanently flooded, excavated

- USGS Topographic mapping – was used to reference any mapped locations of waterways and ponds within the proposed project area.
- Google Earth – was used to locate open water features.

After the field investigations, additional private data sources related to active and inactive mining permits were referenced. These permits provided past and approved jurisdictional mapping and approved mitigation for these permitting actions. The Kentucky mining permit Numbers 807-0372 and 807-0353 were reviewed for pertinent information. This permit information was provided by RESPEC.

IV. FIELD RECONNAISSANCE

A. Wetlands/Open Water

After reviewing the public data sources, reconnaissance of the proposed project area was conducted. This reconnaissance included ground truthing of the NWI mapping and looking closely at any non-mapped wetland sites based upon the potential for hydric soils or hydric inclusions. Wetland reviews were performed based on the criteria set forth in the 1987 manual[3], with priority set to the 2012 manual addendum for the region[4]. Table 1 provides a summary of the wetlands located within the assessment area. Included in the appendix are photos and delineation forms for these wetlands. Reference the JD map for locations. All open water features that are currently present are associated with active sediment ponds. These ponds are not included as jurisdictional features.

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[3] Army Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1. 1987. Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

[4] Army Corps of Engineers. April 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (ver. 2.0)..

Table 1. Section 404 Regulated Wetlands and Open Water

Wetland	Area (ac)	NWI Classification*	1979 Cowardin Classification**
5	0.63	Not classified	PEM
7	0.07	Not classified	PSS
8	0.22	Not classified	PSS
Total	0.92		

* "Classification of Wetlands and Deepwater Habitats of the United States," US Fish and Wildlife Service, FWS/OBS-79/31, December 1979.
**PEM – palustrine, emergent PSS – palustrine scrub/schrub

B. Streams

Stream reconnaissance was performed in order to determine the presence of jurisdictional streams within the proposed project area. A stream was defined as having discernible bed and bank features. Streams with these features within the proposed project area were documented for habitat value, specific conductivity, and upstream and downstream termini. These results are provided in Table 2.

A map and photos illustrating the streams within the assessment area are included in the appendix. Rapid Bioassessment Protocol (RBP) habitat sheets and Ecological Integrity Index (EII) calculation sheets for the streams to be directly impacted are also included in the appendix. Table 2 provides a summary of the streams located, delineated, and mapped within the study area. These streams are regulated under Section 404 of the Clean Water Act. As required, the streams have been assigned a designation of Relatively Permanent Water (RPW) or NonRPW, based on a reach based analysis.

The Cumberland River can be impacted in two different manners. First, on the northeastern end of the project area, a utility corridor would span the river. No direct impact to the river would occur at this location. Second, on the southern end of the project area, a water withdrawal corridor would directly access the river.

Table 2. Section 404 Regulated Streams

Reach	Stream Order	Flow Regime	Reach Length (Ft)	Total Reach Length (Ft)	Reach Desig-nation	Total Reach Desig-nation	Jurisdic-tional (Yes/No)	RBP Score	Ecological Integrity Index (EII)
1 Upper	3rd	perennial	1,106	1,106	RPW	RPW	YES	99	0.10
1 Lower	3rd	perennial	3,573	3,573	RPW	RPW	YES	128	0.24
3	2nd	ephemeral	480	+480	RPW	RPW	YES	128	0.24
3A	1st	ephemeral	673	673	Non RPW	Non RPW	NO	128	0.24
3B	1st	ephemeral	763	763	Non RPW	Non RPW	NO	128	0.24
4 Upper	1st	perennial	955	955	RPW	RPW	YES	111	0.16
4 Lower	2nd	perennial	1,059	1,059	RPW	RPW	YES	117	0.19
4A	1st	perennial	163	163	RPW	RPW	YES	92	0.10
5	1st	intermittent	1,546	1,546	RPW	RPW	YES	111	0.27
5A	2nd	intermittent	811	811	RPW	RPW	YES	111	0.30
5A-1	1st	ephemeral	573	573	Non RPW	Non RPW	NO	113	0.31
5A-2	1st	ephemeral	852	852	Non RPW	Non RPW	NO	113	0.31
6	1st	ephemeral	1,290	2,462	Non RPW	Non RPW	NO	113	0.17
6	1st	intermittent	487		RPW			113	0.17
6	1st	perennial	350		RPW			123	0.22
7	2nd	intermittent	447	447	RPW	RPW	YES	102	0.31
7A	1st	intermittent	443	1,378	RPW	Non RPW	NO	102	0.31
7A-1	1st	ephemeral	935		Non RPW			102	0.31
7B	1st	intermittent	532	1,225	RPW	Non RPW	NO	93	0.30
7B-1	1st	ephemeral	693		Non RPW			93	0.30
8	1st	ephemeral	1,769	1,986	Non RPW	Non RPW	NO	112	0.54
8	1st	intermittent	217		RPW			133	0.64
9	1st	ephemeral	747	1,105	Non RPW	Non RPW	NO	75	0.10
10	1st/2nd	perennial	486	486	RPW	RPW	YES	134	0.27
10A	1st	perennial	195	195	RPW	RPW	YES	134	0.27
11	1st	ephemeral	848	848	Non RPW	Non RPW	NO	95	0.10
11	2nd	perennial	157	157	RPW	RPW	YES	133	0.27
11A	1st	perennial	367	367	RPW	RPW	YES	133	0.27
11B	1st	perennial	409	409	RPW	RPW	YES	119	0.20
12	1st	perennial	514	+514	RPW	RPW	YES	127	0.24
13	1st	ephemeral	1,015	1,737	Non RPW	Non RPW	NO	93	0.10
14	1st	perennial	615	1,649	RPW	RPW	YES	124	0.22
15	1st	ephemeral	139	+1,423	Non RPW	RPW	YES	114	0.17
15	1st	perennial	1,284		RPW			113	0.17
16	1st/2nd	perennial	1,562	+1,562	RPW	RPW	YES	133	0.27
16A	1st	ephemeral	282	282	Non RPW	Non RPW	NO	123	0.22
17	1st	ephemeral	1,032	2,365	Non RPW	RPW	YES	101	0.11
17	1st	perennial	190		RPW			126	0.23
18	1st	ephemeral	318	318	Non RPW	Non RPW	NO	77	0.10
19	1st/2nd	perennial	1,582	+1,582	RPW	RPW	YES	126	0.23
19A	1st	perennial	63	63	RPW	RPW	YES	108	0.14
Total Stream Length within Project Area			**31,522**						
Total Non-RPW Waters			**12,787**						
Total RPW Waters			**18,735**						

In addition to the streams listed in Table 2, several jurisdictional stream reaches had been previously permitted within the limits of active mining permits. These streams are listed in Table 3. As represented in the approved US Army Corps of Engineers (ACE) permit, the mitigation for these permitted streams is for on-site restoration. The overlay of the proposed project area onto these stream reaches would require the replacement of that projected mitigation value. These overlain streams are labeled on the JD map as Old Reaches.

Table 3. Proposed Impacts on Active Mine Permit 807-0353 (LRN-2007-01642)

Original Mine Permit On-Site Mitigation Information					**Proposed Project Replacement Mitigation**	
Old Stream Reach	**Stream Length (LF)**	**Baseline EII**	**Mature EII**	**Total Restored Ecological Integrity Unit (EIU)**	**Stream Impact Length (LF)**	**Required Replaced EIU's***
Reach 1 Mine Area	1,100	0.1	0.42	462.00	205	86.1
Reach 1 Pond 1	300	0.1	0.42	126.00	0	0.0
Reach 2 Mine Area	1,030	0.1	0.42	432.60	207	86.94
Reach 2 Pond 2	300	0.1	0.42	126.00	0	0.0
Reach 3 Mine Area	1,630	0.1	0.42	684.60	1,630	684.6
Reach 3 Pond 6	160	0.1	0.42	67.20	160	67.2
Reach 4 Mine Area	2,400	0.24	0.42	1,008.00	1,506	632.52
Reach 4A Mine Area	222	0.24	0.42	93.24	222	93.24
Reach 4 Pond 4	300	0.24	0.42	126.00	300	126.0
Reach 5 Mine Area	2,550	0.1	0.42	1,071.00	1,180	495.6
Reach 5 Pond 5	350	0.1	0.42	147.00	350	147.0
Reach 6 Mine Area	600	0.1	0.42	252.00	0	0.0
Totals	10,942			4,595.64	5,760	2,419.2

******Required Replaced EIU's = Stream Impact Length * Mature EII*

Wetland	**Delineated Area (AC)**	**Proposed Replacement Area (AC)**
Reach 5 Wetland	0.05	0.15

Based on the 2023 annual monitoring report for the approved ACE permit, the status of the reconstructed reaches follows:

- Old Reach 1 and 2, upper portions reconstructed with the lower portions not yet reconstructed
- Old Reach 3, disturbed, not yet reconstructed
- Old Reach 3 Pond 6, disturbed, not yet reconstructed
- Old Reach 4, never disturbed
- Old Reach 5, upper and lower portions are reconstructed, the balance was never disturbed
- Old Reach 5 Pond 5, disturbed, not yet reconstructed
- Old Reach 5 Wetland, disturbed, not yet reconstructed
- Old Reach 6, never disturbed

V. SUMMARY

The following Section 404 regulated features were documented or located within the proposed project area:

- Wetlands
    - 0.92 acre
- Streams
    - Total Streams within the Project Area – 31,522 linear feet
    - Total Non-RPW waters – 12,787 linear feet
    - Total RPW waters – 18,735 linear feet

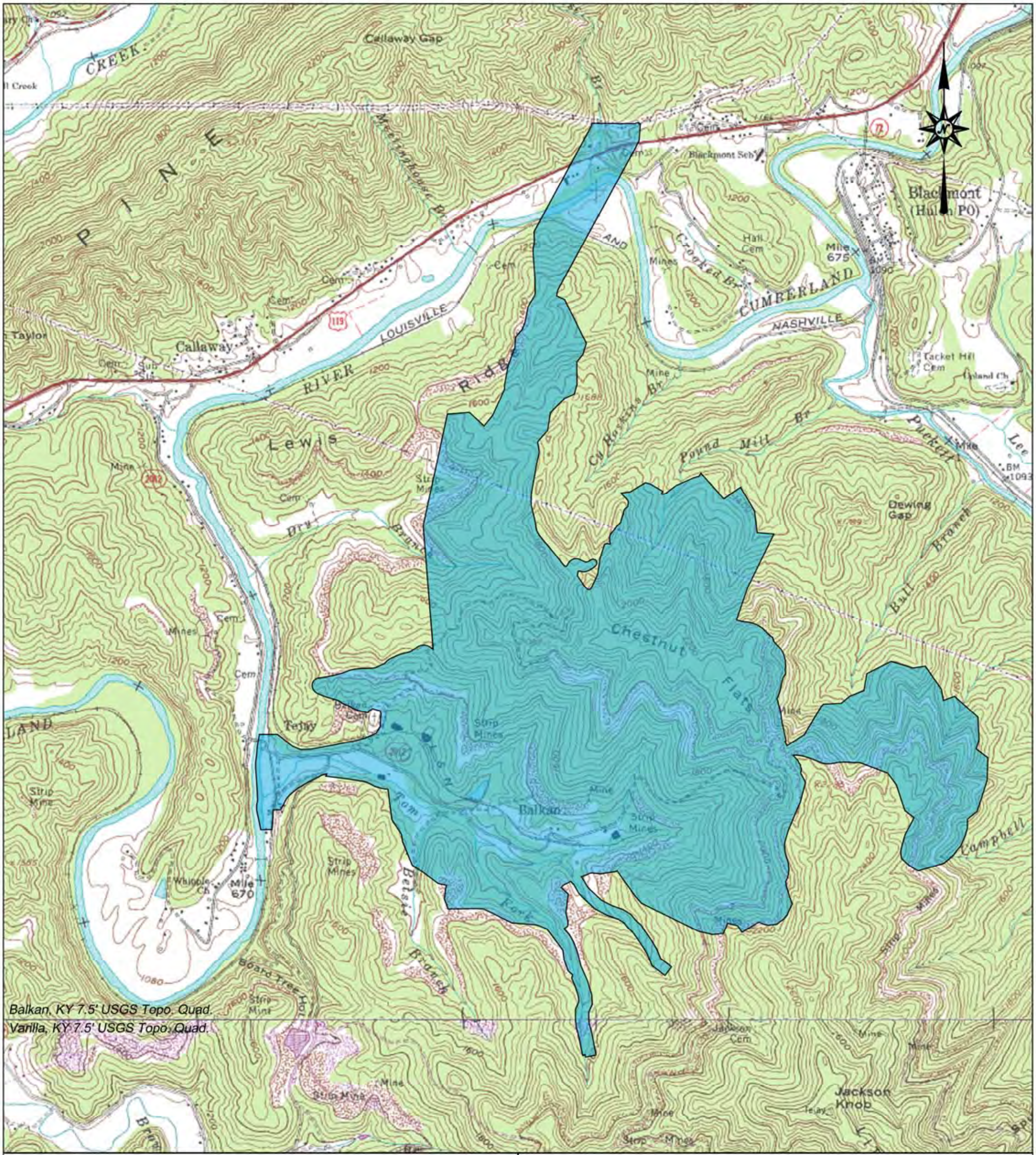
Additionally, other jurisdictional waters are present that were included in a prior surface mining permitting action. These waters include the following: streams 10,942 linear feet and wetlands 0.05 acre.

VI. REFERENCES

Current Soil Survey: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
NWI Mapping: https://www.fws.gov/wetlands/data/Mapper.html
USGS Topographic Mapping: https://ngmdb.usgs.gov/topoview/
Aerial Imagery:
- Google Earth Pro
- Bing
https://www.arcgis.com/home/webmap/viewer.html?webmap=8651e4d585654f6b955564efe44d04e5#!
Plant Lists: USDA Plant Database (https://plants.sc.egov.usda.gov/)
Wetland Manuals:
- Army Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1. 1987. Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- Army Corps of Engineers. April 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (ver. 2.0).

ATTACHMENT A – MAPS

- **Specific Location Map**
- **Jurisdictional Determination Map**
- **NWI and Soils Map**



EcoSource, Inc.

426 North Broadway, Georgetown, Kentucky 40324
(502) 868-5200

FIGURE:
Specific Location Map

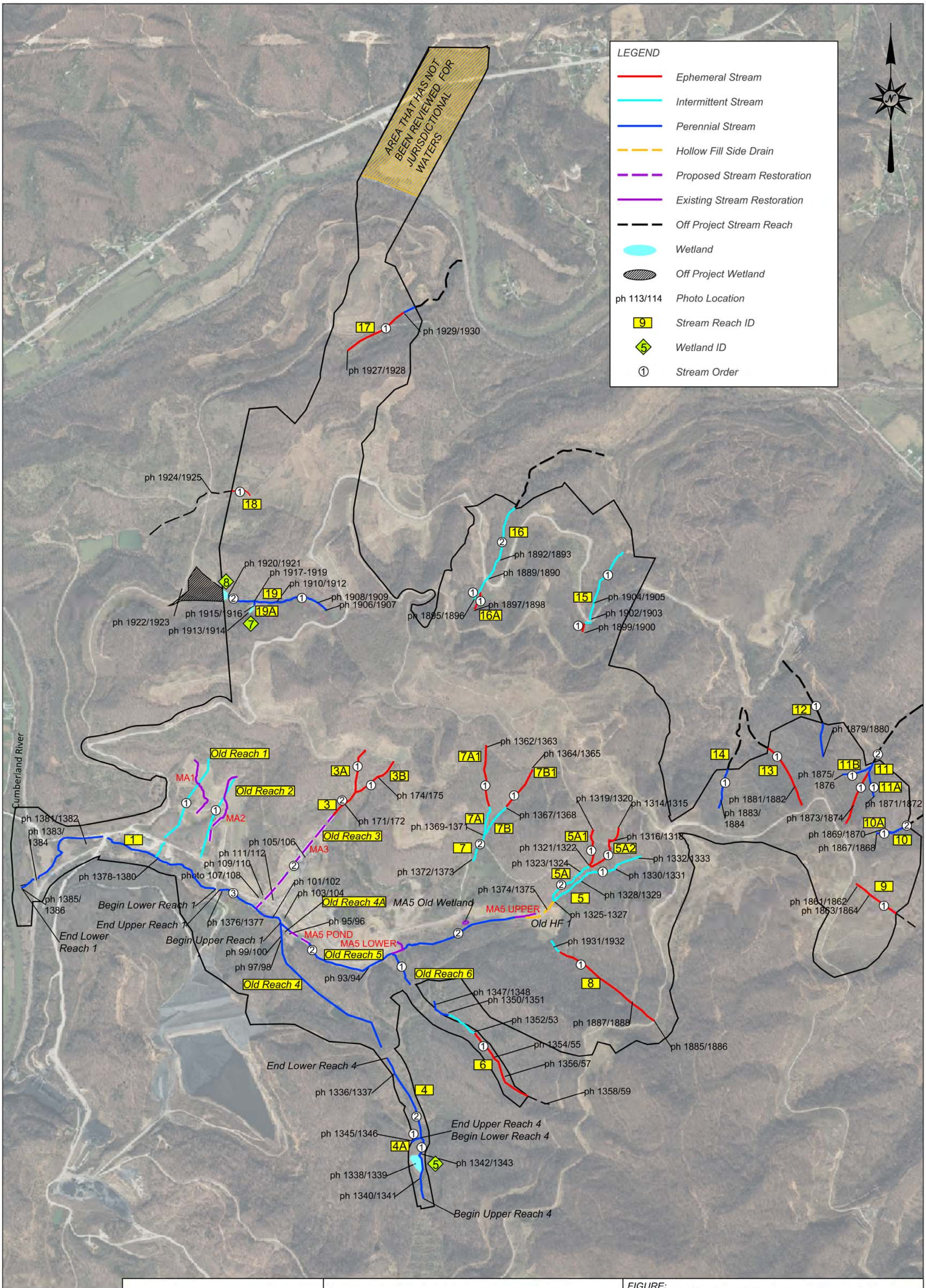
PROJECT NAME:
Lewis Ridge
Pumped Storage

APPLICANT:
Lewis Ridge Pumped
Storage LLC

ACE ID NO:

DNR WQC No:

SCALE:
1" = 2500'



☐ PROJECT AREA

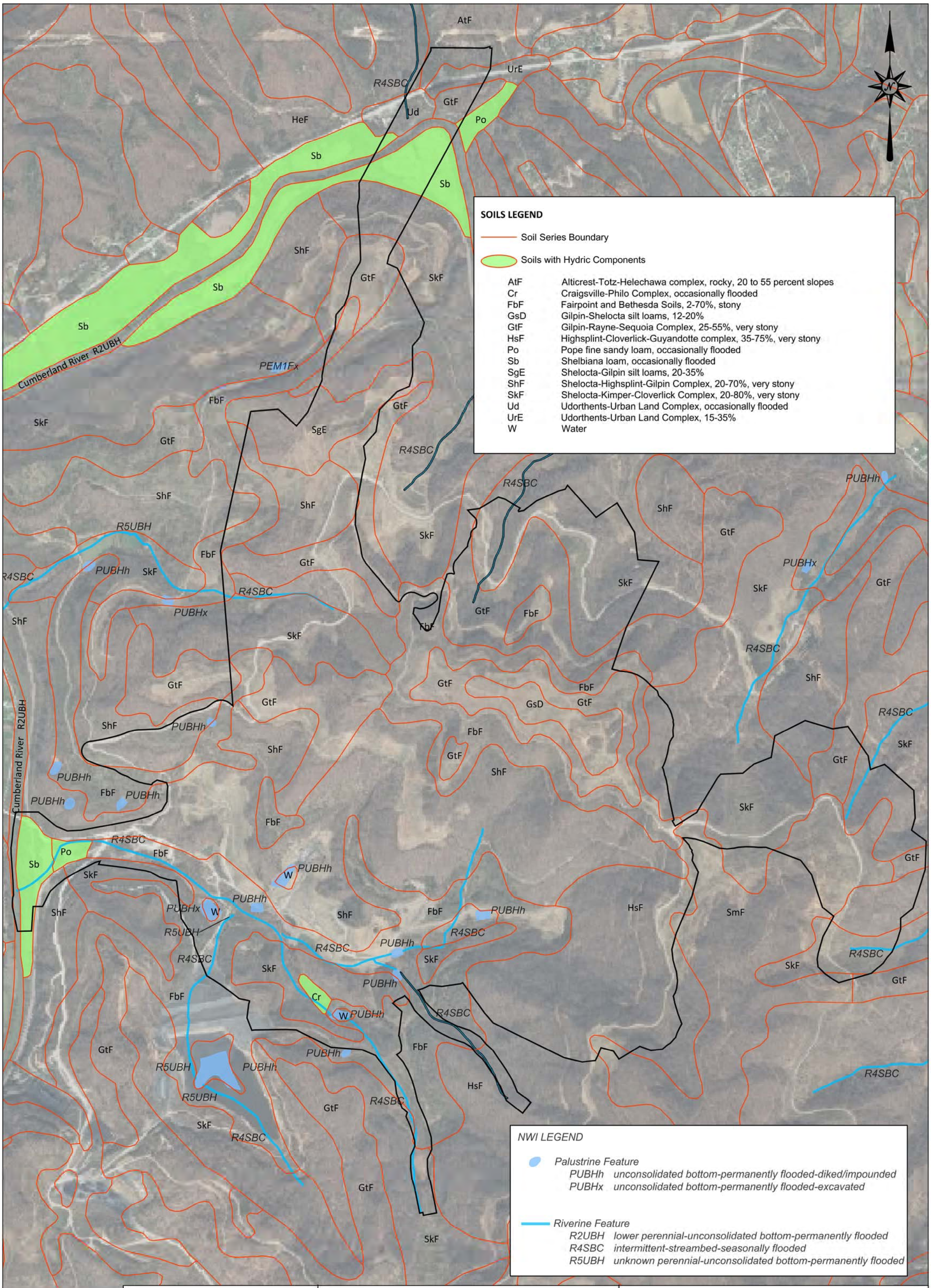
EcoSource, Inc.

120 Marketplace Circle, Ste C-163
Georgetown, Kentucky 40324
(502) 868-5200

FIGURE:
Jurisdictional Determination Map

PROJECT NAME: Lewis Ridge Pumped Storage	APPLICANT: Lewis Ridge Pumped Storage LLC

ACE ID NO.:	DNR WQC NO.:	SCALE: 1"=1200'



SOILS LEGEND

Soil Series Boundary

Soils with Hydric Components

AtF	Alticrest-Totz-Helechawa complex, rocky, 20 to 55 percent slopes
Cr	Craigsville-Philo Complex, occasionally flooded
FbF	Fairpoint and Bethesda Soils, 2-70%, stony
GsD	Gilpin-Shelocta silt loams, 12-20%
GtF	Gilpin-Rayne-Sequoia Complex, 25-55%, very stony
HsF	Highsplint-Cloverlick-Guyandotte complex, 35-75%, very stony
Po	Pope fine sandy loam, occasionally flooded
Sb	Shelbiana loam, occasionally flooded
SgE	Shelocta-Gilpin silt loams, 20-35%
ShF	Shelocta-Highsplint-Gilpin Complex, 20-70%, very stony
SkF	Shelocta-Kimper-Cloverlick Complex, 20-80%, very stony
Ud	Udorthents-Urban Land Complex, occasionally flooded
UrE	Udorthents-Urban Land Complex, 15-35%
W	Water

NWI LEGEND

Palustrine Feature

PUBHh	*unconsolidated bottom-permanently flooded-diked/impounded*
PUBHx	*unconsolidated bottom-permanently flooded-excavated*

Riverine Feature

R2UBH	*lower perennial-unconsolidated bottom-permanently flooded*
R4SBC	*intermittent-streambed-seasonally flooded*
R5UBH	*unknown perennial-unconsolidated bottom-permanently flooded*

☐ *PROJECT AREA*

EcoSource, Inc.

120 Marketplace Circle, Ste C-163
Georgetown, Kentucky 40324
(502) 868-5200

Soils and NWI Map

PROJECT NAME:	*APPLICANT:*	
Lewis Ridge Pumped Storage	Lewis Ridge Pumped Storage LLC	
ACE ID NO.:	*DNR WQC NO.:*	*SCALE:* 1"=1200'

ATTACHMENT B – FIELD DATA

- **Wetland Delineation Form**
- **Stream RBP Sheets**
- **EII Calculation Sheets**
- **Photos**

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Bell County Water Battery City/County: Bell Sampling Date: September 3, 2024

Applicant/Owner: Rye Development State: KY Sampling Point: 5 (in)

Investigator(s): D. Collinsworth Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): old pond Local relief (concave, convex, none): concave Slope (%): <1

Subregion (LRR or MLRA): LRR N Lat: 36.74945 Long: -83.54276 Datum: NAD 83

Soil Map Unit Name: Shelocta-Kimper-Cloverlick Complex, 20-80%, very stony NWI classification: not classified

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐

Hydric Soil Present? Yes ☒ No ☐

Wetland Hydrology Present? Yes ☒ No ☐

Is the Sampled Area within a Wetland? **Yes** ☒ **No** ☐

Remarks: Community type:

old pond

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☒ Surface Water (A1)
- ☐ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☒ No ☐ Depth (inches): 1

Water Table Present? Yes ☐ No ☒ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ☒ No ☐ Depth (inches): 2

Wetland Hydrology Present? **Yes** ☒ **No** ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: 5 (in)

Tree Stratum (Plot size: 30 ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8. 50%=25 20%=10			
= Total Cover	10		

Sapling/Shrub Stratum (Plot size: 15 ft radius)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
= Total Cover			

Herb Stratum (Plot size: 5 ft radius)			
1. *Typha angustifolia*	10	NO	OBL
2. *Scirpus cyperinus*	50	NO	FACW
3. *Eutrochium fistulosum*	10	NO	FACW
4. *Liquidambar styraciflua*	10	NO	FAC
5. *Scirpus atrovirens*	5	NO	OBL
6. *Lespedeza cuneata*	5	NO	FACU
7.			
8.			
9.			
10.			
11.			
12. 50%=42.5 & 20%=17			
= Total Cover	85		

Woody Vine Stratum (Plot size: 15' R)			
1.			
2.			
3.			
4.			
5.			
6.			
= Total Cover			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	2	x 1 = 2
FACW species	2	x 2 = 4
FAC species	1	x 3 = 3
FACU species	1	x 4 = 4
UPL species		x 5 =
Column Totals:	6 (A)	11 (B)

Prevalence Index = B/A = 1.83

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☒ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ☒ No ☐

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: 5 (in)

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-12	10YR 5/2	80	10YR 6/6	5	C	M		
			10YR 5/4	5	D	M		

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5)
☐ 2 cm Muck (A10) **(LRR N)**
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)

☐ Dark Surface (S7)
☐ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
☐ Thin Dark Surface (S9) **(MLRA 147, 148)**
☐ Loamy Gleyed Matrix (F2)
☒ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
☐ Umbric Surface (F13) **(MLRA 136, 122)**
☐ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

☐ 2 cm Muck (A10) **(MLRA 147)**
☐ Coast Prairie Redox (A16) **(MLRA 147, 148)**
☐ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
☐ Red Parent Material (TF2)
☐ Very Shallow Dark Surface (TF12)
☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes ☒ **No** ☐

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Bell County Water Battery City/County: Bell Sampling Date: April 29, 2025
Applicant/Owner: Rye Development State: KY Sampling Point: 7 (in)
Investigator(s): D. Collinsworth Section, Township, Range: N/A
Landform (hillslope, terrace, etc.): fill material Local relief (concave, convex, none): concave Slope (%): <1
Subregion (LRR or MLRA): LRR N Lat: 36.772461 Long: -83.550531 Datum: NAD 83
Soil Map Unit Name: Shelocta-Kimper-Cloverlick Complex, 20-80%, very stony NWI classification: not classified
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)
Are Vegetation ☐, Soil ☒, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐
Hydric Soil Present? Yes ☒ No ☐
Wetland Hydrology Present? Yes ☒ No ☐

Is the Sampled Area within a Wetland? **Yes** ☒ **No** ☐

Remarks: Community type:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☒ Surface Water (A1)
- ☐ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☒ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☒ No ☐ Depth (inches): 1
Water Table Present? Yes ☐ No ☒ Depth (inches):
Saturation Present? (includes capillary fringe) Yes ☒ No ☐ Depth (inches): at 0

Wetland Hydrology Present? **Yes** ☒ **No** ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: 7 (in)

Tree Stratum (Plot size: 30 ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8. 50%= 20%=			
	10	= Total Cover	

Sapling/Shrub Stratum (Plot size: 15 ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Salix nigra*	10	YES	OBL
2. *Liquidambar styraciflua*	10	YES	FAC
3. *Acer rubrum*	10	YES	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10. 50%=15 20%=6			
	30	= Total Cover	

Herb Stratum (Plot size: 5 ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Typha angustifolia*	20	YES	OBL
2. *Scirpus sp.*	30	YES	FAC
3. *Schoenoplectus tabernaemontani*	10	NO	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12. 50%=30 & 20%=12			
	60	= Total Cover	

Woody Vine Stratum (Plot size: 15' R)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☒ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ☒ **No** ☐

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: 7 (in)

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features				Texture	Remarks
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
atypical	mine soils							

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ 2 cm Muck (A10) **(LRR N)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7)
- ☐ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ☐ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ☐ Umbric Surface (F13) **(MLRA 136, 122)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) **(MLRA 147)**
- ☐ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☒ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____

Depth (inches): ____

Hydric Soil Present? Yes ☒ **No** ☐

Remarks:

Soils are atypical due to being on surface coal mine material.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Bell County Water Battery City/County: Bell Sampling Date: April 29, 2025
Applicant/Owner: Rye Development State: KY Sampling Point: 7 (out)
Investigator(s): D. Collinsworth Section, Township, Range: N/A
Landform (hillslope, terrace, etc.): fill material Local relief (concave, convex, none): concave Slope (%): <1
Subregion (LRR or MLRA): LRR N Lat: 36.772474 Long: -83.550395 Datum: NAD 83
Soil Map Unit Name: Shelocta-Kimper-Cloverlick Complex, 20-80%, very stony NWI classification: not classified
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)
Are Vegetation ☐, Soil ☒, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☐ No ☒
Hydric Soil Present? Yes ☐ No ☒
Wetland Hydrology Present? Yes ☐ No ☒

Is the Sampled Area within a Wetland? **Yes** ☐ **No** ☒

Remarks: Community type:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): ______
Water Table Present? Yes ☐ No ☒ Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): ______

Wetland Hydrology Present? **Yes** ☐ **No** ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: 7 (out)

Tree Stratum (Plot size: 30 ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8. 50%= 20%=			
	10	= Total Cover	

Sapling/Shrub Stratum (Plot size: 15 ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Liriodendron tulipifera			FACU
2. Prunus serotina			FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10. 50%=15 20%=6			
	30	= Total Cover	

Herb Stratum (Plot size: 5 ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Festuca sp.			---
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12. 50%=30 & 20%=12			
	60	= Total Cover	

Woody Vine Stratum (Plot size: 15' R)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ________ (A)

Total Number of Dominant Species Across All Strata: ________ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ________ (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ________

Hydrophytic Vegetation Indicators:

☐ 1 - Rapid Test for Hydrophytic Vegetation

☐ 2 - Dominance Test is >50%

☐ 3 - Prevalence Index is ≤3.0[1]

☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: 7 (out)

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
atypical	mine soils							

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5)
☐ 2 cm Muck (A10) **(LRR N)**
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Dark Surface (S7)
☐ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
☐ Thin Dark Surface (S9) **(MLRA 147, 148)**
☐ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
☐ Umbric Surface (F13) **(MLRA 136, 122)**
☐ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

☐ 2 cm Muck (A10) **(MLRA 147)**
☐ Coast Prairie Redox (A16) **(MLRA 147, 148)**
☐ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
☐ Red Parent Material (TF2)
☐ Very Shallow Dark Surface (TF12)
☒ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? **Yes** ☐ **No** ☒

Remarks:

Soils are atypical due to being on surface coal mine material.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Bell County Water Battery City/County: Bell Sampling Date: April 29, 2025
Applicant/Owner: Rye Development State: KY Sampling Point: 8 (in)
Investigator(s): D. Collinsworth Section, Township, Range: N/A
Landform (hillslope, terrace, etc.): fill material Local relief (concave, convex, none): concave Slope (%): <1
Subregion (LRR or MLRA): LRR N Lat: 36.772474 Long: -83.550395 Datum: NAD 83
Soil Map Unit Name: Shelocta-Kimper-Cloverlick Complex, 20-80%, very stony NWI classification: not classified
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)
Are Vegetation ☐, Soil ☒, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☒ No ☐	**Is the Sampled Area within a Wetland?** **Yes** ☒ **No** ☐
Hydric Soil Present?	Yes ☒ No ☐	
Wetland Hydrology Present?	Yes ☒ No ☐	

Remarks: Community type:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☒ Surface Water (A1)
- ☐ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☒ No ☐ Depth (inches): 2
Water Table Present? Yes ☐ No ☒ Depth (inches):
Saturation Present? (includes capillary fringe) Yes ☒ No ☐ Depth (inches): at 0

Wetland Hydrology Present? Yes ☒ **No** ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: 8 (in)

Tree Stratum (Plot size: 30 ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8. 50%= 20%=			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 ft radius)			
1. Platanus occidentalis	30	YES	FACW
2. Acer rubrum	30	YES	FAC
3. Acer negundo	10	NO	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10. 50%=35 20%=14			
	70 = Total Cover		

Herb Stratum (Plot size: 5 ft radius)			
1. Rumex crispus	5		FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12. 50%=30 & 20%=12			
	60 = Total Cover		

Woody Vine Stratum (Plot size: 15' R)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ______ (A)

Total Number of Dominant Species Across All Strata: ______ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ______ (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

☐ 1 - Rapid Test for Hydrophytic Vegetation

☐ 2 - Dominance Test is >50%

☐ 3 - Prevalence Index is ≤3.0[1]

☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ☒ **No** ☐

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: 8 (in)

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
atypical	mine soils							

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ 2 cm Muck (A10) **(LRR N)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7)
- ☐ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ☐ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ☐ Umbric Surface (F13) **(MLRA 136, 122)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) **(MLRA 147)**
- ☐ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☒ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? **Yes** ☒ **No** ☐

Remarks:

Soils are atypical due to being on surface coal mine material.

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)

LOCATION: Reach 1 LOWER

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: LONG.:

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: September 12, 2024 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

	Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
	θ	θ Heavy rain	θ Yes [✓ θ No]
	θ	θ Steady rain	Air Temperature _27 ºC. Inches rainfall in past 24 hours __0_ in.
	θ	θ Intermittent showers	__10_ % Cloud Cover
	[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond.__1181____ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]	θ Construction	θ Forest
θ Deep Mining	θ Commercial	θ Pasture/Grazing
θ Oil Wells	θ Industrial	θ Silviculture
θ Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments

θ Island θ Waterfalls

θ Other ___________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]

θ High θ Very Rapid or Torrential

Stream Type:

[✓ θ Perennial] θ Intermittent

θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs

θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)

θ Partially Exposed (25-50%)

θ Partially Shaded (50-75%)

[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging

[✓ θ Channelization]

(θFull θPartial)

Habitat Parameter	**Condition Category** Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 4 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 4 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

128 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)	LOCATION: Reach 1 UPPER
STATION #: MILE:	BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: LONG.:	COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: October 12, 2022 TIME: ☐AM ☐PM	INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:	Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
	θ	θ Heavy rain	θ Yes [✓ θ No]
	θ	θ Steady rain	Air Temperature _10 ºC. Inches rainfall in past 24 hours __0_ in.
	θ	θ Intermittent showers	__50_ % Cloud Cover
	[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond.__1100____ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]	θ Construction	θ Forest
θ Deep Mining	θ Commercial	θ Pasture/Grazing
θ Oil Wells	θ Industrial	θ Silviculture
θ Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other _________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
[✓ θ Perennial] θ Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
[✓ θ Fully Exposed (0-25%)]
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
θ Fully Shaded (75-100%)

Channel Alterations:
θ Dredging
[✓ θ Channelization]
(θFull θPartial)

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. **Channel Flow Status**	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. **Channel Alteration**	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. **Frequency of Riffles (or bends)**	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 2 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

99 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)

LOCATION: Reach 3 and 3A and 3B

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: LONG.:

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: November 14, 2022 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER: Now / Past 24 hours

θ / θ Heavy rain

θ / θ Steady rain

θ / θ Intermittent showers

[✓ θ] / [✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days?

θ Yes [✓ θ No]

Air Temperature _13 ºC. Inches rainfall in past 24 hours __0_ in.

__20_ % Cloud Cover

P-Chem: Temp (ºC)________ D.O. (mg/l)_________ % Saturation_________ pH (S.U.)_________ Cond.________ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]

θ Deep Mining

θ Oil Wells

θ Land Disposal

θ Construction

θ Commercial

θ Industrial

θ Row Crops

θ Forest

θ Pasture/Grazing

θ Silviculture

θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments

θ Island θ Waterfalls

θ Other ________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]

θ High θ Very Rapid or Torrential

Stream Type:

θ Perennial θ Intermittent

[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs

θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)

θ Partially Exposed (25-50%)

θ Partially Shaded (50-75%)

[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging

θ Channelization

(θFull θPartial)

Habitat Parameter	Condition Category Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

128 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)

LOCATION: Reach 4 LOWER

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: LONG.:

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: September 3, 2024 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
θ	θ Heavy rain	θ Yes [✓ θ No]
θ	θ Steady rain	Air Temperature _27 °C. Inches rainfall in past 24 hours __0_ in.
θ	θ Intermittent showers	__10_ % Cloud Cover
[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (°C)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._1005___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ___________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
[✓ θ Perennial] θ Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
[✓ θ Partially Shaded (50-75%)]
θ Fully Shaded (75-100%)

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat	**Condition Category**			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

117 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)

LOCATION: Reach 4 UPPER

STATION #:

MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.:

LONG.:

COUNTY: Bell

USGS 7.5 TOPO: Balkan, KY

DATE: September 3, 2024

TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]

Air Temperature _27 ºC. Inches rainfall in past 24 hours __0_ in.

__10_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._1005___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments

θ Island θ Waterfalls

θ Other ___________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]

θ High θ Very Rapid or Torrential

Stream Type:

[✓ θ Perennial] θ Intermittent

θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs

θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)

θ Partially Exposed (25-50%)

[✓ θ Partially Shaded (50-75%)]

θ Fully Shaded (75-100%)

Channel Alterations:

θ Dredging

θ Channelization

(θFull θPartial)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

111 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)
LOCATION: Reach 4A

STATION #: MILE:
BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: LONG.:
COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: September 3, 2024 TIME: ☐AM ☐PM
INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER: Now Past 24 hours Has there been a heavy rain in the last 7 days?

θ θ Heavy rain θ Yes [✓ θ No]

θ θ Steady rain Air Temperature _27 °C. Inches rainfall in past 24 hours __0_ in.

θ θ Intermittent showers __10_ % Cloud Cover

[✓ θ] [✓ θ Clear/sunny]

P-Chem: Temp (°C)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._824___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining] θ Construction θ Forest
θ Deep Mining θ Commercial θ Pasture/Grazing
θ Oil Wells θ Industrial θ Silviculture
θ Land Disposal θ Row Crops θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other _________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
[✓ θ Perennial] θ Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
[✓ θ Partially Exposed (25-50%)]
θ Partially Shaded (50-75%)
θ Fully Shaded (75-100%)

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat	**Condition Category**			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

92 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)

LOCATION: Reach 5

STATION #:

MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.:

LONG.:

COUNTY: Bell

USGS 7.5 TOPO: Balkan, KY

DATE: August 22, 2024

TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now / Past 24 hours
θ / θ Heavy rain
θ / θ Steady rain
θ / θ Intermittent showers
[✓ θ] / [✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days?
θ Yes [✓ θ No]
Air Temperature _27 ºC. Inches rainfall in past 24 hours __0_ in.
_10_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._402___ θ Grab

INSTREAM WATERSHED FEATURES:
Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:
[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ___________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial [✓ θ Intermittent]
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat	Condition Category			
Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

111 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)
LOCATION: Reach 5A
STATION #: MILE:
BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: LONG.:
COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: August 22, 2024 TIME: ☐AM ☐PM
INVESTIGATORS: DLC
TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER: Now Past 24 hours
θ θ Heavy rain
θ θ Steady rain
θ θ Intermittent showers
[✓ θ] [✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days?
θ Yes [✓ θ No]
Air Temperature _27 °C. Inches rainfall in past 24 hours __0_ in.
_10_ % Cloud Cover

P-Chem: Temp (°C)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._375___ θ Grab

INSTREAM WATERSHED FEATURES:
Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:
[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial [✓ θ Intermittent]
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

111 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)

LOCATION: Reach 5A-1 AND 5A-2

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: LONG.:

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: August 22, 2024 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER: Now / Past 24 hours

θ / θ Heavy rain

θ / θ Steady rain

θ / θ Intermittent showers

[✓ θ] / [✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]

Air Temperature _27 °C. Inches rainfall in past 24 hours __0_ in.

_10_ % Cloud Cover

P-Chem: Temp (°C)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._375___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining] θ Deep Mining θ Oil Wells θ Land Disposal

θ Construction θ Commercial θ Industrial θ Row Crops

θ Forest θ Pasture/Grazing θ Silviculture θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments

θ Island θ Waterfalls

θ Other ________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]

θ High θ Very Rapid or Torrential

Stream Type:

θ Perennial θ Intermittent

[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs

θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)

θ Partially Exposed (25-50%)

θ Partially Shaded (50-75%)

[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging

θ Channelization

(θFull θPartial)

Habitat	**Condition Category**			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. **Channel Flow Status**	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. **Channel Alteration**	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. **Frequency of Riffles (or bends)**	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

113 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)

LOCATION: Reach 6 EPHEMERAL/INTERMITTENT

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: LONG.:

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: September 3, 2024 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours	
		Has there been a heavy rain in the last 7 days?
θ	θ Heavy rain	θ Yes [✓ θ No]
θ	θ Steady rain	Air Temperature _27 ºC. Inches rainfall in past 24 hours __0_ in.
θ	θ Intermittent showers	_10_ % Cloud Cover
[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._657___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:

θ Perennial [✓ θ Intermittent]
[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

113 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)
LOCATION: Reach 6 PERENNIAL
STATION #: MILE:
BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: LONG.:
COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: September 3, 2024 TIME: ☐AM ☐PM
INVESTIGATORS: DLC
TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
θ	θ Heavy rain	θ Yes [✓ θ No]
θ	θ Steady rain	Air Temperature _27 ºC. Inches rainfall in past 24 hours __0_ in.
θ	θ Intermittent showers	__10_ % Cloud Cover
[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._657___ θ Grab

INSTREAM WATERSHED FEATURES:
Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:
[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ___________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
[✓ θ Perennial] θ Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

123 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)
LOCATION: Reach 7, 7A, AND 7B
STATION #: MILE:
BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: LONG.:
COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: September 3, 2024 TIME: ☐AM ☐PM
INVESTIGATORS: DLC
TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER: Now Past 24 hours
θ θ Heavy rain
θ θ Steady rain
θ θ Intermittent showers
[✓ θ] [✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]
Air Temperature _27 °C. Inches rainfall in past 24 hours __0_ in.
_10_ % Cloud Cover

P-Chem: Temp (°C)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._322___ θ Grab

INSTREAM WATERSHED FEATURES:
Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:
[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other _________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial [✓ θ Intermittent]
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat	**Condition Category**			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

102 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Tom Fork (of Cumberland River)

LOCATION: Reach 7A-1 AND 7B-1

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: LONG.:

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: September 3, 2024 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]

Air Temperature _27 ºC. Inches rainfall in past 24 hours __0_ in.

_10_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._322___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial θ Intermittent
[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

93 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Toms Fork

LOCATION: Reach 8 (EPHEMERAL)

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.756077 LONG.: -83.531307

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 16, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]

Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.

__0_ % Cloud Cover

P-Chem: Temp (ºC)________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._201 ___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:

θ Perennial θ Intermittent
[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat	Condition Category			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. **Channel Flow Status**	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE __0	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. **Channel Alteration**	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. **Frequency of Riffles (or bends)**	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE _10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE __7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE __7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE _8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE _8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE __9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE __9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

112 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Toms Fork

LOCATION: Reach 8 (INTERMITTENT)

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.758436 LONG.: -83.535354

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 29, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours	
θ	θ Heavy rain	Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]
θ	θ Steady rain	Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.
θ	θ Intermittent showers	___0_ % Cloud Cover
[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._201 ___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining] θ Construction θ Forest

θ Deep Mining θ Commercial θ Pasture/Grazing

θ Oil Wells θ Industrial θ Silviculture

θ Land Disposal θ Row Crops θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments

θ Island θ Waterfalls

θ Other _________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]

θ High θ Very Rapid or Torrential

Stream Type:

θ Perennial [✓ θ Intermittent]

θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs

θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)

θ Partially Exposed (25-50%)

θ Partially Shaded (50-75%)

[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging

θ Channelization

(θFull θPartial)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __13__	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __15__	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __6__	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __13__	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

133 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Campbell Branch
LOCATION: Reach 9
STATION #: MILE:
BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: 36.760289 LONG.: -83.519171
COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: April 16, 2025 TIME: ☐AM ☐PM
INVESTIGATORS: DLC
TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days?
θ Yes [✓ θ No]
Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.
___0_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._ ___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ___________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial θ Intermittent
[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 0	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 2 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

75 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Campbell Branch

LOCATION: Reach 10 & 10A

STATION #:

MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.762774

LONG.: -83.518746

COUNTY: Bell

USGS 7.5 TOPO: Balkan, KY

DATE: April 16, 2025

TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]

Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.

__0_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._840___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal

θ Construction
θ Commercial
θ Industrial
θ Row Crops

θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other __________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:

[✓ θ Perennial] θ Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs
θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging
θ Channelization
(θFull θPartial)

Habitat	Condition Category			
Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

134 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Campbell Branch

LOCATION: Reach 11

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.763863 LONG.: -83.519925

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 16, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
θ	θ Heavy rain	θ Yes [✓ θ No]
θ	θ Steady rain	Air Temperature _21 °C. Inches rainfall in past 24 hours _<0.1_ in.
θ	θ Intermittent showers	___0_ % Cloud Cover
[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (°C)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._804___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]	θ Construction	θ Forest
θ Deep Mining	θ Commercial	θ Pasture/Grazing
θ Oil Wells	θ Industrial	θ Silviculture
θ Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments

θ Island θ Waterfalls

θ Other _________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]

θ High θ Very Rapid or Torrential

Stream Type:

θ Perennial θ Intermittent

[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs

θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)

θ Partially Exposed (25-50%)

θ Partially Shaded (50-75%)

[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging

θ Channelization

(θFull θPartial)

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 0	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

95 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Campbell Branch

LOCATION: Reach 11 & 11A

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.764283 LONG.: -83.518821

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 16, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
θ	θ Heavy rain	θ Yes [✓ θ No]
θ	θ Steady rain	Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.
θ	θ Intermittent showers	__0_ % Cloud Cover
[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._804___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other _________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:

[✓ θ Perennial] θ Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

133 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Campbell Branch
LOCATION: Reach 11B
STATION #: MILE:
BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: 36.765199 LONG.: -83.520398
COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: April 16, 2025 TIME: ☐AM ☐PM
INVESTIGATORS: DLC
TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

	Now	Past 24 hours
	θ	θ Heavy rain
	θ	θ Steady rain
	θ	θ Intermittent showers
	[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days?
θ Yes [✓ θ No]
Air Temperature _21 °C. Inches rainfall in past 24 hours _<0.1_ in.
__0_ % Cloud Cover

P-Chem: Temp (°C)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._799___ θ Grab

INSTREAM WATERSHED FEATURES:
Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:
[✓ θ Surface Mining] θ Deep Mining θ Oil Wells θ Land Disposal
θ Construction θ Commercial θ Industrial θ Row Crops
θ Forest θ Pasture/Grazing θ Silviculture θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other __________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial θ Intermittent
[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

119 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Bull Branch

LOCATION: Reach 12

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.766130 LONG.: -83.521425

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 16, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days?
θ Yes [✓ θ No]

Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.

__0_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._760___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other __________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
[✓ θ Perennial] θ Intermittent
θ Ephemeral☐ θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

127 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Bull Branch

LOCATION: Reach 13

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.764792 LONG.: -83.522967

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 16, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER: Now / Past 24 hours

θ / θ Heavy rain
θ / θ Steady rain
θ / θ Intermittent showers
[✓ θ] / [✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]

Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.

__0_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._ ___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other __________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:

θ Perennial θ Intermittent
[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs
θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging
θ Channelization
(θFull θPartial)

Habitat	**Condition Category**			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. **Channel Flow Status**	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 0	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. **Channel Alteration**	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. **Frequency of Riffles (or bends)**	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

93 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Bull Branch

LOCATION: Reach 14

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.764338 LONG.: -83.526600

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 16, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER: Now Past 24 hours

θ θ Heavy rain

θ θ Steady rain

θ θ Intermittent showers

[✓ θ] [✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days?

θ Yes [✓ θ No]

Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.

___0_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._790 ___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]

θ Deep Mining

θ Oil Wells

θ Land Disposal

θ Construction

θ Commercial

θ Industrial

θ Row Crops

θ Forest

θ Pasture/Grazing

θ Silviculture

θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments

θ Island θ Waterfalls

θ Other _________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]

θ High θ Very Rapid or Torrential

Stream Type:

[✓ θ Perennial] θ Intermittent

θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs

θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)

θ Partially Exposed (25-50%)

θ Partially Shaded (50-75%)

[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging

θ Channelization

(θFull θPartial)

Habitat	**Condition Category**			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 3	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

124 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Pound Mill Branch

LOCATION: Reach 15 PERENNIAL

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.771901 LONG.: -83.533071

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 29, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days?
θ Yes [✓ θ No]
Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.
__0_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._606 ___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ___________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
[✓ θ Perennial] θ Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat	Condition Category			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE __6__	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE __15__	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE __6__	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE __8__ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE __8__ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE __9__ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE __9__ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE __9__ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE __9__ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

113 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Pound Mill Branch
LOCATION: Reach 15
STATION #: MILE:
BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: 36.771901 LONG.: -83.533071
COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: April 29, 2025 TIME: ☐AM ☐PM
INVESTIGATORS: DLC
TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]
Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.
__0_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._606 ___ θ Grab

INSTREAM WATERSHED FEATURES:
Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:
[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other __________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial θ Intermittent
[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE _6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE _6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. **Channel Flow Status**	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. **Channel Alteration**	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. **Frequency of Riffles (or bends)**	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

113 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Pound Mill Branch

LOCATION: Reach 16

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.773725 LONG.: -83.538257

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 29, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]

Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.

___0_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._935 ___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

- [✓ θ Surface Mining]
- θ Deep Mining
- θ Oil Wells
- θ Land Disposal
- θ Construction
- θ Commercial
- θ Industrial
- θ Row Crops
- θ Forest
- θ Pasture/Grazing
- θ Silviculture
- θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments

θ Island θ Waterfalls

θ Other __________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]

θ High θ Very Rapid or Torrential

Stream Type:

θ Perennial [✓ θ Intermittent]

θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs

θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)

θ Partially Exposed (25-50%)

θ Partially Shaded (50-75%)

[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging

θ Channelization

(θFull θPartial)

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

133 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Pound Mill Branch
LOCATION: Reach 16A
STATION #: MILE:
BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: 36.772387 LONG.: -83.538966
COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: April 29, 2025 TIME: ☐AM ☐PM
INVESTIGATORS: DLC
TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours	
		Has there been a heavy rain in the last 7 days?
θ	θ Heavy rain	θ Yes [✓ θ No]
θ	θ Steady rain	Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.
θ	θ Intermittent showers	___0_ % Cloud Cover
[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._935 ___ θ Grab

INSTREAM WATERSHED FEATURES:
Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:
[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other _________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial θ Intermittent
[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE _6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. **Channel Flow Status**	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. **Channel Alteration**	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. **Frequency of Riffles (or bends)**	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

123 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Cumberland River

LOCATION: Reach 17 (EPHEMERAL)

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.783171 LONG.: -83.545156

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 29, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
θ	θ Heavy rain	θ Yes [✓ θ No]
θ	θ Steady rain	Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.
θ	θ Intermittent showers	___0_ % Cloud Cover
[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._660___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

- [✓ θ Surface Mining]
- θ Deep Mining
- θ Oil Wells
- θ Land Disposal
- θ Construction
- θ Commercial
- θ Industrial
- θ Row Crops
- θ Forest
- θ Pasture/Grazing
- θ Silviculture
- θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments

θ Island θ Waterfalls

θ Other ________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]

θ High θ Very Rapid or Torrential

Stream Type:

θ Perennial θ Intermittent

[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs

θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)

θ Partially Exposed (25-50%)

[✓ θ Partially Shaded (50-75%)]

θ Fully Shaded (75-100%)

Channel Alterations:

θ Dredging

θ Channelization

(θFull θPartial)

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE _8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE _8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE __0	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE _8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE _7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE _7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE _8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE _8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE __8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE __8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

101 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Cumberland River

LOCATION: Reach 17 (PERENNIAL)

STATION #: MILE:

BASIN/WATERSHED: Upper Cumberland (05130101)

LAT.: 36.784671 LONG.: -83.542226

COUNTY: Bell USGS 7.5 TOPO: Balkan, KY

DATE: April 29, 2025 TIME: ☐AM ☐PM

INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER: Now Past 24 hours

θ θ Heavy rain

θ θ Steady rain

θ θ Intermittent showers

[✓ θ] [✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days? θ Yes [✓ θ No]

Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.

__0_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._660___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft

Range of Depth ________ ft

Average Velocity ________ ft/s

Discharge ________ cfs

Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:

θ Dams θ Bridge Abutments

θ Island θ Waterfalls

θ Other _________________________

Stream Flow:

θ Dry θ Pooled θ Low [✓ θ Normal]

θ High θ Very Rapid or Torrential

Stream Type:

[✓ θ Perennial] θ Intermittent

θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa

Dominate Type:

θ Trees θ Shrubs

θ Grasses θ Herbaceous

Number of strata ____

Canopy Cover:

θ Fully Exposed (0-25%)

θ Partially Exposed (25-50%)

θ Partially Shaded (50-75%)

[✓ θ Fully Shaded (75-100%)]

Channel Alterations:

θ Dredging

θ Channelization

(θFull θPartial)

Habitat Parameter	Condition Category Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE _8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE _10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

126 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed Trib to Dry Branch	LOCATION: Reach 18
STATION #: MILE:	BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: 36.777455 LONG.: -83.551178	COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: April 29, 2025 TIME: ☐AM ☐PM	INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

	Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
	θ	θ Heavy rain	θ Yes [✓ θ No]
	θ	θ Steady rain	Air Temperature _21 °C. Inches rainfall in past 24 hours _<0.1_ in.
	θ	θ Intermittent showers	__0_ % Cloud Cover
	[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (°C)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond.____ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]	θ Construction	θ Forest
θ Deep Mining	θ Commercial	θ Pasture/Grazing
θ Oil Wells	θ Industrial	θ Silviculture
θ Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other _______________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial θ Intermittent
[✓ θ Ephemeral] θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
[✓ θ Partially Shaded (50-75%)]
θ Fully Shaded (75-100%)

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE _1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE _8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 0	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 2	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

77 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Dry Branch
LOCATION: Reach 19
STATION #: MILE:
BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: 36.772998 LONG.: -83.549121
COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: April 29, 2025 TIME: ☐AM ☐PM
INVESTIGATORS: DLC
TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
[✓ θ]	[✓ θ Clear/sunny]

Has there been a heavy rain in the last 7 days?
θ Yes [✓ θ No]
Air Temperature _21 ºC. Inches rainfall in past 24 hours _<0.1_ in.
___0_ % Cloud Cover

P-Chem: Temp (ºC)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._1500 ___ θ Grab

INSTREAM WATERSHED FEATURES:
Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:
[✓ θ Surface Mining]
θ Deep Mining
θ Oil Wells
θ Land Disposal
θ Construction
θ Commercial
θ Industrial
θ Row Crops
θ Forest
θ Pasture/Grazing
θ Silviculture
θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other _________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
[✓ θ Perennial] θ Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
[✓ θ Fully Shaded (75-100%)]

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat	Condition Category			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

126 **Total Score**

Notes/Comments:

High Gradient Stream Data Sheet

STREAM NAME: Dry Branch	LOCATION: Reach 19A
STATION #: MILE:	BASIN/WATERSHED: Upper Cumberland (05130101)
LAT.: 36.772787 LONG.: -83.550349	COUNTY: Bell USGS 7.5 TOPO: Balkan, KY
DATE: April 29, 2025 TIME: ☐AM ☐PM	INVESTIGATORS: DLC

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

	Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
	θ	θ Heavy rain	θ Yes [✓ θ No]
	θ	θ Steady rain	Air Temperature _21 °C. Inches rainfall in past 24 hours _<0.1_ in.
	θ	θ Intermittent showers	__0_ % Cloud Cover
	[✓ θ]	[✓ θ Clear/sunny]	

P-Chem: Temp (°C)_________ D.O. (mg/l)__________ % Saturation__________ pH (S.U.)__________ Cond._850___ θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ________ ft
Range of Depth ________ ft
Average Velocity ________ ft/s
Discharge ________ cfs
Est. Reach Length ________

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use:

[✓ θ Surface Mining]	θ Construction	θ Forest
θ Deep Mining	θ Commercial	θ Pasture/Grazing
θ Oil Wells	θ Industrial	θ Silviculture
θ Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ___________________________

Stream Flow:
θ Dry θ Pooled θ Low [✓ θ Normal]
θ High θ Very Rapid or Torrential

Stream Type:
[✓ θ Perennial] θ Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
θ Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
[✓ θ Partially Shaded (50-75%)]
θ Fully Shaded (75-100%)

Channel Alterations:
θ Dredging
θ Channelization
(θFull θPartial)

Habitat	**Condition Category**			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE __10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE __11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE _5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE _11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High Gradient Stream Data Sheet (page 2)

5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

108 **Total Score**

Notes/Comments:

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: REACH 1 LOWER

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.24	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units
RBP Habitat Parameters		
1. Epifaunal Substrate	13	no units
2. Embeddedness	10	no units
3. Velocity/Depth Regime	12	no units
4. Sediment Deposition	13	no units
5. Channel Flow Status	15	no units
6. Channel Alteration	13	no units
7. Freq. Of Riffles (bends)	12	no units
8. Bank stability (both combined)	16	no units
9. Veg. Protection (both combined)	16	no units
10. Riparian Width (both combined)	8	no units

			Subindex
Total Habitat Score	128	no units	
Habitat Integrity Index			0.38
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	1181	microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: REACH 1 UPPER

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.10	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	10	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	8	no units	
4. Sediment Deposition	11	no units	
5. Channel Flow Status	10	no units	
6. Channel Alteration	11	no units	
7. Freq. Of Riffles (bends)	10	no units	
8. Bank stability (both combined)	10	no units	
9. Veg. Protection (both combined)	11	no units	
10. Riparian Width (both combined)	8	no units	
Total Habitat Score	99	no units	
Habitat Integrity Index			0.10
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	1100	microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID:	**Rye Development - Bell County Water Battery**
Stream/Reach:	**Reach 3&3A&3B**
Assessment Objectives:	**Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.24	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

Variables	Measure	Units
1. Epifaunal Substrate	10	no units
2. Embeddedness	15	no units
3. Velocity/Depth Regime	10	no units
4. Sediment Deposition	14	no units
5. Channel Flow Status	1	no units
6. Channel Alteration	16	no units
7. Freq. Of Riffles (bends)	10	no units
8. Bank stability (both combined)	16	no units
9. Veg. Protection (both combined)	18	no units
10. Riparian Width (both combined)	18	no units
Total Habitat Score	**128**	no units

			Subindex
Habitat Integrity Index			**0.38**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**500**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID:	**Rye Development - Bell County Water Battery**
Stream/Reach:	**REACH 4 LOWER**
Assessment Objectives:	**Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.19	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	
RBP Habitat Parameters			
1. Epifaunal Substrate	8	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	10	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	15	no units	
6. Channel Alteration	13	no units	
7. Freq. Of Riffles (bends)	13	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	12	no units	
Total Habitat Score	117	no units	**Subindex**
Habitat Integrity Index			**0.27**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**1005**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: REACH 4 UPPER

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.16	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	8	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	10	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	15	no units	
6. Channel Alteration	11	no units	
7. Freq. Of Riffles (bends)	13	no units	
8. Bank stability (both combined)	12	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	10	no units	
Total Habitat Score	111	no units	
Habitat Integrity Index			0.21
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	1005	microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 4A**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.10	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	5	no units	
2. Embeddedness	12	no units	
3. Velocity/Depth Regime	5	no units	
4. Sediment Deposition	12	no units	
5. Channel Flow Status	10	no units	
6. Channel Alteration	13	no units	
7. Freq. Of Riffles (bends)	7	no units	
8. Bank stability (both combined)	10	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	6	no units	
Total Habitat Score	**92**	no units	
Habitat Integrity Index			**0.10**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**824**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID:	**Rye Development - Bell County Water Battery**
Stream/Reach:	**REACH 5**
Assessment Objectives:	**Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.27	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	13	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	7	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	6	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	10	no units	
8. Bank stability (both combined)	10	no units	
9. Veg. Protection (both combined)	14	no units	
10. Riparian Width (both combined)	16	no units	
Total Habitat Score	111	no units	
Habitat Integrity Index			0.21
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	402	microMHOs	0.32

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: REACH 5A

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.30	Ecological Integrity Index (Habitat Integrity + Conductivity)

\>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	13	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	7	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	6	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	10	no units	
8. Bank stability (both combined)	10	no units	
9. Veg. Protection (both combined)	14	no units	
10. Riparian Width (both combined)	16	no units	
Total Habitat Score	111	no units	
Habitat Integrity Index			0.21
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	375	microMHOs	0.39

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: REACH 5A -1 AND 5A-2

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.31	Ecological Integrity Index (Habitat Integrity + Conductivity)

Variables	Measure	Units	Subindex
>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	11	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	7	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	6	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	10	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	14	no units	
10. Riparian Width (both combined)	16	no units	
Total Habitat Score	113	no units	
Habitat Integrity Index			0.23
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	375	microMHOs	0.39

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID:	**Rye Development - Bell County Water Battery**
Stream/Reach:	**REACH 6 EPHEMERAL AND INTERMITTENT**
Assessment Objectives:	**Baseline**

EII	**Model**
NA	**Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)**
0.17	**Ecological Integrity Index (Habitat Integrity + Conductivity)**

\>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	**Measure**	**Units**	
RBP Habitat Parameters			
1. Epifaunal Substrate	13	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	10	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	5	no units	
6. Channel Alteration	13	no units	
7. Freq. Of Riffles (bends)	10	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	16	no units	
Total Habitat Score	**113**	no units	**Subindex**
Habitat Integrity Index			**0.23**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**657**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 6 PERENNIAL**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.22	Ecological Integrity Index (Habitat Integrity + Conductivity)

\>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	13	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	10	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	15	no units	
6. Channel Alteration	13	no units	
7. Freq. Of Riffles (bends)	10	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	16	no units	
Total Habitat Score	123	no units	
Habitat Integrity Index			0.33
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	657	microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: REACH 7A-1 AND 7B-1

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.30	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	8	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	5	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	5	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	8	no units	
8. Bank stability (both combined)	12	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	8	no units	
Total Habitat Score	93	no units	
Habitat Integrity Index			0.10
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	322	microMHOs	0.51

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 7A-1 AND 7B-1**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.30	Ecological Integrity Index (Habitat Integrity + Conductivity)

\>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	
RBP Habitat Parameters			
1. Epifaunal Substrate	8	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	5	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	5	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	8	no units	
8. Bank stability (both combined)	12	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	8	no units	
Total Habitat Score	**93**	no units	**Subindex**
Habitat Integrity Index			**0.10**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**322**	microMHOs	**0.51**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID:	**Rye Development - Bell County Water Battery**
Stream/Reach:	**Reach 8 EPHEMERAL**
Assessment Objectives:	**Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.54	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	13	no units	
2. Embeddedness	14	no units	
3. Velocity/Depth Regime	1	no units	
4. Sediment Deposition	13	no units	
5. Channel Flow Status	0	no units	
6. Channel Alteration	13	no units	
7. Freq. Of Riffles (bends)	10	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	16	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	**112**	no units	
Habitat Integrity Index			**0.22**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**201**	microMHOs	**0.85**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID:	**Rye Development - Bell County Water Battery**
Stream/Reach:	**Reach 8 INTERMITTENT**
Assessment Objectives:	**Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.64	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	13	no units	
2. Embeddedness	15	no units	
3. Velocity/Depth Regime	6	no units	
4. Sediment Deposition	13	no units	
5. Channel Flow Status	6	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	15	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	18	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	**133**	no units	
Habitat Integrity Index			**0.43**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**201**	microMHOs	**0.85**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **Reach 9**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.10	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	
RBP Habitat Parameters			
1. Epifaunal Substrate	8	no units	
2. Embeddedness	8	no units	
3. Velocity/Depth Regime	1	no units	
4. Sediment Deposition	8	no units	
5. Channel Flow Status	0	no units	
6. Channel Alteration	5	no units	
7. Freq. Of Riffles (bends)	13	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	4	no units	
10. Riparian Width (both combined)	14	no units	
Total Habitat Score	**75**	no units	**Subindex**
Habitat Integrity Index			**0.10**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity		microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: Reach 10 AND 10A

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.27	Ecological Integrity Index (Habitat Integrity + Conductivity)

\>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	13	no units	
2. Embeddedness	13	no units	
3. Velocity/Depth Regime	5	no units	
4. Sediment Deposition	15	no units	
5. Channel Flow Status	16	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	13	no units	
8. Bank stability (both combined)	12	no units	
9. Veg. Protection (both combined)	14	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	134	no units	
Habitat Integrity Index			0.44
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	840	microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: REACH 11 EPHEMERAL

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.10	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	10	no units	
2. Embeddedness	13	no units	
3. Velocity/Depth Regime	1	no units	
4. Sediment Deposition	11	no units	
5. Channel Flow Status	0	no units	
6. Channel Alteration	10	no units	
7. Freq. Of Riffles (bends)	6	no units	
8. Bank stability (both combined)	12	no units	
9. Veg. Protection (both combined)	14	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	95	no units	
Habitat Integrity Index			0.10
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	804	microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID:	**Rye Development - Bell County Water Battery**
Stream/Reach:	**REACH 11AND 11A PERENNIAL**
Assessment Objectives:	**Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.27	Ecological Integrity Index (Habitat Integrity + Conductivity)

Variables	Measure	Units	
>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	10	no units	
2. Embeddedness	15	no units	
3. Velocity/Depth Regime	5	no units	
4. Sediment Deposition	15	no units	
5. Channel Flow Status	16	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	13	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	133	no units	**Subindex**
Habitat Integrity Index			0.43
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	804	microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 11B**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.20	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	10	no units	
2. Embeddedness	11	no units	
3. Velocity/Depth Regime	1	no units	
4. Sediment Deposition	13	no units	
5. Channel Flow Status	16	no units	
6. Channel Alteration	13	no units	
7. Freq. Of Riffles (bends)	7	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	16	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	119	no units	
Habitat Integrity Index			0.29
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	799	microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 12**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.24	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	11	no units	
2. Embeddedness	13	no units	
3. Velocity/Depth Regime	1	no units	
4. Sediment Deposition	13	no units	
5. Channel Flow Status	13	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	13	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	16	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	**127**	no units	**Subindex**
Habitat Integrity Index			**0.37**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**760**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 13**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.10	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	10	no units	
2. Embeddedness	11	no units	
3. Velocity/Depth Regime	1	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	0	no units	
6. Channel Alteration	13	no units	
7. Freq. Of Riffles (bends)	6	no units	
8. Bank stability (both combined)	12	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	93	no units	
Habitat Integrity Index			0.10
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity		microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 14**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.22	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	13	no units	
2. Embeddedness	13	no units	
3. Velocity/Depth Regime	3	no units	
4. Sediment Deposition	13	no units	
5. Channel Flow Status	16	no units	
6. Channel Alteration	13	no units	
7. Freq. Of Riffles (bends)	6	no units	
8. Bank stability (both combined)	16	no units	
9. Veg. Protection (both combined)	16	no units	
10. Riparian Width (both combined)	15	no units	
Total Habitat Score	**124**	no units	**Subindex**
Habitat Integrity Index			**0.34**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**790**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 15 EPHEMERAL**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.17	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	11	no units	
2. Embeddedness	13	no units	
3. Velocity/Depth Regime	5	no units	
4. Sediment Deposition	12	no units	
5. Channel Flow Status	0	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	6	no units	
8. Bank stability (both combined)	16	no units	
9. Veg. Protection (both combined)	18	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	**114**	no units	
Habitat Integrity Index			**0.24**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**606**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 15**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.17	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units
RBP Habitat Parameters		
1. Epifaunal Substrate	11	no units
2. Embeddedness	11	no units
3. Velocity/Depth Regime	6	no units
4. Sediment Deposition	6	no units
5. Channel Flow Status	6	no units
6. Channel Alteration	15	no units
7. Freq. Of Riffles (bends)	6	no units
8. Bank stability (both combined)	16	no units
9. Veg. Protection (both combined)	18	no units
10. Riparian Width (both combined)	18	no units

Total Habitat Score	**113**	no units	**Subindex**
Habitat Integrity Index			**0.23**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**606**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: REACH 16

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.27	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	
RBP Habitat Parameters			
1. Epifaunal Substrate	13	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	10	no units	
4. Sediment Deposition	13	no units	
5. Channel Flow Status	13	no units	
6. Channel Alteration	16	no units	
7. Freq. Of Riffles (bends)	8	no units	
8. Bank stability (both combined)	16	no units	
9. Veg. Protection (both combined)	16	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	133	no units	Subindex
Habitat Integrity Index			0.43
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	935	microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 16A**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.22	Ecological Integrity Index (Habitat Integrity + Conductivity)

\>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	
RBP Habitat Parameters			
1. Epifaunal Substrate	15	no units	
2. Embeddedness	15	no units	
3. Velocity/Depth Regime	6	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	5	no units	
6. Channel Alteration	15	no units	
7. Freq. Of Riffles (bends)	7	no units	
8. Bank stability (both combined)	16	no units	
9. Veg. Protection (both combined)	16	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	**123**	no units	**Subindex**
Habitat Integrity Index			**0.33**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**935**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 17 EPHEMERAL**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.11	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	11	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	8	no units	
4. Sediment Deposition	8	no units	
5. Channel Flow Status	0	no units	
6. Channel Alteration	10	no units	
7. Freq. Of Riffles (bends)	8	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	16	no units	
10. Riparian Width (both combined)	16	no units	
Total Habitat Score	101	no units	
Habitat Integrity Index			0.11
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	660	microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID:	**Rye Development - Bell County Water Battery**
Stream/Reach:	**REACH 17 PERENNIAL**
Assessment Objectives:	**Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.23	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	13	no units	
2. Embeddedness	13	no units	
3. Velocity/Depth Regime	8	no units	
4. Sediment Deposition	10	no units	
5. Channel Flow Status	12	no units	
6. Channel Alteration	12	no units	
7. Freq. Of Riffles (bends)	10	no units	
8. Bank stability (both combined)	14	no units	
9. Veg. Protection (both combined)	16	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	**126**	no units	
Habitat Integrity Index			**0.36**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**660**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: REACH 18

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.10	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	Subindex
RBP Habitat Parameters			
1. Epifaunal Substrate	8	no units	
2. Embeddedness	10	no units	
3. Velocity/Depth Regime	1	no units	
4. Sediment Deposition	8	no units	
5. Channel Flow Status	0	no units	
6. Channel Alteration	10	no units	
7. Freq. Of Riffles (bends)	2	no units	
8. Bank stability (both combined)	12	no units	
9. Veg. Protection (both combined)	16	no units	
10. Riparian Width (both combined)	10	no units	
Total Habitat Score	77	no units	
Habitat Integrity Index			0.10
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity		microMHOs	0.10

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

(Family Level Taxonomy - All Habitats)

Project ID: Rye Development - Bell County Water Battery

Stream/Reach: REACH 19

Assessment Objectives: Baseline

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.23	Ecological Integrity Index (Habitat Integrity + Conductivity)

Variables	Measure	Units	
>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	11	no units	
2. Embeddedness	11	no units	
3. Velocity/Depth Regime	12	no units	
4. Sediment Deposition	11	no units	
5. Channel Flow Status	15	no units	
6. Channel Alteration	13	no units	
7. Freq. Of Riffles (bends)	7	no units	
8. Bank stability (both combined)	12	no units	
9. Veg. Protection (both combined)	16	no units	
10. Riparian Width (both combined)	18	no units	
Total Habitat Score	**126**	no units	**Subindex**
Habitat Integrity Index			**0.36**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**1500**	microMHOs	**0.10**

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (Version 2002.6)

****(Family Level Taxonomy - All Habitats)****

Project ID: **Rye Development - Bell County Water Battery**

Stream/Reach: **REACH 19A**

Assessment Objectives: **Baseline**

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.14	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> Enter quantitative or categorical measure from Field Data Sheet in shaded cells

Variables	Measure	Units	
RBP Habitat Parameters			
1. Epifaunal Substrate	10	no units	
2. Embeddedness	11	no units	
3. Velocity/Depth Regime	5	no units	
4. Sediment Deposition	11	no units	
5. Channel Flow Status	12	no units	
6. Channel Alteration	11	no units	
7. Freq. Of Riffles (bends)	6	no units	
8. Bank stability (both combined)	16	no units	
9. Veg. Protection (both combined)	14	no units	
10. Riparian Width (both combined)	12	no units	
Total Habitat Score	**108**	no units	**Subindex**
Habitat Integrity Index			**0.18**
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
15. mFBI	0	no units	
Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**850**	microMHOs	**0.10**

Photo 93 – Old Reach 5 – facing upstream (at upstream limits of project)

Photo 94 – Old Reach 5 – facing downstream (at upstream limits of project)

Photo 95 – Old Reach 5 – pond inlet

Photo 96 – Old Reach 5 – pond overview

Photo 97 – Old Reach 4 – facing upstream

Photo 98 – Old Reach 4 – facing downstream

Photo 99 – Old Reach 4 – at stream confluence – facing upstream

Photo 100 – Old Reach 4 – facing downstream

Photo 101 – Reach 1 – facing upstream

Photo 102 - Reach 1 – facing downstream

Photo 103 – Old Reach 5 – pond overview

Photo 104 – Old Reach 5 – pond overview

Photo 105 – Old Reach 3 – inside faceup area

Photo 106 – Old Reach 3 – inside faceup area

Photo 107 – Old Reach 3 – pond overview

Photo 108 – Old Reach 3 – pond overview

Photo 109 – Old Reach 3 – small pond overview

Photo 110 – Old Reach 3 – small pond overview

Photo 111 – Old Reach 3 – pond overview

Photo 112 – Old Reach 3 – pond overview

Photo 171 – Reach 3 – facing upstream

Photo 172 – Reach 3 – facing downstream

Photo 174 – Reach 3B – facing upstream

Photo 175 – Reach 3B – facing downstream

Photo 1314 – Reach 5A-2 – facing upstream

Photo 1315 – Reach 5A-2 – facing downstream

Photo 1316 – Reach 5A-2 – facing upstream

Photo 1318 – Reach 5A-2 – facing downstream

Photo 1319 – Reach 5A-1 – facing upstream

Photo 1320 – Reach 5A-1 – facing downstream

Photo 1321 – Reach 5A-1 and 5A-2 – facing upstream

Photo 1322 – Reach 5A – facing downstream

Photo 1323 – Reach 5A – facing upstream

Photo 1324 – Reach 5A – facing downstream

Photo 1325 – Reach 5A – facing upstream

Photo 1326 – Reach 5 – facing upstream

Photo 1327 – Old Hollow Fill 1 side drain – facing downstream

Photo 1328 – Reach 5 – facing upstream

Photo 1329 – Reach 5 – facing downstream

Photo 1330 – Reach 5 – facing upstream

Photo 1331 – Reach 5 – facing downstream

Photo 1332 – Reach 5 – facing upstream (near upstream terminus)

Photo 1333 – Reach 5 – facing downstream (near upstream terminus)

Photo 1336 – Reach 4 – facing upstream

Photo 1337 – Reach 4 – facing downstream

Photo 1338 – Wetland 5

Photo 1339 – Wetland 5

Photo 1340 – Reach 4 – facing upstream

Photo 1341 – Reach 4 – facing downstream

Photo 1342 – Reach 4 – facing upstream

Photo 1343 – Reach 4 – facing downstream

Photo 1345 – Reach 4A – facing upstream

Photo 1346 – Reach 4A – facing downstream

Photo 1347 – Reach 6 – facing upstream

Photo 1348 – Reach 6 – facing downstream

Photo 1350 – Reach 6 – facing upstream

Photo 1351 – Reach 6 – facing downstream

Photo 1352 – Reach 6 – facing upstream into ephemeral break point

Photo 1353 – Reach 6 – facing downstream into intermittent break point

Photo 1354 – Reach 6 – facing upstream

Photo 1355 – Reach 6 – facing downstream

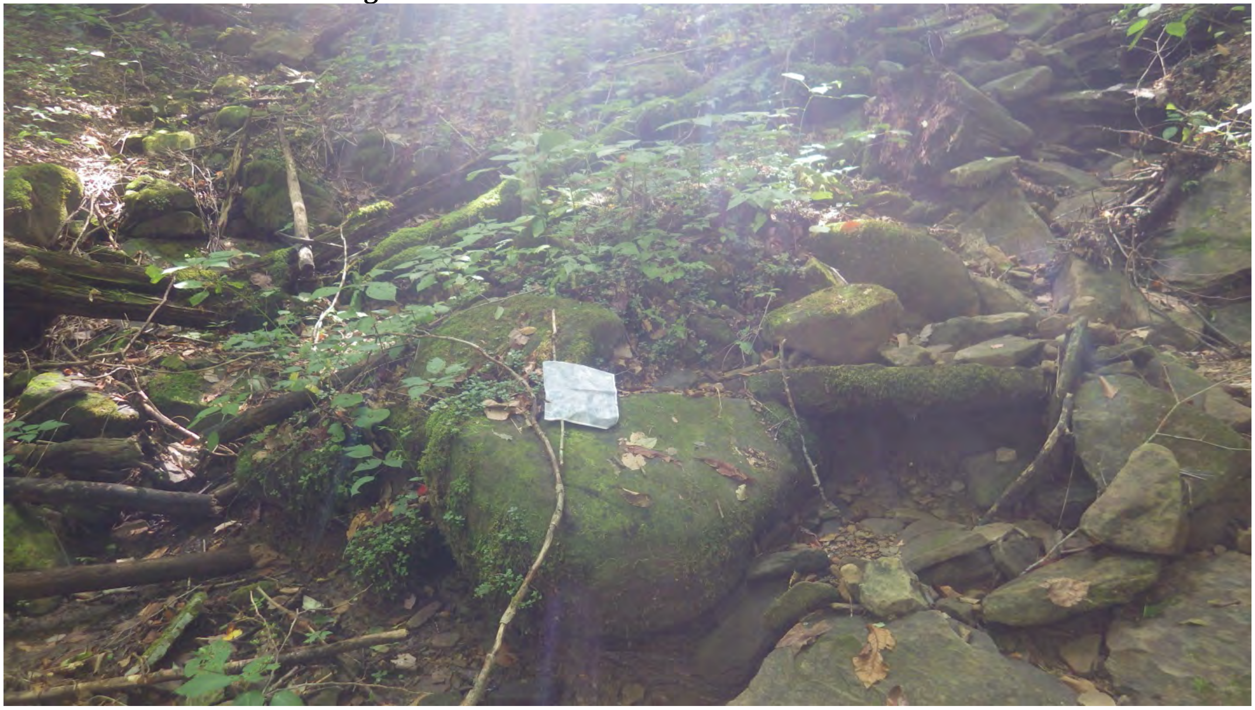


Photo 1356 – Reach 6 – facing upstream

Photo 1357 – Reach 6 – facing downstream

Photo 1358 – Reach 6 – facing upstream near terminus

Photo 1359 – Reach 6 – facing downstream near terminus

Photo 1362 – Reach 7A-1 – facing upstream

Photo 1363 – Reach 7A-1 – facing downstream

.

Photo 1364 – Reach 7B-1 – facing upstream


Photo 1365 – Reach 7B-1 – facing downstream


Photo 1367 – Reach 7B-1 – facing upstream

Photo 1368 – Reach 7B-1 – facing downstream

Photo 1369 – Reach 7A – facing upstream

Photo 1370 – Reach 7B – facing upstream

Photo 1371 – Reach 7 – facing downstream

Photo 1372 – Reach 7 – facing upstream

Photo 1373 – Reach 7 – facing downstream

Photo 1374 – Old Hollow Fill side drain facing upstream

Photo 1375 – Old Hollow Fill side drain – facing downstream

Photo 1376 – Reach 1 – facing upstream

Photo 1377 – Reach 1 – facing downstream

Photo 1378 – Old Reach 1 – facing upstrea mnear office

Photo 1379 – Reach 1 – facing upstream

Photo 1380 – Reach 1 – facing downstream

Photo 1381 – Reach 1 – facing upstream

Photo 1382 – Reach 1 – facing downstream

Photo 1383 – Reach 1 – facing upstream (at railroad crossing)

Photo 1384 – Reach 1 – facing downstream (at railroad crossing)

Photo 1385 – Reach 1 – facing upstream at confluence with the Cumberland River

Photo 1386 – Reach 1 – facing downstream at confluence with the Cumberland River

Photo 1861 – Reach 9 – facing upstream at upstream terminus

Photo 1862 – Reach 9 – facing downstream at upstream terminus

Photo 1863 – Reach 9 – facing upstream

Photo 1864 – Reach 9 – facing downstream

Photo 1867 – Reach 10 – facing upstream at upstream terminus

Photo 1868 – Reach 10 – facing downstream at upstream terminus

Photo 1869 – Reach 10A – facing upstream at upstream terminus

Photo 1870 – Reach 10A – facing downstream at upstream terminus

Photo 1871 – Reach 11A – facing upstream at upstream terminus

Photo 1872 – Reach 11A – facing downstream at upstream terminus

Photo 1873 – Reach 11 – facing upstream on ephemeral reach

Photo 1874 – Reach 11 – facing downstream on ephemeral reach

Photo 1875 – Reach 11B – facing upstream at upstream terminus

Photo 1876 – Reach 11B – facing downstream at upstream terminus

Photo 1879 – Reach 12 – facing upstream at upstream terminus

Photo 1880 – Reach 12 – facing downstream at upstream terminus

Photo 1881 - Reach 13 – facing upstream

Photo 1882 - Reach 13 – facing downstream

Photo 1883 – Reach 14 – facing upstream

Photo 1884 – Reach 14 – facing downstream

Photo 1885 – Reach 8 – facing upstream at upstream terminus

Photo 1886 – Reach 8 – facing downstream at upstream terminus

Photo 1887 – Reach 8 – facing upstream

Photo 1888 – Reach 8 – facing downstream

Photo 1889 – Reach 16 – facing upstream

Photo 1890 – Reach 16 – facing downstream

Photo 1892 – Reach 16 – facing upstream

Photo 1893 – Reach 16 – facing downstream

Photo 1895 – Reach 16 – facing upstream at upstream terminus

Photo 1896 – Reach 16 – facing downstream at upstream terminus

Photo 1897 – Reach 16A – facing upstream at upstream terminus

Photo 1898 – Reach 16A – facing downstream at upstream terminus

Photo 1899 – Reach 15 – facing upsteam at upstream terminus

Photo 1900 – Reach 15 – facing downstream at upstream terminus

Photo 1902 – Reach 15 – facing upstream

Photo 1903 – Reach 15 – facing downstream

Photo 1904 – Reach 15 – facing upstream

Photo 1905 – Reach 15 – facing downstream

Photo 1906 – Reach 19 – facing upstream at upstream terminus (base of hollow fill)

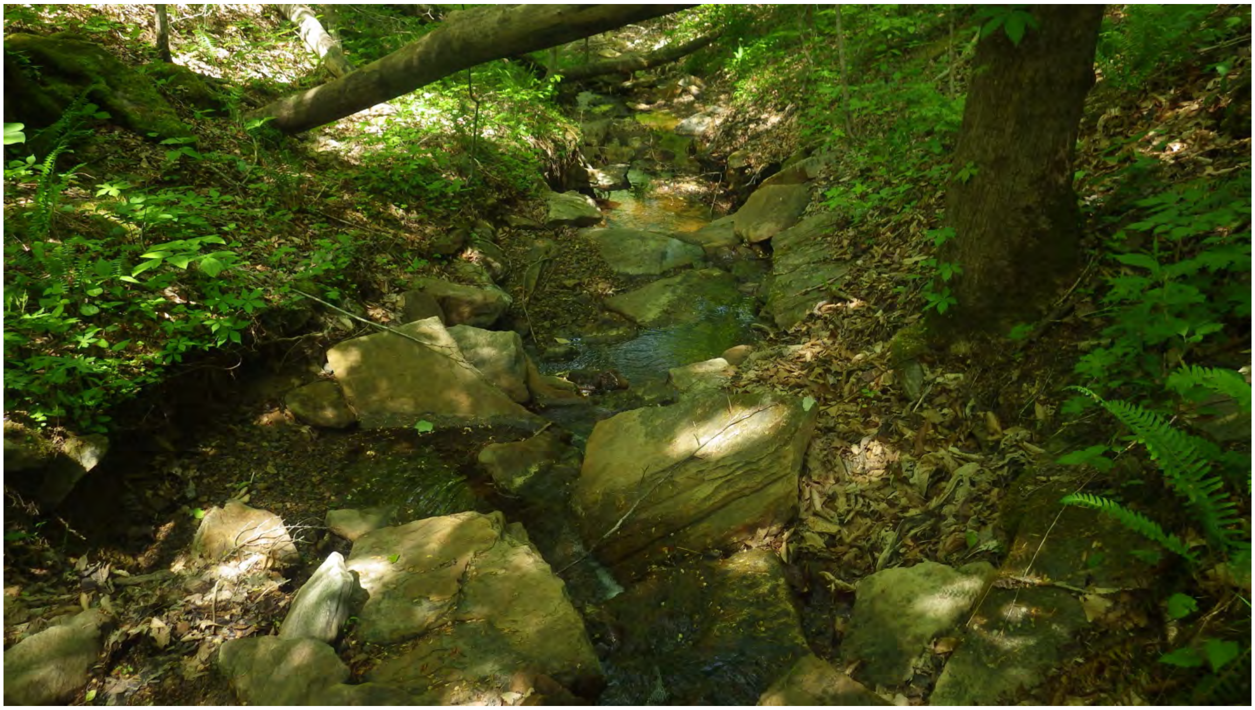


Photo 1907 – Reach 19 – facing downstream at upstream terminus (base of hollow fill)

Photo 1908 – Reach 19 – facing upstream

Photo 1909 – Reach 19 – facing downstream

Photo 1910 – Reach 19 – facing upstream

Photo 1912 – Reach 19 – facing downstream

Photo 1913 – Wetland 7

Photo 1914 – Wetland 7

Photo 1915 - Wetland 7

Photo 1916 – Reach 19A – facing downstream (exiting wetland 7)

Photo 1917 – Reach 19 – facing upstream at confluence with Reach 19A

Photo 1918 – Reach 19A – facing upstream at confluence with Reach 19

Photo 1919 – Reach 19 – facing downstream at confluence with Reach 19A

Photo 1920 – Wetland 8

Photo 1921 – Wetland 8

Photo 1922 – Reach 19 – facing upstream (off project area)

Photo 1923 – Reach 19 – facing downstream (off project area)

Photo 1924 – Reach 18 – facing upstream (off project area)

Photo 1925 – Reach 18 – facing downstream (off project area)

Photo 1927 – Reach 17 – facing upstream at upstream terminus

Photo 1928 – Reach 17 – facing downstream at upstream terminus

Photo 1929 – Reach 17 – facing upstream (base of hollow fill)

Photo 1930 – Reach 17 – facing downstream (base of hollow fill)

Photo 1931 – Reach 8 – facing upstream (immediately upstream of hollow fill)

Photo 1932 – Reach 8 – facing downstream (immediately upstream of hollow fill)

APPENDIX G

2024 BLACKSIDE DACE HABITAT ASSESSMENT

BLACKSIDE DACE HABITAT ASSESSMENT

Project ID:	Lewis Ridge Pumped Storage Project FERC No. 15249 Bell County, Kentucky Project No. KY24-035
Prepared for:	Michael Ricci, PE, Principal Engineer RESPEC
Prepared by:	Bert Remley Senior Aquatic Ecologist
Prepared on:	August 26, 2024

BACKGROUND

Third Rock Consultants, LLC (Third Rock) was retained by RESPEC to provide threatened and endangered species services associated with the potential development of a site on Tom Fork in Bell County, Kentucky (**Vicinity Map**, **Appendix A**). Specifically, Third Rock was asked to assess Tom Fork and its tributaries for suitability of federally listed threatened blackside dace (*Chrosomus cumberlandemsis*) habitat associated with the proposed Lewis Ridge Pumped Storage Project. The Project is a proposed, unconstructed pumped storage hydroelectric generating facility located in Bell County, Kentucky on previously mined land. This Technical Memorandum (TM) documents the methodology and findings of the blackside dace (BSD) habitat assessment.

STUDY AREA

For purposes of this TM, "study area" is defined as Tom Fork and tributaries as illustrated on **Exhibit 1** (**Appendix B**).

The study area is within the Puckett Creek - Cumberland River (HUC12: 051301010204) watershed at center coordinates 36.761031, -83.552943. Land use is primarily active/inactive surface mining, floodplain forest, and upland forested areas. Forested areas adjacent to Tom Fork are generally narrow and composed of mature trees with dense groundcover. The topography is relatively steep, with settlement ponds interspersed within the Tom Fork watershed.

METHODOLOGY

Third Rock permitted personnel evaluated Tom Fork within the proposed project area for potential BSD habitat on July 25, 2024. Third Rock personnel followed procedures outlined in the draft Lewis Ridge Pump Storage Project Study Plan developed by Kleinschmidt Associates (May 2024). Potential BSD habitat was assessed in 10 stations within the Tom Fork watershed, the locations of which were delineated with an EOS Arrow 100+ GPS unit. Field data sheets were completed, and representative photo documentation of upstream and downstream habitat were taken at each station within the study area.

Water quality and physical habitat were evaluated at each station. Sampling locations were located near the confluence with the Cumberland River and at evenly spaced sampling locations along Toms Fork until the stream was no longer considered capable of supporting BSD (i.e. intermittent flow, steep gradient).

Water quality measurements were taken with a Hydrolab multi-parameter water quality probe. The probe was calibrated prior to field use. Dissolved oxygen concentration, dissolved oxygen percent saturation, pH, and specific conductance were recorded from each sampling location on a Kentucky Division of Water (KDOW) High Gradient Habitat Assessment Datasheet.

Physical habitat assessments were conducted at each site concurrent with water quality sampling. The US EPA's Rapid Bioassessment Protocol (RBP) (Barbour *et al.* 1999, KDOW 2022) were used for assessing stream habitat based on ten physical habitat parameters that characterize the stream "micro-scale" habitat, "macro-scale" features, and the riparian and bank structure features. Habitat scores were then compared to habitat criteria for the Mountain Bioregion to determine a narrative rating. For the Mountain Bioregion, habitat scores less than 117 are labeled "poor", scores between 117 to 159 are labeled "fair", and scores greater than 159 are labeled "good" (KDOW 2022).

Water quality data and habitat assessments were compared to BSD requirements (USFWS 2015). BSD are usually excluded from streams with specific conductance levels over 343 microsiemens per centimeter (μS/cm). BSD inhabit perennial headwater streams that have a wetted width of 6 to 17 feet, relatively high riffle-pool ratio, gradient between 1 and 6 percent, and moderate current velocities. They are not found in the steeper, high gradient upper headwater reaches, or in low gradient downstream reaches with a much higher proportion of deeper pools containing large predators. Other habitat factors that correlate well with the presence of BSD are low turbidity and low silt loads and relatively cool summer water temperatures. The latter is tied to good riparian cover and shading that helps keep water temperatures down. Adult BSD are found in pools with undercut banks, root wads, or overhanging vegetation. Pool depth can vary from less than a foot to more than three (3) feet deep.

FINDINGS

Habitat assessment and water quality sampling station locations are illustrated on aerial mapping (**Exhibit 2, Appendix B**) and documented by representative photographs (**Photo Log**, **Appendix C**). Field habitat assessment data sheets are included in **Appendix D**.

BSD habitat assessments and water quality sampling were conducted at nine (9) stations on the mainstem of Tom Fork, and on one (1) unnamed tributary (Station S7). All other tributaries were too small to support BSD. Water quality sampling results are presented in **Table 1** below.

The water temperature generally decreased from downstream to upstream in the watershed, except for the unnamed tributary (Station S7) which had the warmest temperature recorded (23.9 °Celsius). The riparian zone right descending bank was dominated by kudzu (*Pueraria* sp.) and provided little to no shade for the stream. Dissolved oxygen levels were above both chronic (>5.0 mg/L) and acute (>4.0 mg/L) warmwater aquatic habitat (WAH) standards for all stations. Additionally, pH was with WAH criteria (6 to 9 standard units) for all stations. Specific conductance generally decreased from downstream to upstream. The unnamed tributary (S7) had the lowest specific conductance (581 µS/cm) of all stations. It is possible that the unnamed tributary was diluting specific conductance in the mainstem of Tom Fork for the first couple stations (S5 and S6) immediately downstream of its confluence with the mainstem.

Table 1. Water Quality Sampling Results

Parameter	Station									
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7***	**S8**	**S9**	**S10**
Temperature (Celsius)	21.3	21.2	20.0	20.5	20.3	20.4	23.9	18.5	18.1	17.7
Dissolved Oxygen (mg/L)	8.6	8.3	11.3	8.3	8.4	8.4	7.3	8.6	9.0	8.8
% Dissolved Oxygen Saturation	96.7	94.9	98.8	93.6	95.7	95.2	88.4	93.9	97.4	95.7
pH (Standard Units)	7.8	8.2	7.6	7.7	7.9	7.9	7.6	8.0	7.9	8.0
Specific Conductance (µS/cm)	888	894	746	754	684	688	581	772	774	775

* Station S7 was located on an Unnamed tributary to Tom Fork, all other stations were located on the mainstem of Tom Fork.

Habitat rated "fair" at all stations assessed on Tom Fork and on the unnamed tributary. The riparian zone of the descending bank along Tom Fork was generally narrower than the left descending bank due to either previous mining activity or the presence of a mining road. The amount of epifaunal substrate/available cover decreased slightly from downstream to upstream stations. Root wads and undercut banks became sparse then entirely absent from the downstream to upstream stations. Additionally, the stream gradient became steeper in the upstream stations compared to the downstream stations, especially compared to Stations S1 and S2. Habitat assessment results are summarized in **Table 2** (Page 4).

Table 2. Habitat Assessment Results

Habitat Parameter	Station									
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**
Epifaunal Substrate/Available Cover	14	12	13	12	11	11	11	10	12	10
Embeddedness	14	15	14	14	12	11	12	11	12	11
Velocity Depth/Regime	12	12	10	11	8	10	7	9	10	8
Sediment Deposition	15	13	12	11	10	13	13	9	13	10
Channel Flow Status	12	12	8	10	9	12	12	12	12	9
Channel Alteration	14	13	15	15	14	11	11	14	17	15
Frequency of Riffles	17	17	17	17	17	17	17	17	17	17
Bank Stability - Left Bank	8	6	8	9	9	9	6	5	6	8
Bank Stability - Right Bank	8	8	8	9	9	6	6	6	6	8
Vegetative Protection - Left Bank	8	7	7	7	9	8	7	6	7	9
Vegetative Protection - Right Bank	8	4	8	7	6	6	6	6	7	9
Riparian Vegetative Zone Width - Left Bank	4	9	2	9	9	9	9	9	9	9
Riparian Vegetative Zone Width - Right Bank	3	1	6	9	7	1	1	8	9	7
Habitat Score	**137**	**129**	**128**	**140**	**130**	**124**	**118**	**122**	**137**	**130**
Habitat Rating*	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair

*Habitat Ratings for streams of the Mountain Bioregion: < 117 (Poor), 117-159 (Fair), and >159 (Good).

Riffle and run substrates were generally dominated by coarse substrate (cobble/boulder), and pools were generally dominated by finer substrates (gravel/sand). Pool habitat was scarce throughout the watershed but became mostly absent in the upstream stations as the gradient increased contributing to the stream being dominated by riffle/run habitat.

Fish were observed in the downstream stations, most likely creek chub (*Semotilus atromaculatus*) a pioneer fish species. Pioneer fishes are species that are usually the first fish species to colonize or re-colonize damaged or altered habitat. No fish were observed upstream of Station S5.

CONCLUSIONS

Blackside Dace Habitat

The specific conductance levels in the Tom Fork watershed make the stream and its tributaries uninhabitable for BSD. Specific conductance levels were mostly double or triple the specific conductance level (343 µS/cm) that usually exclude BSD from a stream. BSD habitat such as pool habitat, undercut banks, and root wads were mostly absent from Station S5 and upstream from there. Additionally, the stream gradient becomes too steep for BSD habitat beginning at Station S5. According to the United States Fish and Wildlife Service (USFWS 2015) there are not any known BSD populations in Tom Fork, or other Cumberland River tributaries within proximity to Tom Fork. Informal coordination with the USFWS Frankfort Field Office may be required prior to the initiation of construction activity.

REFERENCES

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish.* Second Edition. EPA 841-B-99-002. USEPA, Office of Water, Washington, D.C.

Kentucky Division of Water (KDOW). 2022. Methods for Assessing Habitat in Wadeable Waters. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky.

United States Fish and Wildlife Service. 2015. Blackside Dace (*Chrosomus cumberlandensis*) 5 Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region Kentucky Ecological Services Field Office. Frankfort, KY.

APPENDIX A

VICINITY MAP

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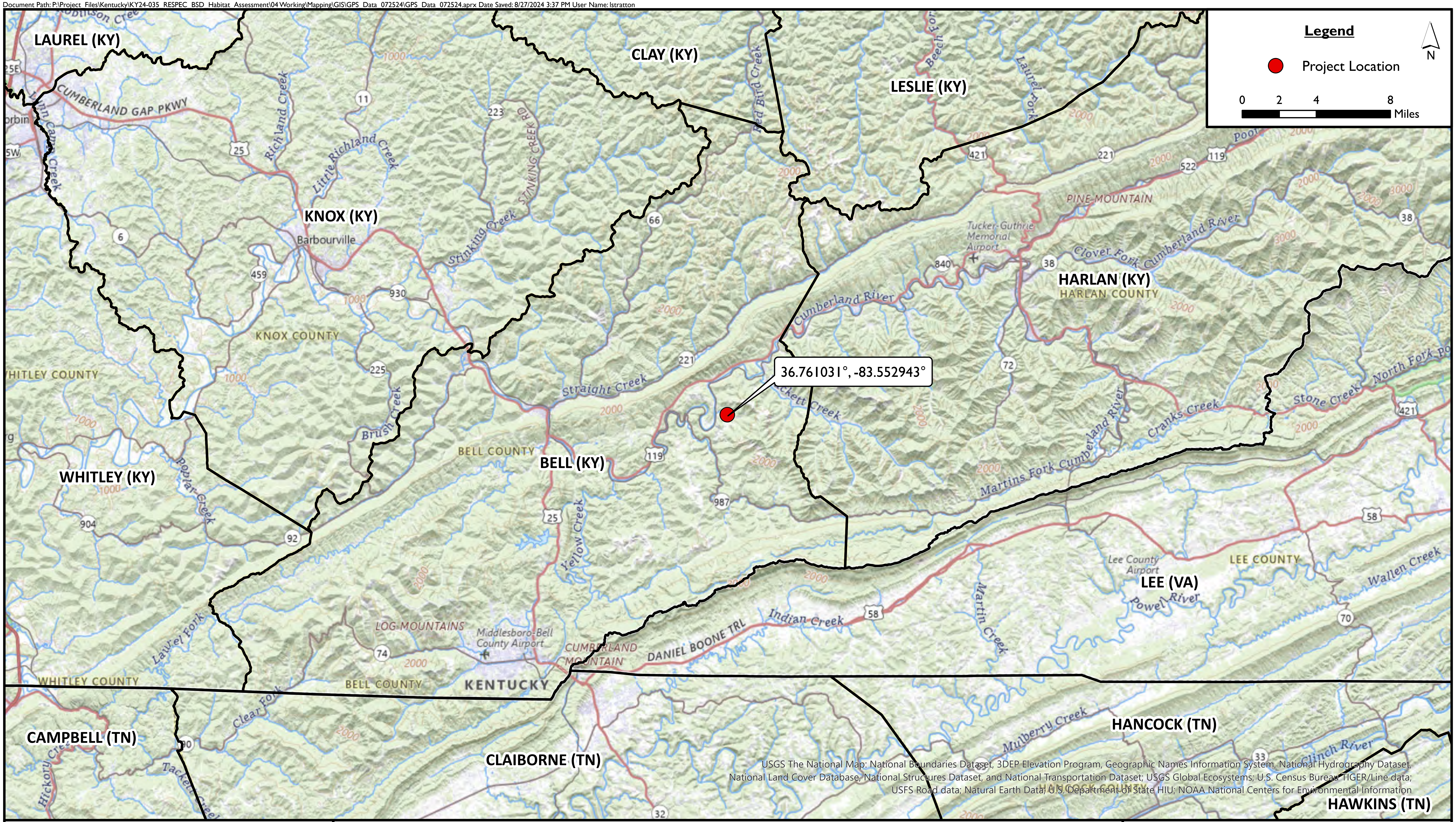


USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road data; Natural Earth Data; U.S. Department of State HIU; NOAA National Centers for Environmental Information

THIRD ROCK CONSULTANTS

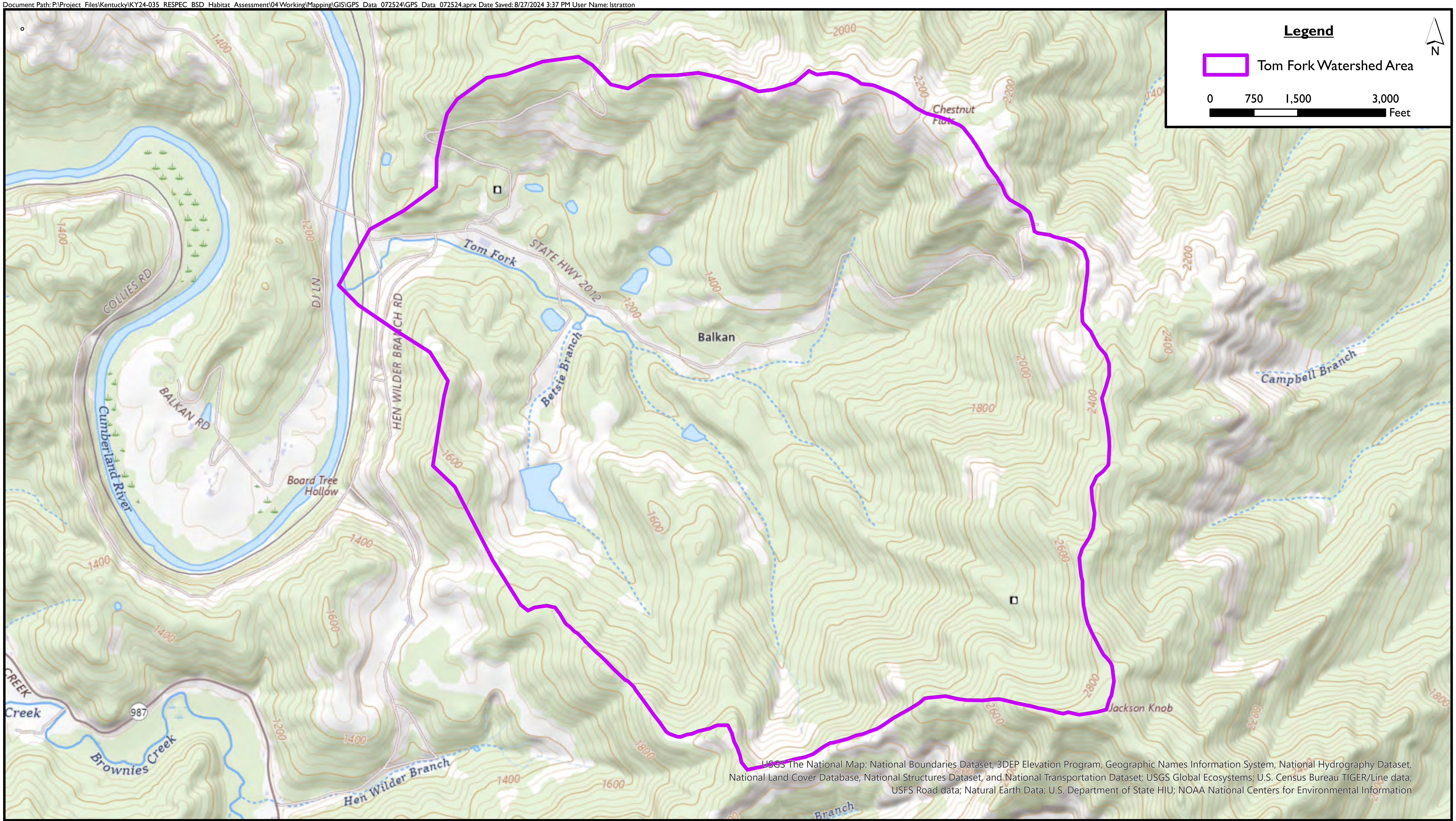
Project Vicinity
Blackside Dace Habitat Assessment
Lewis Ridge Pumped Storage Project
Bell County, Kentucky

Prepared for:
RESPEC
146 E Third St.
Lexington, Kentucky 40508

APPENDIX B

EXHIBITS 1 AND 2

Document Path: P:\Project_Files\Kentucky\KY24-035_RESPEC_BSD_Habitat_Assessment\04 Working\Mapping\GIS\GPS_Data_072524\GPS_Data_072524.aprx Date Saved: 8/27/2024 3:37 PM User Name: lstratton



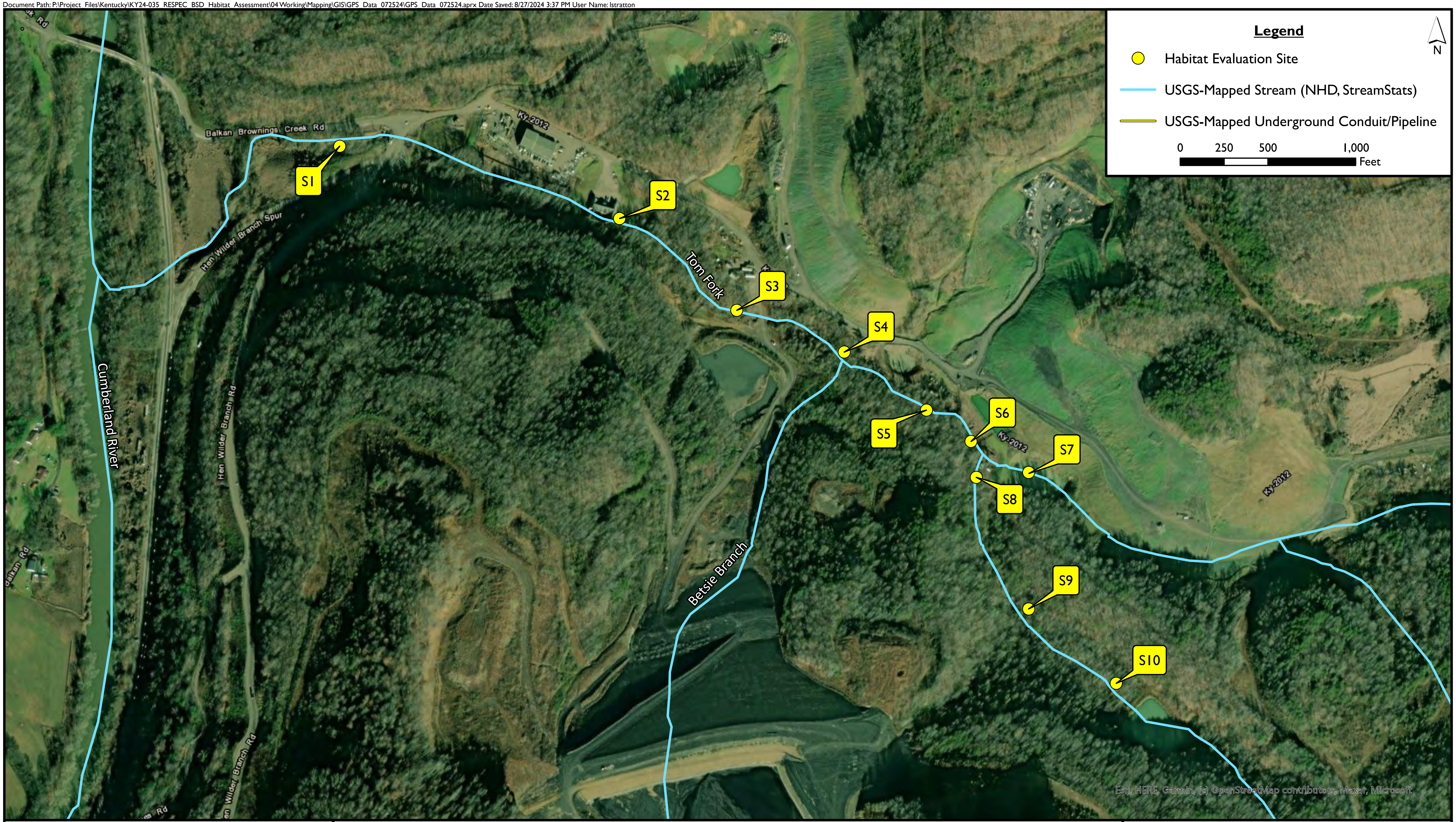
USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road data; Natural Earth Data; U.S. Department of State HIU; NOAA National Centers for Environmental Information

THIRDROCK
CONSULTANTS

Exhibit 1 - Tom Fork Watershed
Blackside Dace Habitat Assessment
Lewis Ridge Pumped Storage Project
Bell County, Kentucky

Prepared for:
RESPEC
146 E Third St.
Lexington, Kentucky 40508

Document Path: P:\Project Files\Kentucky\KY24-035 RESPEC BSD Habitat Assessment\04 Working\Mapping\GIS\GPS Data 072524\GPS Data 072524.aprx Date Saved: 8/27/2024 3:37 PM User Name: lstratton



THIRDROCK CONSULTANTS

Exhibit 2 - Habitat Assessment Sites
Blackside Dace Habitat Assessment
Lewis Ridge Pumped Storage Project
Bell County, Kentucky

Prepared for:
RESPEC
146 E Third St.
Lexington, Kentucky 40508

APPENDIX C

PHOTO LOG

Station S1, Upstream View.jpg

Station S1, Downstream View.jpg

Station S2, Upstream View.jpeg

Station S2, Downstream View.jpeg

Station S3, Downstream View.jpeg

Station S3, Upstream View.jpeg

Station S4, Upstream View IMG_2037.jpeg

Station S4, Downstream View IMG_2038.jpeg

Station S5, Upstream View IMG_2039.jpeg

Station S5, Downstream View IMG_2040.jpeg

Station S6, Downstream View IMG_2041.jpeg

Station S6, Upstream View IMG_2042.jpeg

Station S7, Upstream View IMG_2043.jpeg

Station S7, Downstream View IMG_2044.jpeg

Station S8, Downstream View IMG_2045.jpeg

Station S8, Upstream View IMG_2046.jpeg

Station S9, Upstream View IMG_2047.jpeg

Station S9, Downstream View IMG_2049.jpeg


Station S10, Upstream View IMG_2052.jpeg


Station S10, Downstream View IMG_2053.jpeg

APPENDIX D

FIELD DATA SHEETS

High Gradient Habitat Assessment Datasheet

Page 1

Station Visit Information

Locale Name:	Tom Fork	Project:	KY 24-035	Trip:	BSD Habitat	County:	Bell
Station ID:	S1	Loc. Desc.:	downstream of Hen Wilder Br. Road			Visit Date:	7-25-24
Field Lead:	B. Remley	Primary Bioregion:	Mountain	Secondary Bioregion:	—	Visit Start Time:	1040a
Team:	BR/CW	Stream Perm.	Eph | Int | [✓ Per]	Stream Type (HW or WA):	HW	Visit Finish Time:	1115

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.763091				K-WADE Field	Staff:	
Long:		-83.559144	[✓ Y] | N	[✓ Y] | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN: Y | [✓ N]

Now: Circle 1: HR | SR | IS | CS | [✓ CO] | SSH

Past 24hr: HR | SR | [✓ IS] | CS | CO | SSH

Stream Shading

Leafed Out? Y/N: [✓ Y] | N

General Shading Circle 1: [✓ Full] | Partial | None

STREAM FLOW Circle 1

Dry | Pooled | Low | [✓ Seasonal Normal] | Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	3
Maximum Depth (m):	0.5
Reach Length (m):	100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	5
# of runs in reach	5
# of pools in reach	5

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | [✓ N]

Channelization: F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type: Herbs | Grasses | Shrubs | [✓ Trees]

# of Strata: 3

Dom. Taxa: Box Elder / SYC

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	21.3	DO (mg/l):	8.6	DO %Sat:	96.7	pH (SU):	7.8	Sp. Cond (µS/cm):	888	Discharge CFS | Uncert.	moderate	

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)							
Algae:			QualMHC:		Visual Form:		R4MULTI:		Other:	
Fish:			Equip.:	BPEF | Seine | Barge	EF Seconds:		Seine Minutes:			
Habitat:		BR/CW	Habitat data other than RBP?		NO					
Invertebrate:			1m² riffle + MH:		MACS 20-Jab:		Other:			
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: Bedrock/Slab:	Sticks/Wood: Depositional:		Leaf Packs: Rock Pick:		Justicia : Em. Veg.:		Aufwuchs: Wood Pick:	Edge: Other:
Chemistry:			H_2SO_4 Lot #:				HNO$_3$ Lot #:			
Multi-Probe:		BR/CW	Inst. ID:	Quanta			Cal. Date:	7/25/24		
Discharge:			Inst. ID:				Beam Check:			
Other:			Other Desc:							

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 45	% Run: 35	% Pool: 20	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	20	40	55	34
Gravel (2-64 mm)	30	20	30	26.5
Cobble (64 – 256 mm)	45	40	15	37.25
Boulders (>256 mm)	5			2.25
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

Land Owner Denial
Too Deep/Impounded
Site Not Found
Unsafe
Dry
Other (See Comments)

Reach Location Description: Just downstream of Nelly Hamilton mine entrance

Weather Choices:
HR = Heavy Rain | SR = Steady Rain
IS = Intermittent Showers | CS = Clear Sunny
CO = Cloudy Overcast | SSH = Snow Sleet

Initial Data Review By:	ML	Initial Data Review Date:	7/26/24	Date Entered:	7/26/24

Habitat	**Condition Category**			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover **Score** 14	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking
2.Embeddedness **Score** 14	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime **Score** 12	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep)
4. Sediment Deposition **Score** 15	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition
5.Channel Flow Status 12 **Score**	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate is exposed	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools.
6.Channel Alteration **Score** 14	Channelization or dredging absent or minimal; stream with normal pattern	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) **Score** 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 8 RB 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection 8 LB RB 8	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 4 RB 3	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

137 Kudzu present in non forested areas

Some pools present with cover for BSD.

High Gradient Habitat Assessment Datasheet

Station Visit Information

Locale Name:	Tom Fork	Project:	KY24-035	Trip:	BSO HabitaT	County:	Bell
Station ID:	S2	Loc. Desc.:	behind Nally+Hamilton office			Visit Date:	7-2
Field Lead:	B. Remley	Primary Bioregion:	Mountain	Secondary Bioregion:	—	Visit Start Time:	1120
Team:	BR/CO	Stream Perm.	Eph | Int | [✓ Per]	Stream Type (HW or WA):	HW	Visit Finish Time:	1150

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.762187				K-WADE / Field	Staff:	
Long:		-83.554777	[✓ Y] | N	[✓ Y] | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN: Y | [✓ N]

Now: Circle 1: HR | SR | IS | CS | [✓ CO] | SSH

Past 24hr: HR | SR | [✓ IS] | CS | CO | SSH

Stream Shading

Leafed Out? Y/N: [✓ Y] | N

General Shading Circle 1: [✓ Full] | Partial | None

STREAM FLOW Circle 1

Dry | Pooled | Low | Seasonal Normal | Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	3
Maximum Depth (m):	0.5
Reach Length (m):	100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	5
# of runs in reach	4
# of pools in reach	3

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal	—	Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | N

Channelization: F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type: Herbs | Grasses | Shrubs | [✓ Trees]

# of Strata: 3

Dom. Taxa: sugar maple

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	21.2	DO (mg/l):	8.3	DO %Sat	94.9	pH (SU):	8.2	Sp. Cond (µS/cm):	894	Discharge CFS | Uncert.	moderate

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)					
Algae:			QualMHC:		Visual Form:		R4MULTI:	Other:
Fish:			Equip.:	BPEF | Seine | Barge	EF Seconds:		Seine Minutes:	
Habitat:		BR/CW	Habitat data other than RBP?	NO				
Invertebrate:			1m² riffle + MH:		MACS 20-Jab:		Other:	
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: Bedrock/Slab:	Sticks/Wood: Depositional:	Leaf Packs: Rock Pick:	Justicia : Em. Veg.:	Aufwuchs: Wood Pick:	Edge: Other:	
Chemistry:			H_2SO_4 Lot #:		HNO$_3$ Lot #:			
Multi-Probe:		BR/CW	Inst. ID:	Quanta	Cal. Date:	7/25/24		
Discharge:			Inst. ID:		Beam Check:			
Other:			Other Desc:					

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 50	% Run: 40	% Pool: 10	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	5	10	20	8.5
Gravel (2-64 mm)	10	30	50	22
Cobble (64 – 256 mm)	55	40	25	46
Boulders (>256 mm)	20	15	5	16.5
Bedrock/Hardpan Clay	10	5		7

Site Not Sampled (Reason)- Please Add Comments

- Land Owner Denial
- Too Deep/Impounded
- Site Not Found
- Unsafe
- Dry
- Other (See Comments)

Reach Location Description: behind N+H office

Weather Choices:
HR = Heavy Rain | SR = Steady Rain
IS = Intermittent Showers | CS = Clear Sunny
CO = Cloudy Overcast | SSH = Snow Sleet

Initial Data Review By:	MM	Initial Data Review Date:	7/26/24	Date Entered:	7/26/24

High Gradient Habitat Assessment Datasheet

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover Score 12	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking
2.Embeddedness Score 15	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime Score 12	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow) (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes)	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low)	Dominated by 1 velocity/ depth regime (usually slow-deep)
4. Sediment Deposition Score 13	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status Score 12	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration 7 20 years Score 13	Channelization or dredging absent or minimal; stream with normal pattern	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
7.Frequency of Riffles (or bends) Score 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 6 RB 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 7 RB 4	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height
10. Riparian Vegetative Zone Width LB 9 RB 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

129

undercut banks + root wads sparse.
some Large boulders provide BSD cover

High Gradient Habitat Assessment Datasheet

Station Visit Information

Locale Name:	Tom Fork	**Project:**	K123-055	**Trip:**	BSD Habitat	**County:**	Bell
Station ID:	53	**Loc. Desc.:**	below mine Road crossing			**Visit Date:**	7-25-24
Field Lead:	B. Remley	**Primary Bioregion:**	Mountain	**Secondary Bioregion:**	—	**Visit Start Time:**	1200
Team:	BR/CW	**Stream Perm.**	Eph | Int | [✓ Per]	**Stream Type (HW or WA):**	HW	**Visit Finish Time:**	1230

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.761028				K-WADE | Field	**Staff:**	
Long:		-83.552938	[✓ Y] | N	[✓ Y] | N			**Date:**	

WEATHER

Scouring Rain In Last 14 Days? YN	Y | [✓ N]
Now: Circle 1	HR | SR | IS CS | [✓ CO] | SSH
Past 24hr:	HR | SR | [✓ IS] CS | CO | SSH

Stream Shading

Leafed Out? Y/N	[✓ Y] | N
General Shading Circle 1	[✓ Full] | Partial | None 100%

STREAM FLOW Circle 1

Dry | Pooled | Low | [✓ Seasonal Normal] | Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	3
Maximum Depth (m):	0.2
Reach Length (m):	100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	6
# of runs in reach	6
# of pools in reach	0

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	**Construction**		**Pasture/Grazing**	
Deep Mining		**Commercial**		**Silviculture**	
Oil Wells		**Industrial**		**Urban Runoff**	
Land Disposal		**Row Crops**		**Storm Sewers**	
Residential		**Forest**	✓	**Permitted Outfalls**	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging:	F | P | [✓ N]	**Channelization:**	F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type:	Herbs | Grasses Shrubs | Trees	**# of Strata:**	3
Dom. Taxa:	Sugar maple		

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		**Bridge Abutments:**		**Fords:**		**Islands:**		**Waterfalls:**		**Berms:**	

FIELD METER DATA

Temp (°C):	20.0	**DO (mg/l):**	11.3	**DO %Sat:**	98.8	**pH (SU):**	7.6	**Sp. Cond (µS/cm):**	746	**Discharge CFS | Uncert.**	Fast

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)					
Algae:			**QualMHC:**		**Visual Form:**		**R4MULTI:**	**Other:**
Fish:			**Equip.:**	BPEF | Seine | Barge	**EF Seconds:**		**Seine Minutes:**	
Habitat:		BR/CW	**Habitat data other than RBP?**	N/A				
Invertebrate:			**1m² riffle + MH:**		**MACS 20-Jab:**		**Other:**	
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: Bedrock/Slab:	Sticks/Wood: Depositional:	Leaf Packs: Rock Pick:	Justicia: Em. Veg.:	Aufwuchs: Wood Pick:	Edge: Other:	
Chemistry:			**H_2SO_4 Lot #:**		**HNO_3 Lot #:**			
Multi-Probe:			**Inst. ID:**	Quanta	**Cal. Date:**	7-25-24		
Discharge:			**Inst. ID:**		**Beam Check:**			
Other:			**Other Desc:**					

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 60	% Run: 40	% Pool: 0	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	10	10		10
Gravel (2-64 mm)	20	20		20
Cobble (64 – 256 mm)	40	40		40
Boulders (>256 mm)	30	30		30
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

- Land Owner Denial
- Too Deep/Impounded
- Site Not Found
- Unsafe
- Dry
- Other (See Comments)

Reach Location Description: downstream mine Road Culvert

Weather Choices:

HR = Heavy Rain	SR = Steady Rain
IS = Intermittent Showers	CS = Clear Sunny
CO = Cloudy Overcast	SSH = Snow Sleet

Initial Data Review By:	M	**Initial Data Review Date:**	7/26/24	**Date Entered:**	7/26/24

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover N undercut banks Score 13	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are *not* new fall and *not* transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2.Embeddedness Score 14	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime No deep Score 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition Score 12	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status Score 8	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration Score 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) Score 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 8 RB 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 7* RB 8	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 2 RB 6	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
128	* Non-native Kudzu present			

High Gradient Habitat Assessment Datasheet

Station Visit Information

Locale Name:	Tom Fork	Project:	KY 24-035	Trip:	BSD Habitat	County:	Bell
Station ID:	54	Loc. Desc.:	Upstream of Mine Road crossing			Visit Date:	7-25-24
Field Lead:	B. Renley	Primary Bioregion:	Mountain	Secondary Bioregion:		Visit Start Time:	1300
Team:	BR/CW	Stream Perm.	Eph | Int | [✓ Per]	Stream Type (HW or WA):	HW	Visit Finish Time:	1330

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.760482				K-WADE | Field	Staff:	
Long:		-83.551270	[✓ Y] | N	[✓ Y] | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN	Y | [✓ N]		
Now: Circle 1	HR	SR	IS
	[✓ CS]	CO	SSH
Past 24hr:	HR	SR	[✓ IS]
	CS	CO	SSH

Stream Shading

Leafed Out? Y/N	[✓ Y] | N
General Shading Circle 1	[✓ Full] | Partial | None 100%

STREAM FLOW Circle 1

Dry | Pooled | Low
[✓ Seasonal Normal]
Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	2.5
Maximum Depth (m):	0.5
Reach Length (m):	120

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	6
# of runs in reach	6
# of pools in reach	1

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | [✓ N]
Channelization: F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type:	Herbs | Grasses Shrubs | [✓ Trees]	# of Strata: 3
Dom. Taxa:	Sugar maple	

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	20.5	DO (mg/l):	8.3	DO %Sat:	93.6	pH (SU):	7.7	Sp. Cond (µS/cm):	754	Discharge CFS | Uncert.	Fast	

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)							
Algae:			QualMHC:		Visual Form:		R4MULTI:		Other:	
Fish:			Equip.:	BPEF | Seine | Barge	EF Seconds:				Seine Minutes:	
Habitat:		BR/CW	Habitat data other than RBP?	NO						
Invertebrate:			1m² riffle + MH:		MACS 20-Jab:				Other:	
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: Bedrock/Slab:	Sticks/Wood: Depositional:	Leaf Packs: Rock Pick:	Justicia: Em. Veg.:	Aufwuchs: Wood Pick:	Edge: Other:			
Chemistry:			H_2SO_4 Lot #:				HNO_3 Lot #:			
Multi-Probe:		BR/CW	Inst. ID:	Quanta			Cal. Date:	7-25-24		
Discharge:			Inst. ID:				Beam Check:			
Other:			Other Desc.:							

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 50	% Run: 40	% Pool: 10	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	10	10	20	12
Gravel (2-64 mm)	30	30	40	31
Cobble (64 – 256 mm)	35	35	20	33.5
Boulders (>256 mm)	25	25	10	23.5
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

- Land Owner Denial
- Too Deep/Impounded
- Site Not Found
- Unsafe
- Dry
- Other (See Comments)

Reach Location Description:	downstream of supposed Betsie Br conf

Weather Choices:

HR = Heavy Rain	SR = Steady Rain
IS = Intermittent Showers	CS = Clear Sunny
CO = Cloudy Overcast	SSH = Snow Sleet

Initial Data Review By:	BR	Initial Data Review Date:	7/26/24	Date Entered:	7/26/24

High Gradient Habitat Assessment Datasheet

Habitat	**Condition Category**			
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover **Score** 12	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2.Embeddedness **Score** 14	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime **Score** 11	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition **Score** 11	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status **Score** 10	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration **Score** 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) **Score** 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 9 RB 9	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection non natives plant LB 7 RB 7	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 9 RB 9	Width of riparian zone >18 meters; human activities (i.e , parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

140

Pool habitat is scarce, mostly riffle run. a few fish observed (creek chubs). Fast current, steeper gradient than S1-S3. no undercut banks.

No sign of Betsie Branch confluence even though mapping indicates should be present. Likely moved during surface mining activities.

High Gradient Habitat Assessment Datasheet

Page 1

Station Visit Information

Locale Name:	Tom Fork	Project:	KY24-035	Trip:	BSO Habitat	County:	Bell
Station ID:	55	Loc. Desc.:	upstream 54			Visit Date:	7-25-24
Field Lead:	B. Penley	Primary Bioregion:	mountain	Secondary Bioregion:	—	Visit Start Time:	1334
Team:	BP/CW	Stream Perm.	Eph | Int | [✓ Per]	Stream Type (HW or WA):	HW	Visit Finish Time:	1345

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.7597894				K-WADE | Field	Staff:	
Long:		-83.5499864	[✓ Y] | N	[✓ Y] | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN: Y | [✓ N]

Now: Circle 1: HR | SR | IS | CS | [✓ CO] | SSH

Past 24hr: HR | SR | [✓ IS] | CS | CO | SSH

Stream Shading

Leafed Out? Y/N: [✓ Y] | N

General Shading Circle 1: [✓ Full] | Partial | None 100

STREAM FLOW Circle 1

Dry | ~~Pooled~~ | Low | [✓ Seasonal Normal] | Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	2.5
Maximum Depth (m):	0.25
Reach Length (m):	100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	10
# of runs in reach	10
# of pools in reach	0

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | [✓ N]

Channelization: F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type: Herbs | Grasses | Shrubs | [✓ Trees]

# of Strata: 3

Dom. Taxa: Elm

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	20.3	DO (mg/l):	8.4	DO %Sat:	95.7	pH (SU):	7.9	Sp. Cond (µS/cm):	684	Discharge CFS | Uncert.	Est	

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)
Algae:			QualMHC: ___ Visual Form: ___ R4MULTI: ___ Other: ___
Fish:			Equip.: BPEF | Seine | Barge EF Seconds: ___ Seine Minutes: ___
Habitat:		BP/CW	Habitat data other than RBP? NO
Invertebrate:			1m² riffle + MH: ___ MACS 20-Jab: ___ Other: ___
Multihabs Sampled Y/N or # Jabs			Undercuts/Roots: | Sticks/Wood: | Leaf Packs: | Justicia: | Aufwuchs: | Edge: Bedrock/Slab: | Depositional: | Rock Pick: | Em. Veg.: | Wood Pick: | Other:
Chemistry:			H_2SO_4 Lot #: ___ HNO_3 Lot #: ___
Multi-Probe:		BP/CW	Inst. ID: Quanta Cal. Date: 7-25-24
Discharge:			Inst. ID: ___ Beam Check: ___
Other:			Other Desc:

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 50	% Run: 50	% Pool:	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)		20		10
Gravel (2-64 mm)	20	40		30
Cobble (64 – 256 mm)	40	20		30
Boulders (>256 mm)	40	20		30
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

- Land Owner Denial
- Too Deep/Impounded
- Site Not Found
- Unsafe
- Dry
- Other (See Comments)

Reach Location Description: upstream 54

Weather Choices:
HR = Heavy Rain | SR = Steady Rain
IS = Intermittent Showers | CS = Clear Sunny
CO = Cloudy Overcast | SSH = Snow Sleet

Initial Data Review By:	m	Initial Data Review Date:	7/26/24	Date Entered:	7/26/24

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover **Score** 11	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking
2.Embeddedness **Score** 12	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime **Score** 8	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow) (Sow is < 0 3 m/s, deep is > 0 5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition **Score** 10	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status **Score** 9	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools
6.Channel Alteration > 20 years **Score** 14	Channelization or dredging absent or minimal; stream with normal pattern	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) **Score** 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 9 RB 9	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 9 RB 6 Non-natives	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 9 RB 7	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

130

Gradient increasing. Fish observed
water does not reach banks, there are no rootwads
or undercut banks for cover

High Gradient Habitat Assessment Datasheet

Station Visit Information

Locale Name:	Tom Fork	Project:	KY24-035	Trip:	BSD Habitat	County:	Bell
Station ID:	56	Loc. Desc.:	Just downstream conF/with UNT			Visit Date:	7-25-24
Field Lead:	B. Remley	Primary Bioregion:	mountain	Secondary Bioregion:	—	Visit Start Time:	1350
Team:	BR/CW	Stream Perm.	Eph | Int | [✓ Per]	Stream Type (HW or WA):	HW	Visit Finish Time:	1400

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.759398				K-WADE | Field	Staff:	
Long:		-83.549291	[✓ Y] | N	[✓ Y] | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN	Y | [✓ N]
Now: Circle 1	HR | SR | IS CS | [✓ CO] | SSH
Past 24hr:	HR | SR | [✓ IS] CS | CO | SSH

Stream Shading

Leafed Out? Y/N	[✓ Y] | N
General Shading Circle 1	Full | [✓ Partial] | None 50%

STREAM FLOW Circle 1

Dry | Pooled | Low
[✓ Seasonal Normal]
Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	2
Maximum Depth (m):	0.1
Reach Length (m):	100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	4
# of runs in reach	4
# of pools in reach	0

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging:	F | P | [✓ N]	Channelization:	F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type:	[✓ Herbs] | Grasses Shrubs | Trees	# of Strata:	3
Dom. Taxa:	Kudzu		

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	20.4	DO (mg/l):	8.4	DO %Sat:	95.2	pH (SU):	7.9	Sp. Cond (µS/cm):	688	Discharge CFS | Uncert.	Fast

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)					
Algae:			QualMHC:		Visual Form:		R4MULTI:	Other:
Fish:			Equip.:	BPEF | Seine | Barge	EF Seconds:		Seine Minutes:	
Habitat:		BR/CW	Habitat data other than RBP?	NC				
Invertebrate:			1m² riffle + MH:		MACS 20-Jab:		Other:	
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: Bedrock/Slab:	Sticks/Wood: Depositional:	Leaf Packs: Rock Pick:	Justicia : Em. Veg.:	Aufwuchs: Wood Pick:	Edge: Other:	
Chemistry:			H_2SO_4 Lot #:		HNO$_3$ Lot #:			
Multi-Probe:		BR/CW	Inst. ID:	Quanta	Cal. Date:	7-25-24		
Discharge:			Inst. ID:		Beam Check:			
Other:			Other Desc:					

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 50	% Run: 50	% Pool: 0	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	10	20		15
Gravel (2-64 mm)	30	40		35
Cobble (64 – 256 mm)	40	30		35
Boulders (>256 mm)	20	10		15
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

Land Owner Denial
Too Deep/Impounded
Site Not Found
Unsafe
Dry
Other (See Comments)

Reach Location Description:	Just below conF w/ UNT

Weather Choices:

HR = Heavy Rain | SR = Steady Rain
IS = Intermittent Showers | CS = Clear Sunny
CO = Cloudy Overcast | SSH = Snow Sleet

Initial Data Review By:		Initial Data Review Date:	7-26-24	Date Entered:	7-26-24

High Gradient Habitat Assessment Datasheet

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover **Score** 11	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient)	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking
2.Embeddedness **Score** 11	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment
3.Velocity/ Depth Regime **Score** 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes)	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low)	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition **Score** 13	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition
5.Channel Flow Status **Score** 12	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate is exposed	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools
6.Channel Alteration >20 years **Score** 11	Channelization or dredging absent or minimal; stream with normal pattern	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
7.Frequency of Riffles (or bends) **Score** 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 9 RB 6	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars
9. Vegetative Protection LB 6 RB 6 Kudzu	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height
10. Riparian Vegetative Zone Width LB 9 RB 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
174	Right bank 100% Kudzu. no pool habitat no fish observed NO undercut banks or root wad habitat.			

High Gradient Habitat Assessment Datasheet

Page 1

Station Visit Information

Locale Name:	UNT Tom Fork	Project:	KY 24-035	Trip:	BSD Habitat	County:	Bell
Station ID:	57	Loc. Desc.:	UNT Tom Fork			Visit Date:	7-25-24
Field Lead:	B. Remley	Primary Bioregion:	Mountain	Secondary Bioregion:	—	Visit Start Time:	1405
Team:	BR/CW	Stream Perm.	Eph | Int | [✓ Per]	Stream Type (HW or WA):	HW	Visit Finish Time:	1418

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.759332				K-WADE Field	Staff:	
Long:		-83.549215	[✓ Y] | N	[✓ Y] | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN: Y | [✓ N]

Now: Circle 1: HR | SR | IS | CS | [✓ CO] | SSH

Past 24hr: HR | SR | [✓ IS] | CS | CO | SSH

Stream Shading

Leafed Out? Y/N: [✓ Y] | N

General Shading Circle 1: Full | [✓ Partial] | None 50%

STREAM FLOW Circle 1

Dry | Pooled | Low | [✓ Seasonal Normal] | Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	1
Maximum Depth (m):	0.1
Reach Length (m):	100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	4
# of runs in reach	4
# of pools in reach	0

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | [✓ N]

Channelization: F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type: [✓ Herbs] | Grasses | Shrubs | Trees

# of Strata: 3

Dom. Taxa: Arundinaria

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	23.9	DO (mg/l):	7.3	DO %Sat:	88.4	pH (SU):	7.6	Sp. Cond (µS/cm):	581	Discharge CFS | Uncert.	Fast

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)					
Algae:			QualMHC:		Visual Form:		R4MULTI:	Other:
Fish:			Equip.:	BPEF | Seine | Barge	EF Seconds:		Seine Minutes:	
Habitat:		BR/CW	Habitat data other than RBP?		NO			
Invertebrate:			1m² riffle + MH:		MACS 20-Jab:		Other:	
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: Bedrock/Slab:	Sticks/Wood: Depositional:	Leaf Packs: Rock Pick:	Justicia: Em. Veg.:	Aufwuchs: Wood Pick:	Edge: Other:	
Chemistry:			H_2SO_4 Lot #:		HNO_3 Lot #:			
Multi-Probe:		BR/CW	Inst. ID:	Quanta	Cal. Date:	7-25-24		
Discharge:			Inst. ID:		Beam Check:			
Other:			Other Desc:					

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 60	% Run: 40	% Pool: 0	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	10	30		18
Gravel (2-64 mm)	20	30		24
Cobble (64 – 256 mm)	50	40		46
Boulders (>256 mm)	20			12
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

Land Owner Denial
Too Deep/Impounded
Site Not Found
Unsafe
Dry
Other (See Comments)

Reach Location Description: Upstream From conf w/Tom Fork

Weather Choices:
HR = Heavy Rain | SR = Steady Rain
IS = Intermittent Showers | CS = Clear Sunny
CO = Cloudy Overcast | SSH = Snow Sleet

Initial Data Review By:	MR	Initial Data Review Date:	7-26-24	Date Entered:	7-26-24

High Gradient Habitat Assessment Datasheet

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover **Score** 11	Greater than 70% of substrate favorable for epifaunal colonization and fish cover: mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2.Embeddedness **Score** 12	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime **Score** 7	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition **Score** 13	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status **Score** 12	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration >20 yrs **Score** 11	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) **Score** 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 6 RB 6	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 7 RB 6	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 9 RB 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

118

Kudzu dominated RDB stream is too small For BSD, possibly intermittent during dry periods. No Cover or pools present For BSD. not BSD habitat.

High Gradient Habitat Assessment Datasheet

Page 1

Station Visit Information

Locale Name:	Tom Fork	Project:	KY24-035	Trip:	BSD Habitat	County:	Bell
Station ID:	S8	Loc. Desc.:	Tom Fork upstream of Conf/wnt			Visit Date:	7/25/24
Field Lead:	B. Renley	Primary Bioregion:	Mountain	Secondary Bioregion:	—	Visit Start Time:	1420
Team:	BR/CW	Stream Perm.:	Eph | Int | [✓ Per]	Stream Type (HW or WA):	HW	Visit Finish Time:	1437

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.758949				K-WADE Field	Staff:	
Long:		-83.549208	[✓ Y] | N	[✓ Y] | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN: Y | [✓ N]

Now: Circle 1: HR | SR | IS | CS | [✓ CO] | SSH

Past 24hr: HR | SR | [✓ IS] | CS | CO | SSH

Stream Shading

Leafed Out? Y/N: [✓ Y] | N

General Shading Circle 1: [✓ Full] | Partial | None 100%

STREAM FLOW Circle 1

Dry | Pooled | Low | [✓ Seasonal Normal] | Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	2
Maximum Depth (m):	0.15
Reach Length (m):	100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	7
# of runs in reach	6
# of pools in reach	0

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | [✓ N] Channelization: F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type: Herbs | Grasses | Shrubs | [✓ Trees] # of Strata:

Dom. Taxa:

HYDRAULIC STRUCTURES (Check all that are present)

Dams: Bridge Abutments: Fords: Islands: Waterfalls: Berms:

FIELD METER DATA

Temp (°C):	DO (mg/l):	DO %Sat:	pH (SU):	Sp. Cond (µS/cm):	Discharge CFS | Uncert.	
18.5	9.6	93.9	8.0	772	Fast	

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)			
Algae:			QualMHC:	Visual Form:	R4MULTI:	Other:
Fish:			Equip.: BPEF | Seine | Barge	EF Seconds:		Seine Minutes:
Habitat:		BR/CW	Habitat data other than RBP?	No		
Invertebrate:			1m² riffle + MH:	MACS 20-Jab:		Other:
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: | Bedrock/Slab:	Sticks/Wood: | Depositional: | Leaf Packs: | Rock Pick:	Justicia: | Em. Veg.:	Aufwuchs: | Wood Pick:	Edge: | Other:
Chemistry:			H_2SO_4 Lot #:		HNO_3 Lot #:	
Multi-Probe:		BR/CW	Inst. ID:	Quanta	Cal. Date:	7-25-24
Discharge:			Inst. ID:		Beam Check:	
Other:			Other Desc:			

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 50	% Run: 50	% Pool: 0	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	10	20		15
Gravel (2-64 mm)	30	50		40
Cobble (64 – 256 mm)	40	20		30
Boulders (>256 mm)	20	10		15
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

- Land Owner Denial
- Too Deep/Impounded
- Site Not Found
- Unsafe
- Dry
- Other (See Comments)

Reach Location Description: Upstream of Conf W/wnt

Weather Choices:

HR = Heavy Rain	SR = Steady Rain
IS = Intermittent Showers	CS = Clear Sunny
CO = Cloudy Overcast	SSH = Snow Sleet

Initial Data Review By: mm

Initial Data Review Date: 7-26-24

Date Entered: 7-26-24

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover Score 10	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2.Embeddedness Score 11	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime Score 9	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition Score 9	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status Score 12	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration Score 14	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) Score 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 5 RB 6	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 6 RB 6	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 9 RB 8	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

122

Larger than UNT but still small. no pools, no Fish observed. no undercut banks

High Gradient Habitat Assessment Datasheet

Page 1

Station Visit Information

Locale Name:	Tom Fork	Project:	KY 24-035	Trip:	BSD Habitat	County:	Bell
Station ID:	59	Loc. Desc.:	upstream S8			Visit Date:	7/25/24
Field Lead:	B. Rumley	Primary Bioregion:	Mountain	Secondary Bioregion:	—	Visit Start Time:	1440
Team:	BR/CW	Stream Perm.	Eph | [✓ Int | Per]	Stream Type (HW or WA):	HW	Visit Finish Time:	1455

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.757301				Field K-WADE	Staff:	
Long:		83.548391	[✓ Y] | N	[✓ Y] | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN	Y | [✓ N]
Now: Circle 1	HR | SR | IS CS | [✓ CO] | SSH
Past 24hr:	HR | SR | [✓ IS] CS | CO | SSH

Stream Shading

Leafed Out? Y/N	[✓ Y] | N
General Shading Circle 1	[✓ Full] | Partial | None 100%

STREAM FLOW Circle 1

Dry | Pooled | Low
Seasonal Normal
Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	1.5
Maximum Depth (m):	0.15
Reach Length (m):	100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	7
# of runs in reach	6
# of pools in reach	2

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging:	F | P | [✓ N]	Channelization:	F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type:	Herbs | Grasses Shrubs | [✓ Trees]	# of Strata:	3
Dom. Taxa:	Elm / Beech		

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	18.1	DO (mg/l):	9.0	DO %Sat:	97.4	pH (SU):	7.9	Sp. Cond (µS/cm):	774	Discharge CFS | Uncert.	Fast	

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)					
Algae:			QualMHC:		Visual Form:		R4MULTI:	Other:
Fish:			Equip.:	BPEF | Seine | Barge	EF Seconds:		Seine Minutes:	
Habitat:		BR/CW	Habitat data other than RBP?	NO				
Invertebrate:			1m² riffle + MH:		MACS 20-Jab:		Other:	
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: Bedrock/Slab:	Sticks/Wood: Depositional:	Leaf Packs: Rock Pick:	Justicia: Em. Veg.:	Aufwuchs: Wood Pick:	Edge: Other:	
Chemistry:			H_2SO_4 Lot #:		HNO_3 Lot #:			
Multi-Probe:		BR/CW	Inst. ID:	Quanta	Cal. Date:	7-25-24		
Discharge:			Inst. ID:		Beam Check:			
Other:			Other Desc:					

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 60	% Run: 20	% Pool: 20	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	10	10	30	14
Gravel (2-64 mm)	20	30	40	26
Cobble (64 – 256 mm)	40	50	20	38
Boulders (>256 mm)	30	10	10	22
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

- Land Owner Denial
- Too Deep/Impounded
- Site Not Found
- Unsafe
- Dry
- Other (See Comments)

Reach Location Description:	upstream S8	Weather Choices:	HR = Heavy Rain | SR = Steady Rain IS = Intermittent Showers | CS = Clear Sunny CO = Cloudy Overcast | SSH = Snow Sleet
Initial Data Review By:	MR	Initial Data Review Date:	7-26-24
Date Entered:	7-26-24		

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover Score 12	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2.Embeddedness Score 12	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime Score 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition Score 13	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status Score 12	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration Score 17	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) Score 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 6 RB 6	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 7 RB 7	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 9 RB 9	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

137

steep gradient: No Fish observed.

High Gradient Habitat Assessment Datasheet

Station Visit Information

Locale Name:	Tom Fork	Project:	KY24-035	Trip:	BSD Habitat	County:	Bell
Station ID:	S10	Loc. Desc.:	Below old Settlement Pond			Visit Date:	7-25-24
Field Lead:	B. Renley	Primary Bioregion:	Mountain	Secondary Bioregion:	—	Visit Start Time:	1500
Team:	BR/CW	Stream Perm.	Eph | [✓ Int] | Per	Stream Type (HW or WA):	HW	Visit Finish Time:	1530

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.756371				K-WADE | Field	Staff:	
Long:		-83.547025	[✓ Y] | N	[✓ Y] | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN: Y | [✓ N]

Now: Circle 1: HR | SR | IS / CS | [✓ CO] | SSH

Past 24hr: HR | SR | [✓ IS] / CS | CO | SSH

Stream Shading

Leafed Out? Y/N: [✓ Y] | N

General Shading Circle 1: [✓ Full] | Partial | None
100

STREAM FLOW Circle 1

Dry | Pooled | Low | [✓ Seasonal Normal] | Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	1
Maximum Depth (m):	0.15
Reach Length (m):	100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	8
# of runs in reach	8
# of pools in reach	0

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | [✓ N] Channelization: F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type: Herbs | Grasses | Shrubs | [✓ Trees] # of Strata: 3

Dom. Taxa: Beech/sugar maple

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	17.7	DO (mg/l):	8.8	DO %Sat:	95.7	pH (SU):	8.0	Sp. Cond (µS/cm):	775	Discharge CFS | Uncert.	Fast	

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)
Algae:			QualMHC: Visual Form: R4MULTI: Other:
Fish:			Equip.: BPEF | Seine | Barge EF Seconds: Seine Minutes:
Habitat:		BR/CW	Habitat data other than RBP? NO
Invertebrate:			1m² riffle + MH: MACS 20-Jab: Other:
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: | Sticks/Wood: | Leaf Packs: | *Justicia* : | Aufwuchs: | Edge: Bedrock/Slab: | Depositional: | Rock Pick: | Em. Veg.: | Wood Pick: | Other:	
Chemistry:			H_2SO_4 Lot #: HNO_3 Lot #:
Multi-Probe:		BR/CW	Inst. ID: Quanta Cal. Date: 7-25-24
Discharge:			Inst. ID: Beam Check:
Other:			Other Desc:

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 60	% Run: 40	% Pool: 0	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)		10		4
Gravel (2-64 mm)	20	50		32
Cobble (64 – 256 mm)	55	30		45
Boulders (>256 mm)	25	10		19
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

- Land Owner Denial
- Too Deep/Impounded
- Site Not Found
- Unsafe
- Dry
- Other (See Comments)

Reach Location Description: Below old Settlement Pond

Weather Choices: HR = Heavy Rain | SR = Steady Rain | IS = Intermittent Showers | CS = Clear Sunny | CO = Cloudy Overcast | SSH = Snow Sleet

Initial Data Review By: MC

Initial Data Review Date: 7-26-24

Date Entered: 7-26-24

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover Score 10	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2.Embeddedness Score 11	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime Score 8	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition Score 10	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status Score 9	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration 15 Score	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) Score 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 8 RB 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 9 RB 9	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 9 RB 7	Width of riparian zone >18 meters; human activities (i.e , parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

130

Steep gradient, No pools, NO Fish, no BSD habitat. old mine pond upstream. Rock Dam approximately 15' tall, Old pond upstream has been converted back to a very small intermittent stream, not BSD habitat.

APPENDIX H

AQUATIC BASELINE ASSESSMENT
(PRIVILEGED. PUBLIC VERSION FILED WITH REDACTED APPENDIX.)

THIRD ROCK CONSULTANTS

AQUATIC BASELINE ASSESSMENT

Project ID:	Lewis Ridge Pumped Storage Project Bell County, Kentucky Project No. KY24-035
Prepared for:	Michael Ricci, PE, Principal Engineer RESPEC
Prepared by:	Bert Remley Senior Aquatic Ecologist
Prepared on:	June 5, 2025

Third Rock Consultants, LLC (Third Rock) was retained by RESPEC to conduct an aquatic baseline assessment of portions of Tom Fork and the Cumberland River in Bell County, Kentucky (***Vicinity Map***, **Appendix A**). Specifically, Third Rock was asked to document the aquatic macroinvertebrate mussel, and fish communities of Tom Fork and portions of the Upper Cumberland River at the confluence with Tom Fork. The objective was to document existing conditions to help evaluate potential impact resulting from the proposed construction of the Lewis Ridge Pumped Storage Project, a hydroelectric generating facility on previously mined land. Due to heavy rainfall and associated high flows throughout spring 2025, assessment of the aquatic habitat communities in the Upper Cumberland River was not possible at this time. However, the Kentucky Department of Fish and Wildlife Resources (KDFWR) provided fish data for the Upper Cumberland River, and distribution records of native mussels within the Upper Cumberland River mainstem were reviewed. This Technical Memorandum (TM) documents the methodology and findings of the aquatic surveys of Tom Fork, and a summary of fish and mussel species of the Upper Cumberland River.

STUDY AREA

For purposes of this TM, "study area" is defined as Tom Fork and tributaries as illustrated on **Exhibit 1** (**Appendix B**).

The study area is within the Puckett Creek – Cumberland River (HUC12: 051301010204) watershed at center coordinates 36.761031°, -83.552943°. Land use is primarily active/inactive surface mining, floodplain forest, and upland forested areas. Forested areas adjacent to Tom Fork are generally narrow and composed of mature trees with dense groundcover. The topography is relatively steep, with settlement ponds interspersed within the Tom Fork watershed.

METHODOLOGY

Third Rock permitted personnel conducted aquatic surveys on five (5) stations on Tom Fork and its tributaries within the proposed project area on May 14, 15, and 28, 2025. Additionally, US Fish and Wildlife Service (USFWS) Information Planning and Consultation (IPaC) Tool, and the Office of Kentucky Nature Preserves (OKNP) Biological Assessment Tool were consulted to document listed aquatic species within the project area.

Physical Habitat and Water Quality

Water quality and physical habitat were evaluated at each station. Sampling locations were located at five (5) stations that had been previously evaluated for potential blackside dace (*Chrosomus cumberlandensis*), a federally listed species, habitat (Third Rock 2024). Location coordinates were recorded at each station with an EOS Arrow 100+ GPS unit and georeferenced photo documentation of stream habitat conditions were collected.

Water quality measurements were taken with a Hydrolab multi-parameter water quality probe. The probe was calibrated prior to field use. Temperature, dissolved oxygen, percent dissolved oxygen saturation, pH, and specific conductance were recorded from each sampling location on a Kentucky Division of Water (KDOW) High Gradient Habitat Assessment Datasheet.

Physical habitat assessments were conducted at each site concurrent with water quality sampling. The US Environmental Protection Agency's Rapid Bioassessment Protocol (RBP) (Barbour *et al.* 1999, KDOW 2022) were used for assessing stream habitat based on ten physical habitat parameters that characterize the stream "micro-scale" habitat, "macro-scale" features, and the riparian and bank structure features. Habitat scores were then compared to habitat criteria for the Mountain Bioregion to determine a narrative rating. For the Mountain Bioregion habitat scores less than 117 are "poor", between 117 to 159 are "fair", and greater than 159 are "good" (KDOW 2022).

Benthic Macroinvertebrates

Semi-quantitative and qualitative macroinvertebrate sampling was conducted at each station during the respective sampling index periods in accordance with KDOW *Methods for Sampling Benthic Macro Communities in Wadeable Waters* (2015). Sampling was not conducted during periods of excessively high or low flows or within two (2) weeks of a known scouring flow event. Semi-quantitative sampling involved the collection of four (4) 0.25m^2-samples collected from at least two (2) separate riffles at each station. Riffle collections were composited to form one (1) semi-quantitative sample. Qualitative, multi-habitat sampling involved sampling unique microhabitats using various techniques and then combining the results to form one (1) composite sample for each station. Microhabitats sampled for the multi-habitat sample included rock picks, root wads, undercut banks, leaf packs, woody debris, emergent vegetation, and fine sediments. A KDOW Headwater (< 5 mi^2) Macroinvertebrate Collection Check Sheet was completed for each Tom Fork station.

Samples were transported to Third Rock's laboratory under a chain-of-custody (COC) for processing and identification following KDOW *Laboratory Procedures for Sample Processing and Identification* (KDOW 2018). Random 300-specimen subsamples were removed from the riffle samples using a Canton sorting tray divided into 30 equally sized grids. Organisms were removed from randomly selected grids until the 300-specimen total is reached or all specimens have been removed. Representative individuals for all distinct taxa were removed from the multi-habitat sample for identification.

All organisms were identified to the lowest possible taxonomic level by Society of Freshwater Science (SFS) certified taxonomist and recorded on laboratory bench sheets. Results were analyzed through evaluation of the following community metrics: taxa richness, EPT (mayfly, stonefly and caddisfly) richness, total number of individuals, modified percent EPT individuals, percent Ephemeroptera, percent primary clingers, percent Chironomidae (midges) plus Oligochaeta (aquatic worms), and modified Hilsenhoff biotic index (mHBI). Results of community metrics at each station were combined to compute a Macroinvertebrate Bioassessment Index (MBI) score ranging from 0 (worst) to 100 (best). MBI scores were then compared to scoring criteria for the Mountain Bioregion of Kentucky to arrive at a narrative rating identified in *Kentucky Macroinvertebrate Bioassessment Index Derivative of Regional Narrative Ratings for Assessing Wadeable and Headwater Streams* (KDOW 2003).

Fish

Fish sampling was conducted at each station during the respective sampling index periods in accordance with KDOW *Collection Methods for Fish in Wadeable Streams* (2022). A Smith-Root backpack electroshocker was used to sample a 100 to 300-meter reach at each of the Tom Fork stations. Each reach included at least two riffle, run, and pool habitats. Fish were captured, identified, and enumerated in the field, recorded in a field book, and released unharmed. Photo documentation of each species encountered was collected.

Results were analyzed through the evaluation of the following community metrics (where positive (+) or negative (-) indicates relation to improving water quality): native species richness (+); darter, madtom and sculpin richness (+); intolerant species richness (+); simple lithophile spawning species (+); percent insectivore individuals (+); tolerant individuals (-); and percent facultative headwater individuals (-). Results of community metrics at each station were combined to compute an Index of Biotic Integrity (IBI)) score ranging from 0 (worst) to 100 (best). IBI scores will then be compared to scoring criteria for the Cumberland River Above the Falls Ichthyoregion Kentucky in accordance with KDOW *Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky* (2008).

Mussels

Tom Fork was evaluated for the presence of mussels during the macroinvertebrate survey. Sieving fine sediments, riffle kick sampling and searches for relict or dead mussel surveys were conducted during the macroinvertebrate survey.

RESULTS

Aquatic baseline sampling station locations are illustrated on aerial mapping (**Exhibits 1, Appendix B**) and documented by representative photographs (**Photo Log, Appendix C**).

The USFWS IPaC Tool indicated one federally listed aquatic species for the project area; Eastern hellbender (*Cryptobranchus a. alleganiensis*), a proposed endangered amphibian species. Eastern hellbender occupies large, cool, clear streams under large flat rocks (Minton 2001). Tom Fork is not hellbender habitat; however, the Upper Cumberland River is hellbender habitat within the project area. The OKNP Biological Assessment Tool did not indicate any listed aquatic species within the project area. Agency correspondence is included in **Appendix D**.

Aquatic baseline assessments and water quality sampling were conducted at four (4) stations on the mainstem of Tom Fork, and on one unnamed tributary (Station S7). Water quality sampling results are presented in **Table 1** below.

Dissolved oxygen levels were above both chronic (>5.0 mg/L) and acute (>4.0 mg/L) warmwater aquatic habitat (WAH) standards for all stations except for Station S7. Station S7 had very little flow partially due to a beaver dam built within the channel, which likely contributed to the low dissolved oxygen levels (4.6 mg/L) compared to the other stations. pH was within WAH criteria (6 to 9 standard units) for all stations. Specific conductance generally decreased from downstream to upstream. The unnamed tributary (S7) had the lowest specific conductance (522 µS/cm) of all stations. This gradient of specific conductance levels is similar specific conductance levels observed during blackside dace habitat evaluation on July 25, 2024. However, specific conductance levels were generally lower during this field visit compared to the previous visit. Wet conditions during the spring of 2025 compared to dry conditions of the previous sampling effort are likely responsible for diluting specific conductance levels.

Table 1 – Tom Fork Water Quality Sampling Results

Parameter	Station				
	S1	**S3**	**S5**	**S7***	**S9**
Date	5/14/25	5/14/25	5/14/25	5/15/25	5/15/25
Temperature (Celsius)	17.8	18.9	19.2	16.8	14.6
Dissolved Oxygen (mg/L)	9.3	9.1	8.9	4.6	9.9
% Dissolved Oxygen Saturation	99.1	98.5	96.7	47.0	98.2
pH (Standard Units)	8.1	8.1	8.1	7.2	8.1
Specific Conductance (µS/cm)	695	621	574	522	686

* Station S7 was located on an Unnamed tributary to Tom Fork, all other stations were located on the mainstem of Tom Fork.

Habitat rated “fair” at all stations assessed on Tom Fork except for the unnamed tributary (S7) which rated “poor”. The right descending bank along Tom Fork was generally narrower than the left descending bank due to either previous mining activity or the presence of a mining road. The amount of epifaunal substrate/available cover decreased slightly from downstream to upstream stations. Root wads and undercut banks became sparse then entirely absent from the downstream to upstream stations. Additionally, the stream gradient became steeper in the upstream stations compared to the downstream stations. Except for Station S7 habitat was similar at all stations compared to the July 25, 2024 visit. A beaver dam had been constructed on the unnamed tributary of Tom Fork (Station S7), which lowered the habitat rating due to a reduction in frequency of riffles and increased embeddedness. Habitat assessment results are summarized below in **Table 2**. Habitat assessment field datasheets are provided in **Appendix E**.

Table 2 – Tom Fork Habitat Assessment Results

	Station				
Habitat Parameter	**S1**	**S3**	**S5**	**S7**	**S9**
Epifaunal Substrate/Available Cover	14	12	12	7	14
Embeddedness	13	13	12	7	15
Velocity Depth/Regime	14	11	10	10	12
Sediment Deposition	13	13	14	11	13
Channel Flow Status	16	14	16	12	14
Channel Alteration	15	14	15	12	16
Frequency of Riffles	18	18	18	11	18
Bank Stability – Left Bank	8	7	8	8	5
Bank Stability – Right Bank	8	8	7	8	7
Vegetative Protection – Left Bank	7	6	8	6	6
Vegetative Protection – Right Bank	7	6	7	4	6
Riparian Vegetative Zone Width – Left Bank	4	3	9	5	9
Riparian Vegetative Zone Width – Right Bank	3	7	4	2	6
Habitat Score	**140**	**120**	**140**	**103**	**141**
Habitat Rating*	**Fair**	**Fair**	**Fair**	**Poor**	**Fair**

*Habitat Ratings for streams of the Mountain Bioregion: < 117 (Poor), 117-159 (Fair), and >159 (Good).

Riffle and run substrates were generally dominated by coarse substrate (cobble/boulder), and pools were generally dominated by finer substrates (gravel/sand). Pool habitat was scarce throughout the watershed but became mostly absent in the upstream stations as the gradient increased contributing to the stream being dominated by riffle/run habitat.

Macroinvertebrates

The macroinvertebrate community of Tom Fork generally rated "poor" for the Mountain bioregion based on MBI scores. The exception was the most upstream station (S9) which rated "fair" with an MBI score of 66.7. Relatively high abundance of generally pollution intolerant EPT (83.6%) and mayflies (Ephemeroptera) (51.7%) compared to the other stations contributed to the macroinvertebrate community rating the highest with an MBI score of 66.7. The three most downstream stations (S1, S3, and S5) on Tom Fork were just below the score needed to rate "fair" (48) with MBI scores of 47.1, 45.1, and 46.9 respectively. The unnamed tributary of Tom Fork (S7) had the lowest MBI score (32.9) of all stations. Relatively low abundance of EPT (2.7%) and mayfly individuals (0.9%) contributed to the unnamed tributary having the lowest rated macroinvertebrate community of all stations with a MBI score of 32.9. Low EPT richness (<12) and abundance (<35%), and mayfly abundance (<21%) contributed to the "poor" macroinvertebrate communities of all stations except S9. Mayflies are generally sensitive to brine, therefore past mining activity downstream of S9 might be negatively impacting their abundance levels. Macroinvertebrate survey results are summarized in **Table 3** below. Macroinvertebrate field datasheets, laboratory bench sheets, metric calculations, and laboratory COC are provided in **Appendix F**.

Table 3 – Tom Fork Macroinvertebrate Survey Results

Parameter	Station				
	S1	**S3**	**S5**	**S7***	**S9**
Date	5/14/25	5/14/25	5/14/25	5/15/25	5/15/25
Taxa Richness	32	41	46	34	40
EPT Richness	7	11	9	7	12
Modified Hilsenhoff Biotic Index	5.28	4.90	4.50	6.88	3.52
EPT Abundance (%)	26.8	23.9	34.7	2.7	83.6
Ephemeroptera Abundance (%)	20.3	11.3	8.6	0.9	51.7
Midge and Aquatic Worm Abundance (%)	26.8	45.8	38.8	7.9	9.7
Primary Clingers (%)	43.5	34.9	27.5	10.0	9.4
MBI Score	**47.1**	**45.1**	**46.9**	**32.9**	**66.7**
MBI Rating*	**Poor**	**Poor**	**Poor**	**Poor**	**Fair**

*MBI Ratings for streams of the headwater streams of Mountain Bioregion: 0-23 (Very Poor), 24-47 (Poor), 48-71 (Fair), 72-82 (Good), and >82 (Excellent).

Fish

The fish community of Tom Fork rated “good” in the lower sections (S1, S3, and S5) of the stream but declined to “fair” in the upper sections 9S7 and S9). The upper sections had a much steeper gradient (S9) or very little flow (S7). Additionally, as the watershed size decreased the number of fish individuals decreased from 127 (S1) to only 7 individuals (S9). Stream reaches upstream of S7 on the unnamed tributary of Tom Fork and S9 on the main stem of Tom Fork are most likely fishless. No blackside dace individuals were encountered during the fish survey, which was expected due to the high specific conductance levels of Tom Fork.

Stations S1 and S3 had the greatest number of individuals (127 and 117, respectively) and at least double the diversity (8 and 10 species, respectively) of the upstream reaches. Pool habitat became less common and of poorer quality in the upper sections, which most likely contributed to the decline in number of individuals and diversity. Fish survey results of Tom Fork are presented in **Table 4** below. IBI metric calculations, species list, and voucher photographs are provided in **Appendix G**.

Table 4 – Tom Fork Fish Survey Results

Parameter	Station				
	S1	**S3**	**S5**	**S7**[*]	**S9**
Date	5/14/25	5/28/25	5/28/25	5/28/25	5/28/25
Native Species Richness	8	10	4	4	3
Darter-Madtom-Sculpin Richness	1	1	1	1	0
Intolerant Species Richness	0	0	0	0	0
Simple Lithophile Species Richness	2	4	2	1	1
Insectivore Abundance (%)	36	33	88	5	0
Facultative Headwater Abundance (%)	65	60	12	14	57
Tolerant Species Abundance (%)	46	40	12	14	100
Number of Individuals	127	117	59	22	7
IBI Score	**49**	**53**	**52**	**31**	**32**
IBI Rating*	**Good**	**Good**	**Good**	**Fair**	**Fair**

[*] IBI Ratings for streams of the Cumberland River Above the Falls Ichthyoregion: 0-15 (Very Poor), 16-30 (Poor), 31-46 (Fair), 47-55 (Good), and >55 (Excellent).

Mussels

No live, fresh dead, or relict mussels were observed on Tom Fork during the macroinvertebrate survey.

Upper Cumberland River Data

KDFWR conducted sport fish surveys of the Upper Cumberland River at 5 sites in 2017, and six (6) sites in 2021 (Jay Herrala, personal communication, May 19, 2025). The results of the surveys are summarized in **Table 5** below.

Table 5 – KDFWR Fish Survey Results for the Upper Cumberland River

Species		Year Sampled	
Common Name	**Scientific Name**	**2017**[1]	**2021**[2]
Smallmouth bass	*Micropterus dolomieu*	23	40
Largemouth bass	*Micropterus nigricans*	5	2
Spotted bass	*Micropterus punctulatus*	75	64
Rock bass	*Ambloplites rupestris*	9	28
Bluegill	*Lepomis macrochirus*	17	15
Redear sunfish	*Lepomis microlophus*	2	1
Channel catfish	*Ictalurus punctatus*	108	148
Flathead catfish	*Pylodictis olivaris*	6	7
Black crappie	*Pomoxis nigromaculatus*	7	4
White crappie	*Pomoxis annularis*	0	1
Walleye	*Sander vitreus*	24	5

[1] 4.25 hours of electrofishing at 5 sites. [2] 5.75 hours of electrofishing at 6 sites

Cumberland Falls, which is located approximately 110 miles downstream from the project area, is a barrier to movement of mussels and their host fish into the Upper Cumberland River watershed, and only twelve (12) mussel species have been reported (Haag and Cicerello, 2016). During a 2001 survey of the Upper Cumberland River watershed only seven (7) live or fresh dead mussel species were observed (Cicerello and Laudermilk, 2001). Of those 7 species only four (4) were observed in the mainstem of the Upper Cumberland River; *Ortmanniana pectorosa*, *Elliptio dilatata*, *Lampsilis cardium*, and *Lampsilis fasciola*.

CONCLUSIONS

Tom Fork

Habitat was relatively unchanged from July 24, 2024, site visit except for a beaver dam built on the unnamed tributary to Tom Fork (S7), which contributed to a lower habitat rating.

The macroinvertebrate community of Tom Fork was generally "poor" except the most upstream site (S9) that rated "fair". An increase of generally pollution intolerant mayflies, stoneflies, and caddisflies (EPT) was partially responsible for the improved rating. The primary difference in the physical habitat between S9 and the downstream stations was increased riparian vegetative zone width along both banks. This physical condition likely contributed to the lower water temperature observed at station S9 (14.6 C°). Stoneflies are associated with cooler water temperatures and were more abundant and diverse at S9 compared to the other stations and contributed to the improved MBI rating.

The fish community of Tom Fork rated "good" in the lower reaches but only "fair" in the upper reaches. The decline in the fish community rating at Station S7 was most likely due to the reduced flow, low dissolved oxygen levels, and habitat alterations caused by detention basins upstream of the reach, and a beaver dam within the stream reach. Fish were mostly absent at Station S9 and was most likely due to the reduced drainage area (might go dry during late summer/fall), and the steep gradient of this reach, which might be acting as a natural fish barrier. No blackside dace were collected during the fish survey of Tom Fork. Tom Fork is not suitable blackside dace habitat due to its elevated specific conductance levels associated with past mining activities within the watershed. Specific conductance levels were approximately double the specific conductance level (343 µS/cm) that usually exclude blackside dace from a stream, even during a wet period which most likely diluted levels during the survey. According to USFWS (USFWS 2015) there are no known blackside dace populations in Tom Fork. Informal coordination with the USFWS Frankfort Field Office may be required prior to the initiation of construction activity.

No mussels were collected or observed in Tom Fork during the surveys. Tom Fork is most likely too small of a stream to support native mussel populations.

REFERENCES

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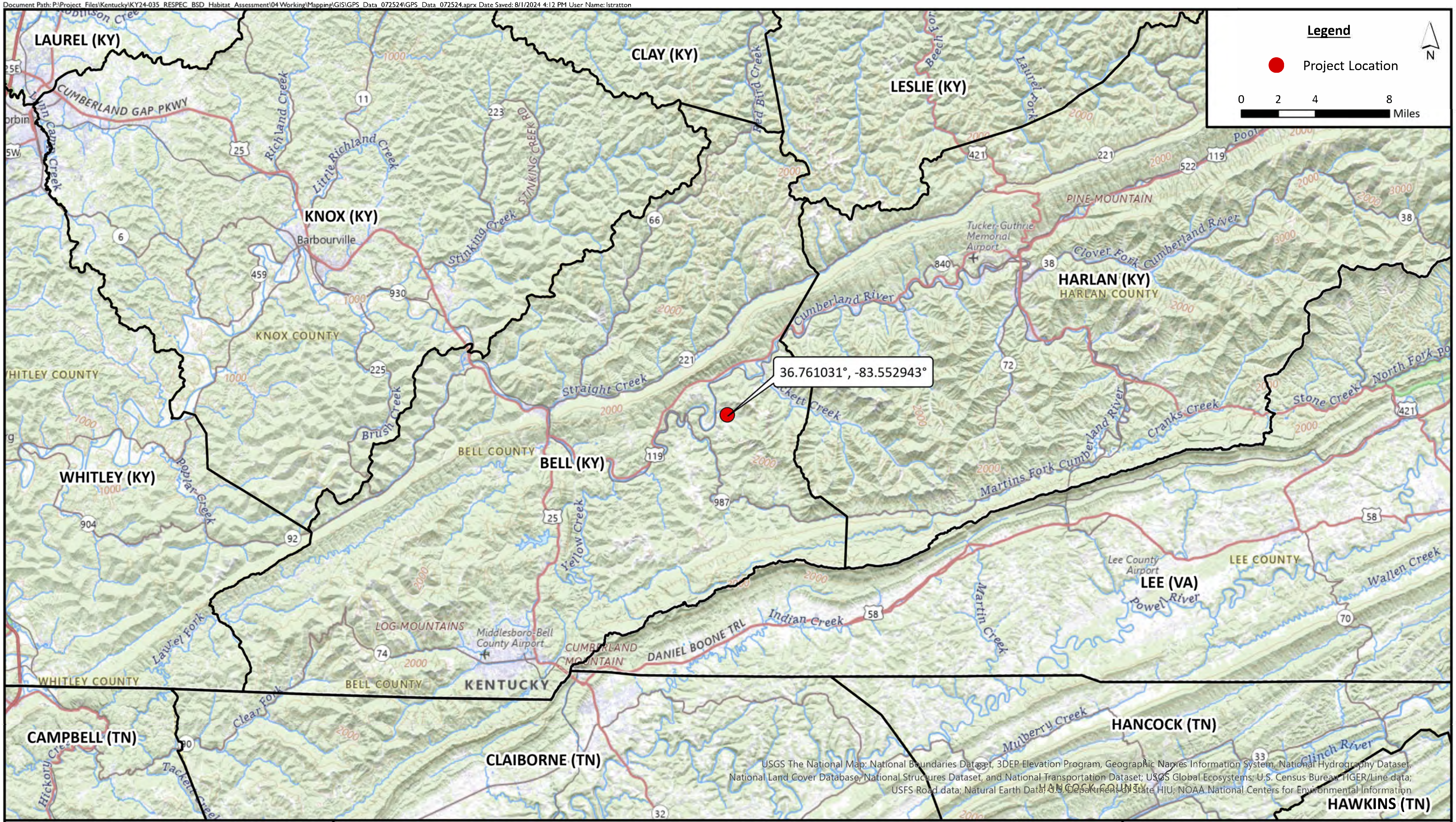
APPENDIX A
VICINITY MAP

Document Path: P:\Project_Files\Kentucky\KY24-035_RESPEC_BSD_Habitat_Assessment\04 Working\Mapping\GIS\GPS_Data_072524\GPS_Data_072524.aprx Date Saved: 8/1/2024 4:12 PM User Name: lstratton



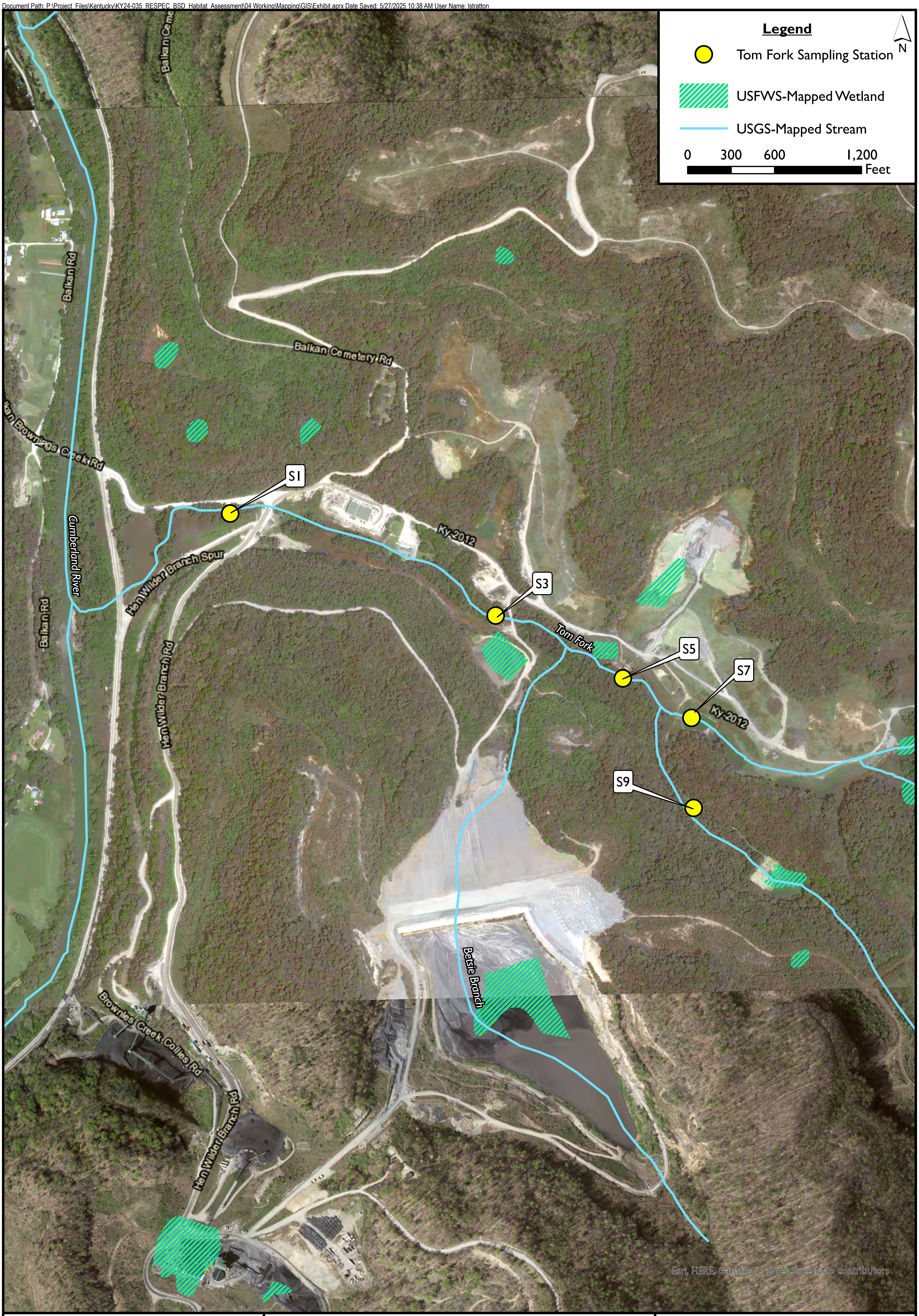
USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road data; Natural Earth Data; U.S. Department of State HIU; NOAA National Centers for Environmental Information

THIRDROCK CONSULTANTS

Project Vicinity
Lewis Ridge Pumped Storage Project
Aquatic Baseline Assessment
Bell County, Kentucky

Prepared for:
RESPEC
146 E Third St.
Lexington, Kentucky 40508

APPENDIX B
EXHIBIT 1



THIRD ROCK CONSULTANTS

Exhibit 1 Tom Fork Aquatic Sampling Stations

Lewis Ridge
Pumped Storage Project
Bell County, Kentucky

APPENDIX C
PHOTO LOG

S1 edge habitat.jpg

S1 looking downstream.jpg

S1 looking uptream.jpg

S1 pool habitat.jpg

S1 riffle habitat.jpg

S1 undercut banks and root wads.jpg

S3 edge habitat.jpg

S3 looking downstream.jpg

S3 looking upstream.jpg

S3 root wad.jpg

S3 undercut bank.jpg

S5 edge habitat.jpg

S5 looking downstream.jpg

S5 looking upstream.jpg

S7 looking downstream.jpg

S7 looking upstream.jpg

S7 pool habitat.jpg

S7 substrate.jpg

S9 edge habitat.jpg

S9 looking downstream.jpg

S9 looking upstream.jpg

S9 riffle habitat.jpg

S9 root wad.jpg

APPENDIX D
AGENCY CORRESPONDENCE

REDACTED

Pages have been intentionally redacted and filed as privileged information.

APPENDIX E
HABITAT SHEETS

High Gradient Habitat Assessment Datasheet

Station Visit Information

Locale Name:	Lewis Ridge	Project:	KY24-035	Trip:	Macro and Fish	County:	Bell
Station ID:	51	Loc. Desc.:	Tom Fork			Visit Date:	5-14-25
Field Lead:	BR	Primary Bioregion:	MT	Secondary Bioregion:		Visit Start Time:	1200
Team:	BR/JS	Stream Perm.	Eph | Int | [✓ Per]	Stream Type (HW or WA):	HW	Visit Finish Time:	1415

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.763091				K-WADE / Field	Staff:	
Long:		-83.559144	Y | N	Y | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN	Y [✓ N]
Now: Circle 1	HR | SR | IS [✓ CS] | CO | SSH
Past 24hr:	HR | SR | [✓ IS] CS | CO | SSH

Stream Shading

Leafed Out? Y/N	[✓ Y] | N
General Shading Circle 1	[✓ Full] | Partial | None

STREAM FLOW Circle 1

Dry | Pooled | Low
[✓ Seasonal Normal]
Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	4
Maximum Depth (m):	1
Reach Length (m):	120

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	5
# of runs in reach	5
# of pools in reach	5

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | [✓ N]   Channelization: F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type:	Herbs | Grasses Shrubs | [✓ Trees]	# of Strata:	3
Dom. Taxa:	Box Elder / SYC		

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	17.6	DO (mg/l):	9.3	DO %Sat:	99.1	pH (SU):	8.1	Sp. Cond (µS/cm):	695	Discharge CFS | Uncert.	—

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)					
Algae:			QualMHC:		Visual Form:		RAMULTI:	Other:
Fish:			Equip.:	BPEF | Seine | Barge	EF Seconds:		Seine Minutes:	
Habitat:		BR/JS	Habitat data other than RBP?	NO				
Invertebrate:		BR/JS	1m² riffle + MH:	✓	MACS 20-Jab:		Other:	
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: ✓ Bedrock/Slab:	Sticks/Wood: ✓ Depositional: ✓	Leaf Packs: ✓ Rock Pick: ✓	Justicia: Em. Veg.: ✓	Aufwuchs: ✓ Wood Pick: ✓	Edge: ✓ Other:	
Chemistry:			H_2SO_4 Lot #:		HNO₃ Lot #:			
Multi-Probe:		YSI	Inst. ID:	YSI	Cal. Date:	5-13-25		
Discharge:			Inst. ID:		Beam Check:			
Other:			Other Desc:					

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 45	% Run: 35	% Pool: 20	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	10	30	36	
Gravel (2-64 mm)	30	30	40	
Cobble (64 – 256 mm)	40	30	20	
Boulders (>256 mm)	20	10	5	
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

Land Owner Denial
Too Deep/Impounded
Site Not Found
Unsafe
Dry
Other (See Comments)

Reach Location Description:

Weather Choices:	
HR = Heavy Rain	SR = Steady Rain
IS = Intermittent Showers	CS = Clear Sunny
CO = Cloudy Overcast	SSH = Snow Sleet

Initial Data Review By:		Initial Data Review Date:		Date Entered:	

High Gradient Habitat Assessment Data Sheet

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover 14 Score	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2.Embeddedness Score 13	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime Score 14	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition 13 Score	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status 16 Score	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration 15 Score	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) 18 Score	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 8 RB 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 7 RB 7	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height
10. Riparian Vegetative Zone Width LB 4 RB 3	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

140

High Gradient Habitat Assessment Datasheet

Station Visit Information

Locale Name: Lewis Ridge
Project: KY24-035
Trip: Macro and Fish
County: Bell
Station ID: 53
Loc. Desc.: tom Fork
Visit Date: 5-14-25
Field Lead: BR
Primary Bioregion: MT
Secondary Bioregion:
Visit Start Time: 1420
Team: BR/JS
Stream Perm.: Eph | Int | [✓ Per]
Stream Type (HW or WA): HW
Visit Finish Time: 1530

STATION POINT VERIFICATION

1) K-WADE Target Point		2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.761028				K-WADE Field	Staff:	
Long:		-83.552938	Y | N	Y | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN: Y | [✓ N]
Now: Circle 1: HR | SR | IS | [✓ CS] | CO | SSH
Past 24hr: HR | SR | [✓ IS] | CS | CO | SSH

Stream Shading

Leafed Out? Y/N: [✓ Y] | N
General Shading Circle 1: [✓ Full] | Partial | None

STREAM FLOW Circle 1

Dry | Pooled | Low | [✓ Seasonal Normal] | Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m): 4
Maximum Depth (m): 0.5
Reach Length (m): 100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach: 6
# of runs in reach: 6
# of pools in reach: 0

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | [✓ N]
Channelization: F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type: Herbs | Grasses | Shrubs | [✓ Trees]
# of Strata: 3
Dom. Taxa: Sugar maple

HYDRAULIC STRUCTURES (Check all that are present)

Dams:
Bridge Abutments:
Fords:
Islands:
Waterfalls:
Berms:

FIELD METER DATA

Temp (°C): 16.9
DO (mg/l): 9.1
DO %Sat: 98.5
pH (SU): 8.1
Sp. Cond (µS/cm): 621
Discharge CFS | Uncert.:

FIELD ACTIVITIES

Activity Completed?		Collectors
Algae:		
Fish:		
Habitat:		BR/JS
Invertebrate:		BR/JS
Chemistry:		
Multi-Probe:		YSI
Discharge:		
Other:		

Collection Information (Check all that apply and/or enter/circle necessary information)

QualMHC:
Visual Form:
MMULTI:
Other:
Equip.: BPEF | Seine | Barge
EF Seconds:
Seine Minutes:
Habitat data other than RBP? NO
1m² riffle + MH: ✓
MACS 20-Jab:
Other:

Multihabs Sampled Y/N or # Jabs

Undercuts/Roots: ✓	Sticks/Wood: ✓	Leaf Packs: ✓	Justicia:	Aufwuchs: ✓	Edge: ✓
Bedrock/[✓ Slab] ✓	Depositional: ✓	Rock Pick: ✓	Em. Veg.: ✓	Wood Pick: ✓	Other:

H_2SO_4 Lot #:
HNO_3 Lot #:
Inst. ID: YSI
Cal. Date: 5-13-25
Inst. ID:
Beam Check:
Other Desc:

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 60	% Run: 40	% Pool: 0	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	20	20		
Gravel (2-64 mm)	20	20		
Cobble (64 – 256 mm)	30	30		
Boulders (>256 mm)	30	30		
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments
Land Owner Denial
Too Deep/Impounded
Site Not Found
Unsafe
Dry
Other (See Comments)

Reach Location Description:

Weather Choices:
HR = Heavy Rain | SR = Steady Rain
IS = Intermittent Showers | CS = Clear Sunny
CO = Cloudy Overcast | SSH = Snow Sleet

Initial Data Review By:
Initial Data Review Date:
Date Entered:

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover Score 12	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2.Embeddedness Score 13	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime Score 11	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition 13 Score	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status 14 Score	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration 14 Score	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) 18 Score	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 7 RB 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 6 RB 6	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 3 RB 7	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

non natives

120

High Gradient Habitat Assessment Datasheet

Station Visit Information

Locale Name:	Lewis Ridge	Project:	KY24-035	Trip:	Macro and Fish	County:	Bell
Station ID:	55	Loc. Desc.:	Tom Fork			Visit Date:	5-14-25
Field Lead:	BR	Primary Bioregion:	MT	Secondary Bioregion:		Visit Start Time:	1550
Team:	BR/JS	Stream Perm.	Eph | Int | [✓ Per]	Stream Type (HW or WA):	WA	Visit Finish Time:	1700

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat		36.7597894				K-WADE Field	Staff:	
Long:		-83.5499464	Y | N	Y | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN	Y | [✓ N]
Now: Circle 1	HR | SR | IS [✓ CS] | CO | SSH
Past 24hr:	HR | SR | [✓ IS] CS | CO | SSH

Stream Shading

Leafed Out? Y/N: [✓ Y] | N

General Shading Circle 1: [✓ Full] | Partial | None

STREAM FLOW Circle 1

Dry | Pooled | Low

[✓ Seasonal Normal]

Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	4
Maximum Depth (m):	0.3
Reach Length (m):	100

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	10
# of runs in reach	10
# of pools in reach	0

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | N

Channelization: F | P | N

RIPARIAN VEGETATION

Dom. Veg. Type:	Herbs | Grasses Shrubs | [✓ Trees]	# of Strata:	
Dom. Taxa:	Beech/Elm		

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	19.2	DO (mg/l):	8.9	DO %Sat:	96.7	pH (SU):	8.1	Sp. Cond (µS/cm):	574	Discharge CFS | Uncert.	

FIELD ACTIVITIES

Activity Completed?		Collectors	Collection Information (Check all that apply and/or enter/circle necessary information)					
Algae:			QualMHC:		Visual Form:		R4MULTI:	Other:
Fish:			Equip.:	BPEF | Seine | Barge	EF Seconds:		Seine Minutes:	
Habitat:		BR/JS	Habitat data other than RBP?	no				
Invertebrate:		BR/JS	$1m^2$ riffle + MH:	✓	MACS 20-Jab:		Other:	
Multihabs Sampled Y/N or # Jabs		Undercuts/Roots: ✓ Bedrock/Slab: ✓	Sticks/Wood: ✓ Depositional: ✓	Leaf Packs: ✓ Rock Pick: ✓	Justicia: Em. Veg.:	Aufwuchs: ✓ Wood Pick: ✓	Edge: ✓ Other:	
Chemistry:			H_2SO_4 Lot #:		HNO$_3$ Lot #:			
Multi-Probe:		YSI	Inst. ID:	YSI	Cal. Date:	5-13-25		
Discharge:			Inst. ID:		Beam Check:			
Other:			Other Desc:					

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 50	% Run: 50	% Pool: 0	Reach Total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)		20		
Gravel (2-64 mm)	20	30		
Cobble (64 – 256 mm)	40	30		
Boulders (>256 mm)	40	20		
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

- Land Owner Denial
- Too Deep/Impounded
- Site Not Found
- Unsafe
- Dry
- Other (See Comments)

Reach Location Description:		Weather Choices:	HR = Heavy Rain | SR = Steady Rain IS = Intermittent Showers | CS = Clear Sunny CO = Cloudy Overcast | SSH = Snow Sleet
Initial Data Review By:		Initial Data Review Date:	Date Entered:

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover **Score** 12	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2.Embeddedness **Score** 12	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime **Score** 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition 14 **Score**	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status **Score** 16	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration 15 **Score**	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) 18 **Score**	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 8 RB 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection 8 LB RB 7	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 9 RB 4	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

140

High Gradient Habitat Assessment Datasheet

Station Visit Information

Locale Name:	Lewis Ridge	Project:	KY24-035	Trip:	Macro and Fish	County:	Bell
Station ID:	57	Loc. Desc.:	Tom Fork			Visit Date:	5-15-25
Field Lead:	BR	Primary Bioregion:	MT	Secondary Bioregion:		Visit Start Time:	0830
Team:	BR/JS	Stream Perm.	Eph | [✓ Int] | Per	Stream Type (HW or WA):	HW	Visit Finish Time:	0950

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.759332				K-WADE | Field	Staff:	
Long:		-83.549215	Y | N	Y | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN: Y | [✓ N]

Now: Circle 1: HR | SR | IS | [✓ CS] | CO | SSH

Past 24hr: HR | SR | IS | [✓ CS] | CO | SSH

Stream Shading

Leafed Out? Y/N: [✓ Y] | N

General Shading Circle 1: Full | [✓ Partial] | None

STREAM FLOW Circle 1

Dry | Pooled | Low | [✓ Seasonal Normal] | Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m): 1

Maximum Depth (m): 0.25

Reach Length (m): 100

RIFFLE/RUN/POOL SEQ.

\# of riffles in reach: 3

\# of runs in reach: 3

\# of pools in reach: 2

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging: F | P | [✓ N]

Channelization: F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type: Herbs | [✓ Grasses] | Shrubs | Trees

\# of Strata: 3

Dom. Taxa: Japanese Knotweed, Kudzu

HYDRAULIC STRUCTURES (Check all that are present)

Dams:

Bridge Abutments:

Fords:

Islands:

Waterfalls:

Berms:

FIELD METER DATA

Temp (°C):	16.9	DO (mg/l):	4.6	DO %Sat:	47.0	pH (SU):	7.2	Sp. Cond (µS/cm):	522	Discharge CFS | Uncert.	

FIELD ACTIVITIES

Activity Completed?		Collectors
Algae:		
Fish:		
Habitat:		BR/JS
Invertebrate:		BR/JS
Chemistry:		
Multi-Probe:		YSI
Discharge:		
Other:		

Collection Information (Check all that apply and/or enter/circle necessary information)

QualMHC:

Visual Form:

R4MULTI:

Other:

Equip.: BPEF | Seine | Barge

EF Seconds:

Seine Minutes:

Habitat data other than RBP? no

1m² riffle + MH: ✓

MACS 20-Jab:

Other:

Multihabs Sampled Y/N or # Jabs: Undercuts/Roots: ✓ | Sticks/Wood: ✓ | Leaf Packs: ✓ | Justicia: | Aufwuchs: ✓ | Edge: ✓ | Bedrock/Slab: | Depositional: ✓ | Rock Pick: ✓ | Em. Veg.: ✓ | Wood Pick: ✓ | Other:

H_2SO_4 Lot #:

HNO_3 Lot #:

Inst. ID: YSI

Cal. Date: 5-13-25

Inst. ID:

Beam Check:

Other Desc:

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 40	% Run: 40	% Pool: 20	Reach Total
Silt/Clay (<0.06 mm)			70	
Sand (0.06 – 2 mm)	20	30	20	
Gravel (2-64 mm)	30	30	10	
Cobble (64 – 256 mm)	40	40		
Boulders (>256 mm)	10			
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

- Land Owner Denial
- Too Deep/Impounded
- Site Not Found
- Unsafe
- Dry
- Other (See Comments)

Reach Location Description:

Weather Choices: HR = Heavy Rain | SR = Steady Rain | IS = Intermittent Showers | CS = Clear Sunny | CO = Cloudy Overcast | SSH = Snow Sleet

Initial Data Review By:

Initial Data Review Date:

Date Entered:

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover **Score** 7	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2.Embeddedness **Score** 7	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime **Score** 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition **Score** 11	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status **Score** 12	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration **Score** 12	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) **Score** 11	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 8 RB 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 6 RB 4	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 5 RB 2	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

103

Beaver has built a dam @ end of reach, inundating Lower 1/4 of reach. Formed pool that wasn't there July of 24.

High Gradient Habitat Assessment Datasheet

Station Visit Information

Locale Name:	Lewis Ridge	Project:	KY24-035	Trip:	Macro and Fish	County:	Bell
Station ID:	S9	Loc. Desc.:	Tom Fork			Visit Date:	5-15-25
Field Lead:	BR	Primary Bioregion:	MT	Secondary Bioregion:		Visit Start Time:	1000
Team:	BR / JS	Stream Perm.:	Eph | [✓ Int] | Per	Stream Type (HW or WA):	HW	Visit Finish Time:	1115

STATION POINT VERIFICATION

	1) K-WADE Target Point	2) Field GPS Location	Nav. to Target Point Within GPS Error?	Target On Correct Stream?	Field GPS Error (M)	3) GPS Final	K-WADE Station Update	
Lat:		36.757301				K-WADE / Field	Staff:	
Long:		-83.548391	Y | N	Y | N			Date:	

WEATHER

Scouring Rain In Last 14 Days? YN	Y | [✓ N]
Now: Circle 1	HR | SR | IS [✓ CS] | CO | SSH
Past 24hr:	HR | SR | IS [✓ CS] | CO | SSH

Stream Shading

Leafed Out? Y/N	[✓ Y] | N
General Shading Circle 1	[✓ Full] | Partial | None

STREAM FLOW Circle 1

Dry | Pooled | Low
[✓ Seasonal Normal]
Above Normal | Flood

INSTREAM FEATURES

Avgerage Wetted Width (m):	2
Maximum Depth (m):	0.4
Reach Length (m):	130

RIFFLE/RUN/POOL SEQ.

# of riffles in reach	10
# of runs in reach	10
# of pools in reach	3

LOCAL WATERSHED FEATURES (Major Land Use): (Check all that are present)

Surface Mining	✓	Construction		Pasture/Grazing	
Deep Mining		Commercial		Silviculture	
Oil Wells		Industrial		Urban Runoff	
Land Disposal		Row Crops		Storm Sewers	
Residential		Forest	✓	Permitted Outfalls	

CHANNEL ALTERATIONS- Full, Partial or Not/None

Dredging:	F | P | [✓ N]	Channelization:	F | P | [✓ N]

RIPARIAN VEGETATION

Dom. Veg. Type:	Herbs | Grasses Shrubs | [✓ Trees]	# of Strata:	3
Dom. Taxa:	Beech / Elm		

HYDRAULIC STRUCTURES (Check all that are present)

Dams:		Bridge Abutments:		Fords:		Islands:		Waterfalls:		Berms:	

FIELD METER DATA

Temp (°C):	14.6	DO (mg/l):	9.9	DO %Sat:	98.2	pH (SU):	8.1	Sp. Cond (µS/cm):	686	Discharge CFS | Uncert.		

FIELD ACTIVITIES

Sample Completed:		Collectors
Algae:		
Fish:		
Habitat:		BR / JS
Invertebrate:		BR / JS
Chemistry:		
Multi-Probe:		VST
Discharge:		
Other:		

Collection Information (Check all that apply and/or enter/circle necessary information)

QualMHC:		Visual Form:		R4MULTI:		Other:	
Equip.:	BPEF | Seine | Barge	EF Seconds:				Seine Minutes:	
Habitat data other than RBP?	No						
$1m^2$ riffle + MH:	✓	MACS 20-Jab:		Other:			
H₂SO₄ Lot #:				HNO₃ Lot #:			
Inst. ID:	VST			Cal. Date:	5-13-25		
Inst. ID:				Beam Check:			
Other Desc:							

Multihabs Sampled Y/N or # Jabs

Undercuts/Roots: ✓	Sticks/Wood: ✓	Leaf Packs: ✓	*Justicia* :	Aufwuchs: ✓	Edge: ✓
Bedrock/Slab: ✓	Depositional: ✓	Rock Pick: ✓	Em. Veg.:	Wood Pick: ✓	Other:

SUBSTRATE CHARACTERIZATION

Substrate Category	% Riffle: 60	% Run: 20	% Pool: 20	Reach Total
Silt/Clay (<0.06 mm)			5	
Sand (0.06 – 2 mm)	5	10	25	
Gravel (2-64 mm)	25	30	40	
Cobble (64 – 256 mm)	35	50	20	
Boulders (>256 mm)	35	10	10	
Bedrock/Hardpan Clay				

Site Not Sampled (Reason)- Please Add Comments

Land Owner Denial
Too Deep/Impounded
Site Not Found
Unsafe
Dry
Other (See Comments)

Reach Location Description:	

Weather Choices:

HR = Heavy Rain	SR = Steady Rain
IS = Intermittent Showers	CS = Clear Sunny
CO = Cloudy Overcast	SSH = Snow Sleet

Initial Data Review By:		Initial Data Review Date:		Date Entered:	

High Gradient Habitat Assessment Datasheet

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1.Epifaunal Substrate/ Available Cover Score 14	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking
2.Embeddedness Score 15	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3.Velocity/ Depth Regime Score 12	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
4. Sediment Deposition Score 13	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5.Channel Flow Status Score 14	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6.Channel Alteration Score 16	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7.Frequency of Riffles (or bends) Score 18	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
Left/Right Bank	10 9	8 7 6	5 4 3	2 1 0
8.Bank Stability LB 5 RB 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB 6 RB 6	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB 9 RB 6	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

141

APPENDIX F
MACROINVERTEBRATE RESULTS

THIRD ROCK CONSULTANTS, LLC

LABORATORY CHAIN-OF-CUSTODY PAGE 1 OF __

Client Name: Respec
Client P.O. / D.O. / Contract No.:OC:
Third Rock Project No.: KY24-035
Project Name / Description / Location: Lewis Ridge Pumped Storage
Client POC Name: Michael Ricci
Total No. of Samples: 10
Total No. of Containers: 10
Electronic Deliverable to (email): Michael Ricci

Client Station ID No.	Stream Name	Sample Type[1]	Drainage Type[2]	Ecoregion	Collected by	Date	Preservative	# Containers
S1	Tom Fork	QuanT	H	MT	BR/JS	5-14-25	Ethanol	1
↓	↓	Qual	↓	↓	↓	↓	↓	↓
S3	↓	Quant	↓	↓	↓	↓	↓	↓
↓	↓	Qual	↓	↓	↓	↓	↓	↓
S5	↓	Quant	↓	↓	↓	↓	↓	↓
↓	↓	Qual	↓	↓	↓	↓	↓	↓
S7	UnT Tom Fork	QuanT	↓	↓	↓	5-15-25	↓	↓
↓	~~Tom Fork~~	Qual	↓	↓	↓	↓	↓	↓
S9	Tom Fork	Quant	↓	↓	↓	↓	↓	↓
↓	↓	Qual	↓	↓	↓	↓	↓	↓

[1] Sample Type: Qualitative or Quantitative. [2] DrainageType: Headwater or Wadeable. *Note: List additional samples on reverse in space provided.*

Relinquished by: Mat Remley
Date: 5/15/25 Time: 1630

Received by:
Date: 5/15/25 Time: 16:30

Samples properly preserved, bottles intact, seals intact? [✓ Y] / N If no, explain

Additional documentation? Y / [✓ N] If yes, describe

Special Instruction/Notes: KDOW protocols

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 5-14-25 Time: 1200 Project No: KY24-035 Project Name: Lewis Ridge Pumped Storage

Collector(s) Initials: BL/JS Station ID: S1 Lat: 36.763091 Long: -83.559144

✓ Collected during the headwater sampling period (March 1– May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 120 meters
Number of riffles in stream reach: 5 (at least 3)
Number of runs in stream reach: 6 (at least 3)
Number of pools in stream reach: 6 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalweg of Riffle #1
✓ 0.25 m^2 quadrat from the thalweg of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalweg of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalweg of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies and 3 sweeps in 2 runs/riffles within reach)
✓ Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach)
____Other Sweeps (Ex. Bedrock sweeps) Comments: N/A

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles) poor

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

✓ Submerged Wood Picks: Linear Meters of Wood Sampled 4 (Wood from riffles, runs and pools/ side channels/eddies within reach shall be represented.)

Field Measurements: 9.3 DO 17.8 Temperature 8.1 pH 695 Conductivity
99.1

Comments:

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 5-14-25 Time: 1420 Project No: KY24-035 Project Name: Lewis Ridge Pumped Storage

Collector(s) Initials: BR/JS Station ID: S3 Lat: ____ Long: ____

____ Collected during the headwater sampling period (March 1– May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 160 meters
Number of riffles in stream reach: 6 (at least 3)
Number of runs in stream reach: 8 (at least 3)
Number of pools in stream reach: 0 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies and 3 sweeps in 2 runs/riffles within reach)
✓ Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach) Poor
✓ Other Sweeps (Ex. Bedrock sweeps) Comments: Slab rocks

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles) Poor, very small

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

✓ Submerged Wood Picks: Linear Meters of Wood Sampled 3 (Wood from riffles, runs and pools/ side channels/eddies within reach shall be represented.)

Field Measurements: 9.1 DO 18.9 Temperature 8.1 pH 621 Conductivity

98.5

Comments:

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 5-14-25 Time: 1550 Project No: KY24-035 Project Name: Lewis Ridge Pumped Storage

Collector(s) Initials: BR/JS Station ID: S5 Lat:________ Long:________

✓ Collected during the headwater sampling period (March 1– May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 100 meters
Number of riffles in stream reach: 10 (at least 3)
Number of runs in stream reach: 10 (at least 3)
Number of pools in stream reach: 0 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (~~3 sweeps in 2 poo~~ls/side channels/eddies and 3 sweeps in 2 runs/riffles within reach)
✓ Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach)
✓ Other Sweeps (Ex. Bedrock sweeps) Comments: Slab rocks

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles) Poor ✓

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

✓ Submerged Wood Picks: Linear Meters of Wood Sampled 3 (Wood from riffles, runs and pools/side channels/eddies within reach shall be represented.)

Field Measurements: 8.9 DO 19.2 Temperature 8.1 pH 574 Conductivity
96.7

Comments:

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 5-15-25 Time: 0840 Project No: KY24-035 Project Name: Lewis Ridge Pumped Storage

Collector(s) Initials: BR/JS Station ID: S 7 Lat: 36.759932 Long: -83.549215

✓ Collected during the headwater sampling period (March 1– May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 100 meters
Number of riffles in stream reach: 3 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 2 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalweg of Riffle #1
✓ 0.25 m^2 quadrat from the thalweg of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalweg of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalweg of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach) ______

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

Pool only
✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies and 3 sweeps ~~in 2 runs/riffles within reach~~)
✓ Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach)
____Other Sweeps (Ex. Bedrock sweeps) Comments: NA

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

✓ Submerged Wood Picks: Linear Meters of Wood Sampled 3 (Wood from riffles, runs and pools/ side channels/eddies within reach shall be represented.)

Field Measurements: 4.6 DO 16.4 Temperature 7.2 pH 522 Conductivity
47.0

Comments:

Low D.O. possibly due to beaver pond.

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 5-15-25 Time: 1000 Project No: KY24-035 Project Name: Lewis Ridge Pumped Storage

Collector(s) Initials: BR/JS Station ID: S9 Lat: 36.757301 Long: -83.548391

____ Collected during the headwater sampling period (March 1– May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 130 meters
Number of riffles in stream reach: 10 (at least 3)
Number of runs in stream reach: 10 (at least 3)
Number of pools in stream reach: 3 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies and 3 sweeps in 2 runs/riffles within reach) shallow
✓ Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach)
✓ Other Sweeps (Ex. Bedrock sweeps) Comments: slab

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

✓ Submerged Wood Picks: Linear Meters of Wood Sampled 2.5 (Wood from riffles, runs and pools/ side channels/eddies within reach shall be represented.)

Field Measurements: 9.9 DO 14.6 Temperature 8.1 pH 686 Conductivity
96.2

Comments:

Third Rock Consultants, LLC

Benthic Macroinvertebrate Results

Station ID / No: TF-S1 **Client Name:** RESPEC Lewis Ridge **Collected on:** 05/14/25

Sample ID / No: S01 **Stream Name:** Tom Fork **Delivered on:** 05/15/25

Class	Order	Family	Final ID	FFG	TolVal	FamTV	Clinger	Qual	No.
	Coleoptera	Elmidae	Optioservus sp	SC	2.36	5	x	x	2
	Coleoptera	Elmidae	Stenelmis sp	SC	5.1	5	x		2
	Coleoptera	Hydrophilidae	Unidentified Hydrophilid	PR	6.3	9			1
	Coleoptera	Psephenidae	Psephenus herricki	SC	2.35	5	x		1
	Diptera	Ceratopogonidae	Atrichopogon sp	PR	6.49	7			1
	Diptera	Ceratopogonidae	Unidentified Ceratopogonid	PR	6.7	7			2
	Diptera	Chironomidae	Ablabesmyia mallochi gr	PR	7.19	7			2
	Diptera	Chironomidae	Cardiocladius obscurus	PR	6.2	7	x		2
	Diptera	Chironomidae	Chaetocladius sp	CG	7	7			1
	Diptera	Chironomidae	Cricotopus bicinctus gr	SH	8.54	7			2
	Diptera	Chironomidae	Cricotopus tremulus gr	SH	7	7			2
	Diptera	Chironomidae	Cricotopus trifascia gr	SH	2.84	7			1
	Diptera	Chironomidae	Cricotopus/Orthocladius gr	CG	7.1	7		x	3
	Diptera	Chironomidae	Eukiefferiella claripennis gr	CG	5.58	7			1
	Diptera	Chironomidae	Limnophyes sp	CG	7	7		x	2
	Diptera	Chironomidae	Parametriocnemus sp	CG	3.65	7		x	3
	Diptera	Chironomidae	Polypedilum flavum	SH	5.3	7		x	2
	Diptera	Chironomidae	Procladius sp	PR	9.1	7			1
	Diptera	Chironomidae	Rheocricotopus robacki	CG	7.28	7		x	6
	Diptera	Chironomidae	Tanytarsus sp	CF	6.7	7		x	2
	Diptera	Chironomidae	Thienemannimyia gr	PR	5.9	7		x	2
	Diptera	Chironomidae	Tribelos fuscicorne	CG	6.3	7			2
	Diptera	Simuliidae	Simulium sp	CF	4.4	5	x	x	1
	Diptera	Tipulidae	Dicranota sp	PR	0	5			4
	Ephemeroptera	Baetidae	Acentrella sp	CG	3.6	5		x	1
	Ephemeroptera	Baetidae	Baetis intercalaris	CG	4.99	5			13
	Ephemeroptera	Baetidae	Baetis tricaudatus	CG	1.63	5		x	13

Benthic Macroinvertebrate Results

Station ID / No: TF-S1 **Client Name:** RESPEC Lewis Ridge **Collected on:** 05/14/25

Sample ID / No: S01 **Stream Name:** Tom Fork **Delivered on:** 05/15/25

Class	Order	Family	Final ID	FFG	TolVal	FamTV	Clinger	Qual	No.
	Ephemeroptera	Caenidae	Caenis diminuta grp	CG	7.4	8		x	1
Oligochaeta	Haplotaxida	Naididae	Unidentified Naidid	CG	9.1	9		x	3
	Isopoda	Asellidae	Lirceus fontinalis	CG	7.85	8			4
	Lepidoptera	Pyralidae	Unidentified Pyralidae	SH	8	3			1
	Megaloptera	Sialidae	Sialis sp	PR	7.17	8			1
	Plecoptera	Leuctridae	Leuctra sp	SH	0.67	1		x	1
	Plecoptera	Perlidae	Perlesta sp	PR	4.7	2	x		4
	Trichoptera	Hydropsychidae	Hydropsyche morosa grp	CF	3.2	4	x		1
	Trichoptera	Hydropsychidae	Hydropsyche sparna	CF	3.2	4	x		2
	Trichoptera	Hydropsychidae	Cheumatopsyche sp	CF	6.22	4	x	x	44
	Trichoptera	Hydropsychidae	Hydropsyche depravata grp	CF	4	4	x	x	1

Total No. of Individuals 138

Benthic Macroinvertebrate Results

Station ID / No: TF-S3 **Client Name:** RESPEC Lewis Ridge **Collected on:** 05/14/25

Sample ID / No: S02 **Stream Name:** Tom Fork **Delivered on:** 05/15/25

Class	Order	Family	Final ID	FFG	TolVal	FamTV	Clinger	Qual	No.
	Coleoptera	Elmidae	Stenelmis sp	SC	5.1	5	x	x	6
	Diptera	Ceratopogonidae	Atrichopogon sp	PR	6.49	7			4
	Diptera	Ceratopogonidae	Bezzia/Palpomyia gr	PR	6.9	7		x	
	Diptera	Chironomidae	Cardiocladius obscurus	PR	6.2	7	x		4
	Diptera	Chironomidae	Chaetocladius sp	CG	7	7			2
	Diptera	Chironomidae	Chironomus riparius gr	CG	9.6	7		x	
	Diptera	Chironomidae	Cricotopus bicinctus gr	SH	8.54	7		x	1
	Diptera	Chironomidae	Cricotopus/Orthocladius gr	CG	7.1	7			6
	Diptera	Chironomidae	Eukiefferiella claripennis gr	CG	5.58	7		x	5
	Diptera	Chironomidae	Limnophyes sp	CG	7	7		x	
	Diptera	Chironomidae	Natarsia sp	PR	9.95	7			4
	Diptera	Chironomidae	Parametriocnemus sp	CG	3.65	7		x	32
	Diptera	Chironomidae	Paratanytarsus sp	CG	8.45	7	x	x	2
	Diptera	Chironomidae	Phaenopsectra sp	SC	6.5	7		x	
	Diptera	Chironomidae	Polypedilum aviceps	SH	3.65	7			23
	Diptera	Chironomidae	Polypedilum flavum	SH	5.3	7		x	1
	Diptera	Chironomidae	Polypedilum illinoense	SH	9	7			1
	Diptera	Chironomidae	Rheocricotopus robacki	CG	7.28	7		x	2
	Diptera	Chironomidae	Rheotanytarsus exiguus gr	CF	6.4	7	x	x	11
	Diptera	Chironomidae	Tanytarsus sp	CF	6.7	7		x	10
	Diptera	Chironomidae	Thienemanniella xena	CG	5.9	7		x	1
	Diptera	Chironomidae	Thienemannimyia gr	PR	5.9	7		x	6
	Diptera	Chironomidae	Tribelos fuscicorne	CG	6.3	7			3
	Diptera	Chironomidae	Tvetenia pauncunca	CG	3.65	7		x	8
	Diptera	Empididae	Clinocera sp	PR	8.1	8	x	x	3
	Diptera	Simuliidae	Simulium sp	CF	4.4	5	x	x	7
	Diptera	Tipulidae	Dicranota sp	PR	0	5			7

Third Rock Consultants, LLC

Benthic Macroinvertebrate Results

Station ID / No: TF-S3 **Client Name:** RESPEC Lewis Ridge **Collected on:** 05/14/25

Sample ID / No: S02 **Stream Name:** Tom Fork **Delivered on:** 05/15/25

Class	Order	Family	Final ID	FFG	TolVal	FamTV	Clinger	Qual	No.
	Diptera	Tipulidae	Tipula sp	SH	7.33	5			5
	Ephemeroptera	Baetidae	Baetis tricaudatus	CG	1.63	5		x	18
	Ephemeroptera	Baetidae	Plauditus sp	CG	5.4	5		x	13
	Ephemeroptera	Caenidae	Caenis diminuta grp	CG	7.4	8			1
Oligochaeta	Haplotaxida	Naididae	Unidentified Naidid	CG	9.1	9			8
	Isopoda	Asellidae	Lirceus fontinalis	CG	7.85	8			5
	Megaloptera	Corydalidae	Nigronia serricornis	PR	4.95	6	x	x	
	Odonata	Aeshnidae	Boyeria sp	PR	6	7			1
	Odonata	Calopterygidae	Calopteryx maculata	PR	7.8	7		x	
	Odonata	Gomphidae	Unidentified Gomphid	PR	6	6		x	
	Plecoptera	Leuctridae	Leuctra sp	SH	0.67	1		x	10
	Plecoptera	Nemouridae	Amphinemura sp	SH	3.33	4		x	
	Plecoptera	Perlidae	Perlesta sp	PR	4.7	2	x	x	8
	Trichoptera	Hydropsychidae	Hydropsyche morosa grp	CF	3.2	4	x		1
	Trichoptera	Hydropsychidae	Hydropsyche sparna	CF	3.2	4	x		1
	Trichoptera	Hydropsychidae	Cheumatopsyche sp	CF	6.22	4	x	x	48
	Trichoptera	Hydropsychidae	Diplectrona modesta	CF	2.21	4	x		1
	Trichoptera	Hydropsychidae	Hydropsyche depravata grp	CF	4	4	x	x	6
	Trichoptera	Hydropsychidae	Unidentified Hydropsychidae		4	4			8
	Trichoptera	Limnephilidae	Pycnopsyche sp	SH	2.52	3		x	
	Trichoptera	Philopotamidae	Dolophilodes sp	CF	0.81	2	x		1

Total No. of Individuals 284

Third Rock Consultants, LLC

Benthic Macroinvertebrate Results

Station ID / No: TF-S5 **Client Name:** RESPEC Lewis Ridge **Collected on:** 05/14/25

Sample ID / No: S03 **Stream Name:** Tom Fork **Delivered on:** 05/15/25

Class	Order	Family	Final ID	FFG	TolVal	FamTV	Clinger	Qual	No.
	Coleoptera	Dryopidae	Helichus lithophilus	SC	4.6	5	x	x	
	Coleoptera	Elmidae	Stenelmis sp	SC	5.1	5	x		2
	Coleoptera	Hydrophilidae	Berosus sp	PH	8.43	9		x	
	Diptera	Ceratopogonidae	Atrichopogon sp	PR	6.49	7		x	2
	Diptera	Ceratopogonidae	Bezzia/Palpomyia gr	PR	6.9	7		x	11
	Diptera	Chironomidae	Chironomus decorus gr	CG	9.6	7		x	1
	Diptera	Chironomidae	Cricotopus bicinctus gr	SH	8.54	7			1
	Diptera	Chironomidae	Cricotopus tremulus gr	SH	7	7			2
	Diptera	Chironomidae	Cricotopus trifascia gr	SH	2.84	7			1
	Diptera	Chironomidae	Cricotopus/Orthocladius gr	CG	7.1	7		x	4
	Diptera	Chironomidae	Eukiefferiella claripennis gr	CG	5.58	7			3
	Diptera	Chironomidae	Limnophyes sp	CG	7	7		x	1
	Diptera	Chironomidae	Micropsectra sp	CG	1.52	7		x	1
	Diptera	Chironomidae	Natarsia sp	PR	9.95	7		x	1
	Diptera	Chironomidae	Parametriocnemus sp	CG	3.65	7		x	17
	Diptera	Chironomidae	Paratanytarsus sp	CG	8.45	7	x	x	
	Diptera	Chironomidae	Paratendipes albimanus	CG	9.2	7	x	x	
	Diptera	Chironomidae	Polypedilum aviceps	SH	3.65	7			19
	Diptera	Chironomidae	Polypedilum flavum	SH	5.3	7		x	11
	Diptera	Chironomidae	Rheocricotopus robacki	CG	7.28	7			1
	Diptera	Chironomidae	Rheotanytarsus exiguus gr	CF	6.4	7	x		13
	Diptera	Chironomidae	Stictochironomus sp	CG	6.52	7		x	
	Diptera	Chironomidae	Tanytarsus sp	CF	6.7	7		x	6
	Diptera	Chironomidae	Thienemanniella xena	CG	5.9	7			2
	Diptera	Chironomidae	Thienemannimyia gr	PR	5.9	7		x	6
	Diptera	Chironomidae	Tribelos fuscicorne	CG	6.3	7		x	1
	Diptera	Chironomidae	Tvetenia pauncunca	CG	3.65	7			21

Third Rock Consultants, LLC

Benthic Macroinvertebrate Results

Station ID / No: TF-S5 **Client Name:** RESPEC Lewis Ridge **Collected on:** 05/14/25

Sample ID / No: S03 **Stream Name:** Tom Fork **Delivered on:** 05/15/25

Class	Order	Family	Final ID	FFG	TolVal	FamTV	Clinger	Qual	No.
	Diptera	Empididae	Chelifera sp	PR	8.1	8			1
	Diptera	Empididae	Clinocera sp	PR	8.1	8	x	x	1
	Diptera	Empididae	Hemerodromia sp	PR	8.1	8			1
	Diptera	Empididae	Unidentified Empidid	PR	8.1	8		x	
	Diptera	Ephydridae	Unidentified Ephydrid	SH	9	9			1
	Diptera	Simuliidae	Simulium sp	CF	4.4	5	x	x	6
	Diptera	Tipulidae	Dicranota sp	PR	0	5			1
	Ephemeroptera	Baetidae	Baetis tricaudatus	CG	1.63	5		x	25
Oligochaeta	Haplotaxida	Naididae	Unidentified Naidid	CG	9.1	9		x	1
	Isopoda	Asellidae	Lirceus fontinalis	CG	7.85	8			12
	Megaloptera	Corydalidae	Nigronia fasciatus	PR	5.55	6	x		1
	Megaloptera	Corydalidae	Nigronia serricornis	PR	4.95	6	x		1
	Megaloptera	Sialidae	Sialis sp	PR	7.17	8			2
	Odonata	Calopterygidae	Calopteryx maculata	PR	7.8	7		x	
	Odonata	Coenagrionidae	Ischnura sp	PR	9.52	9		x	
	Odonata	Gomphidae	Gomphus sp	PR	5.8	6		x	
	Plecoptera	Leuctridae	Leuctra sp	SH	0.67	1		x	52
	Plecoptera	Nemouridae	Amphinemura sp	SH	3.33	4		x	3
	Plecoptera	Perlidae	Perlesta sp	PR	4.7	2	x		12
	Trichoptera	Hydropsychidae	Cheumatopsyche sp	CF	6.22	4	x		35
	Trichoptera	Hydropsychidae	Diplectrona modesta	CF	2.21	4	x	x	2
	Trichoptera	Hydropsychidae	Hydropsyche depravata grp	CF	4	4	x		4
	Trichoptera	Philopotamidae	Chimarra obscura	CF	2.8	2	x		2
	Trichoptera	Philopotamidae	Dolophilodes sp	CF	0.81	2	x		1

Total No. of Individuals 291

Third Rock Consultants, LLC

Benthic Macroinvertebrate Results

Station ID / No: TF-S7 **Client Name:** RESPEC Lewis Ridge **Collected on:** 05/15/25

Sample ID / No: S04 **Stream Name:** Tom Fork **Delivered on:** 05/15/25

Class	Order	Family	Final ID	FFG	TolVal	FamTV	Clinger	Qual	No.
	Coleoptera	Dytiscidae	Neoporus sp	PR	8.9	9			1
	Coleoptera	Elmidae	Dubiraphia sp (larvae)	SC	5	5	x	x	
	Coleoptera	Haliplidae	Peltodytes sp	PH	8.73	8		x	11
	Coleoptera	Hydrophilidae	Hydrobius sp	PH	8.3	9		x	
	Diptera	Ceratopogonidae	Atrichopogon sp	PR	6.49	7			2
	Diptera	Ceratopogonidae	Bezzia/Palpomyia gr	PR	6.9	7		x	189
	Diptera	Chironomidae	Chironomus decorus gr	CG	9.6	7		x	
	Diptera	Chironomidae	Clinotanypus sp	PR	8.74	7		x	
	Diptera	Chironomidae	Cricotopus/Orthocladius gr	CG	7.1	7			2
	Diptera	Chironomidae	Parametriocnemus sp	CG	3.65	7			1
	Diptera	Chironomidae	Polypedilum flavum	SH	5.3	7			2
	Diptera	Chironomidae	Rheotanytarsus exiguus gr	CF	6.4	7	x		1
	Diptera	Chironomidae	Tanypus sp	PR	9.19	7		x	2
	Diptera	Chironomidae	Tanytarsus sp	CF	6.7	7			2
	Diptera	Chironomidae	Thienemannimyia gr	PR	5.9	7			6
	Diptera	Culicidae	Unidentified Culicidae		9	9		x	
	Diptera	Simuliidae	Simulium sp	CF	4.4	5	x		5
	Diptera	Stratiomyidae	Stratiomys sp	CG	8.08	10		x	
	Diptera	Tipulidae	Tipula sp	SH	7.33	5			1
	Ephemeroptera	Baetidae	Callibaetis sp	CG	9.84	5		x	
	Ephemeroptera	Baetidae	Procloeon sp	CG	5	5			1
	Ephemeroptera	Caenidae	Caenis diminuta grp	CG	7.4	8		x	2
Oligochaeta	Haplotaxida	Naididae	Unidentified Naidid	CG	9.1	9		x	10
	Heterodonta	Sphaeriidae	Pisidium sp	CF	6.48	7		x	6
	Heterodonta	Sphaeriidae	Sphaerium sp	CF	7.58	7			29
Oligochaeta	Lumbriculida	Lumbriculidae	Unidentified Lumbriculid	CG	7.3	7			1
	Lymnophila	Lymnaeidae	Lymnaea sp	SC	7	8		x	25

Benthic Macroinvertebrate Results

Station ID / No: TF-S7 **Client Name:** RESPEC Lewis Ridge **Collected on:** 05/15/25

Sample ID / No: S04 **Stream Name:** Tom Fork **Delivered on:** 05/15/25

Class	Order	Family	Final ID	FFG	TolVal	FamTV	Clinger	Qual	No.
	Lymnophila	Planorbidae	Helisoma sp	SC	6.2	7			1
	Odonata	Aeshnidae	Boyeria sp	PR	6	7		x	
	Odonata	Coenagrionidae	Ischnura sp	PR	9.52	9		x	
	Plecoptera	Leuctridae	Leuctra sp	SH	0.67	1			2
	Plecoptera	Nemouridae	Amphinemura sp	SH	3.33	4		x	
	Trichoptera	Hydropsychidae	Hydropsyche sparna	CF	3.2	4	x		3
	Trichoptera	Hydropsychidae	Cheumatopsyche sp	CF	6.22	4	x		23
	Trichoptera	Hydropsychidae	Hydropsyche depravata grp	CF	4	4	x		1

Total No. of Individuals 329

Third Rock Consultants, LLC

Benthic Macroinvertebrate Results

Station ID / No: TF-S9 **Client Name:** RESPEC Lewis Ridge **Collected on:** 05/15/25

Sample ID / No: S05 **Stream Name:** Tom Fork **Delivered on:** 05/15/25

Class	Order	Family	Final ID	FFG	TolVal	FamTV	Clinger	Qual	No.
	Basommatophora	Physidae	Physella sp	SC	8.84	9			1
	Diptera	Ceratopogonidae	Bezzia/Palpomyia gr	PR	6.9	7		x	1
	Diptera	Chironomidae	Cricotopus bicinctus gr	SH	8.54	7		x	
	Diptera	Chironomidae	Cricotopus/Orthocladius gr	CG	7.1	7		x	1
	Diptera	Chironomidae	Cryptochironomus sp	PR	6.4	7		x	
	Diptera	Chironomidae	Diamesa sp	CG	8.12	7			1
	Diptera	Chironomidae	Heterotrissocladius marcidus gr	CG	5.4	7		x	
	Diptera	Chironomidae	Limnophyes sp	CG	7	7		x	
	Diptera	Chironomidae	Micropsectra sp	CG	1.52	7		x	
	Diptera	Chironomidae	Natarsia sp	PR	9.95	7		x	1
	Diptera	Chironomidae	Parametriocnemus sp	CG	3.65	7		x	6
	Diptera	Chironomidae	Paratendipes albimanus	CG	9.2	7	x	x	
	Diptera	Chironomidae	Rheotanytarsus exiguus gr	CF	6.4	7	x	x	2
	Diptera	Chironomidae	Tanytarsus sp	CF	6.7	7		x	1
	Diptera	Chironomidae	Thienemannimyia gr	PR	5.9	7		x	8
	Diptera	Chironomidae	Tvetenia pauncunca	CG	3.65	7		x	3
	Diptera	Empididae	Chelifera sp	PR	8.1	8			1
	Diptera	Empididae	Hemerodromia sp	PR	8.1	8		x	1
	Diptera	Simuliidae	Simulium sp	CF	4.4	5	x	x	3
	Diptera	Tipulidae	Dicranota sp	PR	0	5			1
	Diptera	Tipulidae	Limonia sp	SC	9.64	5		x	1
	Diptera	Tipulidae	Pseudolimnophila sp	PR	7.22	5			1
	Diptera	Tipulidae	Tipula sp	SH	7.33	5		x	
	Ephemeroptera	Baetidae	Baetis tricaudatus	CG	1.63	5		x	154
Oligochaeta	Haplotaxida	Naididae	Unidentified Naidid	CG	9.1	9		x	6
	Isopoda	Asellidae	Lirceus fontinalis	CG	7.85	8		x	7
	Megaloptera	Corydalidae	Nigronia serricornis	PR	4.95	6	x	x	
	Odonata	Calopterygidae	Calopteryx maculata	PR	7.8	7		x	

Third Rock Consultants, LLC

Benthic Macroinvertebrate Results

Station ID / No: TF-S9 **Client Name:** RESPEC Lewis Ridge **Collected on:** 05/15/25

Sample ID / No: S05 **Stream Name:** Tom Fork **Delivered on:** 05/15/25

Class	Order	Family	Final ID	FFG	TolVal	FamTV	Clinger	Qual	No.
	Odonata	Cordulegastridae	Cordulegaster sp	PR	5.73	6		x	
	Plecoptera	Leuctridae	Leuctra sp	SH	0.67	1		x	65
	Plecoptera	Nemouridae	Amphinemura sp	SH	3.33	4			10
	Plecoptera	Peltoperlidae	Peltoperla sp	SH	1	2	x	x	
	Plecoptera	Perlidae	Eccoptura xanthenes	PR	3.74	2	x	x	2
	Plecoptera	Perlidae	Perlesta sp	PR	4.7	2	x		1
	Plecoptera	Perlodidae	Yugus sp	PR	0	2	x		2
	Trichoptera	Hydropsychidae	Hydropsyche slossonae	CF	0	4	x		2
	Trichoptera	Hydropsychidae	Cheumatopsyche sp	CF	6.22	4	x	x	3
	Trichoptera	Hydropsychidae	Diplectrona modesta	CF	2.21	4	x	x	10
	Trichoptera	Hydropsychidae	Hydropsyche depravata grp	CF	4	4	x	x	2
	Trichoptera	Hydroptilidae	Hydroptila sp	PH	6.22	3	x		1
	Trichoptera	Limnephilidae	Pycnopsyche sp	SH	2.52	3		x	
	Trichoptera	Rhyacophilidae	Rhyacophila carolina	PR	1	1	x	x	

Total No. of Individuals 298

Third Rock Consultants, LLC

Macroinvertebrate Bioassessment Index (MBI) Calculations

RESPEC Lewis Ridge

Third Rock Project No.	P.O. / D.O. or Contract	Delivery Group	Site / Station		Collected	Stream	BioRegion	Drainage Area	MBI		Metric Calculations							
			Lab	Client ID					Score	Rating	G-TR	G-EPT	mHBI	m%EPT	%Ephem	%C+O	%ClngP	TotInd
KY24-035		2025-05-15	S01	TF-S1	2025-05-14	Tom Fork	Mountain	H	47.12	Poor	32	7	5.28	26.81	20.29	26.81	43.48	138
KY24-035		2025-05-15	S02	TF-S3	2025-05-14	Tom Fork	Mountain	H	45.07	Poor	41	11	4.90	23.94	11.27	45.77	34.86	284
KY24-035		2025-05-15	S03	TF-S5	2025-05-14	Tom Fork	Mountain	H	46.89	Poor	46	9	4.50	34.71	8.59	38.83	27.49	291
KY24-035		2025-05-15	S04	TF-S7	2025-05-15	Tom Fork	Mountain	H	32.95	Poor	34	7	6.88	2.74	0.91	7.90	10.03	329
KY24-035		2025-05-15	S05	TF-S9	2025-05-15	Tom Fork	Mountain	H	66.65	Fair	40	12	3.52	83.56	51.68	9.73	9.40	298

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APPENDIX G
FISH RESULTS

Tom Fork Fish Survey

Lewis Ridge Pumped Storage Project, Bell County, KY

Species	FG	T	FH	SS	BG	Tom Fork Site				
						S1	S3	S5	S7	S9
Campostoma anomalum , stoneroller			X			22	27			
Luxilus chrysocephalus , striped shiner		T	X		SL	6	2			
Pimephales notatus , bluntnose minnow	O	T	X	P		34	22	1	1	
P. promelas , fathead minnow	O	T	X	P					1	
Rhinichthys atratulus , blacknose dace	O	T	X	H	SL		3	5		3
Semotilus atromaculatus , creek chub	O	T		P		6	5			3
Catostomus commersoni , white sucker		T	X	P/H	SL		1			
Lepomis cyanellus , green sunfish		T	X	P		11	12	1	1	1
L. macrochirus , bluegill		T	X			2	2			
L. megalotis , longear sunfish	I		X							
L. auritus , redbreast sunfish	I		X			8	1			
Lepomis sp., juvenile sunfish							4		18	
E. caeruleum , rainbow darter	I				SL	38	38	52	1	

Metrics	Tom Fork Site				
	S1	S3	S5	S7	S9
Native Species Richness	8	10	4	4	3
Darter, Madtom, Sculpin Richness	1	1	1	1	0
Intolerant Species Richness	0	0	0	0	0
Simple Lithophile Species Richness	2	4	2	1	1
Proportion of Insectivore Individuals	36	33	88	5	0
Proportion of Facultative Headwater Individuals	65	60	12	14	57
Proportion of Tolerant Individuals	46	40	12	14	100
Proportion of Omnivore Individuals	31	26	10	9	86
Number of Individuals	127	117	59	22	7
Drainage Area (mi^2)	2.6	2.3	1.6	0.9	0.6
Sampling Effort (seconds)	980	722	850	600	615
Fish Capture/Sampling Effort	0.13	0.16	0.07	0.04	0.01
IBI Score	49	53	52	31	32
IBI Rating / Class[2]	Good	Good	Good	Fair	Fair

---

[1] Feeding Guild (FG): C = Carnivore, I = Insectivore, O = Omnivore; Tolerance (T): I = Intolerant, T = Tolerant; FH = Facultative headwater individuals; Stream Size (SS): H = Headwater, P = Pioneer; Breeding Guild (BG):SL = Simple Lithophiles.

Blacknose Dace.jpg

Bluegill.jpg

Bluntnose Minnow.jpg

Fathead Minnow.jpg

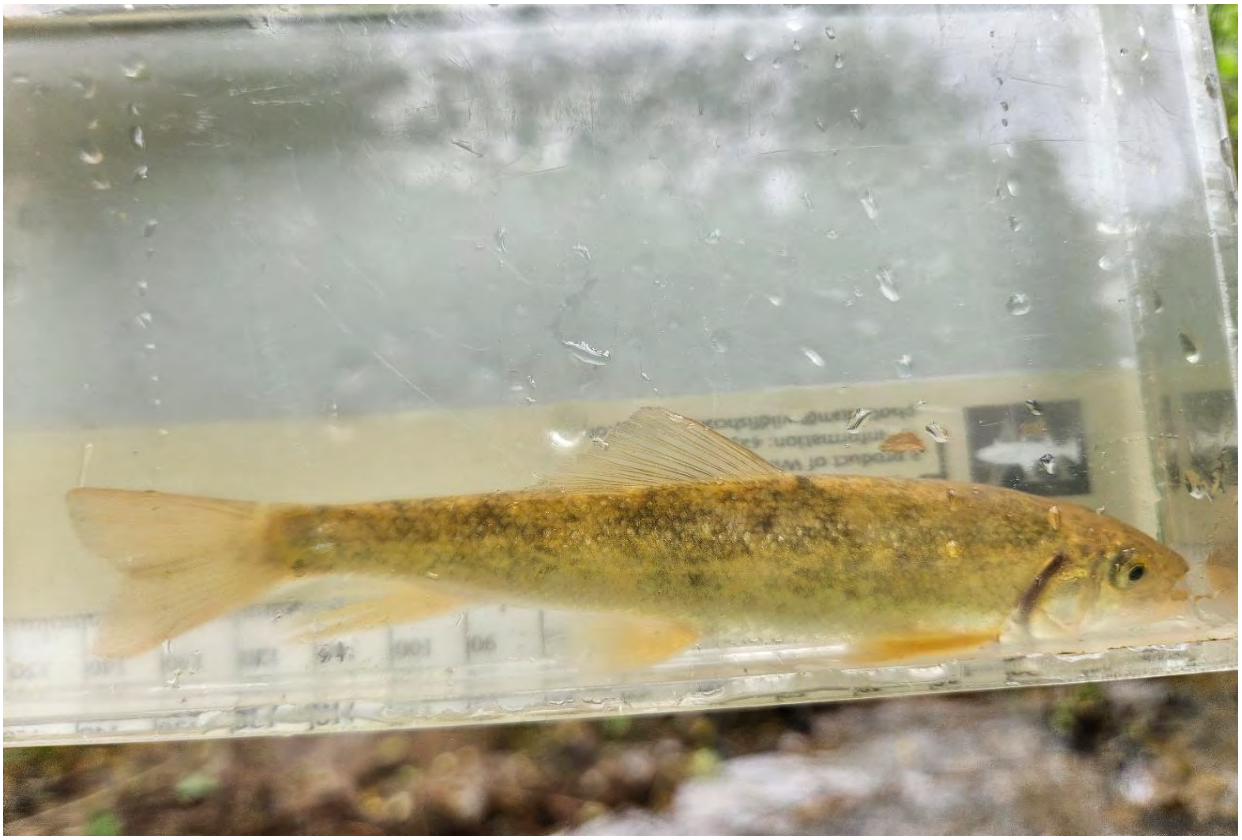
Green Sunfish.jpg

Rainbow Darter.jpg

Redbreast Sunfish.jpg

Stoneroller.jpg

Striped Shiner.jpg



White Sucker.jpg

APPENDIX I

RARE SPECIES REPORTS
(PRIVILEGED)

APPENDIX J

2024 LISTED BAT PRESENCE/PROBABLE ABSENCE SURVEY (MIST NETTING) (PRIVILEGED)

APPENDIX K

LISTED BAT PRESENCE/PROBABLE ABSENCE PORTAL SURVEY REPORT (PRIVILEGED)

APPENDIX L

2025 LISTED BAT PRESENCE/PROBABLE ABSENCE SURVEY (MIST NETTING) (PRIVILEGED)

APPENDIX M

VEGETATION ASSESSMENT REPORT

Vegetation Assessment Report for the Proposed Lewis Ridge Pumped Storage Project, Bell County, Kentucky

Prepared For:
RESPEC Inc.

9 June 2025

COPPERHEAD ENVIRONMENTAL CONSULTING, INC.
P.O. BOX 73 ■ 471 MAIN STREET ■ PAINT LICK, KENTUCKY 40461
(859) 925-9012 OFFICE (859) 925-9816 FAX

www.copperheadconsulting.com

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix A: Vegetation Community Mapping

Appendix B: Species Lists

1. INTRODUCTION

Copperhead Environmental Consulting Inc. (Copperhead) was contracted by RESPEC Inc. (Client) to conduct a vegetation survey for the proposed Lewis Ridge Pumped Storage Project (Project) in Bell County, Kentucky. The Project is comprised of a single parcel totaling approximately 1,635 acres (study area; Figure 1).

The study area is located within the Eastern Mountains and Piedmont (EMP) physiographic province, northeast of the town of Middlesboro near the Harlan County line. The study area lies entirely within the Cumberland Plateau. Terrain within this region is characterized by rugged slopes and steep valleys, with numerous geologic features resulting from the erosive force of water on porus stone (National Park Service, 2011) such as sandstone and shale (Soil Survey Staff, 2025). Elevations within the region generally range from 800 to 1,800 feet and consistent rainfall results in a moderate to temperate climate. Extensive coal mining has occurred historically throughout the Cumberland plateau including within the study area, leaving areas with bare rock, abandoned or actively used roadways, equipment laydown yards, tailing ponds, and other anthropogenic land uses interspersed throughout the landscape.

Within the study area, mining has historically occurred in numerous locations resulting in soil compaction and/or erosion, and limited vegetation growth. Due to the level of disturbance, the vegetation within these areas is largely dominated by ruderals and invasive species. In contrast, areas with less historical disturbance were able to support more mature vegetative communities. These regions were typically present on and surrounding ridges and steep slopes within the study area.

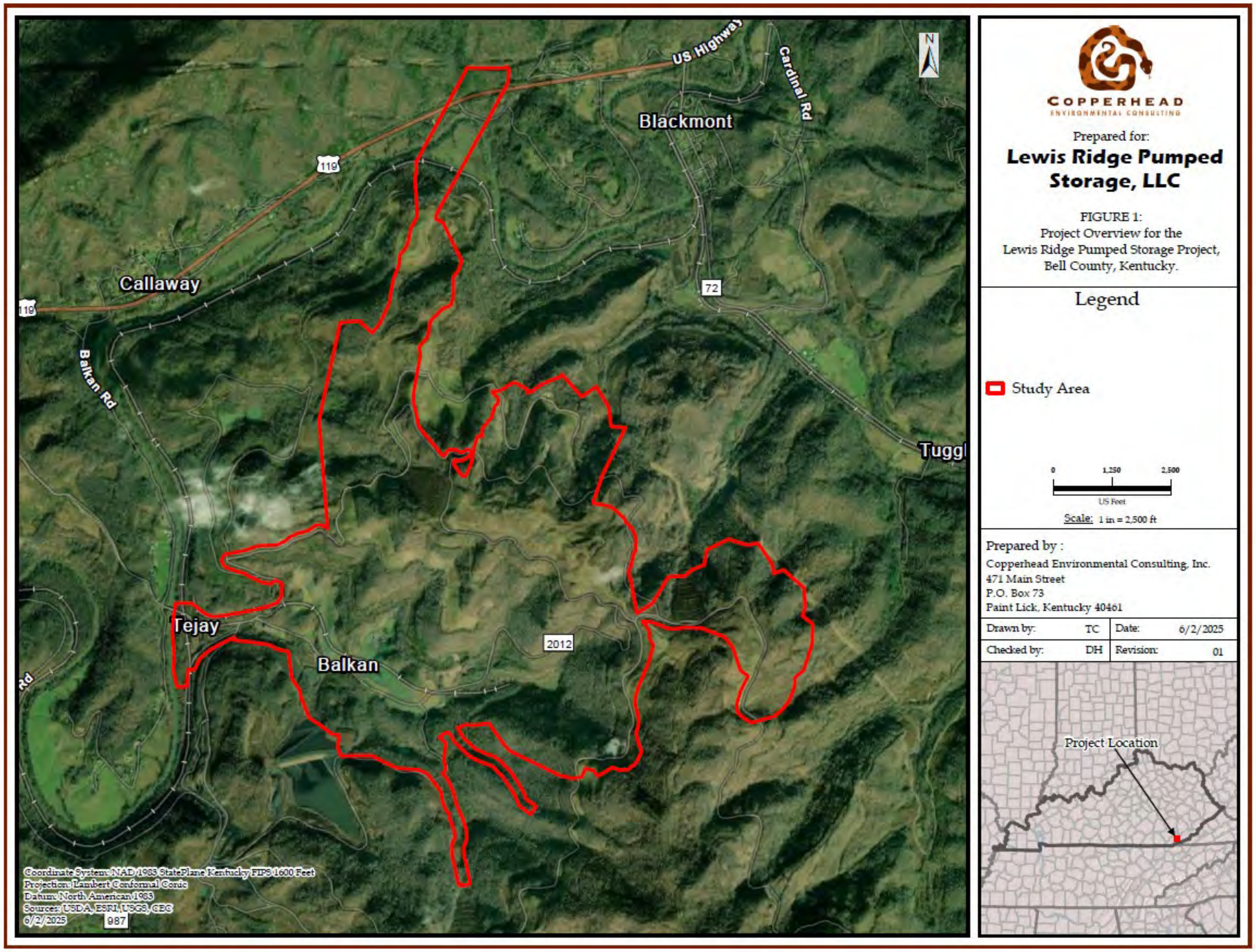


Figure 1. Lewis Ridge Pumped Storage Vegetation Assessment Study Area, Bell County, Kentucky.

2. METHODS

Copperhead botanists Dakota Hunter and Zoe Povilaika completed a desktop review of the study area in March 2025 using datasets including current and historic aerial imagery, the National Wetland Inventory (NWI), National Hydrography Dataset (NHD), United States Department of Agriculture (USDA) Soil Survey Geographic Database (SSURGO) soils data, publicly available LiDAR imagery, and topographic maps to identify potential habitat types. Copperhead catered the survey specifically to answer questions regarding the vegetation conditions within the study area that were posed by FERC during their review of information previously provided about the site. Specifically, the survey aimed to accomplish the following objectives:

1. Generate descriptions of locations, acreages, and types of each vegetation community that occur within the proposed project study area.
2. Provide locations of disturbed and/or non-native invasive vegetation within the proposed project study area.
3. Provide maps/figures showing the locations of each vegetation community type observed within the proposed project study area.
4. Provide locations of any habitat identified that could support rare, threatened, or endangered plants.

After completion of the desktop review, a Copperhead botanist conducted a field survey of the study area on April 1-2, 2025. The survey focused on documenting plant communities and vegetation types within the study area to accomplish objectives 1-4 listed above. The field survey resulted in documentation of six (6) unique vegetation communities, two of which are characterized by the dominance of non-native invasive or weedy vegetation. Desktop mapping of community types was revised following field surveys to more accurately portray conditions within the study area.

3. RESULTS

Using the National Vegetation Classification System (Grossman et al., 1998), vegetation types observed during field surveys were categorized as mixed hardwood forest, deciduous hardwood forest, disturbed shrubland, and disturbed herbaceous vegetation. Deciduous and mixed forests were each assessed to approximate the size and relative age of trees (measured as diameter at breast height [DBH]) and divided into young forest or mature forest for specificity. A breakdown of the approximate acreage of each vegetation type is provided in Table 1.

Weedy, ruderal, or invasive species that can tolerate poor soil conditions were observed as dominant vegetation within recently disturbed areas with evidence of logging or mining activity. Kudzu (*Pueraria montana*) infestations were observed frequently along roadsides, adjacent to man-made ponds, and on exposed slopes where tree clearing had occurred historically. Woody invasive species including autumn olive (*Elaeagnus umbellata*), European privet (*Ligustrum* *vulgare*), tree of heaven (*Ailanthus altissima*), and royal paulownia (*Paulownia tomentosa*) were also observed throughout the study area, often forming dense thickets or stands. Ridges and steep slopes appear to have received less anthropogenic disturbance throughout the site's history, resulting in stands of mature deciduous or mixed forest within these areas. Vegetation species composition within forested habitats varied based on relative elevation, aspect, soil type and depth to bedrock, adjacent hydrology, and proximity to canopy openings due to disturbance. Representative photographs of each habitat type can be found in Sections 3.1-3.4, the locations of each vegetation type within the study area can be found in Appendix A, species lists detailing vegetation observed in each plant community can be found in Appendix B.

Table 1: Breakdown of vegetation community types located within the proposed Lewis Ridge Pumped Storage Project Study Area.

Vegetation Type	Age	Acreage	Estimated Tree Density (stems/acre)
Deciduous Forest	Mature	664	230
	Young	56	470
Mixed Forest	Mature	286	260
	Young	101	370
Disturbed Shrubland	-	382	-
Disturbed Herbaceous	-	77	-
Unvegetated	-	69	-
Total		**1,635**	

3.1 Deciduous Forest

Deciduous forest is defined by vegetation cover consisting of dominant woody species greater than 3-inch DBH with greater than 75 percent of trees having deciduous foliage (Grossman et al., 1998). The majority of the deciduous forests in the study area are located along steep slopes, on ridgetops, and along waterways within the central portion of the study area. Much of the region has been impacted by historical logging and surface and contour coal mining. These disturbances have influenced the structure and distribution of existing forest communities with many areas resulting in patchwork forests with a range of age classes and species compositions.

3.1.1 Mature Deciduous Forests

Mature hardwood forests appeared as secondary growth with signs of disturbance within approximately the last 50-100 years. Canopy cover within mature deciduous forests generally ranged from 60-90 percent, and dominant tree species generally included oaks (*Quercus* species), especially *Q. montana* and *Q. rubra*, hickories (*Carya* species), American beech (*Fagus grandifolia*), and tuliptree (*Liriodendron tulipifera*). Tree stem density within the deciduous forest habitats ranged from 100 to 300 stems per acre with typical stands averaging approximately 230 trees per acre. Mature deciduous forests generally possessed larger trees (>12-in DBH and up to 40-in DBH) with denser canopy cover and more open understory.

3.1.2 Young Deciduous Forests

Young deciduous forests supported an abundance of fast-growing species (e.g., *L. tulipifera, L. Styraciflua, A. Rubrum*) with dense mid-story and understory growth. Additionally, young deciduous forests averaged a higher average stem density than mature hardwood forests (>400 stems/acre) with a range of approximately 300 to 600 stems/acre depending on location. Understory and herbaceous species abundance and composition vary with slope, aspect, soil type, and hydrologic inputs. Figure 2 shows photographs of representative deciduous forest stands. Species lists taken along meanders within each habitat type can be found in Appendix B.

Figure 2. Representative Photographs of Mature Deciduous Forest (Top) and Young Deciduous Forest (Bottom).

3.2 Mixed Evergreen Deciduous Forest (Mixed Forest)

Mixed forest is defined by vegetation cover consisting of dominant woody species greater than 3-in DBH with greater than 25-75 percent of trees having deciduous foliage and 25-75 percent of trees having evergreen foliage (Grossman et al., 1998). Most mixed forests in the study area are located along steep slopes, on ridgetops, and along waterways within the southern portion of the study area.

3.2.1 Mature Mixed Forest

Canopy cover within mixed forests generally ranged from 60-90 percent, and dominant tree species generally included deciduous species such as oaks, especially *Q. montana* and *Q. rubra*, hickories, American beech, and tuliptree as well as eastern redcedar (*Juniperus virginiana*) and conifers such as white pine (*Pinus strobus*) and Virginia pine (*Pinus virginiana*). Tree stem density within the mature mixed forest habitats ranged from approximately 150 to 370 stems per acre with an average of 260 trees per acre. Mature mixed forests generally possessed larger trees (>12-in DBH and up to 40-in DBH) with denser canopy cover and more open understory. Young deciduous forests supported an abundance of fast-growing species (e.g., *L. tulipifera* and *J. virginiana*) with dense mid-story and understory growth. Consequently, young mixed forest habitat types supported higher overall tree densities than mature mixed forest, with estimated stem counts ranging from 300 to 480 stems per acre with an average of approximately 370 stems per acre. Understory and herbaceous species abundance and composition within mature and young mixed forests vary with slope, aspect, soil type and hydrologic inputs. Figure 3 shows photographs of representative mixed forest stands. Species lists taken along meanders within each habitat type can be found in Appendix B.

Figure 3. Representative Photographs of Mature Mixed Forest (Top) and Young Mixed Forest (Bottom)

3.3 Disturbed Shrublands

Shrublands are characterized by greater than 25 percent cover of woody vegetation with a DBH less than 3 in and less than 25 percent cover of woody vegetation with a DBH greater than 3 in. (Grossman et al., 1998). Within the study area, shrublands frequently occurred within areas where evidence of historic anthropogenic disturbance (e.g., mining) was present. These areas were especially abundant at lower relative elevations within the study area and along roadways. Woody invasive species including autumn olive (*Elaeagnus umbellata*), European privet (*Ligustrum vulgare*), tree of heaven (*Ailanthus altissima*), and empress tree (*Paulownia tomentosa*) dominated the woody vegetation within disturbed shrublands alongside some native shrubs including eastern redbud (*Cercis candadensis*), serviceberry (*Amelanchier arborea*), eastern redcedar, and sweetgum (*Liquidambar styraciflua*) saplings. Herbaceous species abundance and composition vary with woody vegetation density, slope, and aspect within disturbed shrublands. Figure 4 shows representative photographs of disturbed shrublands. A list of species observed within disturbed shrublands can be found in Appendix B.

Figure 4. **Representative Photographs of Disturbed Shrublands**

3.4 Disturbed Herbaceous Vegetation

Herbaceous vegetation is characterized by greater than 25 percent cover of graminoids, forbs, and ferns and less than 25 percent cover of trees, shrubs, and dwarf-shrubs (Grossman et al, 1998). Several areas within the southern portion of the study area are dominated by a mixture of perennial graminoid and forb herbaceous species where frequent or recent disturbance and stress due to poor soil conditions limits the growth of woody vegetation. Common species observed within disturbed herbaceous communities include Kudzu, tall fescue *(Schedonorus arundinaceus*), coltsfoot (*Tussilago farafara*), broomsedge (*Andropogon virginicus*), and clover (*trifolium*) species. Drivers of community composition within disturbed herbaceous areas primarily related to soil type (e.g. exposed rock, shallow soils, or well-formed soils), and the abundance of non-native invasive vegetation. Figure 5 shows photographs of representative disturbed herbaceous vegetation. A list of observed species within disturbed herbaceous habitats can be found in Appendix B.

Figure 5. **Representative Photograph of Disturbed Herbaceous Vegetation (top) and a Kudzu Infestation (Bottom)**

3.5 Non-Native Invasive Plants

With the assistance of the University of Georgia Center for Invasive Species and Ecosystem Health, the Kentucky Exotic Pest Plant Council (KY-EPPC or "EPPC") maintains a list of existing and emerging invasive plants known to invade natural communities and disrupt ecosystem functions in the state of Kentucky (University of Georgia Center for Invasive Species and Ecosystem Health. Kentucky Exotic Plant Pest Council, 2015). The EPPC divides invasive plants into the following three categories:

1. **Severe**
   "Exotic plant species which possess characteristics of invasive species and spread easily into native plant communities and displace native vegetation; includes species which are or could become widespread in Kentucky."
2. **Significant**
   "Exotic plant species which possess some invasive characteristics, but have less impact on native plant communities; may have the capacity to invade natural communities along disturbance corridors, or to spread from stands in disturbed sites into undisturbed areas, but have fewer characteristics of invasive species than #1 rank."
3. **Lesser**
   "Exotic plant species which seem to principally spread and remain in disturbed corridors, not readily invading natural areas; also some agronomic weeds."

Within the study area, 18 species of invasive plants were identified (Table 2). Invasive plants were located within all community types but were particularly abundant within disturbed shrublands and disturbed herbaceous community types, where they frequently dominated the vegetation community (comprising 20% or more of the total vegetation cover) or infested an area, with >90% cover of species such as kudzu observed in herbaceous areas in the southern portion of the study area.

Table 2. Invasive Plant Species Recorded Within the Proposed Lewis Ridge Pumped Storage Project Study Area

Common Name	Species Name	Invasiveness	Communities Invaded
Tree of Heaven	*Ailanthus altissima*	Severe	Mature Deciduous, Young Deciduous
Japanese barberry	*Berberis thunbergii*	Significant	Young Mixed
Queen Anne's lace	*Daucus carota*	Significant	Mature Deciduous, Disturbed Shrub, Disturbed Herbaceous

Common Name	**Species Name**	**Invasiveness**	**Communities Invaded**
Autumn olive	*Elaeagnus umbellata*	Severe	Mature Deciduous, Young Deciduous, Mature Mixed, Young Mixed, Disturbed Shrub
Winter creeper	*Euonymus fortunei*	Severe	Mature Deciduous
Ground ivy	*Glechoma hederacea*	Significant	Mature Deciduous, Disturbed Shrub, Disturbed Herbaceous
Henbit	*Lamium amplexicaule*	Lesser	Disturbed shrub, Disturbed Herbaceous
Sericea lespedeza	*Lespedeza cuneata*	Severe	All
Privet	*Ligustrum vulgare*	Severe	Mature Deciduous, Young Mixed, Disturbed Shrub
Tall fescue	*Lolium arundinaceum*	Severe	All
Japanese honeysuckle	*Lonicera japonica*	Severe	All
Amur honeysuckle	*Lonicera maackii*	Severe	Mature Deciduous, Disturbed Shrub
Japanese stiltgrass	*Microstegium vimineum*	Severe	Disturbed Shrub, Disturbed Herbaceous
Royal paulownia	*Paulownia tomentosa*	Severe	Mature Deciduous, Young Deciduous, Young Mixed
Kudzu	*Pueraria montana var. lobata*	Severe	Young Mixed, Disturbed Shrub, Disturbed Herbaceous
Bulbous Buttercup	*Ranunculus bulbosus*	Lesser	Disturbed Herbaceous
Japanese knotweed	*Reynoutria japonica*	Severe	Mature Deciduous, Young Mixed

Common Name	Species Name	Invasiveness	Communities Invaded
Multiflora rose	*Rosa multiflora*	Severe	All
Common chickweed	*Stellaria media*	Severe	All

3.6 Rare, Threatened and Endangered Plant Species Habitat

Using the Office of Kentucky Nature Preserves (OKNP) Rare Plant Database, a list of rare, threatened and endangered (RTE) plant species known to occur in Bell County, KY was generated to appropriately assess whether suitable habitat for RTE plants exists within the proposed project study area. Results from the query are provided in Table 3.

Table 3. Rare, Threatened, and Endangered (RTE) Plant Species within Bell County, KY.

Common Name	Species Name	Listing Status*
Allegheny-vine	*Adlumia fungosa*	SE
Fly Poison	*Amianthium muscitoxicum*	ST
Yellow Wild Indigo	*Baptisia tinctoria*	ST
Brook Saxifrage	*Boykinia aconitifolia*	ST
Porter's Reedgrass	*Calamagrostis porteri ssp. porteri*	ST
Grass Pink	*Calopogon tuberosus*	SE
Tarheel Sedge	*Carex austrocaroliniana*	SCC
Allegheny Chinkapin	*Castanea pumila*	ST
Red Turtlehead	*Chelone obliqua var. obliqua*	SE
American Golden-saxifrage	*Chrysosplenium americanum*	ST
American Lily-of-the-valley	*Convallaria montana*	SE
Rock Harlequin	*Corydalis sempervirens*	SCC
Crinkled Hairgrass	*Deschampsia flexuosa*	ST
Showy Gentian	*Gentiana decora*	SCC
Michaux's Bluets	*Houstonia serpyllifolia*	SE

Common Name	Species Name	Listing Status*
Smooth Veiny Peavine	*Lathyrus venosus*	SCC
Loesel's Twayblade	*Liparis loeselii*	ST
Kidney-leaf Twayblade	*Listera smallii*	ST
American Cowwheat	*Melampyrum lineare var. latifolium*	ST
Sweet Pinesap	*Monotropsis odorata*	ST
A Hair Cap Moss	*Polytrichum pallidisetum*	ST
Nodding Mandarin	*Prosartes maculata*	SCC
Nettle-leaf Sage	*Salvia urticifolia*	SE
Ovate Catchfly	*Silene ovata*	SE
Curtis' Goldenrod	*Solidago curtisii*	ST
Downy Goldenrod	*Solidago puberula*	SCC
Roan Mountain Goldenrod	*Solidago spithamaea*	ST, **FT**
Painted Trillium	*Trillium undulatum*	ST
Appalachian Bunchflower	*Veratrum parviflorum*	SE

*FT: Federally Threatened, ST: State Threatened, SE: State Endangered, SCC: Species of Conservation Concern

Following desktop review and field surveys, no habitat was identified for Roan Mountain goldenrod (*Solidago spithamaea*), the only federally-protected plant species identified by OKNP. Roan Mountain goldenrod habitat is restricted to moist or wet rocky cliffs at elevations exceeding 4,000 ft in the vicinity of Roan Mountain, Grandfather Mountain, and Hanging Rock Mountain in North Carolina and Tennessee. Habitats within the study area match neither the required elevation nor moisture regime to support the species.

State endangered, state threatened, and state species of conservation concern may have habitat present within the proposed project study area; however, that habitat is limited to steep forested slopes and undisturbed ridge tops identified as mature mixed forest or mature hardwood forest. Many areas within the vicinity of access roads, formerly mined areas, and other facilities on site may not meet the minimum habitat requirements for state-listed species due to the abundance of non-native invasive species, erosion, and other recent disturbance resulting from mining activity. The species identified by OKNP are intolerant of competition with invasive species and anthropogenic forces and are therefore unlikely to occur except within portions of the study area that have not been logged or otherwise disturbed within recent history. Additionally, no habitat was identified for species that predominantly occur within wetland or riparian habitats (*C. tuberosus, C. obliqua var. obliqua,* and *G. decora*), as these areas are either not present within the study area or have been significantly disturbed by prior land use. No state-listed species were identified during field surveys.

4. CONCLUSION

The vegetation assessment identified six vegetation communities within the proposed project study area, all of which are well-represented throughout Kentucky. Community types included mixed evergreen deciduous forest (young and mature), deciduous forest (young and mature), disturbed shrubland, and disturbed herbaceous vegetation. Non-native plants were present in several portions of the study area and often dominated or infested areas with an infrequent to frequent disturbance regime. No state- or federally-listed species were observed during surveys, and no habitat was identified for federally-protected plant species. Potential habitat for state-listed species is confined to portions of the site within mature mixed forest and mature deciduous forest that have been undisturbed by mining activities on site and have experienced limited encroachment by non-native invasive plant species.

Descriptions of locations, acreages, and types of each vegetation community that occurs within the study area, locations of disturbed and/or non-native invasive vegetation within the study area, and maps/figures showing the locations of each vegetation community type observed within the study area are provided throughout the report and its appendices.

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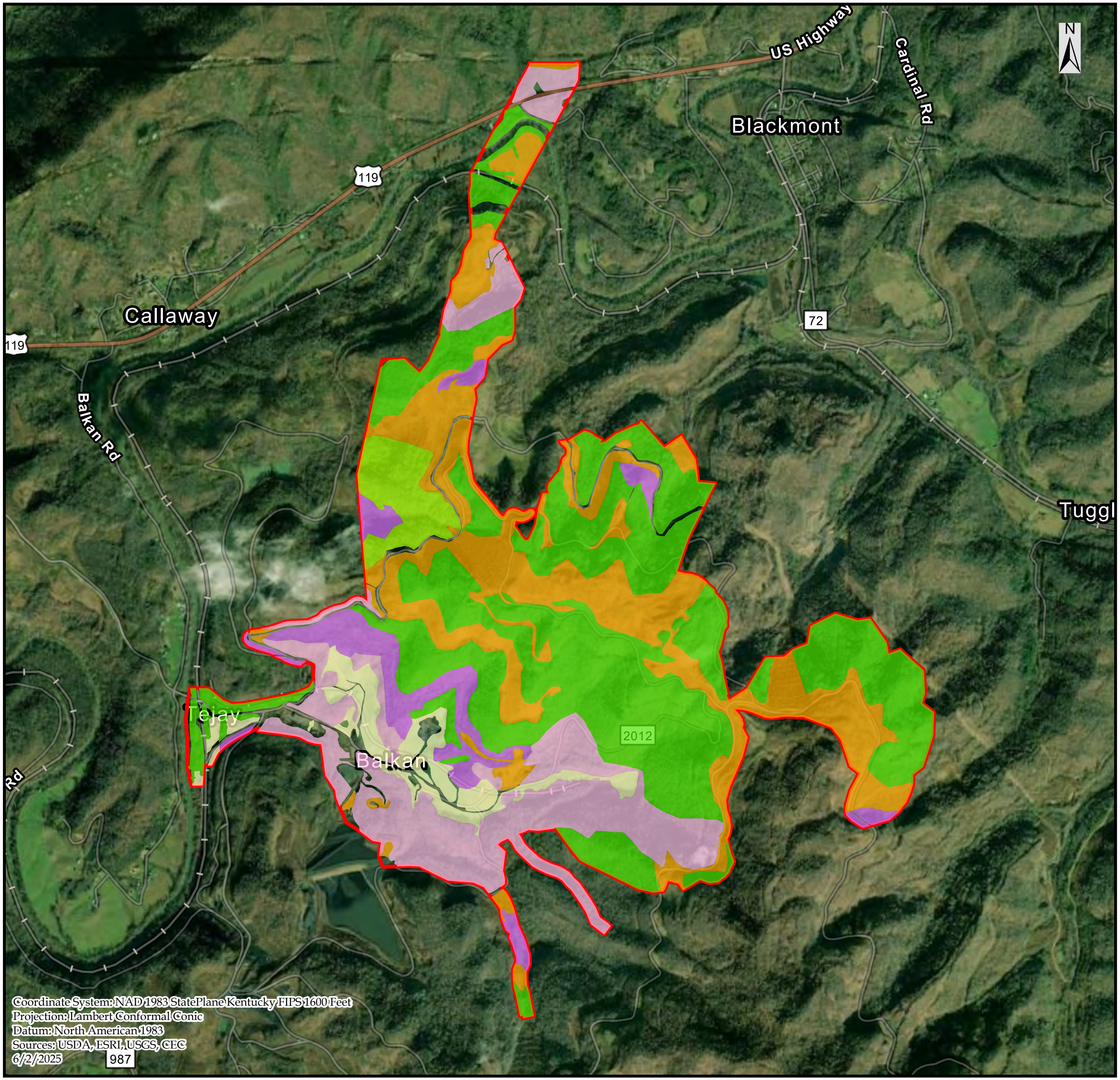
Appendix A: Vegetation Community Mapping



Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Sources: USDA, ESRI, USGS, CEC
6/2/2025

COPPERHEAD
ENVIRONMENTAL CONSULTING

Prepared for:

Lewis Ridge Pumped Storage, LLC

APPENDIX A:
Vegetation Cover Map for the
Lewis Ridge Pumped Storage Project,
Bell County, Kentucky.

Legend

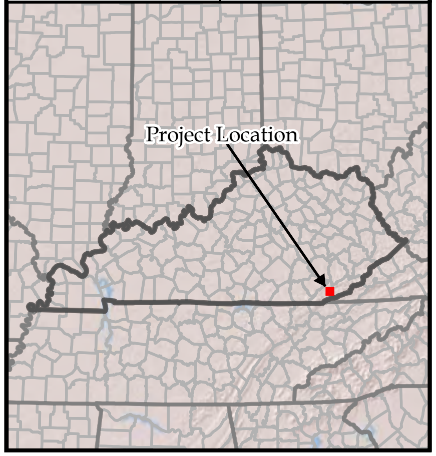
- 🟨 Disturbed Herbaceous
- 🟧 Disturbed Shrubland
- 🟩 Mature Deciduous
- ▨ Mature Mixed
- 🟩 Young Deciduous
- 🟪 Young Mixed
- 🟥 Study Area

0 1,250 2,500
US Feet

Scale: 1 in = 2,500 ft

Prepared by :
Copperhead Environmental Consulting, Inc.
471 Main Street
P.O. Box 73
Paint Lick, Kentucky 40461

Drawn by:	TC	Date:	6/2/2025
Checked by:	DH	Revision:	02



Appendix B: Species Lists

Lewis Ridge Pumped Storage Vegetation Species List by Habitat Type

Habitat Type	Stratum	Common Name	Species	Native	Invasiveness
Mature Deciduous	Vine	Cross-vine	Bignonia capreolata	Y	-
Mature Deciduous	Vine	Winter Creeper	Euonymus fortunei	N	Severe
Mature Deciduous	Vine	Japanese Honeysuckle	Lonicera japonica	N	Severe
Mature Deciduous	Vine	Common Greenbrier	Smilax rotundifolia	Y	-
Mature Deciduous	Tree	Box Alder	Acer negundo var. negundo	Y	-
Mature Deciduous	Tree	Yellow Buckeye	Aesculus flava	Y	-
Mature Deciduous	Tree	Tree of Heaven	Ailanthus altissima	N	Severe
Mature Deciduous	Tree	Sweet Birch	Betula lenta var. lenta	Y	-
Mature Deciduous	Tree	Common Persimmon	Diospyros virginiana	Y	-
Mature Deciduous	Tree	American Beech	Fagus grandifolia	Y	-
Mature Deciduous	Tree	Green Ash	Fraxinus pennsylvanica	Y	-
Mature Deciduous	Tree	Black Walnut	Juglans nigra	Y	-
Mature Deciduous	Tree	Sweetgum	Liquidambar styraciflua	Y	-
Mature Deciduous	Tree	Tulip-tree	Liriodendron tulipifera	Y	-
Mature Deciduous	Tree	Royal Paulownia	Paulownia tomentosa	N	Severe
Mature Deciduous	Tree	Virginia Pine	Pinus virginiana	Y	-
Mature Deciduous	Tree	Sycamore	Platanus occidentalis	Y	-
Mature Deciduous	Tree	Black Cherry	Prunus serotina var. serotina	Y	-
Mature Deciduous	Tree	Southern Red Oak	Quercus falcata	Y	-
Mature Deciduous	Tree	Chestnut Oak	Quercus montana	Y	-
Mature Deciduous	Tree	Northern Red Oak	Quercus rubra	Y	-
Mature Deciduous	Tree	Black Locust	Robinia pseudoacacia	Y	-
Mature Deciduous	Tree	Slippery Elm	Ulmus rubra	Y	-
Mature Deciduous	Sapling/shrub	Serviceberry	Amelanchier arborea	Y	-
Mature Deciduous	Sapling/shrub	Eastern Redbud	Cercis canadensis var. canadensis	Y	-
Mature Deciduous	Sapling/shrub	Autumn Olive	Elaeagnus umbellata	N	Severe
Mature Deciduous	Sapling/shrub	Eastern Redcedar	Juniperus virginiana	Y	-
Mature Deciduous	Sapling/shrub	Mountain Laurel	Kalmia latifolia	Y	-
Mature Deciduous	Sapling/shrub	Common Privet	Ligustrum vulgare	N	Severe
Mature Deciduous	Sapling/shrub	Spicebush	Lindera benzoin	Y	-
Mature Deciduous	Sapling/shrub	Amur Honeysuckle	Lonicera maackii	N	Severe
Mature Deciduous	Sapling/shrub	Great Laurel	Rhododendron maximum	Y	-
Mature Deciduous	Sapling/shrub	Staghorn Sumac	Rhus typhina	Y	-
Mature Deciduous	Sapling/shrub	Multiflora Rose	Rosa multiflora	N	Severe
Mature Deciduous	Sapling/shrub	Common Elderberry	Sambucus canadensis	Y	-
Mature Deciduous	Sapling/shrub	Highbush Blueberry	Vaccinium corymbosum	Y	-
Mature Deciduous	Sapling/shrub	Early Lowbush Blueberry	Vaccinium pallidum	Y	-
Mature Deciduous	Herb	Field Garlic	Allium vineale	N	#N/A
Mature Deciduous	Herb	Broomsedge	Andropogon virginicus var. virginicus	Y	-
Mature Deciduous	Herb	Puttyroot	Aplectrum hyemale	Y	-
Mature Deciduous	Herb	Cut-leaf Toothwort	Cardamine concatenata	Y	-
Mature Deciduous	Herb	Hairy Bittercress	Cardamine hirsuta	N	#N/A
Mature Deciduous	Herb	Black-edged Sedge	Carex nigromarginata	Y	-
Mature Deciduous	Herb	Blue Cohosh	Caulophyllum thalictroides	Y	-
Mature Deciduous	Herb	Spotted Wintergreen	Chimaphila maculata	Y	-
Mature Deciduous	Herb	Carolina Spring Beauty	Claytonia caroliniana	Y	-
Mature Deciduous	Herb	Poverty Oatgrass	Danthonia spicata	Y	-
Mature Deciduous	Herb	Queen-Anne's Lace	Daucus carota	N	Significant
Mature Deciduous	Herb	Common Tree-clubmoss	Dendrolycopodium obscurum	Y	-
Mature Deciduous	Herb	Bosc's Panic Grass	Dichanthelium boscii	Y	-
Mature Deciduous	Herb	Marginal Wood Fern	Dryopteris marginalis	Y	-
Mature Deciduous	Herb	Trailing Arbutus	Epigaea repens	Y	-
Mature Deciduous	Herb	Cleavers	Galium aparine	Y	-

Habitat Type	Stratum	Common Name	Species	Native	Invasiveness
Mature Deciduous	Herb	Wintergreen	Gaultheria procumbens	Y	-
Mature Deciduous	Herb	Wild Geranium	Geranium maculatum	Y	-
Mature Deciduous	Herb	Gill-over-the-ground	Glechoma hederacea	N	Significant
Mature Deciduous	Herb	Marbled Alumroot	Heuchera pubescens	Y	-
Mature Deciduous	Herb	Appalachian Little Brown Jug	Hexastylis arifolia var. ruthii	Y	-
Mature Deciduous	Herb	Wild Hydrangea	Hydrangea arborescens	Y	-
Mature Deciduous	Herb	Orange Jewelweed	Impatiens capensis	Y	-
Mature Deciduous	Herb	Dwarf Crested Iris	Iris cristata	Y	-
Mature Deciduous	Herb	Red Dead-nettle	Lamium purpureum	N	#N/A
Mature Deciduous	Herb	Sericea Lespedeza	Lespedeza cuneata	N	Severe
Mature Deciduous	Herb	Tall Fescue	Lolium arundinaceum	N	Severe
Mature Deciduous	Herb	Partridge-berry	Mitchella repens	Y	-
Mature Deciduous	Herb	Sweet Cicely	Osmorhiza claytonii	Y	-
Mature Deciduous	Herb	American Plantain	Plantago rugelii	Y	-
Mature Deciduous	Herb	Mayapple	Podophyllum peltatum	Y	-
Mature Deciduous	Herb	Christmas Fern	Polystichum acrostichoides	Y	-
Mature Deciduous	Herb	Dwarf Cinquefoil	Potentilla canadensis	Y	-
Mature Deciduous	Herb	Japanese Knotweed	Reynoutria japonica	N	#N/A
Mature Deciduous	Herb	Pennsylvania Blackberry	Rubus pensilvanicus	Y	-
Mature Deciduous	Herb	Curly Dock	Rumex crispus ssp. crispus	N	#N/A
Mature Deciduous	Herb	Bloodroot	Sanguinaria canadensis	Y	-
Mature Deciduous	Herb	Black Snakeroot	Sanicula canadensis var. canadensis	Y	-
Mature Deciduous	Herb	Woolgrass	Scirpus cyperinus	Y	-
Mature Deciduous	Herb	Tall Goldenrod	Solidago altissima var. altissima	Y	-
Mature Deciduous	Herb	Common Chickweed	Stellaria media	N	Severe
Mature Deciduous	Herb	Common Dandelion	Taraxacum officinale	N	#N/A
Mature Deciduous	Herb	Roadside Pennycress	Thlaspi alliaceum	N	#N/A
Mature Deciduous	Herb	Heart-leaved Foamflower	Tiarella cordifolia	Y	-
Mature Deciduous	Herb	Cranefly Orchid	Tipularia discolor	Y	-
Mature Deciduous	Herb	Red Clover	Trifolium pratense	N	#N/A
Mature Deciduous	Herb	Southern Red Trillium	Trillium sulcatum	Y	-
Mature Deciduous	Herb	Coltsfoot	Tussilago farfara	N	#N/A
Mature Deciduous	Herb	Large-flowered Bellwort	Uvularia grandiflora	Y	-
Mature Deciduous	Herb	Perfoliate Bellwort	Uvularia perfoliata	Y	-
Mature Deciduous	Herb	Bird's-eye Speedwell	Veronica persica	N	#N/A
Mature Deciduous	Herb	Halberd-leaved Yellow Violet	Viola hastata	Y	-
Mature Deciduous	Herb	Common Blue Violet	Viola sororia	Y	-
Mature Deciduous	Herb	Heart-leaf Golden-alexanders	Zizia aptera	Y	-
Mature Mixed	Vine	Cross-vine	Bignonia capreolata	Y	-
Mature Mixed	Vine	Japanese Honeysuckle	Lonicera japonica	N	Severe
Mature Mixed	Tree	Red Maple	Acer rubrum	Y	-
Mature Mixed	Tree	American Beech	Fagus grandifolia	Y	-
Mature Mixed	Tree	Common Silverbell	Halesia tetraptera	Y	-
Mature Mixed	Tree	American Holly	Ilex opaca var. opaca	Y	-
Mature Mixed	Tree	Black Walnut	Juglans nigra	Y	-
Mature Mixed	Tree	Virginia Pine	Pinus virginiana	Y	-
Mature Mixed	Tree	Sycamore	Platanus occidentalis	Y	-
Mature Mixed	Sapling/shrub	Eastern Redbud	Cercis canadensis var. canadensis	Y	-
Mature Mixed	Sapling/shrub	Autumn Olive	Elaeagnus umbellata	N	Severe
Mature Mixed	Sapling/shrub	Eastern Redcedar	Juniperus virginiana	Y	-
Mature Mixed	Sapling/shrub	Multiflora Rose	Rosa multiflora	N	Severe
Mature Mixed	Herb	Broomsedge	Andropogon virginicus var. virginicus	Y	-
Mature Mixed	Herb	Sericea Lespedeza	Lespedeza cuneata	N	Severe
Mature Mixed	Herb	Tall Fescue	Lolium arundinaceum	N	Severe

Habitat Type	Stratum	Common Name	Species	Native	Invasiveness
Young Deciduous	Vine	Eastern Poison Ivy	Toxicodendron radicans	Y	-
Young Deciduous	Vine	Japanese Honeysuckle	Lonicera japonica	N	Severe
Young Deciduous	Vine	Virginia Creeper	Parthenocissus quinquefolious	Y	-
Young Deciduous	Tree	Tree of Heaven	Ailanthus altissima	N	Severe
Young Deciduous	Tree	American Beech	Fagus grandifolia	Y	-
Young Deciduous	Tree	Sweetgum	Liquidambar styraciflua	Y	-
Young Deciduous	Tree	Tulip-tree	Liriodendron tulipifera	Y	-
Young Deciduous	Tree	Royal Paulownia	Paulownia tomentosa	N	Severe
Young Deciduous	Tree	Sweet Birch	Betula lenta var. lenta	Y	-
Young Deciduous	Tree	Black Cherry	Prunus serotina var. serotina	Y	-
Young Deciduous	Tree	Southern Red Oak	Quercus falcata	Y	-
Young Deciduous	Tree	Chestnut Oak	Quercus montana	Y	-
Young Deciduous	Tree	Northern Red Oak	Quercus rubra	Y	-
Young Deciduous	Tree	Black Locust	Robinia pseudoacacia	Y	-
Young Deciduous	Tree	Slippery Elm	Ulmus rubra	Y	-
Young Deciduous	Sapling/shrub	Eastern Redbud	Cercis canadensis var. canadensis	Y	-
Young Deciduous	Sapling/shrub	Autumn Olive	Elaeagnus umbellata	N	Severe
Young Deciduous	Sapling/shrub	Eastern Redcedar	Juniperus virginiana	Y	-
Young Deciduous	Sapling/shrub	Multiflora Rose	Rosa multiflora	N	Severe
Young Deciduous	Sapling/shrub	Common Elderberry	Sambucus canadensis	Y	-
Young Deciduous	Sapling/shrub	Highbush Blueberry	Vaccinium corymbosum	Y	-
Young Deciduous	Herb	Mayapple	Podophyllum peltatum	Y	-
Young Deciduous	Herb	Christmas Fern	Polystichum acrostichoides	Y	-
Young Deciduous	Herb	Dwarf Cinquefoil	Potentilla canadensis	Y	-
Young Deciduous	Herb	Tall Goldenrod	Solidago altissima var. altissima	Y	-
Young Deciduous	Herb	Common Chickweed	Stellaria media	N	Severe
Young Deciduous	Herb	Common Blue Violet	Viola sororia	Y	-
Young Deciduous	Herb	Hairy Bittercress	Cardamine hirsuta	N	#N/A
Young Deciduous	Herb	Virginia Wild Rye	Elymus virginicus var. virginicus	Y	-
Young Deciduous	Herb	Cleavers	Galium aparine	Y	-
Young Deciduous	Herb	Sericea Lespedeza	Lespedeza cuneata	N	Severe
Young Deciduous	Herb	Common Evening-primrose	Oenothera biennis	Y	-
Young Deciduous	Herb	Pennsylvania Blackberry	Rubus pensilvanicus	Y	-
Young Mixed	Vine	Japanese Honeysuckle	Lonicera japonica	N	Severe
Young Mixed	Vine	Virginia-creeper	Parthenocissus quinquefolia	Y	-
Young Mixed	Vine	Kudzu	Pueraria montana var. lobata	N	Severe
Young Mixed	Vine	Summer Grape	Vitis aestivalis var. aestivalis	Y	-
Young Mixed	Tree	Eastern Boxelder	Acer negundo var. negundo	Y	-
Young Mixed	Tree	American Holly	Ilex opaca var. opaca	Y	-
Young Mixed	Tree	Sweetgum	Liquidambar styraciflua	Y	-
Young Mixed	Tree	Tulip-tree	Liriodendron tulipifera	Y	-
Young Mixed	Tree	Royal Paulownia	Paulownia tomentosa	N	Severe
Young Mixed	Tree	Eastern White Pine	Pinus strobus	Y	-
Young Mixed	Tree	Virginia Pine	Pinus virginiana	Y	-
Young Mixed	Tree	Sycamore	Platanus occidentalis	Y	-
Young Mixed	Tree	Black Cherry	Prunus serotina var. serotina	Y	-
Young Mixed	Tree	Northern Red Oak	Quercus rubra	Y	-
Young Mixed	Tree	Slippery Elm	Ulmus rubra	Y	-
Young Mixed	Sapling/shrub	Japanese Barberry	Berberis thunbergii	N	Significant
Young Mixed	Sapling/shrub	Eastern Redbud	Cercis canadensis var. canadensis	Y	-
Young Mixed	Sapling/shrub	Autumn Olive	Elaeagnus umbellata	N	Severe
Young Mixed	Sapling/shrub	Eastern Redcedar	Juniperus virginiana	Y	-
Young Mixed	Sapling/shrub	Common Privet	Ligustrum vulgare	N	Severe
Young Mixed	Sapling/shrub	Multiflora Rose	Rosa multiflora	N	Severe

Habitat Type	Stratum	Common Name	Species	Native	Invasiveness
Young Mixed	Sapling/shrub	Common Elderberry	Sambucus canadensis	Y	-
Young Mixed	Sapling/shrub	Coralberry	Symphoricarpos orbiculatus	Y	-
Young Mixed	Herb	Woodland Agrimony	Agrimonia rostellata	Y	-
Young Mixed	Herb	Deceptive Bluestem	Andropogon virginicus var. decipiens	Y	-
Young Mixed	Herb	Plantain-leaved Pussytoes	Antennaria plantaginifolia	Y	-
Young Mixed	Herb	False Nettle	Boehmeria cylindrica	Y	-
Young Mixed	Herb	Fork-leaf Toothwort	Cardamine dissecta	Y	-
Young Mixed	Herb	Hairy Bittercress	Cardamine hirsuta	N	#N/A
Young Mixed	Herb	Common Tree-clubmoss	Dendrolycopodium obscurum	Y	-
Young Mixed	Herb	Virginia Wild Rye	Elymus virginicus var. virginicus	Y	-
Young Mixed	Herb	Cleavers	Galium aparine	Y	-
Young Mixed	Herb	Sericea Lespedeza	Lespedeza cuneata	N	Severe
Young Mixed	Herb	Tall Fescue	Lolium arundinaceum	N	Severe
Young Mixed	Herb	Christmas Fern	Polystichum acrostichoides	Y	-
Young Mixed	Herb	Dwarf Cinquefoil	Potentilla canadensis	Y	-
Young Mixed	Herb	Indian-strawberry	Potentilla indica	Y	-
Young Mixed	Herb	Japanese Knotweed	Reynoutria japonica	N	#N/A
Young Mixed	Herb	Pennsylvania Blackberry	Rubus pensilvanicus	Y	-
Young Mixed	Herb	Curly Dock	Rumex crispus ssp. crispus	N	#N/A
Young Mixed	Herb	Tall Goldenrod	Solidago altissima var. altissima	Y	-
Young Mixed	Herb	Hairy Goldenrod	Solidago hispida var. hispida	Y	-
Young Mixed	Herb	Common Chickweed	Stellaria media	N	Severe
Young Mixed	Herb	Common Dandelion	Taraxacum officinale	N	#N/A
Young Mixed	Herb	Common Blue Violet	Viola sororia	Y	-
Disturbed Shrubland	Vine	Japanese Honeysuckle	Lonicera japonica	N	Severe
Disturbed Shrubland	Vine	Kudzu	Pueraria montana var. lobata	N	Severe
Disturbed Shrubland	Vine	Common Greenbriar	Smilax rotundifolia	Y	-
Disturbed Shrubland	Sapling/shrub	Red Maple	Acer rubrum	Y	-
Disturbed Shrubland	Sapling/shrub	Tree of Heaven	Ailanthus altissima	N	Severe
Disturbed Shrubland	Sapling/shrub	Serviceberry	Amelanchier arborea	Y	-
Disturbed Shrubland	Sapling/shrub	Eastern Redbud	Cercis canadensis var. canadensis	Y	-
Disturbed Shrubland	Sapling/shrub	Autumn Olive	Elaeagnus umbellata	N	Severe
Disturbed Shrubland	Sapling/shrub	Eastern Redcedar	Juniperus virginiana	Y	-
Disturbed Shrubland	Sapling/shrub	Common Privet	Ligustrum vulgare	N	Severe
Disturbed Shrubland	Sapling/shrub	Sweetgum	Liquidambar styraciflua	Y	-
Disturbed Shrubland	Sapling/shrub	Amur Honeysuckle	Lonicera maackii	N	Severe
Disturbed Shrubland	Sapling/shrub	Royal Paulownia	Paulownia tomentosa	N	Severe
Disturbed Shrubland	Sapling/shrub	Eastern White Pine	Pinus strobus	Y	-
Disturbed Shrubland	Sapling/shrub	Virginia Pine	Pinus virginiana	Y	-
Disturbed Shrubland	Sapling/shrub	Callery Pear	Pyrus calleryana	N	Severe
Disturbed Shrubland	Sapling/shrub	Multiflora Rose	Rosa multiflora	N	Severe
Disturbed Shrubland	Sapling/shrub	Slippery Elm	Ulmus rubra	Y	-
Disturbed Shrubland	Herb	Broomsedge	Andropogon virginicus var. virginicus	Y	-
Disturbed Shrubland	Herb	Henbit	Lamium amplexicaule	N	Lesser
Disturbed Shrubland	Herb	Sericea Lespedeza	Lespedeza cuneata	N	Severe
Disturbed Shrubland	Herb	Tall Fescue	Lolium arundinaceum	N	Severe
Disturbed Shrubland	Herb	Japanese Stiltgrass	Microstegium vimineum	N	Severe
Disturbed Shrubland	Herb	Common Evening-primrose	Oenothera biennis	Y	-
Disturbed Shrubland	Herb	Pennsylvania Blackberry	Rubus pensilvanicus	Y	-
Disturbed Shrubland	Herb	Woolgrass	Scirpus cyperinus	Y	-
Disturbed Shrubland	Herb	Tall Goldenrod	Solidago altissima ssp. altissima	Y	-
Disturbed Shrubland	Herb	Common Chickweed	Stellaria media	N	Severe
Disturbed Shrubland	Herb	Common Dandelion	Taraxacum officinale	N	#N/A
Disturbed Shrubland	Herb	Red Clover	Trifolium pratense	N	#N/A

Habitat Type	Stratum	Common Name	Species	Native	Invasiveness
Disturbed Herbaceous	Vine	Japanese Honeysuckle	Lonicera japonica	N	Severe
Disturbed Herbaceous	Vine	Kudzu	Pueraria montana var. lobata	N	Severe
Disturbed Herbaceous	Vine	Common Greenbriar	Smilax rotundifolia	Y	-
Disturbed Herbaceous	Herb	Broomsedge	Andropogon virginicus var. virginicus	Y	-
Disturbed Herbaceous	Herb	Henbit	Lamium amplexicaule	N	Lesser
Disturbed Herbaceous	Herb	Sericea Lespedeza	Lespedeza cuneata	N	Severe
Disturbed Herbaceous	Herb	Tall Fescue	Lolium arundinaceum	N	Severe
Disturbed Herbaceous	Herb	Japanese Stiltgrass	Microstegium vimineum	N	Severe
Disturbed Herbaceous	Herb	Common Evening-primrose	Oenothera biennis	Y	-
Disturbed Herbaceous	Herb	Bulbous buttercup	Ranunculus bulbosus	N	Lesser
Disturbed Herbaceous	Herb	Pennsylvania Blackberry	Rubus pensilvanicus	Y	-
Disturbed Herbaceous	Herb	Woolgrass	Scirpus cyperinus	Y	-
Disturbed Herbaceous	Herb	Tall Goldenrod	Solidago altissima ssp. altissima	Y	-
Disturbed Herbaceous	Herb	Common Chickweed	Stellaria media	N	Severe
Disturbed Herbaceous	Herb	Common Dandelion	Taraxacum officinale	N	#N/A
Disturbed Herbaceous	Herb	Red Clover	Trifolium pratense	N	#N/A
Disturbed Herbaceous	Herb	Coltsfoot	Tussilago farfara	N	#N/A

APPENDIX N

CULTURAL HISTORIC SURVEY REPORT
(PRIVILEGED)

APPENDIX O

ARCHAEOLOGICAL SURVEY REPORT
(PRIVILEGED)

APPENDIX P

ECONOMIC AND FISCAL IMPACT ANALYSIS

Economic and Fiscal Impact Analysis of the Lewis Ridge Pumped Storage Project

May 29, 2025

Prepared for:

Lewis Ridge Pumped Storage, LLC

100 South Olive Avenue
West Palm Beach, Florida 33401

Prepared by

Highland Economics, LLC
www.highlandeconomics.com
503-954-1741

CONTENTS

INTRODUCTION

The Lewis Ridge Project (Project) is a pumped storage energy project proposed for development in Bell County, Kentucky. The Project would be located in the Upper Cumberland River Basin in Bell County, Kentucky near the borders of Tennessee and Virginia. This Project, with total construction cost of approximately $1.68 billion[1] and an annual operating budget of approximately $15 million, would increase demand for local labor, materials, and services—generating economic activity throughout the nation, but particularly in Bell County and the states of Tennessee and Kentucky.[2] The analysis does not consider impacts in Virgina since there are more proximate metropolitan areas in Kentucky and Tennessee (Lexington and Knoxville) that would be more likely sources of Project labor, equipment, and materials than in Virigina, where there are no larger towns or metropolitan areas in similar proximity to the Project.

Economic activity would be generated as the Project and its suppliers hire workers from the local area and throughout the region to build and operate the project; purchase materials, rent and purchase equipment; and pay sales, property and income tax. Additionally, using their income from the Project, workers would also support local businesses through the purchase of goods and services and would support local and state governments through tax payments. All this economic activity would result in money circulating and re-circulating in the local economy, creating a multiplier effect and directly and indirectly supporting jobs, income, and tax revenues.

The purpose of this study is to estimate the fiscal and economic impacts of the Project. The scope of the study is to assess the total (direct, indirect, and induced) income, employment, and tax impacts of the construction and operations phases.[3] Construction is expected to last approximately four years, while the Project is expected to have a potential operating life that exceeds 80 years.

Total estimated job and income impacts are the sum of the following:

- Direct impacts (jobs/income to construction/operations workers at the Project site)

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[1] These costs do not include non-contract costs such as engineering, environmental, geotechnical investigations, permitting, owner's costs, lands, or mitigation. These costs are from the project engineer for the Lewis Ridge Pumped Storage Project dated April 1, 2025.

[2] Economic activity would also be supported elsewhere in the nation, dispersed geographically based on location of supplies to the Project.

[3] The scope of this project does not include assessing the net economic benefit of the Project (i.e., the net value of the Project as measured by the difference between Project revenues, or other benefits and Projects costs), which is an entirely different economic metric (economic activity can be low for a Project with high economic net benefit and vice versa). The scope of this analysis also does not include addressing any possible effects of the Project on economic activity due to any potential changes in aesthetics, recreation, or natural resources.

- Indirect impacts (jobs/income resulting from purchase of goods/services for the site—including everything from legal and environmental services to tires, equipment, and electricity)
- Induced impacts (jobs/income resulting from increased household spending—as employees earn increased wages due to the Project, they spend their increased income at stores, on healthcare and real estate, and at service establishments such as restaurants. These expenditures result in increased jobs/income at these businesses.)

Tax revenue impacts to state and local governments were also analyzed, focusing on Project property taxes, and Kentucky sales and income taxes during construction.[4]

The intent of this analysis is to estimate the approximate magnitude and potential geographic distribution of economic impacts of the Lewis Ridge Pumped Storage Project based on the total Project cost estimate and the general types of materials, services, and equipment that would be necessary for this type of Project. All economic and fiscal impact estimates presented in this report are uncertain; the analysis is based on estimated total construction spending and operations that are themselves uncertain. In addition to the estimated direct and indirect construction spending by Project component, the Project consulting engineers estimated a 7.5 percent cost for unlisted items, a 25 percent design contingency, and a 15 percent bid and post-award contingency. This equates to increasing each estimated cost component by over 50 percent.[5] Further, Project engineers provided estimates of the proportion of spending for each Project component that would be for labor, materials, and equipment, but there remains uncertainty within these categories of what type of materials/equipment/labor would be needed and the source locations for these Project inputs. This contributes to uncertainty because the economic impact of every $1 million in expenditure varies depending on the type of spending and location of spending.[6]

All studies projecting the economic impact of prospective construction projects must grapple with these challenges in allocating and modeling expenditures. This analysis handles uncertainty by coupling the cost data with reasonable assumptions on the type and location of expenditure based on available economic data and existing expenditure patterns in the construction and energy production sectors. This approach provides the likely magnitude of the

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[4] We did not estimate the property taxes, vehicle license fees, or business license fees that may be paid by project employees or businesses supplying inputs to the Project as we expect only a small increase in these taxes associated with economic activity supported by the project (i.e., we expect that these taxes will be paid by state residents and businesses at similar values without the Project).

[5] We assume that the unlisted items are part of the direct construction costs, and we also assume that the same percent contingency applies to both direct and indirect costs in order to allocate contingency costs to specific cost categories for modeling purposes. We further assume that contingency applies equally to all Project estimated cost components (e.g., contingency equally applies to labor, materials, and equipment for each Project element).

[6] The more that spending is on labor, services, and domestically manufactured items, and the more these inputs are supplied from businesses and households in the study area, the greater the economic impact in the study area.

total economic impact of the Project in the study area. A mid-point economic impact result is presented based on the assumptions outlined in the next section; a low and a high estimate are also presented based on a 10 percent variation from the mid-point estimate. Actual economic impacts may be higher or lower than the range presented, but the range is expected to encompass the most likely impact in the study area.

The report is laid out as follows: the approach and key analytical assumptions are first outlined, followed by a section on estimated impacts, a section on fiscal impacts, and a section summarizing results.

APPROACH AND KEY ASSUMPTIONS

The size of the economic impact of the Project depends on two key factors: 1) the total Project expenditures, and 2) where these expenditures will occur—i.e., the extent to which Project expenditures are used to hire local workers, purchase local services, and local materials versus used to purchase goods/services from other locations. Together, these two factors determine the amount of money that will be flowing into the local and state economies because of the Project and the associated economic activity supported. There is uncertainty in these two factors as the analysis is based on preliminary engineering studies of construction and operation. As such, all results in this analysis are presented as a range.

The analysis uses the IMPLAN economic impact modeling software and database to estimate economic impacts. IMPLAN is an input-output economic model that is commonly used by economic professionals and government agencies to estimate how a change in demand for goods/services (such as from the Project) translates into direct and ripple effects on jobs and income at the county-level and state-level.

The analytical approach to the economic impact analysis can be summarized in four steps:

1. **Determine the magnitude of the expenditures on labor, materials, and equipment** from Lewis Ridge Pumped Storage, LLC**.** Supporting, additional detailed data were provided through personal communication from Project engineering consultants to categorize expenditures into labor, equipment, and materials. All values are in 2025 dollars.

2. **Estimate the proportion of the labor and materials/services that are sourced from Bell County, the states of Kentucky/Tennessee, or elsewhere.** Information on this aspect of the analysis is based on the following sources of information: research on the types of firms and their locations that provide specialized material/equipment, information from the Project engineering consultant on the location of vendors and expected sourcing of materials, and data from the IMPLAN regional economic models on the proportion of each type of material/service that is estimated in the model to be purchased locally. Regarding the proportion of local employment, please see the expanded section below for a detailed discussion on the data sources consulted to estimate the proportion of labor that may be sourced from Bell County.

3. **Allocate materials/services to IMPLAN sectors.** As expenditure information is available at a very aggregated level, this analysis also uses aggregated IMPLAN sectors. For example, consumable / temporary materials used in construction were modeled using the industry expenditure pattern for the power/communication structure construction sector, the road construction sector, and the residential structure sector (for expenditures related to worker housing).

4. **Run the IMPLAN economic models for each geography and for each phase (construction and operations).** All values used in the IMPLAN analysis were sourced from cost data provided by Lewis Ridge Pumped Storage Project, LLC in April 2025 for the Tom Fork Alternative. All economic and fiscal impact results presented in this report are provided in 2025 dollars. The analysis made use of Multi-Regional Input Output (MRIO) analysis, such that spillover effects elsewhere in Kentucky and Tennessee from labor and material expenditures in Bell County are accounted for (i.e., if a firm in Bell County provides an input to the project but purchases from other firms located elsewhere in Kentucky or Tennessee, the multiplier effects elsewhere in Kentucky and Tennessee are included).

There are a number of key assumptions and estimates that affect economic impact results. First, there are several important assumptions regarding Project labor, as summarized in **Table 1**. These include the estimated average annual compensation (wages plus benefits) per employee during construction and operations. This is an important assumption as the engineering cost data provided estimates of total labor costs, but not direct Project jobs. The analysis estimates direct Project jobs based on the direct labor costs divided by the estimated average annual employee compensation. Other important assumptions include the proportion of construction workers who are not from Bell County who work at the Project during the week (and support local economic activity by paying for lodging and food in the county) and then travel back to their home residences during weekends. **Table 2** provides information on the distance to and population of communities and cities in Bell County and surrounding areas, which is part of the basis for the Project labor assumptions.

Table 1: Key Labor Assumptions/Estimates

Labor Component	Mid-Point Value	Data Sources
Construction Trade and Skilled Labor		
Total Employee Compensation, Construction Phase	$172,400,000	Estimate from Project consulting engineer for direct labor, plus contingency.
Annual Average Compensation Per Skilled Worker (Wages + Benefits)	$123,000	Davis-Bacon 2025 prevailing wage and fringe benefit rates for Bell County
% from Bell County	33%	Estimates of specialized labor from Project consulting engineer, Quarterly Census of Employment and Wages data on employment in Bell County, population of and distance to surrounding urban areas outside of communities, data on historic construction and mining employment in Bell County, local workforce training and development programs in Bell County
% from Elsewhere in KY/TN	50%	
Operations Labor		
Annual Employee Compensation	$7,500,000	Estimate based on labor constituting 50% of the $15 million operations budget
Annual Average Per Employee Compensation (Wages + Benefits)	$151,000	IMPLAN data on hydropower sector average worker employee compensation in Kentucky and Tennessee and Quarterly Census of Employment and Wages data on utility sector employee compensation.
% Project Employees residing in Bell County	50%	Estimates from Project consulting engineer, population of and distance to surrounding urban areas outside of communities, data on historic construction employment in Bell County.
% Project Employees Residing Elsewhere in KY/TN	50%	

Table 2: Regional Communities: Population and Distance to Lewis Ridge Pump Storage Project

Location	Approximate Distance to Project (Miles)	Approximate Drive Time to Project	2023 Population
Bell County			23,878
Pineville, KY	14	19	1,906
Middlesboro, KY	24	30	9,258
Elsewhere in KY			4,502,276
London, KY	60	70	7,576
Somerset, KY	90	100	12,108
Richmond, KY	110	110	35,498
Prestonburg, KY	120	140	3,823
Lexington-Fayette urban area, KY	130	140	313,117
Tennessee			7,126,489
Morristown, TN	70	90	30,983
Kingsport, TN	80	100	55,807
Knoxville, TN	90	110	198,175
Greeneville, TN	100	120	15,531
Rest of Tennessee			6,825,993

Source: (US Census Bureau, 2024) and (Google Maps, 2024).

Other key assumptions regarding sources of materials and equipment are presented in **Table 3**. All estimates are based on information from the Project consulting engineer and data in the

IMPLAN input-economic model on the percentage of local sourcing in relevant economic sectors (i.e., the regional purchase coefficient). As highlighted in **Table 1**, due to the magnitude and specialized nature of the labor, material, and equipment requirements, the vast majority are expected to be sourced from outside Bell County, and much will be sourced from outside even the local states of Kentucky and Tennessee. **Most of the equipment and material spending in the two-state area is in the wholesale sector, or is modeled using industry spending patterns in IMPLAN in which the average local sourcing proportion is applied to the total spending value** (i.e., for spending on other materials shown in **Table 3**, although $180 million was entered into IMPLAN as the demand for the level of spending on materials in the two state area, only a portion of this was estimated to be sourced from Tennessee and Kentucky suppliers). Despite the high level of spending that benefits supplies and businesses outside the two-state area, as shown in the next section, the economic impacts in Bell County and the two surrounding states are still quite sizable given the magnitude of the Project.

Table 3: Key Material/Equipment Sourcing Assumptions

Component	Total Cost (Millions 2025 $)	Sourcing		
		Portion From Bell County	Portion From Elsewhere KY/TN	Outside KY/TN
Direct Construction	**$1,250,000,000**	$124,300,000	$714,600,000	$411,100,000
*Labor (see detail in **Table 1** above)*	*$316,100,000*	*$106,300,000*	*$158,000,000*	$51,800,000
Construction equipment	*$399,700,000*	*$7,300,000*[b]	*$308,000,000*[b]	$84,400,000
E/M Equipment	*$268,300,000*	*$0*	*$41,300,000*[c]	*$227,000,000*
Substation/Switchyard Equipment	*$36,400,000*	*$0*	*$27,300,000*[d]	*$9,100,000*
Concrete	*$97,800,000*	*$0*	*$89,700,000*	$8,100,000
Other Materials	*$131,700,000*	*$10,700,000* [e]	*$180,000,000*[e]	$30,700,000
Indirect Construction	**$430,000,000**	$0	$86,000,000	$344,000,000
Contractor Overhead & Profit	*$218,400,000*	*$0*	*$43,700,000*	*$174,700,000*
Bonds and Insurance	*$50,600,000*	*$0*	*$10,100,000*	*$40,500,000*
Owner's Indirect Costs[f]	*$161,000,000*	*$0*	*$32,200,000*	*$128,800,000*
Total, Construction Costs	**$1,680,000**	***$124,300,000***[g]	***$800,600,000***[g]	***$755,100,000***
Operations				
Labor[h]	$7,500,000	$3,750,000	$3,750,000	$0
Materials/Equipment/Etc.	IMPLAN production function and sourcing data for local purchase of goods and services to support hydropower production associated with $7.5 million in direct employee compensation.			

a/ Note that contingency costs were separated and allocated to the direct portion of construction costs and the indirect portion of construction costs for modeling purposes.

b/This is modeled as spending (purchaser price) in the wholesale sector, of which approximately 32 percent of this purchase value is retained in the wholesale sector, resulting in approximately $97.3 million of impact experienced in Tennessee/Kentucky (with the remainder leaking outside the region to the original manufacturer). No construction machinery manufacturing was estimated to occur in Kentucky or Tennessee, although there are construction equipment manufacturers in the state so this may result in an underestimate of impact.

c/This is modeled as spending (purchaser price) in the wholesale sector, of which approximately 21 percent of this purchase value is retained in the wholesale sector, resulting in approximately $8.8 million of impact experienced in Tennessee/Kentucky (with the remainder leaking outside the region to the original manufacturer).

d/This is modeled as spending on inputs from wholesale, manufacturing, transportation, and other sectors based on the power/communication construction industry spending pattern in IMPLAN. IMPLAN data suggest that approximately 77% of this money is spent in Tennessee or Kentucky, with the remainder spent out of state.

e/ This is modeled as spending on inputs from wholesale, manufacturing, transportation, and other sectors in the power/communication construction sector based on the industry spending pattern in IMPLAN power/communication construction industry, the other residential construction industry (for worker housing material expenditures), and the road construction sector (for site access roads). Within Bell County, approximately 50% of this expenditure is at Bell County businesses, while approximately 93% of the expenditure in Tennessee/Kentucky is at a business located in the two-state study area (wholesale, contractor, retail, etc.).

f/This includes an assumption of $16.1 million in truck transportation services and $16.1 million in management services that is provided in Tennessee or Kentucky, with the remainder provided out of the region.

g/ As much of the equipment and material spending is in wholesale sectors, only a portion of this spending increases output, employment, and income in the two-state region or in Bell County.

h/The project engineer provided a total operating budget of $15 million; based on past pumped back storage economic analysis, we assumed 50% of this operating budget was for employee compensation.

LOCAL LABOR: CURRENT RESIDENTS VERSUS IN-MIGRATION

The extent to which local workers will be current residents versus others moving to the area will depend on the local labor availability and skill levels, as well as the workforce training program offered by Lewis Ridge. This section describes and analyzes these factors and then provides a rough estimate of the proportion of the local workforce that may be expected to be hired from the current local population. Based on the data presented in this section, this analysis estimates that on an average annual basis there may be approximately 190 to 240 construction jobs filled by Bell County residents during the construction phase and 20 to 30 Project operations jobs filled by Bell County residents during the operations phase. Local workers who are resident in Bell County may include current residents, former residents, as well as new in-migrants.

As described in further detail below, we estimate that in 2024 (the most current year for which complete data are available) there were approximately 520 available workers in Bell County who were either unemployed or were not in the labor force (i.e., had not actively sought a job in the last four weeks) but wanted a job. Additionally, there are over 1,700 workers who reside in Bell County but who commute to other locations outside the county, including 87 workers who commute outside the two-state region. Not all of these unemployed or commuting workers will have the skillsets or interest in working for Lewis Ridge; however, the local available labor supply coupled with the fact that Lewis Ridge is planning on providing training for local workers indicates that a substantial portion of construction and operations jobs will likely be filled by current Bell County residents.

While there is limited data available concerning local job share at other pumped-storage projects, pumped-storage projects are built under conditions that favor a local workforce compared with other clean energy infrastructure. Pumped storage projects involve extensive civil works, which are highly labor-intensive and rely on skills such as heavy equipment operation, concrete work, and earth moving, trades typically available within regional labor pools (HydroWires, 2020) (Daw, et al., 2022). Activities like tunneling, dam building, and reservoir excavation must be performed at the project site, which naturally favors hiring local or regional workers who are available for long-term, on-site employment. Unlike modular technologies (such as wind or solar, where components are largely manufactured off-site and assembled on-site), pumped storage requires that most workers be present at the site.

While there is considerable uncertainty regarding an estimate of local job share, we expect that approximately one-third of construction jobs would be filled by Bell County residents. As such, the mid-point job estimate for Bell County residents during construction may be approximately 215 workers annually; this would indicate that the annual average of construction and mining workers in the county would stay approximately steady over the last three years (see **Table 7** below). Given that there are approximately 650 workers annually expected to be required at the Lewis Ridge site, this suggests that there may be as many as 435 Lewis Ridge workers migrating to the region.

Data on Local Labor Availability

As shown in **Table 4**, the 2024 labor force in Bell County was approximately 7,500 people; of this number, approximately 7,000 were employed and approximately 520 were unemployed. In addition to people classified as unemployed (i.e., not employed and have actively sought work in the last four weeks), there are numerous people who want to have a job but are not actively seeking work and so are not included in the unemployment data. There are also people who are employed but would like to work more hours (the underemployed). Data on the underemployed are scarce, but national data are available that provide insight into the potential number of local people who are not in the labor force (i.e., are not counted as unemployed) but who want a job. These people, plus the unemployed, provide an estimate of the number of people in the area who may be available to work at Lewis Ridge.[7]

As shown in **Table 5**, national data from the Bureau of Labor Statistics (collected through the Current Population Survey), indicate that in 2024, 5.6% of people who are not in the labor force want a job. For individuals aged 16 to 55, the proportion of those who are not in the labor force but who want a job is much higher, approximately 10.4% in 2024, while only about 2.4% to 3.1% of people older than 55 who are outside the labor force want to have a job.
We use these data to characterize the number of workers in the local study area who are not in the labor force but who may want a job. We estimate the number of people aged 18–64 in the study area who are not in the labor force (by subtracting the labor force estimates from the total population in this age group). For example, in 2024, we estimate that there were approximately 6,300 working-age people in Bell County who are not in the workforce (13,821 working age population less 7,507 labor force).

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[7] It is important to note that local workers hired for the Lewis Ridge may be currently employed and may leave their current job to take a job at Lewis Ridge. Their former job, however, would become available for others who are currently unemployed. As such, the number of currently unemployed provides useful insight into the capacity of the local labor force to meet labor requirements at Lewis Ridge.

To this population we then apply the national estimate of people aged 16–55 who are not in the workforce but who want a job; this figure was 10.4% in 2024. (We assume that people aged 18–64 in the local study area who are not in the workforce are like people throughout the nation aged 16–55 who are not in the workforce.)[8] For 2024, we thus estimate that there were approximately 660 people in the local study area (10.4% of 6,300) who are not in the labor force but who may want a job.

In total then, in 2024, we estimate there were approximately 520 individuals in Bell County who were unemployed and an additional 660 individuals in Bell County outside the labor force who want a job, for a total of approximately 1,180 local people who want a job.

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[8] Note that if we used data on all individuals aged 16+ in the local area but not in the labor force, combined with the national data on people aged 16+ who are not in the labor force but want a job (i.e., 5.3% in 2023), the estimated number of local people outside the labor force who want a job would be similar in 2023 (640 people versus 660 people).

Table 4: 2024 Labor Force Data for Local Area

Demographic	2018	2019	2020	2021	2022	2023	2024
Labor Force							
Bell County	7,624	7,573	7,415	7,356	7,320	7,468	7,507
Elsewhere in KY and TN	5,289,565	5,385,916	5,297,670	5,329,776	5,399,333	5,429,162	5,506,729
Total	5,297,189	5,393,489	5,305,085	5,337,132	5,406,653	5,436,630	5,514,236
Employed							
Bell County	7,124	7,080	6,807	6,932	6,922	7,018	6,987
Elsewhere in KY and TN	5,090,824	5,190,483	4,922,465	5,091,985	5,203,572	5,231,833	5,283,684
Total	5,097,948	5,197,563	4,929,272	5,098,917	5,210,494	5,238,851	5,290,671
Unemployed							
Bell County	500	493	608	424	398	450	520
Elsewhere in KY and TN	198,741	195,433	375,205	237,791	195,761	197,329	223,045
Total	199,241	195,926	375,813	238,215	196,159	197,779	223,565

Data Source: Bureau of Labor Statistics Labor Force Data by County, accessed online at: source: https://www.bls.gov/lau/#cntyaa.

Table 5: Estimated Total Unemployed and Potentially Under-Employed

Labor Force Dimension	2018	2019	2020	2021	2022	2023	2024
National Data on People Not in Labor Force (People Aged 16+)							
% Who Want a Job, all ages	5.5%	5.3%	7.2%	6.3%	5.7%	5.3%	5.6%
% Who want a Job, 16-54	9.5%	9.2%	13.0%	11.6%	10.3%	10.0%	10.4%
% Who Want a Job, over 55	2.7%	2.6%	3.1%	2.8%	2.7%	2.4%	2.6%
Bell County Data							
Working Age Population 18-64	16,431	16,113	15,914	14,800	14,450	14,177	13,821[1]
Working Age Population 18-64, Not in Labor Force[2]	8,807	8,540	8,499	7,444	7,130	6,709	6,314
Potentially Underemployed[3]	834	789	1,102	865	734	671	659

Data sources are the U.S. Bureau of Labor Statistics Current Population Survey (Table 35. Persons not in the labor force by desire and availability for work, age, and sex) and the U.S. Census Bureau (Table DP05).

1/Since detailed population information has not yet been released for 2024 by the Census, this figure is an estimate based on the current population of Bell County and the average ratio of workforce population to total population in Bell County between 2018 and 2023.

2/ Estimated as the population aged 18-64 (from U.S. Census), minus the total labor force, as estimated by the Bureau of Labor Statistics.

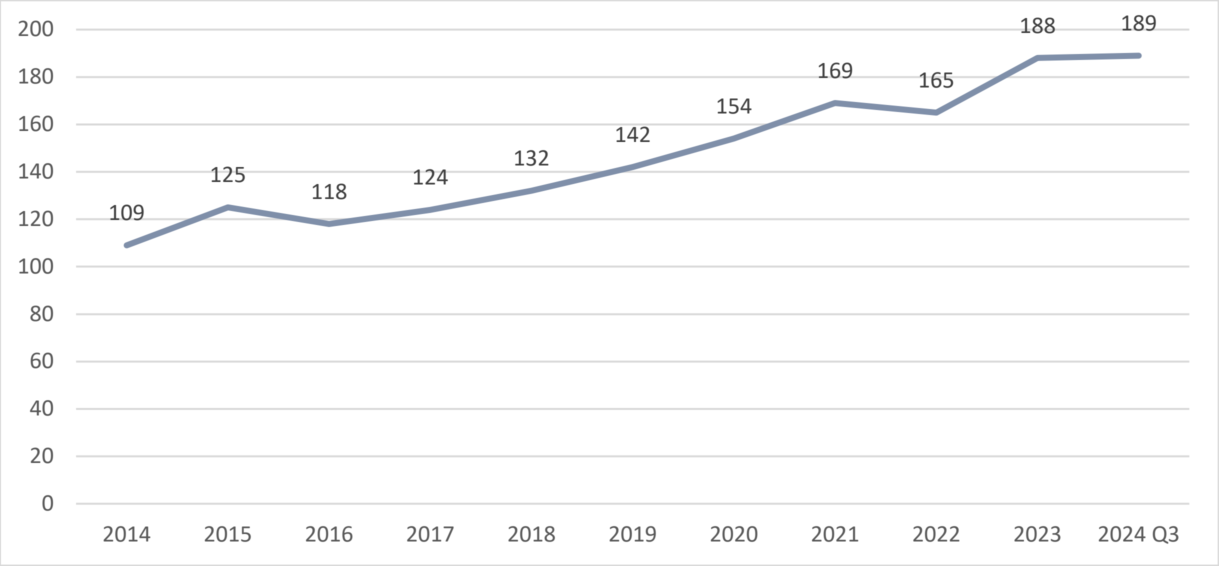
3/ Estimated based on the national proportion of people aged 16 to 55 outside the labor force who want a job, and applying this rate to the number of people in the study area aged 18 to 64 who are outside the labor force.

Finally, an additional source of local labor may be the 1,738 people who live in Bell County but currently commute to jobs outside the county. Of these workers, approximately 87 people work outside the two-state region and must go elsewhere to commute to work.[9] The skillsets of these long-distance commuter workers are not known, but it may be attractive to many of these workers to seek a position at Lewis Ridge rather than commute long distances to other employment locations.

Local Labor Skillsets

The construction industry has a significant presence in the local region. Construction job growth post-pandemic has been especially strong in the region, with a 25% increase in construction employment in Kentucky and Tennessee between 2020 and Q3 of 2024. **Figure 1** summarizes data on employment in the construction industry in Bell County, while **Figure 2** summarizes construction employment in the rest of Kentucky and in Tennessee. As shown in the figures, construction employment has had an upward trend over the past 10 years, which increased in the post-pandemic years. Construction employment has almost doubled in Bell County since 2014.

Figure 1: Construction Employment in Bell County, KY



Source: Bureau of Labor Statistics, Quarterly Census of Employment and Earnings.[10]

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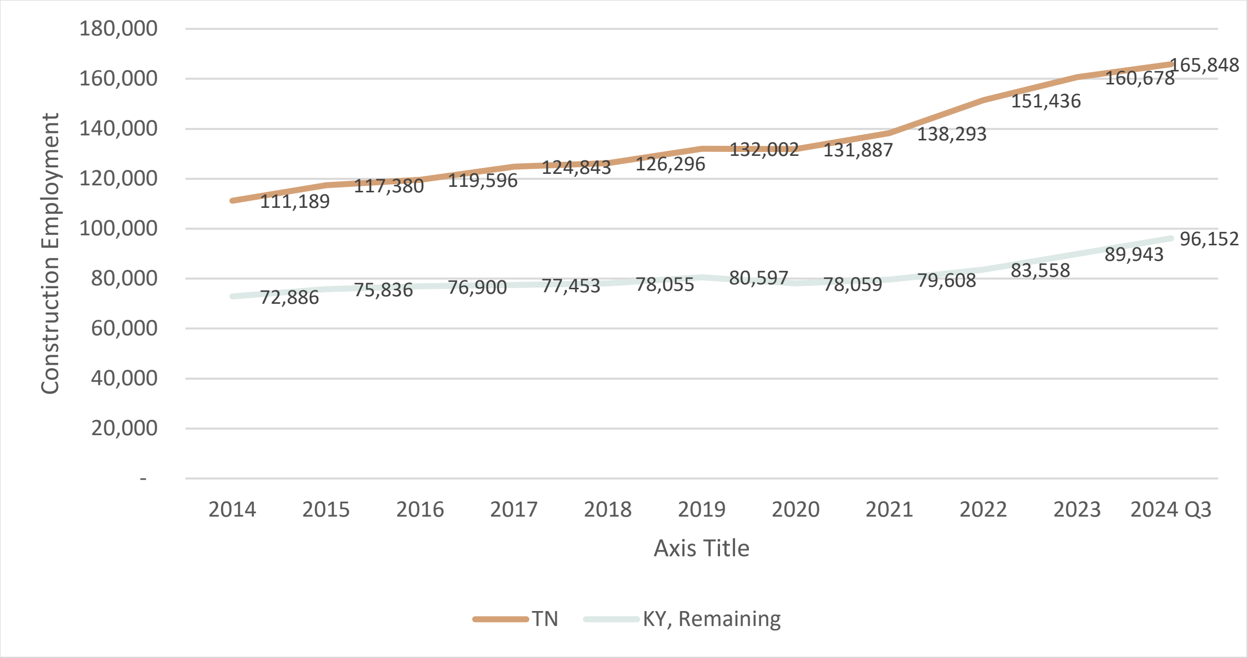
[9] Source: U.S. Census Bureau, American Community Survey. Commuting (Journey to Work) Worker Flows. Accessed online at https://www.census.gov/hhes/commuting/data/commutingflows.html.

[10] For figures in which 2024 Q3 is featured, the figure in question is an average of the first three quarters of 2024.

Figure 2: Construction Employment in Tennessee and Elsewhere in Kentucky



Source: Bureau of Labor Statistics, Quarterly Census of Employment and Earnings.

Furthermore, many workers in the construction and related work force are employed in the skilled trades. As shown in **Table 6**, approximately two-thirds of the KY-TN workforce employed in the Construction and Extraction category are already employed in occupations with relevant skills to the Lewis Ridge project. This category includes workers such as equipment operators, electricians, carpenters, heavy machinery drivers, and similar trades essential for large infrastructure projects.

Table 6: Skilled Workers by State and Occupational Category

Occupation Category	Number of Skilled Workers[1]	Total Number of Workers	Percent Skilled
Kentucky			
Management	3,750	123,890	3%
Architecture and Engineering	12,840	26,900	48%
Construction and Extraction	48,930	72,730	67%
Installation, Maintenance, and Repair	26,350	92,880	28%
Transportation and Material Moving	46,210	229,640	20%
Tennessee			
Management	10,100	220,900	5%
Architecture and Engineering	19,500	44,650	44%
Construction and Extraction	83,310	126,440	66%
Installation, Maintenance, and Repair	29,760	144,910	21%
Transportation and Material Moving	82,760	368,450	22%

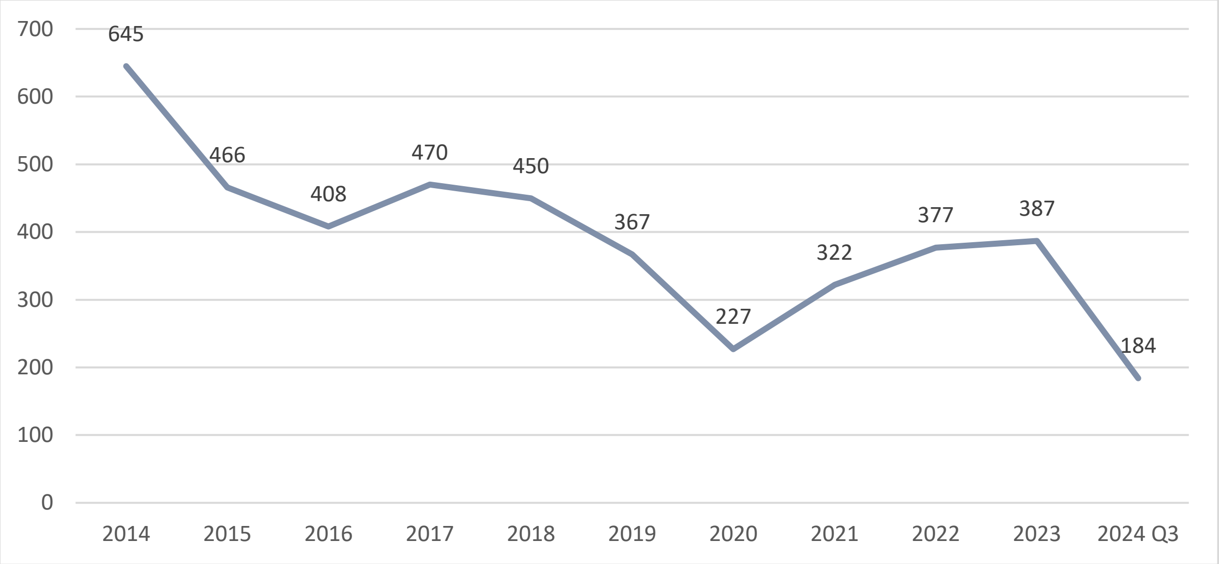
Source: May 2024 Occupational Employment and Wage Statistics

[1] Skilled here means that the occupation requires specialized training and may be closely related or transferable to the building of a pump storage plant.

In addition, Bell County also has a strong mining legacy. In the early 20th century, Bell County was home to some of the largest and best-equipped mines in the Appalachian coal fields, such as the Wallsend Coal and Coke Company, but these industries have since experienced long-term decline (Fuson, 1947). Mining skills are likely highly transferable to construction, especially for large-scale projects like building a pumped storage plant. Many roles in mining, such as heavy equipment operation, drilling, blasting, surveying, and site management, are directly relevant to the civil construction required for pumped storage, which involves large-scale earthmoving, tunneling, and concrete work (De Rose, 2024). Mining workers are typically well-versed in safety protocols, risk assessment, and compliance, skills that are directly applicable to construction. Mining professionals can often transition with minimal training (Brunel, 2020). Lewis Ridge Pumped Storage, LLC has reached out to trade and skill development organizations to boost local worker training, and anticipates that 15% of total labor hours will be apprenticeship hours (Rooney, 2025).

Over the past ten years, mining jobs in Bell County have fluctuated but have overall declined by nearly 460 workers over the last decade, as depicted in **Figure 3**, indicating that there may be a substantial local labor force available for work at Lewis Ridge.

Figure 3: Mining Employment in Bell County, KY



Source: Bureau of Labor Statistics, Quarterly Census of Employment and Earnings.

In the last five years, combined mining and construction employment has varied by over 200 workers (a high of 575 in 2023 and a low of 373 in 2024). In the last decade, construction employment has varied by over 380 workers (a high of 754 in 2014 compared to a low of 373 in 2024), as summarized in **Table 7**.

Table 7: Construction and Mining Employment Total in Bell County, KY (2014 to 2024)

Year	Mining	Construction	Total
2014	645	109	754
2015	466	125	591
2016	408	118	526
2017	470	124	594
2018	450	132	582
2019	367	142	509
2020	227	154	381
2021	322	169	491
2022	377	165	542
2023	387	188	575
2024	184	189	373

Source: Bureau of Labor Statistics, Quarterly Census of Employment and Earnings.

We estimate that a total of approximately one-third of construction workers may be from Bell County, Kentucky. This equates to approximately 215 construction workers annually over the 4-

year construction period. This is based on these above data on the 1) availability of unemployed workers, 2) the historic employment in the mining and construction sectors in Bell County, and 3) the fact that Lewis Ridge Pumped Storage, LLC estimates that approximately 15 percent of total labor hours will be apprenticeship hours from local trade and skill development programs.

ECONOMIC IMPACT RESULTS

Results of the economic impact analysis are presented in terms of employment and labor income benefits to resident households—i.e., for the Bell County impact results, only jobs and income projected to benefit county residents are included, and for the state impact results, only jobs and income projected to benefit state residents are included. Labor income includes employee compensation (workers' wages and benefits such as health, disability, life insurance, retirement payments, and employer-paid payroll taxes) as well as proprietor income. Direct Project employment represents full-time jobs, while employment in other sectors represents both full-and part-time jobs. All dollar values presented are in 2025 dollars.

In interpreting employment results, it is important to note that the number of jobs estimated to be supported by the project is not necessarily the number of *new* jobs that would be created due to the Project. It could be that instead of hiring new people, businesses that supply the Project with goods and services may increase the hours of their current employees. This may especially be true for service sectors that employ significant numbers of part-time employees. The employment estimates in this analysis reflect the current mix of full and part-time employment in each sector in Bell County (and KY/TN).[11] For some indirectly impacted sectors, such as lodging and food services, much of current employment may be part-time. If this is the case, many of the indirect/induced jobs estimated in this analysis for such sectors would also be part-time or may reflect the number of jobs that shift from part-time to full-time.

As estimates of the magnitude and type of Project construction and operations expenditures are conceptual, the economic impact results are presented as a range to reflect uncertainty. **Figures 4** and **5** summarize total economic impact results, presenting the midpoint of the potential economic impact range (the full range of potential impacts are presented in the subsections below)**. Figure 4** summarizes the annual economic impacts in the study area during four years of construction and approximately 80 years of expected operations in Bell County. ***In Bell County, during each of the four years of construction, the Project may directly and indirectly support approximately 270 jobs and $29.0 million in annual income, and during operations the Project may directly and indirectly support approximately 40 jobs and $4.3 million in annual income.***

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[11] IMPLAN employment estimates are based on the current relationship between total employment (full and part-time jobs) and economic activity. Employment in IMPLAN models increases linearly with increased economic activity within each sector. So, for example, if economic output in the lodging industry increases by 10%, IMPLAN results indicate that employment would also increase by 10%.

Figure 4: Total (Direct, Indirect, Induced) Jobs and Income Supported in Bell County, Midpoint Estimates

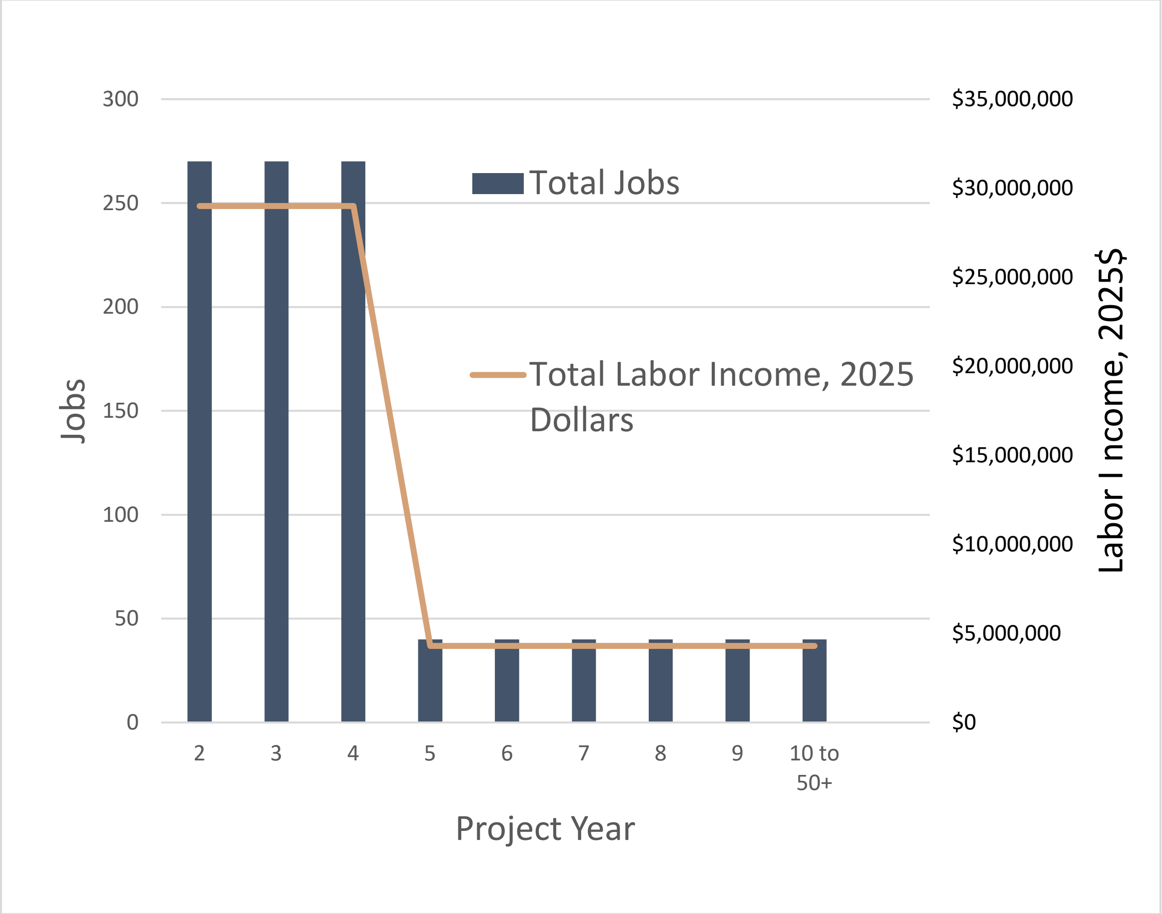
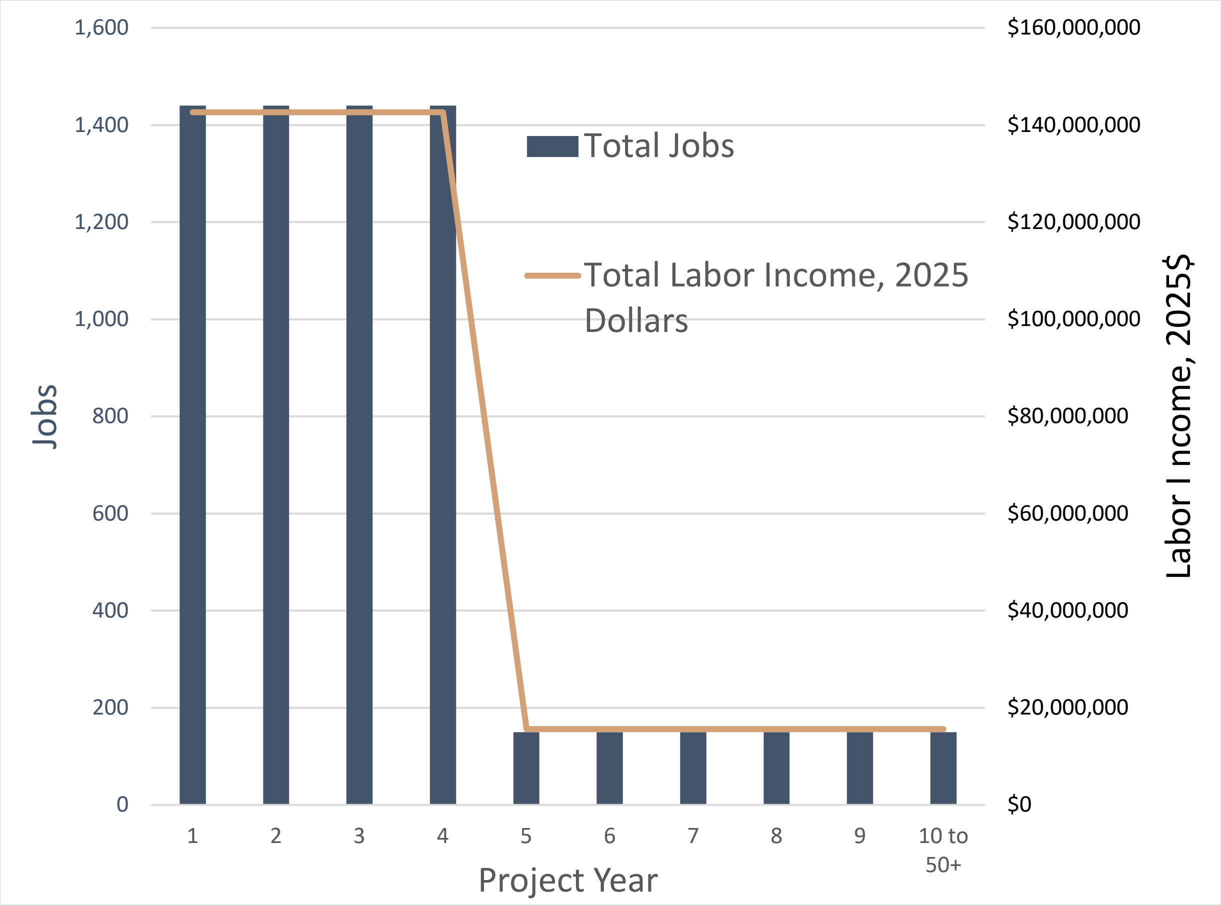


Figure 5 presents the same data for all of Kentucky and Tennessee (including Bell County). ***In the two-state region, in each of the four years of construction the Project may directly and indirectly support approximately 1,440 jobs and $142.6 million in annual income, and during operations the Project may directly and indirectly support approximately 150 jobs and $15.6 million in annual labor income.***

Figure 5: Total (Direct, Indirect, Induced) Jobs and Income Supported in Kentucky and Tennessee[1], Midpoint Estimates



1/Includes impacts for Bell County.

The subsections below present more detailed economic impact results for construction and operations phases.

CONSTRUCTION & PLANNING

Table 8 summarizes estimates of direct Project construction and planning employment and income by worker residency. **Table 9** presents total economic impacts (direct, indirect, and induced) in Bell County and elsewhere in Kentucky and Tennessee. Employment over the construction phase in these tables is presented in terms of “job-years”. One job-year is one job for one year. As Project construction is estimated to last approximately 4 years, for every four job-years, there would be, on average, one construction job lasting approximately four years (although employment levels would vary across the four construction years). Further, some technical services jobs for environmental and design studies are being supported now in the Project planning phase, but these are not modeled in this analysis.

Table 8 shows *direct* sector employment and income for people directly involved in constructing the Project. In total over the four-year period this amounts to approximately 2,300 to 2,800 job-years and $480.6 million to $587.4 million in total labor income, including construction business profit, may be supported. On an average annual basis, this equates to approximately 580 to 710 jobs and $120 million to $147 million in labor income annually. Of these, Bell County residents may fill 190 to 240 jobs and receive approximately $24 million to $29 million in annual labor income. Residents from elsewhere in Kentucky or Tennessee may fill approximately 290 to 360 jobs and receive approximately $55 million to $68 million in annual labor income. In total, in all of Tennessee and Kentucky, residents may fill approximately 490 to 590 jobs and receive approximately $79 million to $97 million in annual income directly from the Project. Residents elsewhere in the Nation may fill other construction jobs.

Table 8: Construction: Direct Project Jobs (Full-Time Equivalents) and Labor Income (2025 Dollars)

Phase/Type of Impact by Worker Residency	Impact During Construction Phase (Job-Years and Labor Income)			Annual Average Impact
	Low	Mid	High	
All Workers				
Employment	2,310	2,570	2,830	**580 to 710**
Labor Income*	$480,600,000	$534,000,000	587,400,000	**$120,000,000 to $147,000,000**
Bell County Residents				
Employment	770	860	950	**190 to 240**
Labor Income	$95,400,000	$106,000,000	116,600,000	**$24,000,000 to $29,000,000**
Elsewhere KY/TN Residents (not including Bell County)				
Employment	1,170	1,290	1,420	**290 to 360**
Labor Income*	$221,400,000	$246,000,000	$270,600,000	**$55,000,000 to $68,000,000**
Total KY/TN Residents (including Bell County)				
Employment	1,940	2,150	2,370	**490 to 590**
Labor Income*	$316,800,000	$352,000,000	387,200,000	**$79,000,000 to $97,000,000**
Other Area (Outside KY/TN) Residents				
Employment	370	420	460	**90 to 120**
Labor Income*	$163,800,000	$182,000,000	$200,200,000	**$41,000,000 to $50,000,000**

*This includes construction contractor proprietor income and profits. We estimate approximately $218 million in contractor proprietor income or profits; we assume 20 percent of this contractor proprietor income accrues in Kentucky or Tennessee.

Table 9 presents *total economic impacts* (direct, indirect, induced) in Bell County and elsewhere in Kentucky and Tennessee during planning and construction. In total over the four-year period there may be approximately 970 to 1,190 job-years and $104.4 million to $127.6 million in total labor income supported in Bell County. Elsewhere in Kentucky and Tennessee, an additional 4,220 to 5,160 jobs years and $409.5 million to $500.5 million in labor income may be supported. On an average annual basis this equates to approximately 240 to 300 jobs and $26.0 million to $32.0 million in labor income annually in Bell County. For elsewhere in Kentucky and Tennessee, this equates to approximately 1,060 to 1,290 jobs and $102 million to $125 million in labor income annually. Note that indirect and induced impacts were modeled only in Bell

County and elsewhere in Kentucky and Tennessee; as such, no total economic impacts are reported for geographic areas outside of these states.

Table 9: Construction & Planning: Summary of Total Economic Impacts (Direct, Indirect, Induced) in Kentucky and Tennessee

Geography/ Type of Impact	**Impact During Construction Phase (Job-Years and Labor Income)**			**Annual Average Impact**
	Low	**Mid**	**High**	
Bell County				
Total Employment (Part and Full-Time Jobs)	970	1,080	1,190	**240 to 300**
Total Labor Income	$104,400,000	$116,000,000	$127,600,000	**$26,000,000 to $32,000,000**
Elsewhere in KY/TN				
Total Employment (Part and Full-Time Jobs)	4,220	4,690	5,160	**1,060 to 1,290**
Total Labor Income	$409,500,000	$455,000,000	$500,500,000	**$102,000,000 to $125,000,000**
Total KY/TN				
Total Employment (Part and Full-Time Jobs)	5,180	5,770	6,340	**1,300 to 1,590**
Total Labor Income	$513,000,000	$571,000,000	627,000,000	**$128,000,000 to $157,000,000**

OPERATIONS

Table 10 summarizes estimates of *direct* project employment and income by worker residency during both operations. There would be approximately 45 to 55 direct employees at the Project during operations, earning $6.8 million to $8.3 million annually in labor income. Of these, approximately half, or 20 to 30 employees may be Bell County residents (earning approximately $3.4 million to $4.1 million), with the remainder likely residing elsewhere in Kentucky or in Tennessee.

As highlighted in **Table 11**, adding the secondary (indirect and induced impacts) to the direct impacts, results in an estimated *total economic impacts* in Bell County during operations of 30 to 40 jobs and $3.9 million to $4.7 million in labor income annually. In all of Kentucky and Tennessee (including Bell County), total economic impacts during operations are estimated to be approximately 140 to 170 jobs and $14 million to $17.2 million in labor income annually.

Table 10: Operations: On-Site, Direct Project Jobs (Full-Time Equivalents) and Labor Income

Phase/Type of Impact by Worker Residency	**Annual Average Impact**
All Workers	
Employment (Jobs)	**45 to 55**
Labor Income	**$6,750,000 to $8,250,000**
Bell County Residents	
Employment (Jobs)	**20 to 30**
Labor Income	**$3,375,000 to 4,125,000**
Elsewhere KY/TN Residents	
Employment (Jobs)	**20 to 30**
Labor Income	**$3,375,000 to $4,125,000**

Table 11: Operations: Summary of Total Economic Impacts (Direct, Indirect, Induced) in Study Area

Geography/ Type of Impact	Annual Average Impact
Bell County	
Total Employment (Part and Full-Time Jobs)	30 to 40
Total Labor Income	$3,900,000 to $4,700,000
Elsewhere in KY/TN	
Total Employment (Part and Full-Time Jobs)	100 to 130
Total Labor Income	$10,100,000 to $12,400,000
Total in KY/TN	
Total Employment (Part and Full-Time Jobs)	140 to 170
Total Labor Income	$14,000,000 to $17,200,000

FISCAL IMPACTS

In addition to the employment and income impacts presented above, the project would contribute to tax revenues in local and state jurisdictions. In particular, property tax revenues would increase in Bell County, sales/use tax revenues[12] would increase in Kentucky and income tax revenues would increase in Kentucky. This analysis does not estimate the impact on property tax revenues, vehicle license fees, or business license fees that may be paid by project employees or businesses supplying inputs to the Project as it is likely that there would be only a small increase in these taxes associated with economic activity supported by the Project (i.e., it is likely that these taxes would be paid by state residents and businesses at similar values without the Project). Taxes paid by the Project, its suppliers, and its employees are challenging to estimate for a number of reasons, including the size of the Project, uncertainty regarding material sourcing and expenditures, and uncertainty regarding potential property tax abatement agreements. That said, this section provides an overview of some of the key taxes that would apply to the Project and the potential magnitude of associated tax revenues to state and local jurisdictions.

Bell County property taxes are assessed at $1.32 per $100 of assessed value (Compton, 2024). According to the County assessor, for energy facilities, property taxes are assessed on the full construction value the first year after construction and then are assessed based on the net profit of the facility. As such, the first year after project construction, property taxes paid to Bell County by the Project may be approximately $16.5 million (based on a $1.25 billion construction cost). Thereafter, the value would fluctuate based on the net profitability of the Project. These property taxes would support local jurisdictions and county services in Bell County. Further, other sub-county taxing districts may also levy property taxes on the facility if the facility falls within their tax district boundaries.

Sales and use taxes in unincorporated portions of Bell County total 6.0 percent, all of which goes to the State (Kentucky Department of Revenue, 2024). Based on historical data on sales and use taxes paid by the power and communications construction sector in Kentucky (as estimated by IMPLAN), total sales and use taxes paid by the Project may be approximately $22.9 million during construction.

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[12] Use tax is a tax on the use of goods and services in Kentucky for which sales tax has not been paid. Use tax would be applicable for Project goods/services that are purchased from another state that does not have a sales tax or that has a sales tax lower than Kentucky's (in which case, the use tax would equal the difference between the Kentucky State sales tax and the sales tax in the other state). In the case of goods/services purchased from Tennessee, there would be no use tax since the sales tax rate in Tennessee is higher. The general sales tax rate in Tennessee is 7 percent.

Kentucky residents pay a flat 4-percent income tax; after deductions and exemptions the effective tax rate may be approximately 3.8 percent.[13] All income earned in the state is taxed, typically including income paid to out-of-state residents working in Kentucky (unless their home state has a reciprocal agreement with the State of Kentucky, which only applies to residents of Illinois, Indiana, Michigan, Ohio, Virginia, West Virginia and Wisconsin) (Kentucky Department of Revenue, 2025). As shown in **Table 8**, during construction an estimated $534 million in labor income may be paid to construction workers and proprietors. Assuming 3.8% of these wages would be paid in Kentucky state income tax, this would equate to approximately $20 million in state income tax revenues, or approximately $5 million in income tax revenues annually in each of the four years during construction.

Thus, during construction, state level tax revenues may increase by a total of approximately $60 million in Kentucky, or approximately $15 million annually over the four years of construction. During operations, tax revenues would increase by a smaller amount.

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[13] This is calculated based on the estimated average annual wage of construction workers of $123,000 and the standard annual household deduction of $6,540 in Kentucky for a married couple. Kentucky does not have personal exemptions, only the standard deduction. Applying a 4 percent tax rate to taxable income of $116,460 yields tax of $4,658. Dividing $4,658 by $123,000 equates to an approximately 3.8 percent effective tax rate.

SUMMARY

With construction expenditures of over $1.68 billion and an estimated operating budget of approximately $15 million, the Lewis Ridge Project will increase demand for labor, materials, and services in Bell County and the states of Tennessee and Kentucky.[14] *Direct* employment and income for people involved in planning and constructing the Project is estimated to total over the four-year construction period approximately 2,300 to 2,800 job-years[15] and $480 million to $587 million in total labor income. On an average annual basis, this equates to approximately 580 to 710 jobs and $120 million to $147 million in labor income annually. Of these, Bell County residents may fill 190 to 240 jobs and receive approximately $24 million to $29 million in annual labor income. In total, residents from Kentucky or Tennessee may fill approximately 490 to 590 construction and planning phase jobs and receive approximately $79 million to $97 in annual labor income.

Including ripple effects in other sectors, *total economic activity* supported by the Project in Bell County during construction is estimated to total approximately 1,000 to 1,200 job-years and $104.4 million to $127.6 million in total labor income. In total, in all of Kentucky and Tennessee, 5,200 to 6,300 jobs-years and $513 million to $627 million in labor income will be supported. On an average annual basis this equates to approximately 240 to 300 jobs and $26 million to $32 million in labor income annually in Bell County. In total in Kentucky and Tennessee, this equates to approximately 1,300 to 1,600 jobs and $128 million to $157 million in labor income annually. The proportion of employment and labor income benefiting residents of Bell County will vary significantly depending on the workforce development and priority to hire locally; the estimates in this analysis are based on an expectation that 15 percent of labor will be from local apprenticeship programs and that approximately another 10 to 20 percent of labor will be from other local Bell County residents who have experience in the mining or construction sectors.

During operations, there would be approximately 45 to 55 *direct* Project employees, earning $6.8 million to $8.3 million annually in labor income. Of these, approximately 20 to 30 may be Bell County residents (earning approximately $3.4 million to $4.1 million annually), with the remainder expecting to reside elsewhere in Kentucky or Tennessee. Adding the ripple effects (or indirect and induced effects) in other sectors, results in an estimated *total economic impact* in Bell County during operations of 30 to 40 jobs and $3.9 million to $4.7 million in labor income annually. For all of Kentucky and Tennessee, total economic impacts during operations are estimated to be approximately 140 to 170 jobs and $14 million to $17.2 million in labor income annually.

In terms of fiscal impacts, during construction, tax revenues may increase by a total of approximately $60 million in the State of Kentucky, or approximately $15 million annually over

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[14] Economic activity would also be supported elsewhere in the nation, dispersed geographically based on location of supplies to the Project.

[15] A job year is one job lasting one year, so five job-years equals one job lasting each of the five years of the construction period.

the four years of construction. During operations, tax revenues would increase by a smaller amount.

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APPENDIX Q

GEOLOGICAL AND SOIL RESOURCES INFORMATION

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
V. E. McKELVEY, DIRECTOR

PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
WALLACE W. HAGAN, DIRECTOR AND STATE GEOLOGIST

GEOLOGIC QUADRANGLE MAP
BALKAN QUADRANGLE, KENTUCKY
GQ-1127

AREA NORTH OF PINE MOUNTAIN AND BENEATH OVERTHRUST FAULT

SYSTEM	SERIES	FORMATION AND BED	LITHOLOGY	THICKNESS OF COAL BED, IN FEET	THICKNESS, IN FEET		DESCRIPTION
QUATERNARY		Alluvium and colluvium			0-30		Sand, silt, clay, and gravel. Alluvium consists of gravel overlain by poorly stratified sand, silt, and clay. Colluvium consists mainly of sandstone blocks and boulders in sandy to clayey matrix; widespread in steep gullies and as talus, fan, or landslide deposits; forms veneer along north slope and foot of Pine Mountain.
PENNSYLVANIAN	Lower and Middle Pennsylvanian	Breathitt Formation * Hindman coal bed Hazard No. 8 coal bed Hazard No. 7(?) coal bed Hazard coal zone		?-3 ?-3½ 0-2 2-4 0-4 ?-3 0-1½ 1-3	240+ 140-180 180-240	660+	Sandstone, shale, siltstone, and coal: Sandstone, light- to dark-gray, very fine to fine-grained, generally silty, medium- to thin-bedded; locally medium to coarse grained, thick bedded, crossbedded, and moderately quartzose; sandstone beds are not continuous across the area. Shale and siltstone, olive-gray to gray; shale is locally sandy or silty. A fossiliferous marine zone consisting of about 10 feet of calcareous gray shale and nodular "blue" limestone locally overlies the Hindman coal bed. The Hazard No. 8 coal bed splits in the northeastern part of this quadrangle and forms a zone that commonly consists of two coal beds separated by 5 to 10 feet of shale or siltstone; the zone generally occurs between cliff-forming, medium- to coarse-grained, quartzose sandstone beds.
		Magoffin Beds of Morse (1931) * * Fire Clay rider coal bed Fire Clay coal bed		0-2½ 0-3½ 0-½ 1-3½ 1½-5½	200-270 190-240	390-460	Sandstone, siltstone, shale, and coal: Sandstone, medium- to light-gray, very fine to medium-grained, silty; interbedded with or gradational to siltstone; poorly exposed. Magoffin Beds of Morse (1931), is a fossiliferous, dark-gray, calcareous marine shale several feet thick. A sparsely fossiliferous silty gray marine shale commonly overlies the Fire Clay rider coal bed. The Fire Clay rider coal bed is thickest west of Stoney Fork in northwestern part of map area. The Fire Clay coal bed generally contains a distinctive flint-clay parting as much as 7 inches thick near its base; the flint clay is brownish gray with pearly luster and conchoidal fracture, and usually contains fossil plant trash.
		* * Kendrick Shale of Jillson (1919) * * * * Rim (Moss) coal zone Straight Creek coal bed		1-2½ 0-3 0?-1½ 0?-3½ 0-2 0-3 0-2½ 0-2 2-4 0-2	60-100	600-720	Shale, siltstone, sandstone, and coal: Shale and siltstone, gray to olive-gray; a thin black shale bed with sparse marine fossils commonly occurs in lowest third of unit. The Kendrick Shale of Jillson (1919) is poorly exposed north of Pine Mountain; sparse fossil fragments were recognized in silty shale only near northwest corner. Sandstone, medium-gray, fine- to medium-grained, locally very silty; common in eastern and western parts of area north of Pine Mountain. The upper coal bed in the Rim coal zone is the principal one in the zone; it is also known as the Moss coal bed (Lyons, 1963, p. 140). The Straight Creek coal bed in Bell County has been correlated with the Jellico coal bed (Lyons, 1963, p. 138); however, the Straight Creek bed may be an older one which lies as much as 200 feet below the Jellico equivalent. The Rim and Straight Creek coal beds apparently persist in the subsurface of most of the area north of the Kettle Island fault zone. The higher coal beds are rarely exposed and may be discontinuous.
		* *		?-1½ 0-3?	50-70	550-620	Shale, siltstone, sandstone, and coal: Shale and siltstone, light- to dark-gray, interbedded; some dark-gray shale beds contain rare linguloid brachiopods. Sandstone, medium- to dark-gray, fine-grained, in thin interbeds in siltstone and shale. Coal beds and carbonaceous shale zones occur near top and middle of unit. Most of this unit, which dips steeply, is poorly exposed in structurally deformed belt north of Pine Mountain and in the Kettle Island fault zone; thickness data are mostly from drillers' logs of core holes.
	Lower Pennsylvanian	Lee Formation *		? ?	700-800	1200-1350	Sandstone, shale, and coal: Sandstone, white to light-gray, fine- to coarse-grained, mostly quartzose and well-indurated; medium to thick bedded, crossbedded, generally pebbly, cliff forming. A thin lenticular chert-pebble conglomerate and a sheared, lenticular coal bed associated with silty carbonaceous shale between pebbly sandstone beds with coal fragments are exposed near mouth of Kettle Island Branch.
MISSISSIPPIAN AND PENNSYLVANIAN	?	Pennington Formation			500-600		Sandstone, shale, and limestone: Sandstone, light- to medium-gray, very fine to medium-grained, argillaceous, moderately quartzose, locally pebbly; poorly exposed in fault slices. Shale, medium- to greenish-gray, rarely crops out. Limestone and shale sequence reported in drillers' logs.
MISSISSIPPIAN		Newman Limestone			360-440		Limestone and shale: Limestone, blue-gray to gray, fine- to medium-crystalline; basal part contains chert nodules; middle part granular and oolitic, locally fossiliferous; sandy and argillaceous near top. Upper part, seen only in fault slices, is medium- to dark-gray, lustrous, partly calcareous shale with thin greenish-gray shale or siltstone interbeds and lenses.
		Grainger Formation			240-330		Shale and siltstone, interbedded, dusky-red to greenish-gray, platy to blocky; thin-bedded, very fine grained greenish-gray sandstone at top of unit in a few places.
DEVONIAN AND MISSISSIPPIAN	? Upper Devonian	Chattanooga Shale			280+		Shale, dark-gray to black, carbonaceous, fissile to platy, locally sheared and slaty; locally silty, pyritic, with reddish-brown plant spores; commonly weathers to fragments with red-, yellow-, or green-hued surfaces.

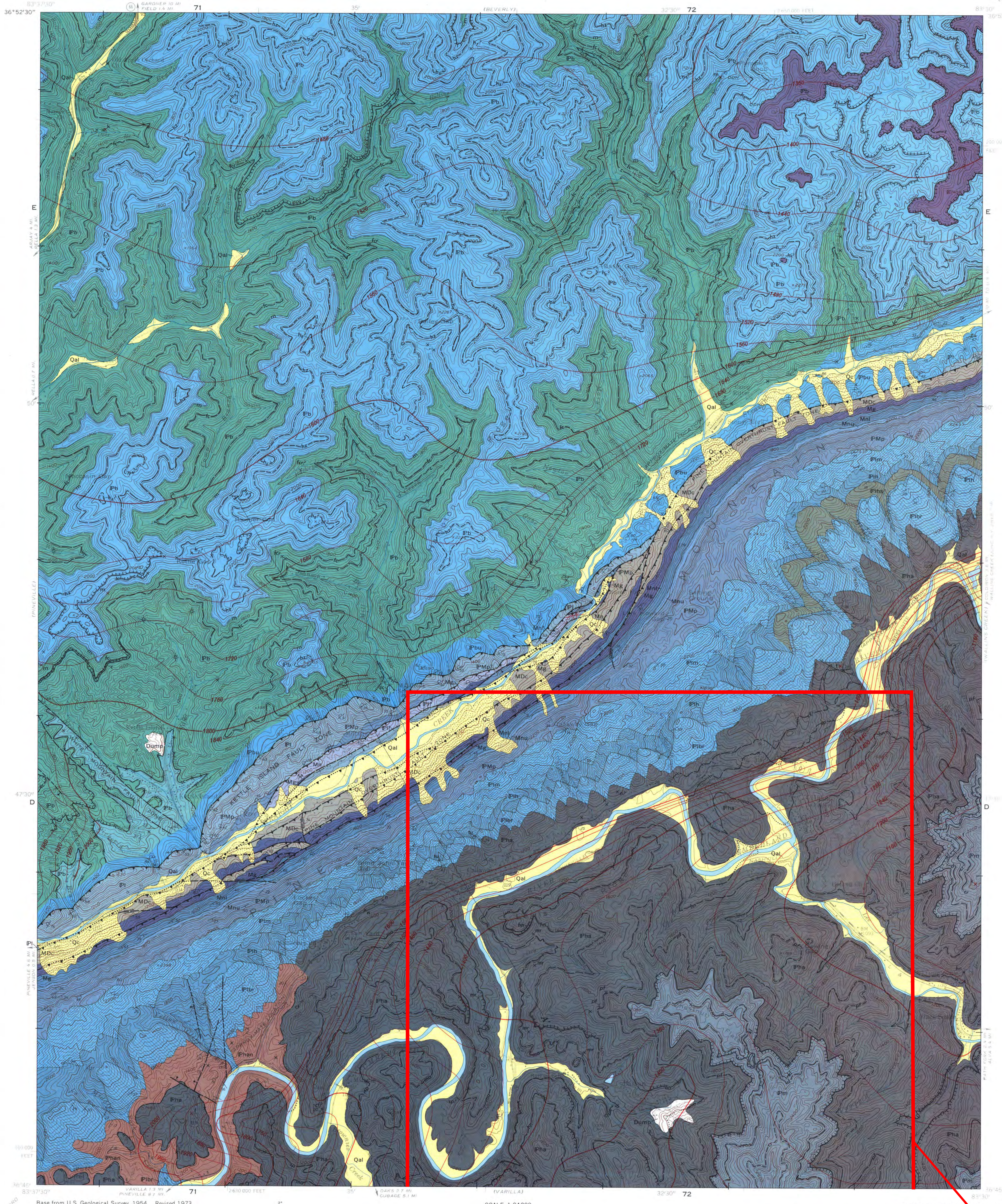
Thickness based on subsurface data only

AREA ALONG AND SOUTH OF PINE MOUNTAIN

SYSTEM	SERIES	GROUP, FORMATION, MEMBER, AND BED	LITHOLOGY	THICKNESS OF COAL BED, IN FEET	THICKNESS, IN FEET		DESCRIPTION
QUATERNARY		Alluvium and colluvium			0-25		Sand, silt, clay and gravel. Alluvium occurs chiefly in poorly stratified floodplain and terrace deposits along Cumberland River, Tom Fork, and Puckett and Brownies Creeks. Colluvium and landslide deposits, not mapped, consist mainly of large angular sandstone blocks and boulders in unsorted sand, silt and clay matrix; common on most hillsides and abundant as veneer on southern foothills of Pine Mountain.
PENNSYLVANIAN	Lower and Middle Pennsylvanian	Breathitt Group Mingo Formation Puckett Sandstone Member Kendrick Shale of Jillson (1919) Creech coal zone Darby(?) coal bed Kellioka coal bed Harlan coal bed		1-3 0-2 1-3 0-2 0-2½ 0-1½ 2½-4½	240+ 220-300 220-260	780+	Shale, siltstone, sandstone, and coal: Shale and siltstone, olive- to dark-gray; shale commonly silty. Kendrick Shale of Jillson (1919) and unnamed fossiliferous siltstone below Creech coal zone contain sparse marine fossils in roadcuts in mining area southeast of Cardinal. Sandstone, light-gray, generally silty, mostly very fine to fine-grained, commonly micaceous; usually discontinuous or interbedded with shale; poorly exposed except for thick, crossbedded Puckett Sandstone Member 120 feet above Creech coal zone near Cardinal. Upper coal bed of Creech coal zone is probably the same as Amburgy(?) coal bed of Varilla quadrangle (Englund, Landis, and Smith, 1963). The name "Kellioka" has been applied to different coal beds in adjacent quadrangles; Kellioka coal bed of Varilla quadrangle is apparently continuous with the Darby(?) coal bed of this quadrangle. Kellioka coal bed of this quadrangle occurs from 40 to 80 feet below the Darby(?) coal bed. In some areas Darby(?) and Kellioka are each split into two coal beds which are separated by as much as 50 feet of shale and siltstone. Harlan coal bed persistent, occurs at base of formation.
		Hance Formation Path Fork coal zone Hance coal zone Mason rider coal bed Mason coal bed Split Seam coal bed Clear Fork coal bed * Naese coal bed †Naese Sandstone Member *		½-2 0-2 0-1½ 0-3 1½-3½ 0-2 1-3½ 0-2 0-3½ 0-2 0-1 0?-2 0-3½ ?	180-240 330-420 160-240 200-280 120-180 120-160 60-180	1110-1500	Shale, siltstone, sandstone, and coal: Shale and siltstone, medium- to dark-gray, locally dark-gray to black with ironstone nodules common in lowest third of unit; generally interbedded with thin silty sandstone beds. Sandstone, medium- to light-gray, very fine to fine-grained, silty, locally micaceous, crossbedded or ripple-bedded. Sandstone ledges below Mason and above Path Fork coal beds are generally prominent and continuous across most of map area. Both the coal bed at base of Hance coal zone and the Naese coal bed contain nonbanded coal and canneloid shale in some areas. The Mason rider coal bed is discontinuous; the Split Seam and Clear Fork coal beds occur in the southwestern part of the quadrangle. The Naese Sandstone Member is medium gray, fine grained, quartzose, crossbedded, with micaceous laminae; contains black shale lenses as much as 10 feet thick; locally contains a breccia bed. Member thins markedly east of Yellow Cliff Branch and is mapped separately only where thicker than about 30 feet. It has been considered the upper member of the Lee Formation in the Varilla quadrangle (Englund, Landis, and Smith, 1963), and the probable lower sandstone member of the Hance Formation in the Ewing quadrangle (Englund, Smith, Harris, and Stephens, 1963, p. B16). The stratigraphic problem at the upper boundary of the Lee Formation is discussed in greater detail by Englund (1964, p. B37-B38). As the Naese Sandstone Member of this quadrangle appears to intertongue with shale and siltstone of the lower Hance Formation, it is here considered a lenticular basal sandstone of the Hance Formation (see correlation diagram). Poor exposures in roadcuts and outcrops near Yellow Cliff Branch and Middle Fork of Watts Creek suggest that the Naese is thickest where it is locally unconformable on the Bee Rock Sandstone Member of the Lee Formation; the sandstone beds of the Naese are essentially indistinguishable from those of the underlying Lee Formation in this quadrangle.
	Lower Pennsylvanian	Lee Formation Bee Rock Sandstone Member			160-325		Sandstone and shale: Sandstone, light- to medium-gray, very fine to coarse-grained, commonly quartzose, locally silty and micaceous, generally crossbedded; forms prominent cliffs along Pine Mountain. Quartz pebbles as much as 1 inch in mean diameter occur sporadically near top of unit over easternmost third of outcrop. Shale is locally interbedded with the sandstone.
		Tunnel coal bed Hensley Member Pebbly sandstone beds		?	250-350	950-1250	Sandstone, siltstone, shale and coal: Sandstone, light- to medium-gray, very fine to medium-grained, generally silty although moderately quartzose near base; in part crossbedded. A sequence of cliff-forming, pebbly, quartzose, fine- to medium-grained sandstone beds as much as 80 feet thick occurs in upper part of unit; mapped separately in eastern part of map area. Siltstone and shale near top of unit are medium to olive gray, form topographic swale; contain Tunnel coal bed which is inferred to be continuous along Pine Mountain, although it is exposed only locally.
		Middlesboro(?) Member			400-575		Sandstone and shale: Sandstone in upper half of unit, white to medium-gray, fine- to medium-grained, mostly quartzose and pebbly, locally a conglomerate, massive, crossbedded; minor gray silty shale interbeds. Sandstone in lower half of unit, light- to olive-gray, silty, very fine to medium-grained, ripplebedded, generally thin-bedded; contains medium- to greenish-gray shale and silty shale interbeds. Basal sandstone, medium-gray, fine-grained, thick-bedded, crossbedded; moderately quartzose, contains scattered pebbles and local conglomeratic zones; cliff forming. Lower half of unit grades westward into very fine to fine-grained moderately quartzose to silty sandstone. Sandstone beds in unit form three or four hogbacks on Pine Mountain.
MISSISSIPPIAN AND PENNSYLVANIAN	?	Pennington Formation			700-1100		Sandstone and shale: Sandstone, light- to light-olive-gray, fine- to medium-grained, silty, in part moderately quartzose; thin to locally thick bedded, in part ripplebedded or wavy bedded. Thick, moderately quartzose sandstone beds occur near top and base of unit. Shale interbeds, medium- to greenish-gray, silty, poorly exposed. Driller's log of the No. 2 Asher hole on Tom Fork shows 80 feet of fossiliferous shale and limestone lying between sandstone beds near middle of unit; this sequence not seen in outcrop.
MISSISSIPPIAN		Newman Limestone Upper member			80-140	350-550	Shale and limestone: Shale, dark-gray, with thin argillaceous dark-gray limestone interbeds near top of unit; underlies topographic bench along north slope of Pine Mountain and is almost completely covered by colluvium.
		Lower member			270-450		Limestone, light-greenish-gray to dark-bluish-gray, fine- to coarse-grained, in part with sparry calcite cement, partly oolitic, locally sandy or argillaceous; finely crystalline; chert nodules in basal part, chert bands and nodules as much as 100 feet above base of unit. Marine fossils common in middle and upper parts.
		Grainger Formation			275-360		Shale, siltstone, and sandstone: Shale, dusky-red to grayish-olive-green; thin interbeds of similarly colored siltstone and of very fine grained sandstone in upper part.
DEVONIAN AND MISSISSIPPIAN	? Upper Devonian	Chattanooga Shale			300+		Shale, grayish-black, in part carbonaceous; brittle, fissile. Contains small asphaltic lenses in extremely deformed outcrop southeast of mouth of Kettle Island Branch. Unit poorly exposed; forms gently sloping, colluvium-covered slopes at base of Pine Mountain.

*Mapped unnamed coal beds

†Mapped as uppermost member of Lee Formation in Varilla quadrangle (Englund, Landis, and Smith, 1963)



Base from U.S. Geological Survey, 1954. Revised 1973

The Carter Coordinate System letters and numbers used to designate five-minute divisions of latitude and longitude are shown along the margins; tick marks indicate one-minute divisions

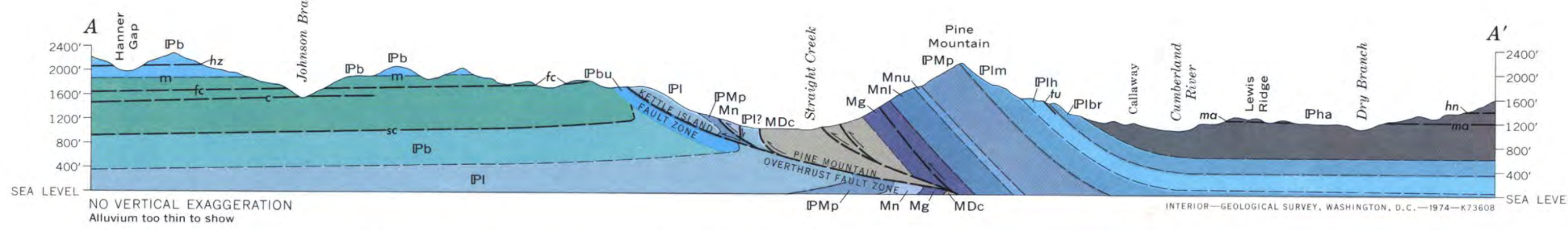
10,000-foot grid based on Kentucky coordinate system south zone

SCALE 1:24000

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

KENTUCKY
QUADRANGLE LOCATION

PROJECT
VICINITY



NO VERTICAL EXAGGERATION

E X P L A N A T I O N

AREA NORTH OF PINE MOUNTAIN

QUATERNARY

Qal — Alluvium

Qc — Colluvium

PENNSYLVANIAN — Lower and Middle Pennsylvanian

IPb — Breathitt Formation
- *c, *unnamed coal bed*
- hi, *Hindman coal bed*
- h₈, *Hazard No. 8 coal bed*
- *h₇, *Hazard No. 7 (?) coal bed*
- hz, *Hazard coal zone*
- m, *base of Magoffin Beds of Morse (1931)*
- *fcr, *Fire Clay rider coal bed*
- fc, *Fire Clay coal bed*
- ri, *coal bed in Rim coal zone*
- sc, *Straight Creek coal bed*

IPbu — Breathitt Formation, intensely deformed, undivided
- *c, *unnamed coal bed*

Lower Pennsylvanian

IPl — Lee Formation
- *c, *unnamed coal bed*

MISSISSIPPIAN AND PENNSYLVANIAN

IPMp — Pennington Formation

MISSISSIPPIAN

Mn — Newman Limestone

Mg — Grainger Formation

DEVONIAN AND MISSISSIPPIAN — Upper Devonian

MDc — Chattanooga Shale

AREA ALONG AND SOUTH OF PINE MOUNTAIN

UNITS IN
PROJECT
VICINITY

QUATERNARY

Qal — Alluvium

PENNSYLVANIAN — Lower and Middle Pennsylvanian — Breathitt Group

IPm — Mingo Formation
- cr, *coal bed in Creech coal zone*
- *c, *unnamed coal bed*
- d, *Darby (?) coal bed*
- kl, *Kellioka coal bed*
- hl, *Harlan coal bed*

IPha — Hance Formation
- *pf, *coal bed in Path Fork coal zone*
- *c, *unnamed coal bed*
- *hn, *coal bed in Hance coal zone*
- *mr, *Mason rider coal bed*
- ma, *Mason coal bed*
- *sp, *Split Seam coal bed*
- *cf, *Clear Fork coal bed*
- *n, *Naese coal bed*
- IPhan, *Naese Sandstone Member*

Lower Pennsylvanian

Lee Formation
- IPlbr, *Bee Rock Sandstone Member*
- IPlh, *Hensley Member*
- *tu, *Tunnel coal bed*
- IPlhs, *pebbly sandstone beds*
- IPlm, *Middlesboro (?) Member*

MISSISSIPPIAN AND PENNSYLVANIAN

IPMp — Pennington Formation

MISSISSIPPIAN

Newman Limestone
- Mnu, *upper member*
- Mnl, *lower member*

Mg — Grainger Formation

DEVONIAN AND MISSISSIPPIAN — Upper Devonian

MDc — Chattanooga Shale

*Shown locally by adit or outcrop symbol only

Structure contours and contacts do not precisely match Varilla quadrangle because of additional data

Contact, approximately located
Dashed where inferred or indefinite; dotted where concealed

Coal bed or coal zone
Dashed where approximately located; short dashed where inferred; dotted where concealed

Thrust fault, approximately located
Dotted where concealed. Sawteeth on upper plate

Fault, approximately located
Short dashed where inferred; dotted where concealed. Bar and ball on downthrown side

Tear fault, approximately located
Dotted where concealed. Arrows indicate relative displacement

Overturned anticline
Showing direction of dip of limbs

25 — Strike and dip of beds

25 — Approximate strike and dip of beds

78 — Strike and dip of overturned beds

Strike of vertical beds

1400 — Structure contours
Drawn on base of Fire Clay coal bed north of Pine Mountain; on base of Hance coal zone south of Pine Mountain. Projected where contoured horizon is missing. Contour interval 40 feet

DRILL HOLES FROM WHICH STRUCTURAL DATA WERE OBTAINED

⊙ DDH — Diamond-drill hole

Gas well

Show of gas

Adit

cf — Caved adit
Letter symbol indicates coal bed

× h₇ — Coal prospect or outcrop
Letter symbol indicates coal bed

Abandoned quarry (limestone)

Contour strip or auger mine

Strip mine
Area completely stripped

Dump

Probable landslide scar
Sawteeth on mobile side

× m — Outcrop of fossil-bearing strata
- m, *Magoffin Beds of Morse (1931)*
- k, *Kendrick Shale of Jillson (1919)*
- f, *unnamed fossil bed*

ECONOMIC GEOLOGY

Coal, gas, oil, and limestone are the principal mineral resources known in the quadrangle. Gas and oil accumulations are present mostly in pre-Pennsylvanian strata north of Pine Mountain. Thick Mississippian limestone beds on the northern slope of Pine Mountain are a potential source of large amounts of crushed limestone.

Coal beds north of Pine Mountain: A general study of coal resources in the region was made by Lyons (1963). All production from this area has been common banded high-volatile A or B rank bituminous coal from the Breathitt Formation.

The Straight Creek coal bed has been mined extensively in the Kettle Island area; it may contain large subsurface coal reserves elsewhere in the quadrangle. The coal bed averages 3 feet in thickness and locally has a very thin shale parting. At mines near Kettle Island the coal is reportedly scoured and overlain by channel-fill sandstone (E. Dean, oral communication, 1968). Lyons (1963, p. 140) has included Straight Creek coal reserves with those of the Jellico coal bed.

Little is known regarding the Rim (or Moss) coal zone and the unnamed coal beds between the Rim and Fire Clay coal beds in this quadrangle. The principal coal bed of the Rim coal zone is mined extensively to the west of the map area; mineable reserves may be present in the subsurface north of Kettle Island. A persistent coal bed, locally called the Vanderpool coal bed, occurs about 100 feet below the Fire Clay coal bed; it has been extensively mined by local residents for house coal.

The Fire Clay coal bed, known locally as the Hazard No. 4, Crockett, or Dean seam, has been mined extensively in the western part of the area where it averages 2½ feet thick. It varies in thickness, is split by shale partings, and has not been mined elsewhere in the quadrangle.

The Fire Clay rider coal bed, locally called the McGuire seam, commonly is thicker than the Fire Clay coal bed in the eastern part of the area and is the principal mined coal bed in the northwestern part of the quadrangle.

The principal coal bed above the Magoffin Beds of Morse (1931) is locally called the Hazard No. 7, although the latter coal occurs about 80 feet above the Hazard coal zone. Both of these coal beds are thickest east of Stoney Fork and in the stripped area north of Kettle Island.

The Hazard No. 8 coal bed is thickest and has been extensively stripped and augered east of Stoney Fork. The coal is split into a zone in this area, and the main coal bed averages 25 inches thick in a 6-foot zone of carbonaceous shale and thin coal beds. An unmapped coal bed about 50 feet below the Hazard No. 8 is locally as much as 4 feet thick in the northeastern part of the quadrangle.

The Hindman coal bed, known locally as the Hazard No. 9, has been extensively augered in the northeastern part of the map area. Locally an overlying calcareous siltstone is in contact with this coal; operators report that where limy rocks directly overlie this coal bed its quality is low.

Coal beds along and south of Pine Mountain: Several collapsed openings in the Tunnel coal bed of the Lee Formation were found north and west of Callaway. The extent and thickness of this bed in the Balkan quadrangle are not known. The coal was 3½ to 5 feet thick where mined a few miles to the east in the Wallins Creek quadrangle (Froelich, 1972).

A general description of the coal resources of the Breathitt Group in this region is given by Smith (1963). All commercial production from this area has been common banded bituminous coal of A or B rank from the Breathitt Group.

Several coals beds were stripped, augered, and mined underground south and southwest of Cardinal in the late 1960's. However, the only active operation at the time of mapping was a small truck mine in the Mason coal bed on Tom Fork. The Mason thickens from an average of 2 feet just south of Pine Mountain to about 3 feet near the southern boundary of the quadrangle.

The Split Seam, Clear Fork, Naese, and possibly coal beds in the Path Fork coal zone are locally thicker than 2 feet; however, they commonly are irregular in thickness, or are impure, or occur in steeply dipping strata.

Two coal beds more than 30 inches thick in the Hance coal zone probably contain the largest reserves in the area. The Hance has been mined underground only locally; because of unreliable roof conditions, it is more safely and readily recovered by stripping or augering.

The Harlan coal bed has been intensively mined and augered in the southeastern part of the quadrangle, and reserves are essentially depleted. The Kellioka and Darby(?) coal beds rarely exceed 2 feet in thickness; only the Kellioka has been locally mined and augered. Coal beds of the Creech coal zone are irregular in thickness and quality, and commonly are less than 2 feet thick.

Of the 21 test holes drilled for oil and gas north of Pine Mountain, about half produce gas. The main producing formations are the Newman Limestone ("Big Lime"), Chattanooga Shale, and Hancock Dolomite ("Lockport" or "Corniferous") of Silurian age, with minor production from sandstone ("Maxton") of the Pennington Formation and sandstone ("Salt") of the Lee Formation. The only exploratory hole drilled south of Pine Mountain was abandoned, but it had gas shows in the lower member of the Newman Limestone and in the Chattanooga Shale.

An abandoned quarry is in the Newman Limestone north of Straight Creek; the limestone is in a fault slice of the Kettle Island fault zone. This limestone deposit is accessible but limited in extent and quality varies from good to poor along the strike. Large limestone reserves are present in the lower member of the Newman Limestone on the north slope of Pine Mountain; however, access is steep and difficult as the bed lies 400 to 800 feet above the railroad spur line along Straight Creek.

One of three reported cave openings in the lower part of the Newman Limestone is on the north side of Pine Mountain east of Laurel Ford. This cave and the nearby park-like Salting Ground are potential recreational sites; however, access in 1970 was difficult.

Availability of ground water in the quadrangle and in surrounding areas is discussed by Price and others (1962) and by Kilburn and others (1962). They indicate that most of the drilled wells in Lee and Breathitt strata yield water at rates adequate for modern domestic supplies. The water comes mainly from joints and bedding plane openings in sandstone, shale, and coal and is soft to moderately hard, with noticeable amounts of iron. The lower member of the Newman Limestone at places produces good flows from Pine Mountain, and some springs yield prolifically from solution cavities and joints.

The most favorable sites for construction are on the flood plain and terraces along Straight Creek, which are the only well-drained level surfaces north of Pine Mountain; similar alluviated areas south of Pine Mountain are present along Cumberland River, Tom Fork, and Puckett and Brownies Creeks; all are prone to periodic flooding.

Rock falls, creep, and landslides have caused engineering design and maintenance problems in new highway and railroad cuts north and south of Pine Mountain. Failure has occurred in unconsolidated colluvial deposits and in dipping bedrock; landslide scars are locally prominent on the south slope of Pine Mountain east of Green Howard Branch. Bedding-plane landslides have repeatedly occurred in jointed rocks of the south-dipping Hance Formation north of Cumberland River (Froelich, 1970).

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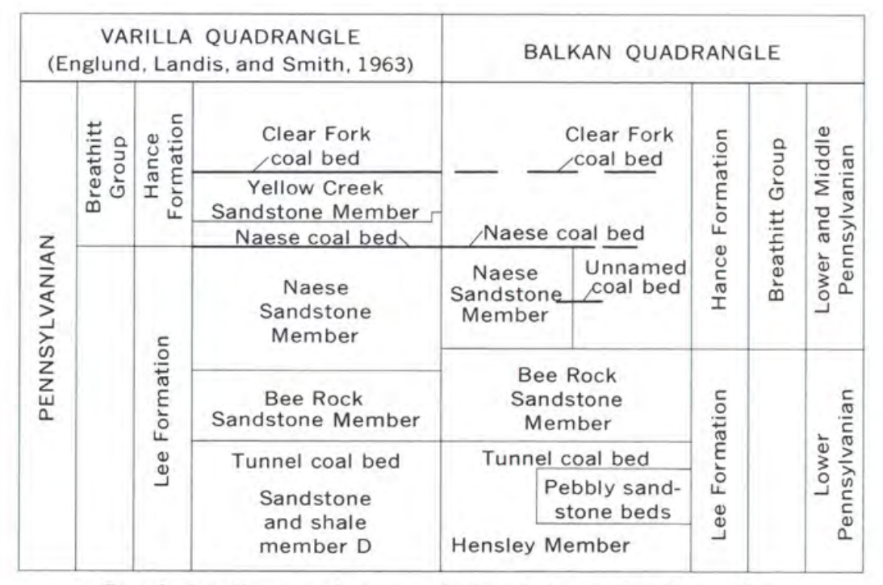


Correlation diagram showing relations between Lee Formation and Breathitt Group in Varilla and Balkan quadrangles

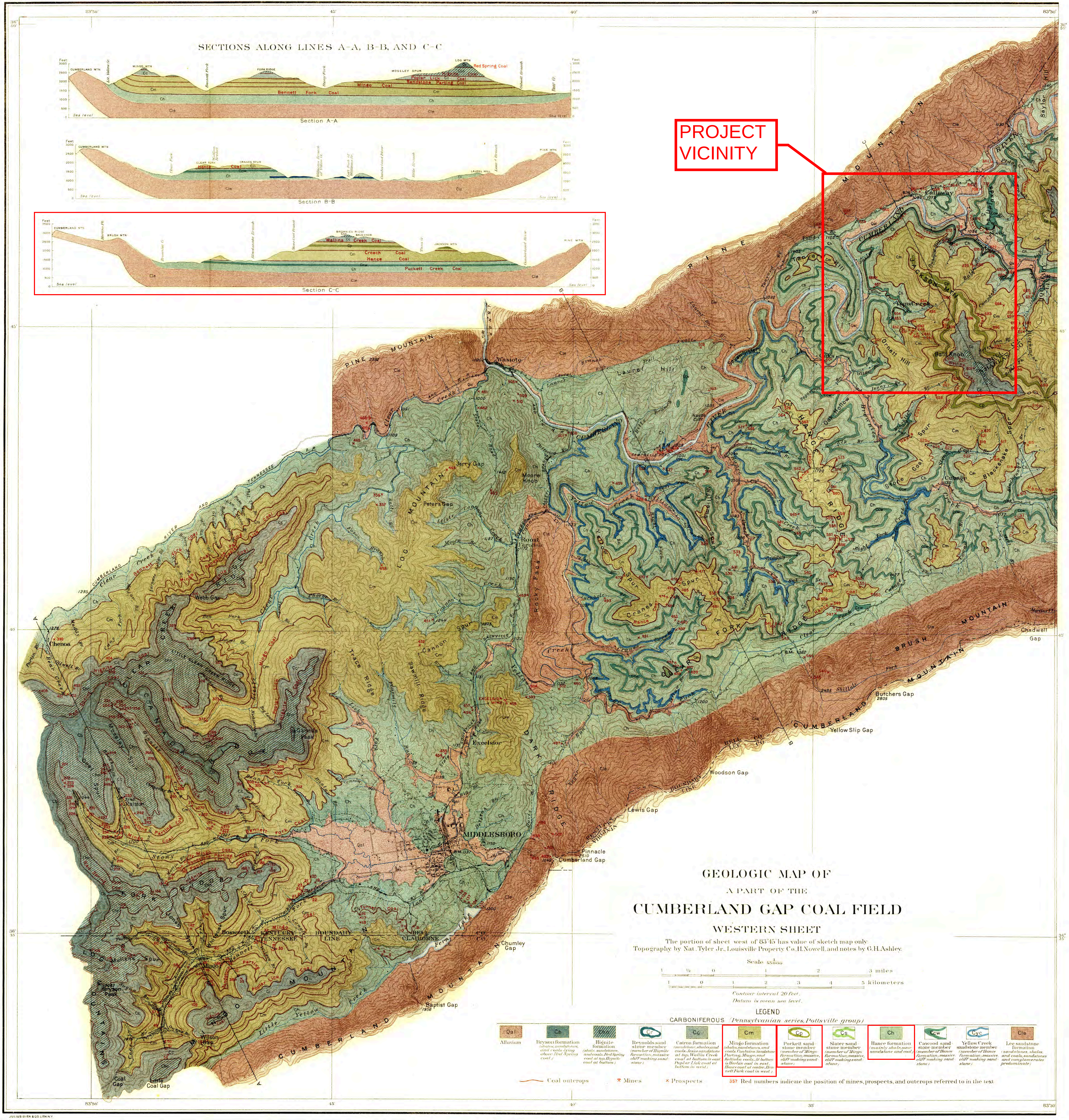
GEOLOGIC MAP OF THE BALKAN QUADRANGLE, BELL AND HARLAN COUNTIES, KENTUCKY

By

Albert J. Froelich and James F. Tazelaar

1973

Price $1.00



GEOLOGIC MAP OF

A PART OF THE

CUMBERLAND GAP COAL FIELD

WESTERN SHEET

The portion of sheet west of 83°45' has value of sketch map only.
Topography by Nat. Tyler Jr., Louisville Property Co., H. Nowell, and notes by G. H. Ashley.

Scale $\frac{1}{45000}$

1 ½ 0 1 2 3 miles

1 0 1 2 3 4 5 kilometers

Contour interval 20 feet.
Datum is mean sea level.

LEGEND

CARBONIFEROUS *(Pennsylvanian series, Pottsville group)*

- Qal Alluvium
- Cb Bryson formation *(shales, sandstones, and coals lying above Red Spring coal)*
- Chn Hignite formation *(shale, sandstones, and coals. Red Spring coal at top, Hignite coal at bottom)*
- Cr Reynolds sandstone member *(member of Hignite formation, massive cliff-making sandstone)*
- Cc Catron formation *(sandstone, shales, and coals. Jesse sandstone at top, Wallin Creek coal at bottom in east, Poplar Lick coal at bottom in west)*
- Cm Mingo formation *(shales, sandstones, and coals. Contains Sandstone Parting, Mingo, and Kellioka coals. At bottom is Harlan coal in east, Hance coal at center, Bennett Fork coal in west)*
- Cp Puckett sandstone member *(member of Mingo formation; massive, cliff-making sandstone)*
- Cs Slater sandstone member *(member of Mingo formation; massive, cliff-making sandstone)*
- Ch Hance formation *(mainly shale; some sandstone and coal)*
- Ccw Cawood sandstone member *(member of Hance formation; massive, cliff-making sandstone)*
- Cyc Yellow Creek sandstone member *(member of Hance formation; massive, cliff-making sandstone)*
- Cle Lee sandstone formation *(sandstones, shales, and coals; sandstones and conglomerates predominate)*

Coal outcrops ⚒ Mines × Prospects

357 Red numbers indicate the position of mines, prospects, and outcrops referred to in the text

JULIUS BIEN & CO. LITH. N.Y.

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

GEOLOGIC MAP OF KENTUCKY

GEOLOGIC MAP OF KENTUCKY

Sesquicentennial Edition of the Kentucky Geological Survey

By the
U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director
In cooperation with the
KENTUCKY GEOLOGICAL SURVEY
Donald C. Haney, State Geologist and Director
1988
Compiled by Martin C. Noger, Kentucky Geological Survey,
from the
Geologic Map of Kentucky (Scale 1:250,000), 1981
by
Robert C. McDowell, George J. Grabowski, Jr., and Samuel L. Moore, U.S. Geological Survey

Cartography directed by James Queen, U.S. Geological Survey. Cartographic contributions by Alicia Antunes, Lawrence Brence, Jan Dennis and Jennifer Fowler. Roger Potts, Kentucky Geological Survey, assisted in the preliminary compilation.

Manuscript approved for publication, Oct. 4, 1990

[1] Revised stratigraphic nomenclature (Rice and others, in press)

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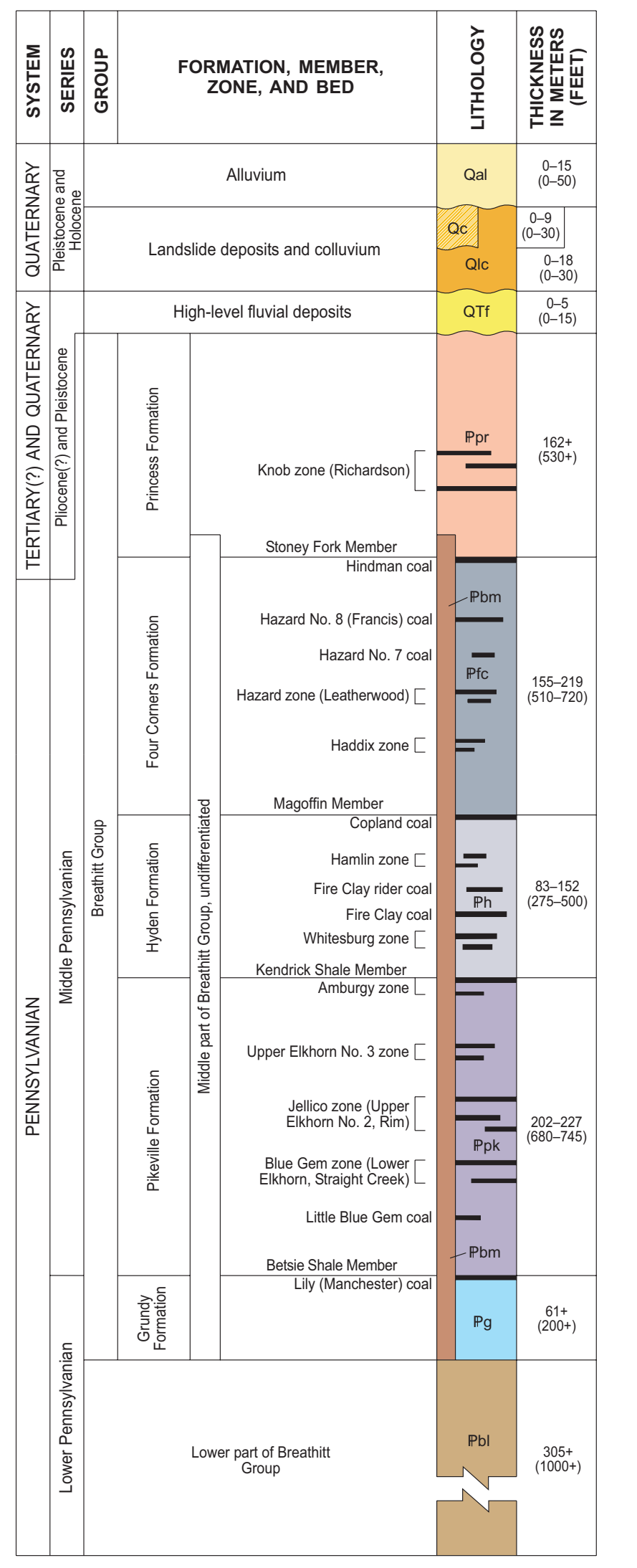
James C. Cobb, State Geologist and Director
UNIVERSITY OF KENTUCKY, LEXINGTON



NORTH AND WEST OF PINE MOUNTAIN

Qal ALLUVIUM—Sand, silt, clay, and gravel. Sand, fine to medium, quartzose, well sorted. Silt and clay, laminated to thin-bedded, rich in organic matter. Gravel, well-rounded pebbles, cobbles, and boulders of quartz, chert, sandstone, siltstone, limestone, and coal from rocks of Mississippian and Pennsylvanian age. Occurs in unconsolidated deposits in narrow valley bottoms, in floodplain and terrace deposits of Cumberland River, and grades into colluvium along valley sides.

Qlc **Qc** LANDSLIDE DEPOSITS AND COLLUVIUM—Landslide deposits commonly contain large slumped sandstone blocks and are often flanked by scarps. Colluvium is poorly sorted to unsorted, angular to rounded pebbles, cobbles, and boulders in a clay, silt, and sand matrix. Present on most slopes, mapped only where thicker than 1.5 m (5 ft); mapped by interpretation of hummocky topography and fan-shaped lobes. Colluvium also mapped with debris fans and landslides at mouths of hollows and on concave slopes, and as talus below escarpments at meanders of Cumberland River; forms veneer along north slope of White Mountain and along north slope and foot of Pine Mountain. Landslide deposits combined with colluvium in the eastern part of quadrangle in steep, narrow gullies, on north slope of Pine Mountain, and along Straight Creek, where deposits are as much as 9 m (30 ft) thick. Colluvium mapped separately in the western half of the quadrangle area.

QTf HIGH-LEVEL FLUVIAL DEPOSITS—Sand, silt, clay, and gravel. Sand, silt, and clay, yellowish- to reddish-brown; sand is fine to medium, quartzose, with scattered gravel lenses. Gravel consists of limonite-coated quartz pebbles; cobbles and boulders of sandstone; and conglomeratic, quartzose sandstone. Some gravel lenses are cemented by limonite, forming conglomerate. Occurs as erosional remnants along old high-level channels of Cumberland River in Artemus and Barbourville quadrangles.

BREATHITT GROUP—The Breathitt was mapped as a formation on the 7.5-minute geologic quadrangle maps, but Chesnut (1992) elevated the Breathitt to group status and divided the group into formations based on regionally widespread shale members with marine fauna. The Breathitt Group contains sandstones, siltstones, shales, coals, and limestones. All formations in the Breathitt Group are lithologically similar and are described below.

Sandstone, fine- to coarse-grained, poorly sorted, quartzose, micaceous, with feldspar and rock fragments; occasionally contains sparse well-rounded quartz pebbles; thin-bedded to massive, crossbedded, and cliff forming. Two types of sandstones occur: quartzarenites (more than 90 percent quartz), which occur in the lower Breathitt beneath the Betsie Shale; and more common, arkosic and sublitharenitic sandstones (60 to 80 percent quartz, 2 to 15 percent feldspar, and lesser amounts of mica, opaque minerals, and rock fragments). Some sandstones are locally extensive and useful as stratigraphic markers. Siltstone and shale, micaceous, locally carbonaceous and calcareous, thin-bedded, coaly partings on some bedding planes. The marine shale members (Betsie, Kendrick, Magoffin, Stoney Fork) at the base of each formation generally contain a thin, black to dark-gray clay shale and discontinuous, dark-gray to black limestone or sideritic sandstone with common marine fossils at their base. Basal shales grade upward into laminated, dark-gray, silty shale with abundant siderite laminae and nodules, elliptical saucer-shaped carbonate concretions, and scarce fossils. Silty shales coarsen upward into thin-bedded, often bioturbated siltstone interbedded with fine-grained, ripple-bedded sandstone and shale; the siltstone-sandstone-shale unit in turn coarsens upward into massive to crossbedded sandstone, which may truncate the coarsening-upward profile. Coarsening-upward shale members are overlain by several coal zones. Each zone consists of multiple coals that may split laterally or grade into carbonaceous shales and rooted seat rocks. Coal zones are separated by shales, siltstones, and sandstones, and generally exhibit considerable lateral variability.

₱pr PRINCESS FORMATION—Previously mapped as upper part of the Breathitt Formation on 7.5-minute quadrangle maps. Renamed by Chesnut (1992) for strata above the base of the Stoney Fork Member and below the Conemaugh Formation (not present in this quadrangle). The base of the Stoney Fork Member is a thin marine carbonate, locally mapped as the Lost Creek Limestone, a dark-gray, argillaceous limestone and calcareous shale with abundant fossil fragments. Because the Stoney Fork Member was not mapped on many of the 7.5-minute quadrangle maps, the base of the Princess Formation is placed at the top of the Hindman coal bed or its inferred position. Coals include the Knob (Richardson) zone. Chert fragments found in the vicinity of the Helton quadrangle were tentatively identified as the Flint Ridge Flint. Unit occurs on hilltops in the northeastern area of the quadrangle at elevations above 600 m (2,000 ft).

₱fc FOUR CORNERS FORMATION— Mapped as part of the Breathitt Formation on earlier maps. Named by Chesnut (1992) for strata between the base of the Magoffin Member and the top of the Hindman coal bed. Basal portion is the Magoffin Member, a 1.5–24 m (5–80 ft) dark-gray, silty, calcareous, fossiliferous shale and dark-gray to black, micaceous, silty, nodular limestone with abundant marine fossils; grades upward into interbedded siltstone and shale; base of Magoffin forms distinct topographic bench. Coals include, in descending order, the Hindman (Hazard No. 9), Hazard No. 8 (Francis), Hazard No. 7, Hazard zone (Leatherwood), and Haddix zone.

₱h HYDEN FORMATION—Mapped as middle part of the Breathitt Formation on earlier maps. Named by Chesnut (1992) for strata between the base of the Kendrick Shale Member and the base of the Magoffin Member. The Kendrick is an olive-gray to dark-gray shale, slightly calcareous, with sparse to moderately abundant marine fossils (small brachiopods, pelecypods, and shell fragments); contains silty lenses, grades into siltstone, and ranges 0 to 18 m (0 to 60 ft). The Kendrick is mapped locally and where the shale is absent the base of the Hyden Formation is approximately located from the top of the Amburgy coal zone or its stratigraphic equivalent. Coals include, in descending order, the Copland, Hamlin zone, Fire Clay rider, Fire Clay, and Whitesburg zone. The Fire Clay coal contains, near its base, a distinctive 1- to 4-cm (2- to 10-in) thick, light to dark brownish-gray flint-clay parting with conchoidal fracture that was deposited as a volcanic ash. The flint clay has been radiometrically dated at 312 ±1 Ma by Lyons and others (1992) and 311 ±1 Ma by Rice and others (1994).

₱pk PIKEVILLE FORMATION—Mapped as middle part of the Breathitt Formation on earlier maps. Named by Chesnut (1992) for strata between the base of the Betsie Shale Member and the base of the Kendrick Shale Member. The Betsie Shale was defined by Rice and others in 1987 and was not mapped on the earlier 7.5-minute quadrangle maps, although it occurs just above the Lily (Manchester) coal. For this quadrangle, the Pikeville Formation was approximated between the top of the Lily coal and the top of the Amburgy coal zone or its equivalent. Coals include, in descending order, the Amburgy zone, Upper Elkhorn No. 3 zone, Jellico zone (Upper Elkhorn No. 2, Rim), Blue Gem zone (Lower Elkhorn, Straight Creek), and Little Blue Gem. The unit predominantly occurs in the northwestern corner of the quadrangle.

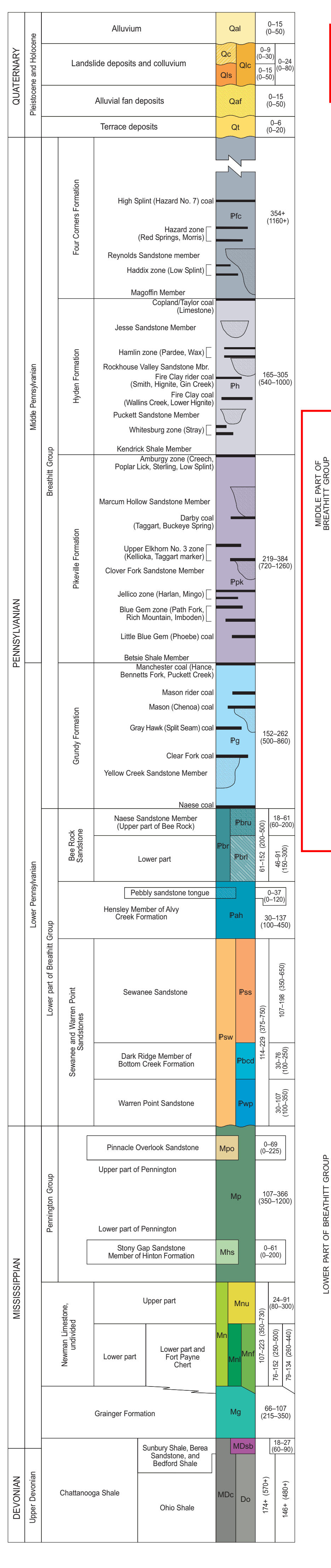
₱g GRUNDY FORMATION—Mapped as lower part of the Breathitt Formation on earlier maps. Named by Chesnut (1992) for strata from the top of the Bee Rock Sandstone to the base of the Betsie Shale. Approximately 61 m (200 ft) of the upper Grundy Formation is exposed along the crest of the Flat Lick Anticline in the Artemus 7.5-minute quadrangle. Coals include the Lily (Manchester).

₱bm MIDDLE PART OF BREATHITT GROUP, UNDIFFERENTIATED—Mapped as Breathitt Formation, undifferentiated; or Breathitt Formation, intensely deformed and undifferentiated. Occurs in two locations: a narrow belt of undifferentiated, deformed rocks adjacent to the north side of the Pine Mountain Overthrust Fault; and a north-south trending, narrow, fault-bounded belt of undifferentiated rocks along the White Mountain Fault Zone. Shale, siltstone, sandstone, and coal. Shale and siltstone, light- to dark-gray, interbedded with thin-bedded sandstone, micaceous, locally carbonaceous, in part calcareous with sparse marine fossils, locally intensely sheared. Sandstone, fine- to medium-grained, poorly to well sorted; thin- to thick-bedded, micaceous, in part quartzose and carbonaceous, crossbedded; some vertically dipping beds as much as 15 m (50 ft) thick. Coal, sheared and slickensided; several unnamed beds 0.5 m (1.5 ft) thick occur near top; a vertically dipping coal bed reported to be as much as 0.8 m (2.5 ft) thick was mined for local use along south bank of Straight Creek. Unit poorly exposed, generally covered by alluvium and colluvium.

₱bl LOWER PART OF BREATHITT GROUP—Mapped as Lee Formation, undivided, on earlier maps. Since the Lee sandstone members were elevated to formations by Chesnut (1992), the name "Lee Formation" was formally dropped in Kentucky. Sandstone, siltstone, and shale. Sandstone, white to dark-gray, fine- to coarse-grained, poorly to moderately well sorted, thin- to thick-bedded, locally friable and quartzose, in part quartzitic, micaceous, crossbedded, and conglomeratic; sheared, fractured and slickensided; vertically dipping beds form prominent ridges and cliffs. Siltstone and shale, interbedded with fine-grained sandstone, micaceous, in part carbonaceous, slickensided and fractured; dark-gray shale contains ironstone concretions. Lower part of unit is conglomeratic, with sheared, well-rounded quartz pebbles up to 2.5 cm (1 in.) in diameter. Unit exposed along northern foothills of Pine Mountain, and on north face of White Mountain. Base of unit, forming sole of Pine Mountain Overthrust Fault, is 6-m (20 ft)-thick, sheared, quartzitic, bleached and altered fine-grained sandstone; possibly includes sandstone from the Pennington Formation.

af ARTIFICIAL FILL—Compacted rock debris from highway, railroad, and earthen dam construction.

▨ MINE DUMP or MINE SPOIL—Tailings and mine waste from coal mining operations.



ALONG AND SOUTH OF PINE MOUNTAIN

Qal ALLUVIUM—Sand, silt, clay, and gravel. Similar to that previously described from north and west of Pine Mountain. Poorly stratified, unconsolidated deposits in valley bottoms; locally includes beds of silt and clay deposited when streams were ponded by landslides; unit merges with colluvium along valley sides. Mapped only in larger stream valleys and in tributaries of the Cumberland River or in the central basin of the Middlesboro impact structure. Trellis pattern noted on front and back edges of the Pine Mountain Thrust Sheet where dipping bedrock is present.

Qlc **Qc** **Qls** LANDSLIDE DEPOSITS AND COLLUVIUM—Similar to that previously described from north and west of Pine Mountain. Landslide deposits include large slumped blocks of bedrock and colluvial debris; in deposits as much as 24 m (80 ft) thick, often flanked by scarps; mapped separately on Kayjay 7.5-minute quadrangle map along Clear Creek. Colluvium consists of sandstone and siltstone blocks and boulders in unsorted, unbedded matrix of sand, silt, and clay; forms continuous veneer of unconsolidated slope deposits on northern foothills of Brush Mountain in the Varilla 7.5-minute quadrangle. Colluvium mapped, in part, with talus, fan, or landslide deposits as combined unit.

Qaf ALLUVIAL FAN DEPOSITS—Boulders, gravel, sand, and silt. Poorly sorted deposits spilling out from the mouths of one or more ravines along Clover Fork of the Cumberland River, and at the foot of Cumberland Mountain along Martins Fork; may include some colluvial material.

Qt TERRACE DEPOSITS—Boulders, gravel, sand, silt, and clay. In stream deposits above normal flood level, range 1.5–6 m (5–20 ft) above river level.

₱fc BREATHITT GROUP
FOUR CORNERS FORMATION—Sandstone, siltstone, shale, coal, and limestone. Similar to that previously described from north and west of Pine Mountain. Sandstones mapped as Bryson and Hignite Formations, or Harlan Formation on earlier quadrangle maps. Top of section not present. Base of section as defined by Chesnut (1992) is base of Magoffin Member; when absent, then base of unit is mapped at top of Limestone(?) coal (Copland/Taylor equivalent). Reynolds Sandstone Member, mapped locally, fine- to coarse-grained, medium- to thick-bedded, usually crossbedded; forms prominent cliffs on highest ridges in map area; occurs near base of the unit. Coals include, in descending order, Hazard No. 7 (High Splint), Hazard zone (Red Springs and Morris), and Haddix zone (Low Splint of Hignite Formation). Unit crops out on highest mountains of Harlan County (Black Mountain and Little Black Mountain) and along elongate ridges of Log Mountain of southwestern Bell County.

MIDDLE PART OF BREATHITT GROUP

₱h HYDEN FORMATION—Sandstone, siltstone, shale, coal, and minor limestone. As previously described from north and west of Pine Mountain. Mapped as Catron and upper part of the Mingo Formations, upper part of the Wise Formation, or Breathitt Formation on earlier quadrangle maps. Base of section is the base of the Kendrick Shale Member, which is locally mapped on the Pennington Gap 7.5-minute quadrangle map. Elsewhere, the base of the unit is mapped from the top of the Poplar Lick (Amburgy) coal zone or its stratigraphic equivalent. Three named sandstones are locally mapped in the unit. The Jesse, Rockhouse Valley, and Puckett Sandstone Members are fine- to coarse-grained sandstones, commonly massive, crossbedded, and cliff-forming. The Jesse is also conglomeratic at base, with white quartz pebbles, clay pellets, and lithic fragments. Coals include, in descending order, Copland/Taylor (Limestone), Hamlin zone (Pardee, Wax), Fire Clay rider (Smith, Hignite, Gin Creek), Fire Clay (Wallins Creek, Lower Hignite), and Whitesburg zone (Stray).

₱pk PIKEVILLE FORMATION—Siltstone, shale, sandstone, and coal. As previously described from north and west of Pine Mountain. Mapped as lower part of the Mingo and upper part of the Hance Formations, lower part of the Wise Formation, or Breathitt Formation on earlier quadrangle maps. Base of section, base of the Betsie Shale Member, was not mapped; therefore the top of the Manchester coal equivalent (Hance, Bennetts Fork, or Puckett Creek coal) was used to map the base of the section. Two named sandstones are mapped locally in the unit. The Marcum Hollow and Clover Fork Sandstone Members are fine- to medium-grained, massive, usually crossbedded, and cliff-forming. In addition, the Clover Fork commonly contains ironstone pebbles. Coals include, in descending order, Amburgy zone (Creech, Poplar Lick, Sterling, Low Splint of Wise Formation), Darby (Taggart, Buckeye Spring), Upper Elkhorn No. 3 zone (Kellioka, Taggart Marker), Jellico zone (Harlan, Mingo), Blue Gem zone (Path Fork, Rich Mountain, Imboden), and Little Blue Gem (Phoebe).

₱g GRUNDY FORMATION—Siltstone, shale, sandstone, and coal. As previously described from north and west of Pine Mountain. Mapped as lower part of Hance Formation, or lower part of Breathitt Formation on earlier quadrangle maps. The base of the section is the top of the underlying Bee Rock Formation (Chesnut, 1992). Upper boundary is at the base of the Betsie Shale Member; where not mapped, the top of the Manchester coal (or its equivalent). Two sandstones were mapped locally in the unit, particularly on Varilla and the east side of Middlesboro North 7.5-minute quadrangle maps: an upper unnamed sandstone and the Yellow Creek Sandstone Member. Sandstones are very fine- to medium-grained, micaeous, cliff-forming; upper sandstone commonly contains argillaceous laminae; Yellow Creek Sandstone is moderately well sorted and quartzose. Mapped unit is exposed in uplifted, flat-lying strata in eastern Bell County, and in dipping beds along two narrow belts (southern foothills of Pine Mountain and northern side of Cumberland Mountain). Coals include, in descending order, Manchester (Hance, Bennetts Fork, Puckett Creek), Mason rider, Mason (Chenoa), Gray Hawk (Split Seam), Clear Fork, and Naese.

₱bd BREATHITT GROUP, INTENSELY DEFORMED—Shale, siltstone, sandstone, and coal. Mapped as Mingo and Hance Formations, undivided, or Breathitt Formation, intensely deformed. As previously described from north and west of Pine Mountain, except rock has been macrobrecciated and shattered; generally not resistant; in fault blocks in Middlesboro Basin, which is described by Englund and Roen (1963) as a meteorite impact scar.

LOWER PART OF BREATHITT GROUP

₱bl LOWER PART OF BREATHITT GROUP—Sandstone, siltstone, and shale. As previously described from north and west of Pine Mountain. Mapped as Lee Formation, undivided, on earlier maps; later redefined as lower part of the Breathitt Group (Chesnut, 1992) when "Lee Formation" was formally dropped from Kentucky nomenclature. Unit exposed in fault slices adjacent to Pine Mountain, and in the central uplift core of the Middlesboro Basin (Englund and Roen, 1963; Milam and Kuehn, 2002b).

₱br BEE ROCK SANDSTONE—Sandstone, conglomeratic sandstone, siltstone, shale, and minor coal. Mapped as member of Lee Formation on earlier quadrangle maps. Chesnut (1992) elevated Bee Rock Sandstone to formation status and included the immediately overlying Naese Sandstone Member of the Hance Formation, where mapped. Sandstone, white to light-gray, fine- to coarse-grained, well-sorted, quartzose, locally micaceous and silty in upper part, thin-bedded to massive, conspicuously crossbedded, locally conglomeratic at base with well-rounded white quartz pebbles 0.6 to 5 cm (1/4 to 2 in.) in diameter; forms prominent cliffs and hogbacks along south slope of Pine Mountain. Siltstone and shale, medium- to dark-gray, micaceous, carbonaceous, silty and sandy, with occasional thin unmapped coal bed. Thin shale occurs near middle of unit and forms persistent slope break, or swales, between cliff-forming sandstones.

₱bru NAESE SANDSTONE MEMBER (UPPER PART OF BEE ROCK SANDSTONE)
Upper part of unit, where previously mapped as Naese Sandstone Member, now mapped as upper part of Bee Rock Sandstone.

₱brl LOWER PART OF BEE ROCK SANDSTONE
Lower part of unit, where mapped separately, now mapped as lower part of Bee Rock Sandstone.

₱ah HENSLEY MEMBER, ALVY CREEK FORMATION—Shale, siltstone, sandstone, and minor coal. Shale and siltstone, medium- to dark-gray, sandy, micaceous, carbonaceous, thin-bedded; form swales at top and base of unit. Sandstone, very fine- to medium-grained, well to poorly sorted, thin- to thick-bedded micaceous and carbonaceous; locally forms cliffs. Pebbly sandstone, mapped locally in upper part of unit, white to medium-gray, medium-grained, well-sorted, quartzose, with well-rounded quartz pebbles, massive and crossbedded, cliff-forming. Tunnel coal bed occurs in upper shaly zone of unit, locally exposed.

₱sw SEWANEE AND WARREN POINT SANDSTONES—Conglomeratic sandstone, sandstone, siltstone, and shale. Sandstone, white to light-gray, fine- to coarse-grained, quartzose, massive, strikingly crossbedded, in part conglomeratic with well-rounded quartz pebbles up to 7.6 cm (3 in.) in diameter; forms several resistant ledges. Siltstone and shale, olive- to dark-gray, micaceous, partly carbonaceous, interbedded with and grades into very fine-grained sandstone; forms narrow valleys separating sandstone ridges. Previously mapped as Middlesboro Member of the Lee Formation, but later divided into Sewanee and Warren Point Sandstones by Chesnut (1992). On this map, combined unit, Sewanee and Warren Point Sandstones, is well exposed in an elongate belt of three or four prominent hogback ridges on the south flank of Pine Mountain. Base sharp and undulating; probably unconformable with underlying units.

₱ss SEWANEE SANDSTONE—Conglomerate, sandstone, siltstone, and shale. Unit identified only where intervening Dark Ridge Member is mapped between the Sewanee and Warren Point Sandstones. Locally divided into four conglomeratic sandstone ledges; forms prominent cliffs and hogbacks on top of Rocky Face and on northwest slope of Cumberland Mountain.

₱bcd DARK RIDGE MEMBER, BOTTOM CREEK FORMATION—Shale, siltstone, sandstone, and coal. Shale and siltstone, medium- to dark-gray, slightly calcareous, locally grayish-green clay shale; interbedded with ripple-laminated siltstone and fine-grained sandstone. Sandstone, light-gray, fine- to medium-grained, lithic fragments common. Cumberland Gap coal bed locally exposed near top of unit. Previously mapped as a member of the Lee Formation, now formally a member of the Bottom Creek Formation (Chesnut, 1992).

₱wp WARREN POINT SANDSTONE—Conglomerate, sandstone, and siltstone. Originally mapped as White Rocks Sandstone Member or Chadwell Member of the Lee Formation; renamed Warren Point Sandstone by Chesnut (1992). Mapped on west side of Rocky Face Fault and forms two or more sandstone ledges near the top of Cumberland Mountain.

Mp PENNINGTON GROUP—Siltstone, shale, sandstone, and minor limestone. Mapped as two units on earlier quadrangle maps, combined as one unit for this map. Siltstone and shale, interbedded, green, gray, reddish-brown, thin-bedded to laminated, in part carbonaceous, locally calcareous with marine fossil fragments, poorly exposed; forms swales between ridges. Sandstone composed of two types: (1) light- to medium-gray, fine- to medium-grained, quartzose, well-sorted, with occasional scattered quartz pebbles with coal and rock fragments, medium- to thick-bedded, crossbedded; and (2) greenish-gray, fine-grained, thin-bedded; grades laterally into silty, ripple-bedded sandstone; forms subdued linear ridges between shale valleys. Limestone, olive-gray, argillaceous, very fossiliferous; forms discontinuous bed or found as float near base of unit. Unit forms prominent cliffs along crest and north side of Pine Mountain and near crest of Cumberland Mountain; also poorly exposed in fault slices along main thrust plane of Pine Mountain Overthrust Fault Zone. May contain parts of Stony Gap Sandstone Member or Pinnacle Overlook Sandstone.

Mpo PINNACLE OVERLOOK SANDSTONE—Sandstone, white to light-gray, fine- to coarse-grained, quartzose, in part conglomeratic with well-rounded quartz pebbles, and small cobbles up to 10 cm (4 in.), crossbedded, massive, cliff-forming; grades laterally into calcareous siltstone and shale. Mapped as lower tongue or sandstone tongue of Lee Formation, believed to be equivalent to the Princeton Sandstone; currently recognized as a sandstone formation of the upper part of the Pennington Group (Chesnut, 1992).

Mhs STONY GAP SANDSTONE MEMBER, HINTON FORMATION—Sandstone, white to light-gray, fine- to coarse-grained, well-sorted, quartzose; lower part is thick-bedded to massive, crossbedded, conglomeratic with well-rounded quartz pebbles; forms prominent cliffs along north-facing crest of Pine Mountain. Unit grades into sandstone, light- to medium-gray, fine- to medium-grained, quartzose, ripple-bedded, thin- to medium-bedded. Member locally mapped in lower part of the Pennington Group.

Mn NEWMAN LIMESTONE, UNDIVIDED—Limestone and shale. Limestone, upper part, seen only in fault slice in Balkan 7.5-minute quadrangle, is medium- to dark-gray, lustrous, partly calcareous shale with thin greenish-gray shale or siltstone interbeds. Elsewhere, identified and mapped separately as upper part of Newman Limestone and lower part of Newman Limestone or lower part of Newman Limestone and Fort Payne Chert. Detailed descriptions below.

Mnu UPPER PART OF NEWMAN LIMESTONE—Shale and limestone. Shale, light- to dark-gray, calcareous, partly laminated to thin-bedded, fossiliferous, grading to blocky claystone; interbedded with limestone. Limestone, medium- to dark-gray, thin- to medium-bedded, fossiliferous; in part argillaceous, oolitic, and bioclastic. Poorly exposed, often covered by colluvium along north slope of Pine Mountain.

Mnl LOWER PART OF NEWMAN LIMESTONE—Limestone, light- to dark-gray, cryptocrystalline to moderately crystalline, generally dense; in part granular, oolitic, and with sparry calcite cement. Upper part, dark-gray, argillaceous, fossiliferous, interbedded with thin gray and green shale, contains some oolitic beds and granular limestone. Middle portion, light-gray to buff, granular, oolitic, sparsely to abundantly fossiliferous. Lower part, usually cryptocrystalline, very dense, with abundant chert nodules or thin irregular chert layers; basal beds tan, rubbly, dolomitic limestone. Unit forms prominent cliff along north slope of Pine Mountain.

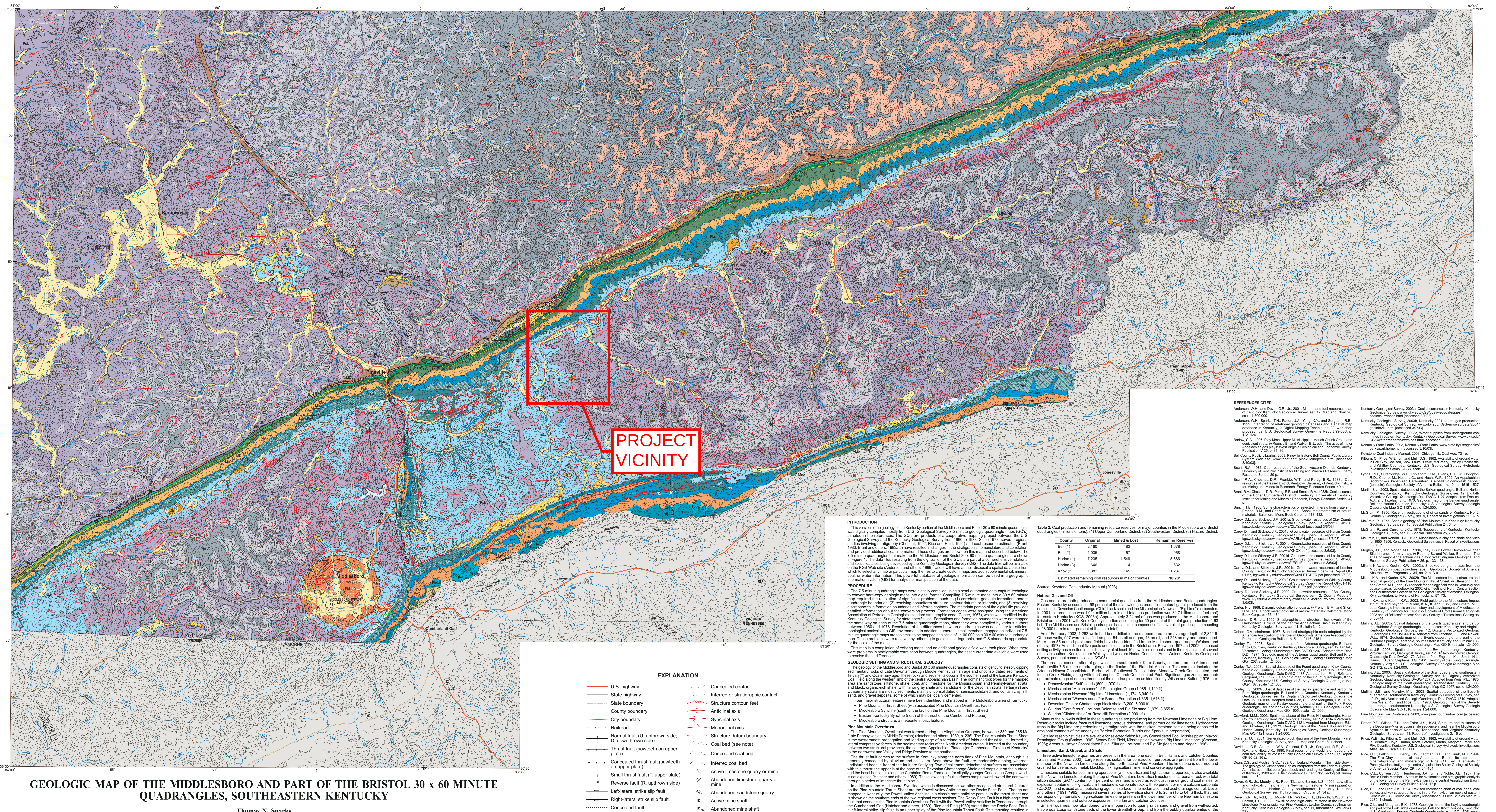
Mnf LOWER PART OF NEWMAN LIMESTONE AND FORT PAYNE CHERT—Limestone, chert, and dolomite. Mapped as a combined unit. Lower part of Newman Limestone as described in preceding paragraph. Fort Payne, chert and dolomite. Chert, light-gray, pink, or white, thin-bedded to nodular, interbedded with silty shale of underlying unit. Dolomite, silty, in thin beds, interbedded with shale. Fort Payne thins eastward, only present on west side of quadrangle; intertongues with underlying Grainger Formation.

Mg GRAINGER FORMATION—Siltstone and shale, interbedded, red, green, and gray, laminated to medium-bedded; upper part more thick-bedded siltstone, lower part dominantly shale. Occurs on north face of Pine Mountain; forms steep, rubble-covered slopes, covered by colluvium and reddish-green soil. Basal contact concealed.

MDc CHATTANOOGA SHALE—Shale, dark-gray to black, weathers rust red to greenish-yellow, fissile to platy, brittle, carbonaceous, locally pyritic and silty, rare conodonts and linguloid brachiopods present, reddish-brown plant spores locally abundant. Poorly exposed, forms gentle colluvium-covered slopes along sole of Pine Mountain Overthrust Fault, locally thickened and deformed by drag folding; base not found.

MDsb SUNBURY SHALE, BEREA SANDSTONE, AND BEDFORD SHALE, UNDIVIDED—Shale and sandstone, 15 m (50 ft) thick interbedded sequence of very fine-grained, light-gray, quartzose sandstone, siltstone, and shale overlain by 3 m (10 ft) of black shale. Presence inferred by drillhole occurrence in quadrangle to northeast and by outcrop exposure in Louellen 7.5-minute quadrangle. Mapped in northeast corner of quadrangle; correlates to upper part of Chattanooga Shale immediately to the southwest.

Do OHIO SHALE—Shale, black shale as described above for Chattanooga Shale. Correlates to middle and lower exposed outcrops of Chattanooga Shale to the southwest. Poorly exposed, unit thickened by imbricate faults and drag folds above Pine Mountain Overthrust Fault; base not found.



GEOLOGIC MAP OF THE MIDDLESBORO AND PART OF THE BRISTOL 30 x 60 MINUTE QUADRANGLES, SOUTHEASTERN KENTUCKY

Thomas N. Sparks

Cartography by Terry D. Hounshell

1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16 KILOMETERS
1	0	1	2	3	4	5	6	7	8	9	10 MILES						
1000	0	5000	10 000	15 000 METERS													
5000	0	10 000	20 000	30 000	40 000	50 000 FEET											

SCALE 1:100 000

universal transverse Mercator projection, zone 17: 1927 North American datum

TOPOGRAPHIC CONTOUR INTERVAL 50 METERS

EXPLANATION

- U.S. highway
- State highway
- State boundary
- County boundary
- City boundary
- Railroad
- Normal fault (U, upthrown side; D, downthrown side)
- Thrust fault (sawteeth on upper plate)
- Concealed thrust fault (sawteeth on upper plate)
- Small thrust fault (T, upper plate)
- Reverse fault (R, upthrown side)
- Left-lateral strike slip fault
- Right-lateral strike slip fault
- Concealed fault
- Concealed contact
- Inferred or stratigraphic contact
- 1600 Structure contour, feet
- Anticlinal axis
- Synclinal axis
- Monoclinal axis
- Structure datum boundary
- Coal bed (see note)
- Concealed coal bed
- Inferred coal bed
- ⚒ Active limestone quarry or mine
- ⚒ Abandoned limestone quarry or mine
- ⚒s Abandoned sandstone quarry
- ◩ Active mine shaft
- ◩ab Abandoned mine shaft

NOTE: Not all coals digitized under the STATEMAP Program are included on this map. Coals included on map are Clear Fork, Gray Hawk, Manchester (Hance), Blue Gem (Path Fork), Jellico (Harlan), Upper Elkhorn No. 3 (Darby), Amburgy (Creech), Fire Clay, Fire Clay rider, Taylor (Limestone), Hazard, Hazard No. 7, Hazard No. 8 (Francis), and Hindman coals.

ACKNOWLEDGMENTS: This map was digitally generated from 1:24,000-scale geologic maps under the STATEMAP Program authorized by the National Geologic Mapping Act of 1992, Grant No. 02HQPA0003, and was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program.

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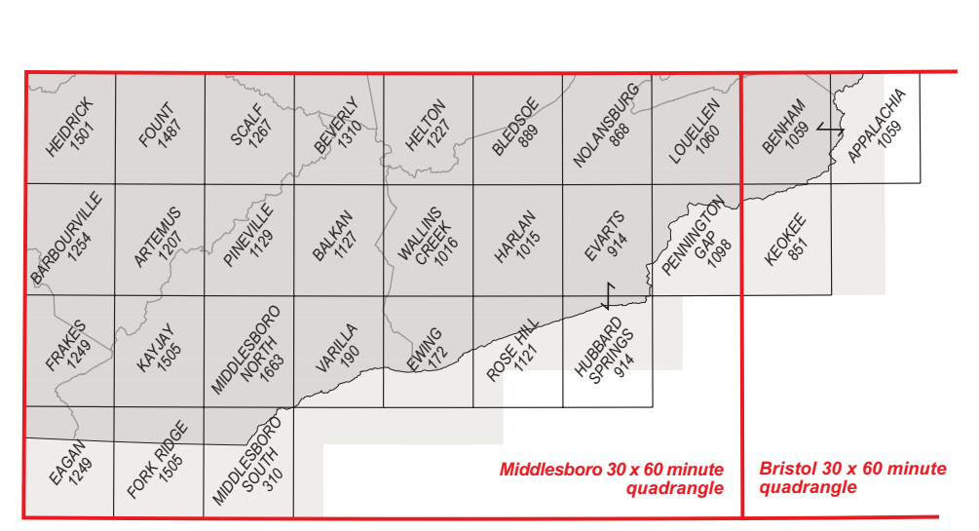


Figure 1. Index map showing the locations of the 29 quadrangles used in the digital compilation of the Middlesboro and Bristol 30 x 60 minute maps. Index shows names of the individual 7.5-minute quadrangle maps and their USGS geologic quadrangle map (GQ) numbers.

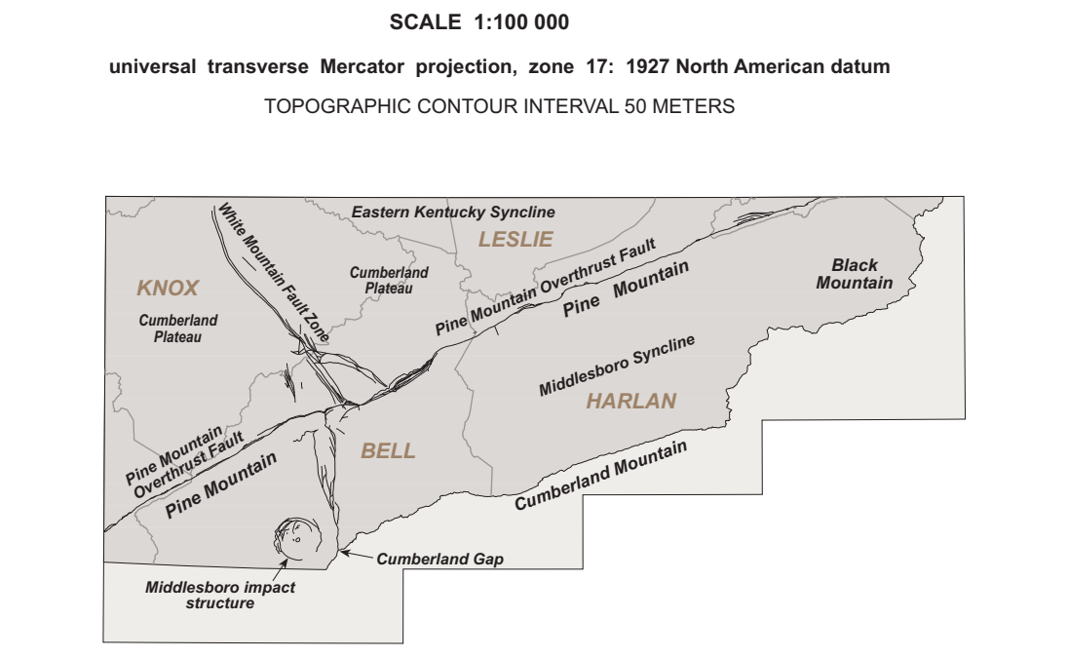


Figure 2. Index map of key structural and physiographic features in the Middlesboro and Bristol 30 x 60 minute quadrangles. Named features are described in the text or lithologic descriptions.

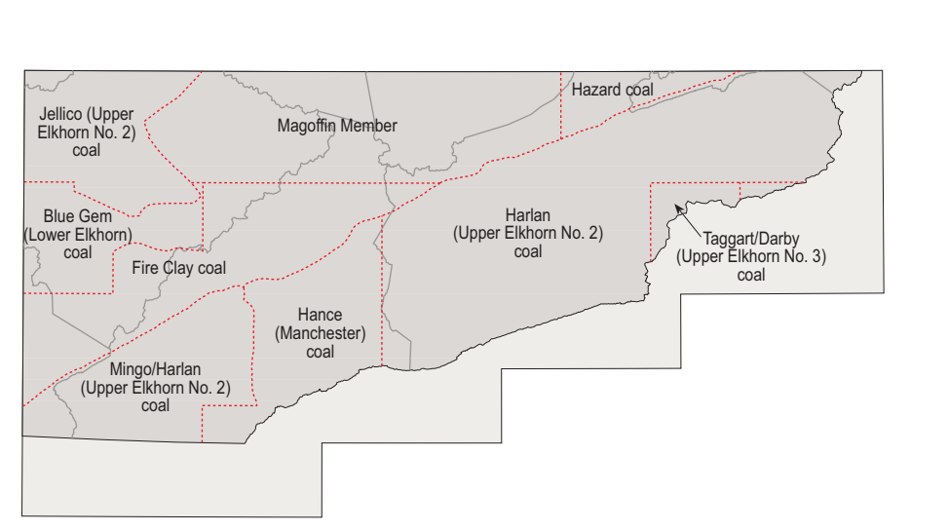
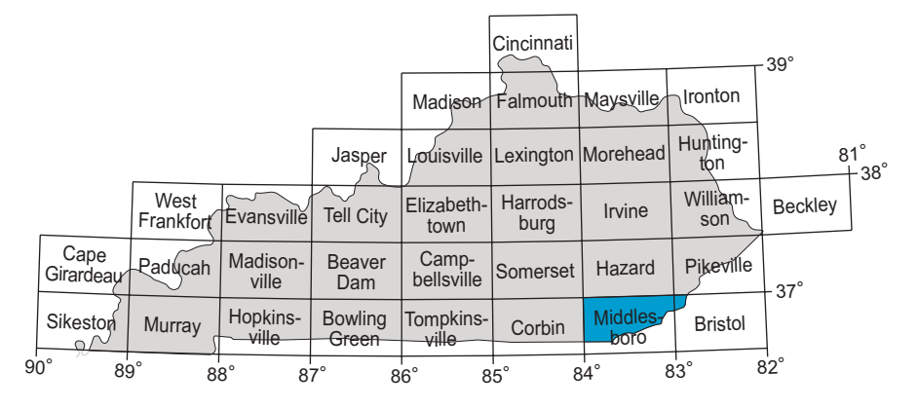
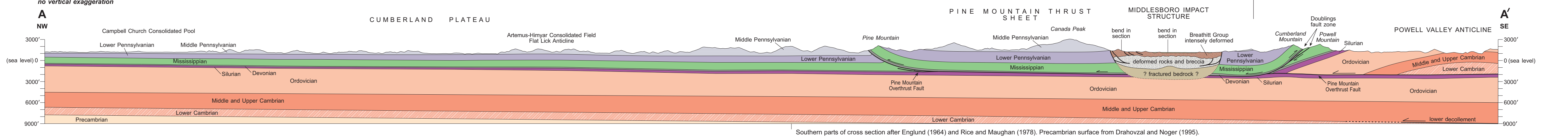


Figure 3. Location map for structure contours in the Middlesboro and Bristol 30 x 60 minute quadrangles. Index gives names of each mapped horizon. The horizon boundaries are shown on the geologic map as thin red dashed lines. Contour interval is 40 feet with index contours at every 200 feet.



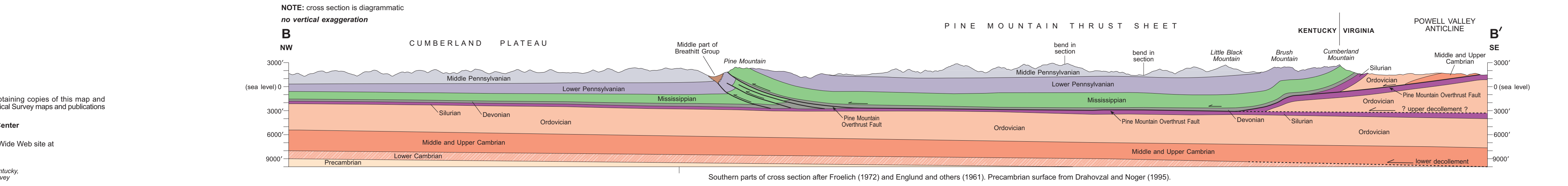
Locations of the 30 x 60 minute quadrangles covering Kentucky. The mapped parts of the Middlesboro and Bristol quadrangles are highlighted in blue.

NOTE: cross section is diagrammatic
no vertical exaggeration



Southern parts of cross section after Englund (1964) and Rice and Maughan (1978). Precambrian surface from Drahovzal and Noger (1995).

NOTE: cross section is diagrammatic
no vertical exaggeration



Southern parts of cross section after Froelich (1972) and Englund and others (1961). Precambrian surface from Drahovzal and Noger (1995).

INTRODUCTION

This version of the geology of the Kentucky portion of the Middlesboro and Bristol 30 x 60 minute quadrangles was digitally compiled mostly from U.S. Geological Survey 7.5-minute geologic quadrangle maps (GQ's), as cited in the references. The GQ's are products of a cooperative mapping project between the U.S. Geological Survey and the Kentucky Geological Survey from 1960 to 1978. Since 1978, several regional studies involving stratigraphy (Chesnut, 1992; Rice and Hiett, 1994) and coal-resource estimates (Brant, 1983; Brant and others, 1983a,b) have resulted in changes in the stratigraphic nomenclature and correlation, and provided additional coal information. These changes are shown on this map and described below. The 7.5-minute quadrangles that make up the Middlesboro and Bristol 30 x 60 minute quadrangles are shown in Figure 1. The data files resulting from the digitization of the GQ's are part of a comprehensive relational and spatial data set being developed by the Kentucky Geological Survey (KGS). The data files will be available on the KGS Web site (Anderson and others, 1999). Users will have at their disposal a spatial database from which to select any map or particular map themes to create custom maps and add supplemental oil, mineral, coal, or water information. This powerful database of geologic information can be used in a geographic information system (GIS) for analysis or manipulation of the data.

PROCEDURE

The 7.5-minute quadrangle maps were digitally compiled using a semi-automated data-capture technique to convert hard-copy geologic maps into digital format. Compiling 7.5-minute maps into a 30 x 60 minute map required the resolution of significant problems, such as (1) correlating geologic formations across quadrangle boundaries, (2) resolving nonuniform structure-contour datums or intervals, and (3) resolving discrepancies in formation boundaries and inferred contacts. The metadata portion of the digital file provides detailed information about the conversion process. Formation codes were assigned using the American Association of Petroleum Geologists' standard stratigraphic code (Cohee, 1967), which was modified by the Kentucky Geological Survey for state-specific use. Formations and formation boundaries were not mapped the same way on each of the 7.5-minute quadrangle maps, since they were compiled by various authors between 1960 and 1978. Resolution of the differences between quadrangles was necessary for efficient topological analysis in a GIS environment. In addition, numerous small members mapped on individual 7.5-minute quadrangle maps are too small to be mapped at a scale of 1:100,000 on a 30 x 60 minute quadrangle map. These problems were resolved by adhering to geologic, cartographic, and GIS standards appropriate for the scale of the map.

This map is a compilation of existing maps, and no additional geologic field work took place. When there were problems in stratigraphic correlation between quadrangles, the best current data available were used to resolve these differences.

GEOLOGIC SETTING AND STRUCTURAL GEOLOGY

The geology of the Middlesboro and Bristol 30 x 60 minute quadrangles consists of gently to steeply dipping sedimentary rocks of Late Devonian through Middle Pennsylvanian age and unconsolidated sediments of Tertiary(?) and Quaternary age. These rocks and sediments occur in the southern part of the Eastern Kentucky Coal Field along the western limb of the central Appalachian Basin. The dominant rock types for the mapped area are sandstone, siltstone, shale, coal, and limestone for the Mississippian and Pennsylvanian strata, and black, organic-rich shale, with minor gray shale and sandstone for the Devonian strata. Tertiary(?) and Quaternary strata are mostly sediments, mainly unconsolidated or semiconsolidated, and contain clay, silt, sand, and gravel deposits, some of which may be locally cemented.

Four major structural features have been identified and mapped in the Middlesboro area of Kentucky;

- Pine Mountain Thrust Sheet (with associated Pine Mountain Overthrust Fault)
- Middlesboro Syncline (south of the fault on the Pine Mountain Thrust Sheet)
- Eastern Kentucky Syncline (north of the thrust on the Cumberland Plateau)
- Middlesboro structure, a meteorite impact feature.

Pine Mountain Overthrust

The Pine Mountain Overthrust was formed during the Alleghanian Orogeny, between ~330 and 265 Ma (Late Pennsylvanian to Middle Permian) (Hatcher and others, 1989, p. 236). The Pine Mountain Thrust Sheet is the westernmost propagation and leading edge of a foreland belt of folds and thrust faults, formed by lateral compressive forces in the sedimentary rocks of the North American craton. It formed at the boundary between two structural provinces, the southern Appalachian Plateau (or Cumberland Plateau of Kentucky) to the northwest and Valley and Ridge Province to the southeast.

The thrust fault comes to the surface in Kentucky along the north flank of Pine Mountain, although it is generally concealed by alluvium and colluvium. Beds above the fault are moderately dipping, whereas undisturbed beds in front of the fault are flat-lying. Two décollement detachment surfaces are associated with this thrust; the upper is at the base of the Devonian Chattanooga Shale and crops out on the surface, and the basal horizon is along the Cambrian Rome Formation (or slightly younger Conasauga Group), which is not exposed (Hatcher and others, 1989). These low-angle fault surfaces ramp upward toward the northwest through a series of imbricate thrust blocks.

In addition to the Middlesboro Syncline, which is discussed below, other recognized structural features on the Pine Mountain Thrust Sheet are the Powell Valley Anticline and the Rocky Face Fault. Though not mapped in Kentucky, the Powell Valley Anticline is a classic ramp anticline parallel to the thrust sheet and is shown on the southern ends of the two regional cross sections. The Rocky Face Fault is a high-angle tear fault that connects the Pine Mountain Overthrust Fault with the Powell Valley Anticline in Tennessee through the Cumberland Gap (Hatcher and others, 1989). Rice and Ping (1989) stated that the Rocky Face Fault, a left-lateral strike-slip fault, is an upper splay of the Pine Mountain Thrust Fault. This thrusting resulted in local tectonic thickening of the Chattanooga Shale in a domal structure due west of the Rocky Face Fault.

Middlesboro Syncline

The Middlesboro Syncline is a large, longitudinal basin, 219 km (136 mi) long, 5,178 km^2 (2,000 mi^2) in area, whose axis is parallel to the Pine Mountain Thrust Sheet (Potter and others, 1984). The syncline is located on the leading edge of the thrust sheet, and was formed along with the Powell Valley Anticline during movement of the detached rock layers up tectonic ramps from deeper to higher décollement surfaces (Harris and Milici, 1977). The Middlesboro Syncline has a broad, flat synclinal axis that is characteristic of central Appalachian folding (Hatcher and others, 1989). Beds that crop out on the northwest limb of the syncline along Pine Mountain have an average dip of 30º to the southeast. On the southeast side of the syncline along Cumberland Mountain, the beds generally dip 40º to the northwest (Dean and Moshier, 1989). The regional dip along the axis in the subsurface is relatively flat (1 to 2º), where the Chattanooga Shale reaches a depth of –914 m (–3,000 ft) (Potter and others, 1984).

Eastern Kentucky Syncline

The Eastern Kentucky Syncline is equivalent to the Coalburg Syncline of West Virginia, and extends across the Eastern Kentucky Coal Field in a northeast–southwest trend (Huddle and others, 1963; Chesnut, 1992). On the Middlesboro quadrangle, only the southernmost edge of the Eastern Kentucky Syncline is observed north of Pine Mountain, where over 152 m (500 ft) of structural relief is mapped on the Cumberland Plateau (see structure contours). Pennsylvanian beds gently dip northwest into the syncline, as shown on cross section B-B', whereas the Mississippian and deeper strata dip to the southeast away from the Cincinnati Arch. Chesnut (1992) attributed part of this dip reversal to a shift of the depositional basin prior to and following Early Pennsylvanian erosion, which was followed by uplift of the basin.

Middlesboro Impact Structure

The Middlesboro impact structure, also known as the Middlesboro Basin by some geologists, is a circular topographic depression about 5.3 km (3.3 mi) in diameter, in which the entire city of Middlesboro is located. The structure is superimposed on the Pine Mountain Thrust Sheet near the junction of Kentucky, Tennessee, and Virginia. Rice and Ping (1989) concluded that the Middlesboro Basin postdates the Alleghanian Orogeny (Late Pennsylvanian to Middle Permian) because the structure's overall morphology was not deformed by movement of the thrust sheet.

Englund and Roen (1963) were the first to propose a meteorite impact origin, based on the presence of a circular basin, deformed rock, an arcuate trend of normal faults, overturned beds, shattered quartz grains, and a central core of uplifted material. The basin is not a crater, but rather the brecciated and faulted material beneath the old crater; the crater itself has long since eroded away. Dietz (1966) discovered shatter cones in the central uplift area, and Bunch (1968) and Carter (1968) identified shocked quartz, further confirming an impact origin. Ehmann (2000, p. 30) determined that based on the presence of shatter cones, intense brecciation, and shocked quartz grains, a meteorite-impact origin for the Middlesboro structure was "probable." Greb and Chesnut (1998) documented the presence of brecciated, deformed gray shales, tilted coal beds, and normal faulting in coal mines in the Middlesboro structure. They concluded these features were consistent with a history of compression followed by relaxation, as would happen during an impact.

Milam and Kuehn (2002a) presented petrographic microanalyses of shocked conglomerates from the Middlesboro impact structure to describe their deformation fabrics. These included planar fractures, planar deformation features, shattering and fracturing of the conglomeratic sandstones, possible melt textures of the matrix, and sheared (microfaulted) quartzite pebbles. Milam and Kuehn (2002b, 2003) also presented an updated guide to the Middlesboro impact structure describing its central uplift, transient crater rim, modification stage, and modified crater rim.

ECONOMIC GEOLOGY

Coal, natural gas, and oil are the principal economic mineral resources in the Middlesboro and Bristol quadrangles. Limestone, sand, gravel, and shale are also available as mineral resources for general construction purposes and for use in the coal industry. The locations of industrial mineral resources, including limestone and sand operations in Bell, Harlan, and Letcher Counties, were mapped and described by Anderson and Dever (2001) and Glass and Malone (2002).

Coal production and reserves

The Middlesboro and Bristol quadrangles comprise a major part (more than 90 percent) of the Upper Cumberland Coal Reserve District, significant parts of the Hazard District, and parts of the Southwestern District, as described by Brant (1983) and Brant and others (1983a,b). The quadrangles encompass the majority of Bell, Harlan, and Knox Counties, with lesser parts of Clay, Laurel, Leslie, Letcher, Perry, and Whitley Counties (see Figure 2). Of the counties that make up these quadrangles, Harlan is ranked second in the state for cumulative coal production (Pike County is first). Total coal production from the three major counties is summarized in Table 1.

Table 1. Cumulative coal production (millions of tons) by county and mining method (1829–2000).

County	Undifferentiated	Underground	Surface	Total
Bell	34.055	154.845	103.900	292.800
Harlan	27.178	786.925	57.120	871.223
Knox	15.410	33.265	24.510	73.185
Total	76.643	975.035	185.530	1,237.208

Source: Kentucky Geological Survey coal production database, kgsweb.uky.edu/DataSearching/Coal/Production [accessed 3/7/03].

The Middlesboro and Bristol quadrangles are bisected by the Pine Mountain Thrust Fault. On the part of the quadrangle north of Pine Mountain (the Cumberland Plateau) at least 17 coal beds have been mined or prospected. The 10 most important beds in the Hazard and Southwestern Districts are, in ascending stratigraphic order: Lily, Blue Gem, Jellico, Upper Elkhorn No. 3, Amburgy, Fire Clay (Hazard No. 4), Fire Clay rider, Hazard No. 7, and Francis (Hazard No. 8). Twenty-one coals are mapped in the Middlesboro Syncline south of the Pine Mountain Thrust Fault. The principal coal beds in the Upper Cumberland District (located on the Pine Mountain Thrust Sheet) are, in ascending stratigraphic order: Hance (Manchester), Path Fork (Lower Elkhorn), Harlan (Upper Elkhorn No. 1 and No. 2), Darby (Upper Elkhorn No. 3), and Creech (Amburgy). The quality of most coals from this area is generally good to high. The Upper Cumberland District coals are of high volatile A or B bituminous rank, with a range of mean heating values of 13,100 to 13,789 Btu/lb; north of Pine Mountain, the coals range from 12,537 to 13,837 Btu/lb (Keystone Coal Industry Manual, 2003).

Coal-availability studies for selected 7.5-minute quadrangles in or adjacent to the mapped area have been completed (Sergeant and others, 1989; Davidson and others, 1990; Greb and others, 1999a,b). Coal-resource and -thickness maps from the availability studies have been published for the Lower Elkhorn coal (Thacker and others, 1998, 2000a), the Fire Clay coal (Thacker and others, 2000b,c), the Upper Elkhorn No. 3 coal (Esterle and others, 2000a–c), and the Amburgy coal (Shultz and others, 2003). Remaining coal reserves for the three largest counties in the Middlesboro and Bristol quadrangles have been tabulated (see Table 2). Coal-availability studies from selected quadrangles in eastern Kentucky indicate that approximately 50 percent of the remaining coal resources are available for mining by current methods, so the actual recoverable reserves may be less (KGS, 2003a).

Table 2. Coal production and remaining resource reserves for major counties in the Middlesboro and Bristol quadrangles (millions of tons). (1) Upper Cumberland District, (2) Southwestern District, (3) Hazard District.

County	Original	Mined & Lost	Remaining Reserves
Bell (1)	2,160	482	1,678
Bell (2)	1,035	67	968
Harlan (1)	7,235	1,549	5,686
Harlan (3)	646	14	632
Knox (2)	1,382	145	1,237
Estimated remaining coal resources in major counties			**10,201**

Source: Keystone Coal Industry Manual (2003)

Natural Gas and Oil

Gas and oil are both produced in commercial quantities from the Middlesboro and Bristol quadrangles. Eastern Kentucky accounts for 98 percent of the statewide gas production; natural gas is produced from the organic-rich Devonian Chattanooga (Ohio) black shale and the Mississippian Newman ("Big Lime") carbonates. In 2001, oil production was 1.024 million barrels and total gas production was 81.7 billion cubic feet (bcf) for eastern Kentucky (KGS, 2003b). Approximately 3.24 bcf of gas was produced in the Middlesboro and Bristol area in 2001, with Knox County's portion accounting for 50 percent of the total gas production (1.63 bcf). The Middlesboro and Bristol quadrangles had a minor component of the overall oil production, amounting to 28,000 barrels (or 1 percent of the state total).

As of February 2003, 1,262 wells had been drilled in the mapped area to an average depth of 2,842 ft. Of these wells, 907 were classified as gas, 54 as oil and gas, 46 as oil, and 248 as dry and abandoned. More than 55 named pools and fields have been identified in the Middlesboro quadrangle (Watson and others, 1997). An additional five pools and fields are in the Bristol area. Between 1997 and 2002, increased drilling activity has resulted in the discovery of at least 10 new fields or pools and in the expansion of several others in southern Knox, eastern Whitley, and western Harlan Counties (Anna Watson, Kentucky Geological Survey, personal communication, 3/7/03).

The greatest concentration of gas wells is in south-central Knox County, centered on the Artemus and Barbourville 7.5-minute quadrangles, on the flanks of the Flat Lick Anticline. This complex includes the Artemus-Himyar Consolidated, Barbourville Southwest Consolidated, Meadow Creek Consolidated, and Indian Creek Fields, along with the Campbell Church Consolidated Pool. Significant gas zones and their approximate range of depths throughout the quadrangle area as identified by Wilson and Sutton (1976) are:

- Pennsylvanian "Salt" sands (600–1,970 ft)
- Mississippian "Maxon sands" of Pennington Group (1,085–1,140 ft)
- Mississippian Newman "Big Lime" Limestone (1,174–3,940 ft)
- Mississippian "Waverly sands" or Borden Formation (1,335–1,616 ft)
- Devonian Ohio or Chattanooga black shale (3,200–6,000 ft)
- Silurian "Corniferous" Lockport Dolomite and Big Six sand (1,979–3,855 ft)
- Silurian "Clinton shale" or Rose Hill Formation (2,000+ ft)

Many of the oil wells drilled in these quadrangles are producing from the Newman Limestone or Big Lime. Reservoir rocks include fractured limestone, porous dolostone, and porous oolitic limestone. Hydrocarbon traps in the Big Lime are predominantly stratigraphic, with the thicker limestone section being deposited in erosional channels of the underlying Borden Formation (Harris and Sparks, in preparation).

Detailed reservoir studies are available for selected fields: KayJay Consolidated Pool, Mississippian "Maxon" Pennington Group (Barlow, 1996); Stoney Fork Field, Mississippian Newman Big Lime Limestone (Smosna, 1996); Artemus-Himyar Consolidated Field; Silurian Lockport; and Big Six (Meglen and Noger, 1996).

Limestone, Sand, Gravel, and Shale

Three active limestone quarries are present in the area: one each in Bell, Harlan, and Letcher Counties (Glass and Malone, 2002). Large reserves suitable for construction purposes are present from the lower member of the Newman Limestone along the north face of Pine Mountain. The limestone is quarried and crushed for use as road metal, blacktop mix, agricultural lime, and concrete aggregate.

Limestone suitable for coal-mining operations (with low-silica and high-calcium properties) is also available in the Newman Limestone along the top of Pine Mountain. Low-silica limestone is carbonate rock with total silicon dioxide (SiO_2) content of 4 percent or less, and is used as rock dust in underground coal mines for explosion abatement. High-calcium limestone is carbonate rock with 95 percent or more calcium carbonate ($CaCO_3$), and is used as a neutralizing agent in surface-mine reclamation and acid-drainage control. Dever and others (1991, 1992) measured several zones of low-silica stone, 3 to 20 m (10 to 64 ft) thick, that had corresponding intervals of high-calcium limestone present in the lower member of the Newman Limestone in selected quarries and outcrop exposures in Harlan and Letcher Counties.

Smaller quarries, now abandoned, were in operation to quarry silica sand and gravel from well-sorted, friable quartzose sandstone beds of the lower Breathitt Group, and from the pebbly quartzarenites of the Sewanee–Warren Point Sandstones and the Bee Rock Sandstone of the Breathitt Group ("Lee" sandstones of McGrain, 1956). Sand and gravel are also available from alluvial deposits. Clay shale below the Blue Gem coal zone of the Breathitt Group has been found to be satisfactory for use in lightweight aggregate and in the manufacture of common brick and structural tile (McGrain and Kendall, 1957).

ENGINEERING GEOLOGY

The highly dissected topography in the Middlesboro and Bristol area, in conjunction with the steeply dipping bedrock exposed along Pine Mountain, has contributed to a history of landslides and also present a future potential for engineering and maintenance problems. The interbedded sequence of sandstone, shale, and coal in the Grundy Formation, on the south-dipping flank of Pine Mountain, is prone to failure by landslide and creep. Numerous slumps and landslides also surround the central uplift in the Middlesboro impact structure. The presence of prominent landslide scars and slumped bedrock indicate that future landslides may occur where these relatively unstable beds are undercut by rivers and their tributaries or by construction work for roads and mines. Because the geologic factors apparently contributing to instability are known, potentially slide-prone areas can be outlined and construction can be planned to avoid disturbing natural conditions of equilibrium (Froelich, 1970). Logging, clearcutting, and removal of vegetation for construction can destabilize slopes. Coal-mining activities can also precipitate landslides, removing vegetation, steepening slopes, and cutting the toes of old slides. Landslides of colluvium from hillsides pose engineering hazards and have damaged roads and railroads.

The escarpment of Pine Mountain (the north-facing flank) has created several naturally occurring, precipitous overhangs of large sandstone boulders, which are an imminent hazard to the communities below. One prominent example is the hanging or Chained Rock at Pineville. This boulder is a thrust sheet remnant, which has minimal basal support and is "held in place" by a thick chain 100 ft long and weighing 1.5 tons. This chain obviously would not prevent a rock fall if the basal support of this boulder were removed. The chain was placed there by local citizens in 1933 more for a publicity stunt than as a safety precaution (Bell County Public Libraries, 2003). The threat is real, however; and caution must be exercised wherever construction may remove material from along the north slope of Pine Mountain.

HYDROGEOLOGY

The Middlesboro and Bristol quadrangles cover parts of the Cumberland River and Kentucky River Basin watersheds. The availability and quality of groundwater in this area are discussed in Price and others (1962) and Kilburn and others (1962). Carey and Stickney (2001a–f, 2002) have written a series of Web-based groundwater resource reports for Bell, Clay, Harlan, Knox, Leslie, Letcher, and Whitley Counties.

Water Quality and Production

Soft to moderately hard water at rates adequate for domestic supply is available from most sandstone beds of the Breathitt Group at shallow to moderate depth across much of the quadrangle area. Groundwater comes from joints and bedding planes in sandstone, shale, and coal. Naturally occurring contaminants that may be present in objectionable amounts in the groundwater are sulfate, salt (sodium chloride), iron, and manganese. In some locations, abandoned oil and gas wells have contaminated shallow, freshwater aquifers with salt water brought up from deeper formations. High iron and manganese levels, found in many wells, can produce objectionable taste and stain laundry and porcelain fixtures. Coal mining increases the amount of fresh surface area of the rocks exposed to oxidation, which can increase the sulfate and metals concentrations (Carey and Stickney, 2001a–f, 2002).

Some wells drilled into permeable units of the lower Breathitt and Pennington Groups, and the Newman Formation south of Pine Mountain, may produce artesian flow. Wells from the lower member of the Newman Limestone on Pine Mountain yield as much as 400 gallons per minute (gpm) near Pineville (Froelich and Tazelaar, 1974). The most prolific wells and springs produce water from solution cavities in the limestone. Most springs throughout the area, however, generally produce at 5 to 10 gal/min (Carey and Stickney, 2001b,c, 2002).

Most of the wells drilled in valley bottoms are adequate for a modern domestic supply; however, fewer wells drilled on hillsides and ridgetops supply adequate yields. Wells drilled into bedrock deeper than 61 m (200 ft) below the valley bottoms may produce enough water for small municipal or industrial supplies. Municipal water-supply resources have also been generated from abandoned underground coal mines. Detailed analyses at sites in Letcher, Perry, Clay, and Harlan Counties (KGS, 2003c) indicate recharge rates ranging from 120,000 to 700,000 gallons per day, and storage volumes ranging from 260 to 480 million gallons. Even though water from abandoned underground mines tends to have higher concentrations of sulfate and dissolved metals (iron, magnesium, and manganese), municipal water systems successfully use this source of water after conventional treatment methods.

Karst

Pine Mountain is one of the four major karst regions in Kentucky (Currens, 2001). Caves and other karst features (sinkholes, vertical shafts, and springs) develop in and along a long, narrow strip of exposed, tilted Newman Limestone. The exposure of the Newman Limestone is the result of the faulting and folding of the Mississippian carbonates during movement of the Pine Mountain Thrust, and the subsequent erosion of overlying strata. The limestone is bounded by sandstones and shales, and karst development is further limited by the area of limestone exposed and by structure restricting groundwater circulation. Many springs are located at major gaps or in small hollows on the northwest slope of the mountain. Sinkholes are small and scattered because of rapid infill by downslope movement of debris and by widely distributed joints and bedding planes.

TOURISM AND SITES OF SPECIAL INTEREST

Pine Mountain and Cumberland Mountain, with their many spectacular sandstone cliffs and hogbacks, are among the most scenic places in southeastern Kentucky. This rugged beauty has been deemed worthy of preservation and development for outdoor recreational purposes.

Two areas of special scenic interest in Bell County are Pine Mountain State Park, on Pine Mountain overlooking Pineville (McGrain, 1975), and Cumberland Gap National Historic Park, south of Middlesboro, which covers part of Cumberland Mountain (Dean and Moshier, 1989; Englund and Harris, 1961). Cumberland Gap, a remnant of an ancient stream channel, is at an elevation of 502 m (1,648 ft). The gap was the gateway through the Cumberland Mountain barrier for early settlers more than 200 years ago, and today is an important route for north–south motor vehicle traffic (McGrain and Currens, 1978; Dean and Moshier, 1989).

The Dr. Thomas Walker State Historic Site at Barbourville, located in adjacent Knox County, commemorates the site where the surveyor and physician led the first expedition through Cumberland Gap in 1750, preceding the pioneer Daniel Boone by 17 years. Kingdom Come State Park, in Cumberland, Ky. (Harlan County), named after the popular Civil War novel *The Little Shepherd of Kingdom Come* by Kentucky author John Fox Jr., preserves 1,283 acres of unspoiled wilderness and some of the most extraordinary rock formations in the state. The park offers a spectacular view of Black Mountain to the south, which at an elevation of 1,263 m (4,145 ft) is the highest point in Kentucky (McGrain and Currens, 1978; Kentucky State Parks, 2003).

In March 2002, the Kentucky legislature passed a bill calling for the creation of the Pine Mountain Trail State Linear Park. The proposed trail will be more than 193 km (120 mi) long and extend from the Breaks Interstate Park on the Kentucky-Virginia border near Elkhorn City, Ky. (Pike County), to the Cumberland Gap National Park at Middlesboro, eventually connecting to the Cumberland Trail into Tennessee. As of spring 2003, 45 km (28 mi) of the trail has been completed (Pine Mountain Trail Conference, 2003). When completed, the Pine Mountain Trail will traverse terrain replete with pioneer homesteads, waterfalls, cliffs, rock shelters, caves, upland bogs, and many other scenic features.

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Physical Soil Properties

Bell and Harlan Counties, Kentucky

[Entries under "Erosion Factors--T" apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of an entry indicates that data were not estimated. This report shows only the major soils in each map unit]

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
AgB:														
Allegheny	0-8	20-52	28-65	10-27	1.43-1.48	4.00-14.00	0.17-0.21	0.4-1.4	1.0-4.0	.32	.32	5	5	56
	8-33	20-60	20-65	12-35	1.44-1.63	4.00-14.00	0.15-0.19	0.5-2.5	0.0-0.5	.37	.37			
	33-42	30-70	15-60	5-35	1.61-1.65	4.00-14.00	0.11-0.15	0.2-2.5	0.0-0.5	.32	.32			
	42-72	30-70	15-50	5-35	1.44-1.62	4.00-14.00	0.11-0.15	0.1-2.5	0.0-0.5	.37	.37			
	72-82	35-75	10-50	5-35	1.49-1.68	4.00-14.00	0.10-0.15	0.1-2.5	0.0-0.5	.32	.32			
AtF:														
Alticrest	0-2	---	---	8-18	1.40-1.55	14.00-42.00	0.12-0.18	0.0-2.9	1.0-3.0	.17	.17	2	3	86
	2-33	---	---	8-18	1.40-1.55	14.00-42.00	0.10-0.16	0.0-2.9	0.0-0.5	.24	.37			
	33-43	---	---	---	---	---	---	---	---	---	---			
Helechawa	0-5	---	---	4-15	1.10-1.40	14.00-42.00	0.10-0.18	0.0-2.9	2.0-10	.15	.15	5	3	86
	5-49	---	---	7-18	1.35-1.70	14.00-42.00	0.08-0.14	0.0-2.9	0.8-1.5	.24	.24			
	49-63	---	---	5-15	1.50-1.70	14.00-42.00	0.08-0.13	0.0-2.9	0.3-0.8	.28	.28			
	63-73	---	---	---	---	---	---	---	---	---	---			
Totz	0-7	---	---	3-12	1.15-1.35	42.00-141.00	0.07-0.12	0.0-2.9	1.0-5.0	.32	.32	1	3	86
	7-18	---	---	3-12	1.50-1.70	42.00-141.00	0.05-0.11	0.0-2.9	0.0-0.8	.37	.37			
	18-28	---	---	---	---	---	---	---	---	---	---			
CgF:														
Cloverlick	0-2	---	---	---	0.05-0.10	42.00-141.00	0.15-0.45	---	61-78	---	---	5	7	38
	2-8	23-52	28-50	7-27	1.05-1.52	14.11-42.34	0.11-0.15	0.2-1.7	0.5-3.0	.10	.20			
	8-24	18-45	28-65	7-27	1.25-1.52	4.23-42.34	0.12-0.16	0.1-1.7	0.3-0.7	.24	.37			
	24-43	20-52	28-65	7-27	1.25-1.52	14.11-42.34	0.07-0.11	0.1-2.1	0.0-1.0	.15	.43			
	43-80	28-60	28-60	5-35	1.00-1.50	4.23-42.34	0.05-0.09	0.0-2.1	0.3-0.7	.10	.37			

Physical Soil Properties

Bell and Harlan Counties, Kentucky

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
CgF:														
Guyandotte	0-2	---	---	---	0.20-0.35	42.00-141.00	0.15-0.39	---	30-90	---	---	5	6	48
	2-5	---	---	---	0.26-0.35	42.00-141.00	0.15-0.38	---	30-90	---	---			
	5-15	52-75	8-35	5-20	1.08-1.53	4.00-42.00	0.07-0.11	0.1-0.7	2.0-10	.02	.05			
	15-67	30-70	15-55	3-20	1.35-1.60	4.00-42.00	0.03-0.07	0.0-1.0	0.2-1.5	.05	.24			
Highsplint	0-1	---	---	---	0.05-0.10	42.00-141.00	0.15-0.43	---	61-78	---	---	5	8	0
	1-4	15-35	50-65	10-27	1.22-1.46	4.23-42.34	0.08-0.12	0.2-1.3	0.5-5.0	.10	.32			
	4-11	15-35	40-65	18-34	1.39-1.48	4.23-42.34	0.07-0.11	0.4-2.0	0.3-0.7	.10	.37			
	11-28	15-35	40-65	18-34	1.39-1.53	4.23-42.34	0.07-0.11	0.4-2.0	0.3-0.7	.10	.37			
	28-48	15-40	35-60	18-34	1.39-1.44	4.23-42.34	0.07-0.11	0.4-2.0	0.3-0.7	.10	.37			
	48-85	15-50	28-50	7-40	1.40-1.58	1.41-14.11	0.07-0.11	0.1-2.7	0.2-0.7	.10	.43			
Cr:														
Craigsville, occasionally flooded	0-9	---	---	5-15	1.20-1.40	14.11-141.14	0.07-0.15	0.0-2.9	1.0-5.0	.10	.17	3	5	56
	9-20	---	---	5-15	1.30-1.60	14.11-141.14	0.06-0.15	0.0-2.9	0.5-1.0	.15	.28			
	20-60	---	---	5-10	1.35-1.55	42.34-141.14	0.04-0.09	0.0-2.9	0.5-1.0	.05	.24			
Philo, occasionally flooded	0-9	---	---	10-18	1.20-1.40	14.11-42.34	0.10-0.14	0.0-2.9	2.0-4.0	.17	.17	5	3	86
	9-60	---	---	5-18	1.20-1.40	4.23-14.11	0.10-0.20	0.0-2.9	0.0-0.5	.55	.55			
Du:														
Dumps, mine (tailings & tipples)	---	---	---	---	---	---	---	---	---	---	---	---	---	---
FbC:														
Fairpoint, unstable fill	0-3	---	---	18-27	1.40-1.55	4.23-14.11	0.09-0.18	0.0-2.9	0.0-0.5	.20	.43	5	7	38
	3-60	---	---	18-35	1.60-1.80	1.41-4.23	0.03-0.10	3.0-5.9	0.0-0.5	.05	.49			
Bethesda, unstable fill	0-7	---	---	18-27	1.40-1.55	4.23-14.11	0.10-0.16	0.0-2.9	0.0-0.5	.15	.37	5	8	0
	7-60	---	---	18-35	1.60-1.90	1.41-4.23	0.04-0.13	0.0-2.9	0.0-0.5	.10	.37			

Physical Soil Properties

Bell and Harlan Counties, Kentucky

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
FbF:														
Fairpoint, unstable fill	0-11	24-52	28-50	7-27	1.35-1.50	4.23-14.11	0.14-0.20	0.3-2.3	0.5-2.0	.20	.37	3	7	38
	11-32	10-52	28-60	7-40	1.60-1.80	1.40-4.00	0.03-0.10	0.2-2.9	0.0-0.3	.10	.43			
	32-41	20-52	28-60	7-27	1.60-1.80	1.40-4.00	0.00-0.10	0.0-1.7	0.0-0.3	.10	.43			
	41-51	20-52	28-60	7-27	1.60-1.80	1.40-4.00	0.01-0.10	0.0-1.0	0.0-0.3	.05	.43			
	51-58	20-52	28-60	7-27	1.60-1.80	1.40-4.00	0.01-0.10	0.0-1.0	0.0-0.3	.10	.49			
	58-72	20-52	28-60	7-27	1.60-1.80	1.40-4.00	0.01-0.10	0.0-1.0	0.0-0.3	.05	.43			
Bethesda, unstable fill	0-12	18-52	28-60	7-40	1.35-1.50	4.23-14.11	0.14-0.20	0.3-4.0	0.5-5.0	.20	.37	5	7	38
	12-36	10-52	28-60	7-40	1.60-1.80	1.40-4.00	0.03-0.10	0.1-3.2	0.0-5.0	.15	.37			
	36-58	10-52	28-60	7-35	1.60-1.80	1.40-4.00	0.03-0.10	0.1-2.5	0.0-5.0	.15	.37			
	58-72	20-52	28-60	7-35	1.60-1.80	1.40-4.00	0.01-0.10	0.0-2.5	0.0-5.0	.10	.28			
GsD:														
Gilpin	0-6	---	---	15-27	1.20-1.40	4.23-14.11	0.18-0.22	0.0-2.9	1.0-3.0	.32	.32	3	6	48
	6-28	---	---	20-35	1.20-1.45	4.23-14.11	0.08-0.16	0.0-2.9	0.0-0.5	.24	.43			
	28-38	---	---	---	---	---	---	---	---	---	---			
Shelocta	0-12	---	---	10-27	1.15-1.30	4.00-14.00	0.16-0.22	0.0-2.9	0.5-5.0	.32	.32	3	5	56
	12-48	---	---	18-45	1.30-1.55	4.00-14.00	0.10-0.20	0.0-2.9	0.0-0.5	.43	.43			
	48-58	---	---	---	---	---	---	---	---	---	---			
GtF:														
Gilpin, very stony	0-1	---	---	---	0.05-0.10	42.00-141.00	0.00-0.30	---	52-86	---	---	2	5	56
	1-5	10-43	30-70	7-27	1.01-1.45	4.00-14.00	0.12-0.18	0.2-1.7	2.0-4.0	.24	.37			
	5-11	10-52	28-70	18-27	1.20-1.61	4.00-14.00	0.08-0.12	0.7-1.8	1.0-2.0	.28	.49			
	11-20	10-45	28-65	18-35	1.20-1.80	4.00-14.00	0.08-0.12	0.7-3.1	0.3-1.0	.32	.55			
	20-28	10-45	28-65	15-35	1.20-1.80	4.00-14.00	0.08-0.12	0.6-3.8	0.0-0.5	.24	.49			
	28-38	---	---	---	---	0.01-0.10	---	---	---	---	---			

Physical Soil Properties

Bell and Harlan Counties, Kentucky

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
GtF:														
Rayne, very stony	0-1	---	---	---	0.05-0.10	42.00-141.00	0.00-0.30	---	52-86	---	---	4	5	56
	1-2	10-45	45-70	10-27	0.50-1.00	4.00-14.00	0.16-0.22	0.4-1.7	1.0-4.0	.37	.37			
	2-7	10-45	28-65	10-27	1.30-1.60	4.00-14.00	0.10-0.20	0.4-1.9	0.5-3.0	.43	.43			
	7-17	10-45	28-62	15-35	1.30-1.50	4.00-14.00	0.08-0.16	0.5-2.0	0.3-0.8	.49	.49			
	17-24	10-45	28-65	18-35	1.40-1.80	4.00-14.00	0.08-0.16	0.3-1.9	0.3-0.8	.49	.49			
	24-31	10-45	28-65	18-35	1.40-1.80	4.00-14.00	0.08-0.16	0.3-2.1	0.0-0.8	.24	.43			
	31-44	10-32	41-70	18-27	1.35-1.46	4.00-14.00	0.08-0.16	0.4-1.0	0.0-0.3	.17	.49			
	44-54	---	---	---	---	0.00-0.01	---	---	---	---	---			
Sequoia, very stony	0-1	---	---	---	0.05-0.10	42.00-141.00	0.00-0.30	---	52-86	---	---	3	5	56
	1-5	6-39	34-72	15-27	1.00-1.42	4.23-14.11	0.17-0.20	0.0-2.9	0.5-2.0	.49	.49			
	5-12	6-39	16-55	27-45	1.31-1.50	1.41-4.23	0.08-0.16	0.0-5.9	0.0-0.5	.43	.43			
	12-20	6-39	6-45	35-55	1.31-1.45	1.41-4.23	0.08-0.16	0.0-5.9	0.0-0.5	.28	.28			
	20-34	6-39	6-45	35-55	1.31-1.45	1.41-4.23	0.08-0.16	0.0-5.9	0.0-0.5	.28	.28			
	34-44	---	---	---	---	0.00-1.41	---	---	---	---	---			
HeF:														
Helechawa	0-1	---	---	---	0.22-0.27	42.00-141.00	0.15-0.45	---	61-78	---	---	5	2	134
	1-3	40-90	2-50	4-15	0.70-1.43	14.00-42.00	0.10-0.14	0.1-0.9	4.0-20	.05	.05			
	3-12	40-90	2-50	4-15	1.40-1.53	14.00-42.00	0.13-0.17	0.1-0.7	1.3-4.0	.15	.15			
	12-45	40-85	2-50	4-17	1.43-1.67	14.00-42.00	0.11-0.15	0.1-0.9	0.1-1.3	.28	.28			
	45-80	40-90	2-50	4-27	1.45-1.64	14.00-42.00	0.10-0.14	0.1-1.4	0.1-1.0	.17	.17			
Varilla	0-2	---	---	---	0.22-0.27	42.00-141.00	0.15-0.45	---	61-78	---	---	3	5	56
	2-5	30-70	20-67	2-27	1.29-1.48	14.00-42.00	0.10-0.14	0.0-1.2	0.7-6.0	.10	.20			
	5-12	30-70	28-67	2-27	1.48-1.60	14.00-42.00	0.09-0.13	0.0-1.1	0.5-2.0	.17	.32			
	12-22	30-70	28-64	2-27	1.48-1.63	14.00-42.00	0.06-0.10	0.0-0.9	0.1-1.0	.15	.37			
	22-36	30-70	21-64	2-27	1.43-1.60	14.00-42.00	0.05-0.09	0.0-0.9	0.1-1.0	.10	.37			
	36-47	40-76	21-50	3-18	1.43-1.60	14.00-42.00	0.03-0.07	0.0-0.6	0.1-0.5	.05	.28			
	47-66	43-90	5-50	2-18	1.43-1.60	14.00-141.00	0.01-0.03	0.0-0.6	0.1-0.5	.02	.17			

Physical Soil Properties

Bell and Harlan Counties, Kentucky

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
HeF:														
Jefferson	0-1	---	---	---	0.22-0.27	42.00-141.00	0.15-0.45	---	61-78	---	---	5	6	48
	1-10	24-70	10-65	10-20	1.34-1.47	14.11-42.34	0.14-0.18	0.3-0.9	0.8-5.0	.20	.32			
	10-24	21-70	10-53	10-27	1.48-1.55	14.11-42.34	0.13-0.17	0.3-1.3	0.4-0.8	.43	.43			
	24-41	21-70	10-53	10-27	1.54-1.64	14.11-42.34	0.13-0.17	0.3-1.3	0.2-0.4	.43	.43			
	41-81	28-75	20-50	5-30	1.50-1.58	14.11-42.34	0.08-0.12	0.1-1.2	0.1-0.2	.15	.37			
HsF:														
Highsplint	0-4	---	---	15-27	1.10-1.30	4.23-42.34	0.07-0.15	0.0-2.9	0.5-5.0	.10	.32	5	8	0
	4-48	---	---	18-34	1.30-1.55	4.23-42.34	0.07-0.13	0.0-2.9	0.3-0.7	.10	.43			
	48-60	---	---	18-34	1.55-1.70	1.41-14.11	0.05-0.11	0.0-2.9	0.2-0.7	.15	.43			
Cloverlick	0-11	---	---	18-27	1.00-1.20	4.00-14.00	0.20-0.24	0.0-2.9	5.0-15	.10	.20	5	8	0
	11-45	---	---	15-30	1.30-1.50	4.00-14.00	0.12-0.20	0.0-2.9	0.3-0.8	.10	.37			
	45-60	---	---	15-30	1.30-1.60	4.00-14.00	0.05-0.12	0.0-2.9	0.0-0.5	.10	.37			
Guyandotte	0-13	---	---	5-27	1.00-1.30	4.00-14.00	0.10-0.16	0.0-2.9	2.0-10	.10	.37	5	8	0
	13-60	---	---	5-27	1.30-1.60	4.00-14.00	0.05-0.15	0.0-2.9	0.3-0.8	.10	.43			
Ph:														
Philo, occasionally flooded	0-9	---	---	10-18	1.20-1.40	14.11-42.34	0.10-0.14	0.0-2.9	2.0-4.0	.17	.17	3	3	86
	9-37	---	---	10-18	1.20-1.40	4.23-14.11	0.10-0.20	0.0-2.9	0.0-0.5	.28	.28			
	37-60	---	---	5-18	1.20-1.40	14.00-42.00	0.06-0.10	0.0-2.9	0.0-0.5	.05	.32			
Po:														
Pope, occasionally flooded	0-4	---	---	5-15	1.20-1.40	14.00-42.00	0.10-0.16	0.0-2.9	1.0-4.0	.20	.20	4	3	86
	4-23	---	---	5-18	1.30-1.60	4.00-42.00	0.10-0.18	0.0-2.9	0.3-0.8	.32	.32			
	23-59	---	---	5-20	1.30-1.60	4.00-42.00	0.10-0.18	0.0-2.9	0.0-0.5	.20	.20			
	59-62	---	---	5-20	1.30-1.60	4.00-42.00	0.10-0.18	0.0-2.9	0.0-0.5	.02	.10			

Physical Soil Properties

Bell and Harlan Counties, Kentucky

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
Sb:														
Shelbiana, occasionally flooded	0-15	---	---	10-27	1.20-1.40	4.23-14.11	0.12-0.22	0.0-2.9	2.0-6.0	.32	.32	5	5	56
	15-70	---	---	18-34	1.20-1.50	4.23-14.11	0.12-0.22	0.0-2.9	0.3-0.8	.43	.43			
SgE:														
Shelocta	0-6	---	---	10-27	1.15-1.30	4.23-14.11	0.16-0.22	0.0-2.9	0.5-5.0	.32	.32	3	5	56
	6-33	---	---	20-34	1.30-1.55	4.23-14.11	0.10-0.20	0.0-2.9	0.5-2.0	.43	.43			
	33-58	---	---	15-45	1.30-1.55	4.23-42.34	0.08-0.16	0.0-2.9	0.0-0.5	.24	.43			
	58-68	---	---	---	---	---	---	---	---	---	---			
Gilpin	0-6	---	---	15-27	1.20-1.40	4.23-14.11	0.18-0.22	0.0-2.9	1.0-3.0	.32	.32	3	6	48
	6-26	---	---	18-35	1.20-1.45	4.23-14.11	0.08-0.16	0.0-2.9	0.0-0.5	.43	.43			
	26-36	---	---	---	---	---	---	---	---	---	---			
ShF:														
Shelocta, very stony	0-1	---	---	---	0.15-0.30	42.00-141.00	0.27-0.38	---	52-86	---	---	4	5	56
	1-3	10-35	50-70	10-27	1.26-1.39	4.00-14.00	0.12-0.22	0.6-2.9	1.0-10	.32	.32			
	3-7	10-45	28-65	10-27	1.31-1.42	4.00-14.00	0.11-0.17	0.5-2.8	0.5-3.0	.37	.37			
	7-23	20-45	28-62	18-35	1.34-1.50	4.00-14.00	0.11-0.19	0.7-2.6	0.3-1.0	.32	.43			
	23-34	10-45	28-65	18-35	1.42-1.53	4.00-14.00	0.07-0.19	0.4-2.7	0.3-0.8	.28	.49			
	34-45	10-45	28-65	18-35	1.42-1.53	4.00-14.00	0.08-0.20	0.4-2.9	0.1-0.5	.17	.43			
	45-59	10-32	50-70	18-27	1.35-1.46	4.00-14.00	0.00-0.18	0.5-1.7	0.0-0.3	.64	.64			
	59-69	---	---	---	---	0.00-0.01	---	---	---	---	---			
Highsplint, very stony	0-1	---	---	---	0.05-0.10	42.00-141.00	0.14-0.26	---	61-78	---	---	5	8	0
	1-4	13-32	50-64	7-27	1.22-1.46	4.23-42.34	0.07-0.14	0.2-1.3	0.5-5.0	.10	.32			
	4-11	13-40	35-64	18-34	1.39-1.48	4.23-42.34	0.07-0.14	0.4-2.0	0.3-0.7	.10	.37			
	11-28	13-35	42-62	18-34	1.39-1.53	4.23-42.34	0.07-0.13	0.4-2.0	0.3-0.7	.10	.37			
	28-48	18-40	40-62	18-34	1.39-1.44	4.23-42.34	0.07-0.15	0.4-2.0	0.3-0.7	.10	.37			
	48-85	18-40	40-62	18-34	1.40-1.58	1.41-14.11	0.07-0.15	0.4-2.0	0.2-0.7	.10	.43			

Physical Soil Properties

Bell and Harlan Counties, Kentucky

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
ShF:														
Gilpin, very stony	0-1	---	---	---	0.05-0.10	42.00-141.00	0.25-0.34	---	52-86	---	---	2	6	48
	1-5	10-40	50-70	7-27	1.01-1.45	4.00-14.00	0.11-0.17	0.1-1.5	2.0-4.0	.24	.37			
	5-11	10-50	30-70	18-27	1.20-1.61	4.00-14.00	0.10-0.20	0.7-1.8	1.0-2.0	.28	.49			
	11-20	10-45	24-70	18-35	1.20-1.80	4.00-14.00	0.10-0.23	0.7-3.1	0.3-1.0	.32	.55			
	20-28	10-45	28-70	15-40	1.20-1.80	4.00-14.00	0.00-0.23	0.6-4.8	0.0-0.5	.24	.49			
	28-38	---	---	---	---	0.01-0.10	---	---	---	---	---			
SkF:														
Shelocta, very stony	0-1	---	---	---	0.05-0.10	42.00-141.00	0.00-0.30	---	52-86	---	---	4	5	56
	1-3	10-45	45-70	10-27	0.50-1.00	4.00-14.00	0.16-0.22	0.3-2.6	2.0-12	.32	.32			
	3-7	10-45	28-65	10-27	1.30-1.60	4.00-14.00	0.10-0.20	0.4-1.9	1.5-5.0	.32	.32			
	7-23	20-45	28-62	18-35	1.30-1.50	4.00-14.00	0.08-0.16	0.5-2.0	1.0-2.0	.28	.43			
	23-34	10-45	28-65	18-35	1.40-1.80	4.00-14.00	0.08-0.16	0.3-1.9	0.3-0.8	.28	.49			
	34-45	10-45	28-65	18-35	1.40-1.80	4.00-14.00	0.08-0.16	0.3-2.1	0.0-0.8	.17	.43			
	45-59	8-32	50-70	18-27	1.35-1.46	4.00-14.00	0.08-0.16	0.4-1.0	0.0-0.3	.64	.64			
	59-69	---	---	---	---	0.00-0.01	---	---	---	---	---			
Kimper, very stony	0-2	---	---	---	0.05-0.10	42.00-141.00	0.00-0.03	---	61-78	---	---	5	7	38
	2-8	23-52	28-50	8-27	1.00-1.50	14.11-42.34	0.09-0.15	0.2-1.9	0.5-3.0	.10	.24			
	8-13	20-65	20-70	8-27	1.00-1.50	14.11-42.34	0.09-0.15	0.2-1.3	0.5-1.8	.17	.37			
	13-27	20-65	20-65	8-27	1.25-1.60	14.11-42.34	0.07-0.15	0.2-1.5	0.0-1.0	.24	.43			
	27-41	20-65	20-65	8-27	1.25-1.50	14.11-42.34	0.07-0.15	0.3-1.9	0.0-1.0	.20	.37			
	41-52	20-65	20-65	8-35	1.25-1.50	14.11-42.34	0.07-0.15	0.2-2.7	0.0-1.0	.15	.37			
	52-64	20-65	20-70	8-35	1.25-1.60	14.11-42.34	0.07-0.15	0.2-2.7	0.0-1.0	.15	.37			
	64-75	20-65	20-70	8-35	1.25-1.50	14.11-42.34	0.07-0.15	0.2-2.7	0.0-1.0	.15	.49			
	75-85	---	---	---	---	0.42-1.40	---	---	---	---	---			

Physical Soil Properties

Bell and Harlan Counties, Kentucky

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
SkF:														
Cloverlick, very stony	0-2	---	---	---	0.05-0.10	42.00-141.00	0.00-0.03	---	61-78	---	---	5	7	38
	2-8	23-52	28-50	8-27	1.00-1.50	14.11-42.34	0.09-0.15	0.2-1.7	0.5-3.0	.10	.20			
	8-24	18-45	28-65	8-27	1.00-1.50	4.23-42.34	0.07-0.13	0.2-3.0	0.3-0.7	.24	.37			
	24-43	20-52	28-65	8-27	1.00-1.50	14.11-42.34	0.07-0.15	0.0-1.6	0.0-1.0	.15	.43			
	43-80	40-60	8-52	8-35	1.00-1.50	4.23-42.34	0.03-0.13	0.0-2.1	0.3-0.7	.10	.37			
SmF:														
Shelocta	0-8	---	---	10-25	1.15-1.30	4.00-14.00	0.16-0.22	0.0-2.9	0.5-5.0	.32	.32	3	5	56
	8-31	---	---	18-34	1.30-1.55	4.00-14.00	0.10-0.20	0.0-2.9	0.3-0.8	.28	.43			
	31-55	---	---	15-34	1.30-1.55	4.00-14.00	0.08-0.16	0.0-2.9	0.0-0.5	.24	.43			
	55-65	---	---	---	---	---	---	---	---	---	---			
Kimper	0-7	---	---	12-27	1.00-1.40	4.23-42.34	0.13-0.20	0.0-2.9	2.0-15	.15	.28	5	6	48
	7-48	---	---	18-30	1.20-1.70	4.23-14.11	0.13-0.20	0.0-2.9	0.5-2.0	.24	.43			
	48-62	---	---	12-20	1.20-1.70	4.23-42.34	0.10-0.16	0.0-2.9	0.0-0.5	.37	.64			
	62-72	---	---	---	---	---	---	---	---	---	---			
Cutshin	0-17	---	---	12-27	1.20-1.40	4.23-14.11	0.08-0.16	0.0-2.9	3.0-7.0	.28	.28	3	5	56
	17-60	---	---	12-27	1.20-1.40	4.23-14.11	0.08-0.16	0.0-2.9	0.5-2.0	.15	.37			
Ud:														
Udorthents, unstable fill	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Urban land	---	---	---	---	---	---	---	---	---	---	---	---	---	---
UrE:														
Udorthents, unstable fill	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Urban land	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Physical Soil Properties

Bell and Harlan Counties, Kentucky

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
VrD:														
Varilla	0-5	---	---	3-20	1.00-1.40	14.11-42.34	0.10-0.13	0.0-2.9	1.0-6.0	.05	.15	5	7	38
	5-31	---	---	3-20	1.45-1.65	14.11-42.34	0.05-0.10	0.0-2.9	0.5-1.5	.10	.32			
	31-60	---	---	3-20	1.45-1.65	14.11-141.14	0.01-0.05	0.0-2.9	0.0-0.5	.05	.24			
W:														
Water	---	---	---	---	---	---	---	---	---	---	---	---	---	---

LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

EXHIBIT F
PRELIMINARY DESIGN DRAWINGS AND PRELIMINARY SUPPORTING DESIGN REPORT

Certain Material is Critical Energy/Electric Infrastructure Information (CEII).
Members of the Public may Obtain Nonpublic or Privileged Information
by Submitting a Freedom of Information Act (FOIA) Request.

TABLE OF CONTENTS

LIST OF TABLES

1.0 PRELIMINARY DESIGN DRAWINGS (18 CFR § 4.41(G)(1))

The specifications associated with the Lewis Ridge Pumped Storage Project (FERC No. 15249) (Lewis Ridge Project) are considered preliminary and may change because of engineering and geotechnical feasibility, environmental concerns, or site agreements and contracts. The preliminary design drawings of the principal Lewis Ridge Project works are filed with the Federal Energy Regulatory Commission (FERC or Commission) as follows. Table 1-1 provides a summary of the drawing numbers and titles for the preliminary design drawings.

Table 1-1: List of Lewis Ridge Project Preliminary Design Drawings

Drawing Number	Title
F-01	Project General Arrangement
F-02	Upper Reservoir Plan
F-03	Upper Reservoir Profile, Elevation, and Section
F-04	Upper Reservoir Water Intake/Outlet Structure Plan, Section and Isometric
F-05	Lower Reservoir Plan
F-06	Lower Reservoir Profile, Section, and Elevation
F-07	Lower Reservoir Water Intake/Outlet Structure Plan, Section and Isometric
F-08	Lower Reservoir Spillway Plan and Profile
F-09	Typical Low Level Outlets Plan and Section Details
F-10	Water Conveyance Plan and Profile
F-11	Powerhouse Plan
F-12	Powerhouse Cross Section Through Unit
F-13	Powerhouse Draft Tube and High Pressure Shaft Cross Section
F-14	One-Line Diagram
F-15	Initial Fill and Recharge Water Supply Pipelines Plan and Profile
F-16	Initial Fill and Recharge Water Supply Intake and Pump Station
F-17	Primary Disposal Site Plan, Profile and Section
F-18	Secondary Disposal Site Plan, Profile and Section
F-19	Overall Project General Arrangement Construction Conditions

In accordance with the Commission's regulations, certain sensitive information related to this relicensing proceeding is being filed under separate cover with the Commission only. Special handling of this material is required to protect the security of critical energy infrastructure. In order to protect critical energy infrastructure, the Commission has enacted regulations to govern public access to certain information.

The preliminary design drawings referenced herein contain sensitive and detailed engineering information considered to be Critical Energy/Electric Infrastructure Information (CEII) that, if used improperly, may compromise the safety of the Lewis Ridge Project and those responsible for its operation. Therefore, the preliminary design drawings have been labeled "CEII." These drawings have been submitted to FERC under separate cover. Agencies may file a CEII request under 18 CFR § 388.113 or a Freedom of Information Act (FOIA) request under 18 CFR § 388.108 to obtain the Exhibit F drawings.

2.0 PRELIMINARY SUPPORTING DESIGN REPORT (18 CFR § 4.41(G)(3))

The Preliminary Supporting Design Report (Preliminary SDR) is included in this Exhibit F. The Preliminary SDR includes information evaluated in support of the proposed Lewis Ridge Project design. The Preliminary SDR includes the following attachments:

Attachment 1:	Preliminary Engineering Geology Technical Memorandum
Attachment 2:	Site-Specific Seismic Hazard Analysis
Attachment 3:	Preliminary Dam Stability and Deformation Analysis Technical Memorandum
Attachment 4:	Probable Maximum Flood and Freeboard Analysis Technical Memorandum
Attachment 5:	Initial Fill and Recharge Technical Memorandum

The Preliminary SDR contains CEII and is submitted to FERC under separate cover. Agencies may file a CEII request under 18 CFR § 388.113 or a FOIA request under 18 CFR § 388.108 to obtain the Exhibit F drawings.

Critical Energy/Electric Infrastructure Information (CEII)
– Do Not Release –

EXHIBIT F

PRELIMINARY DESIGN DRAWINGS

Critical Energy/Electric Infrastructure Information (CEII)

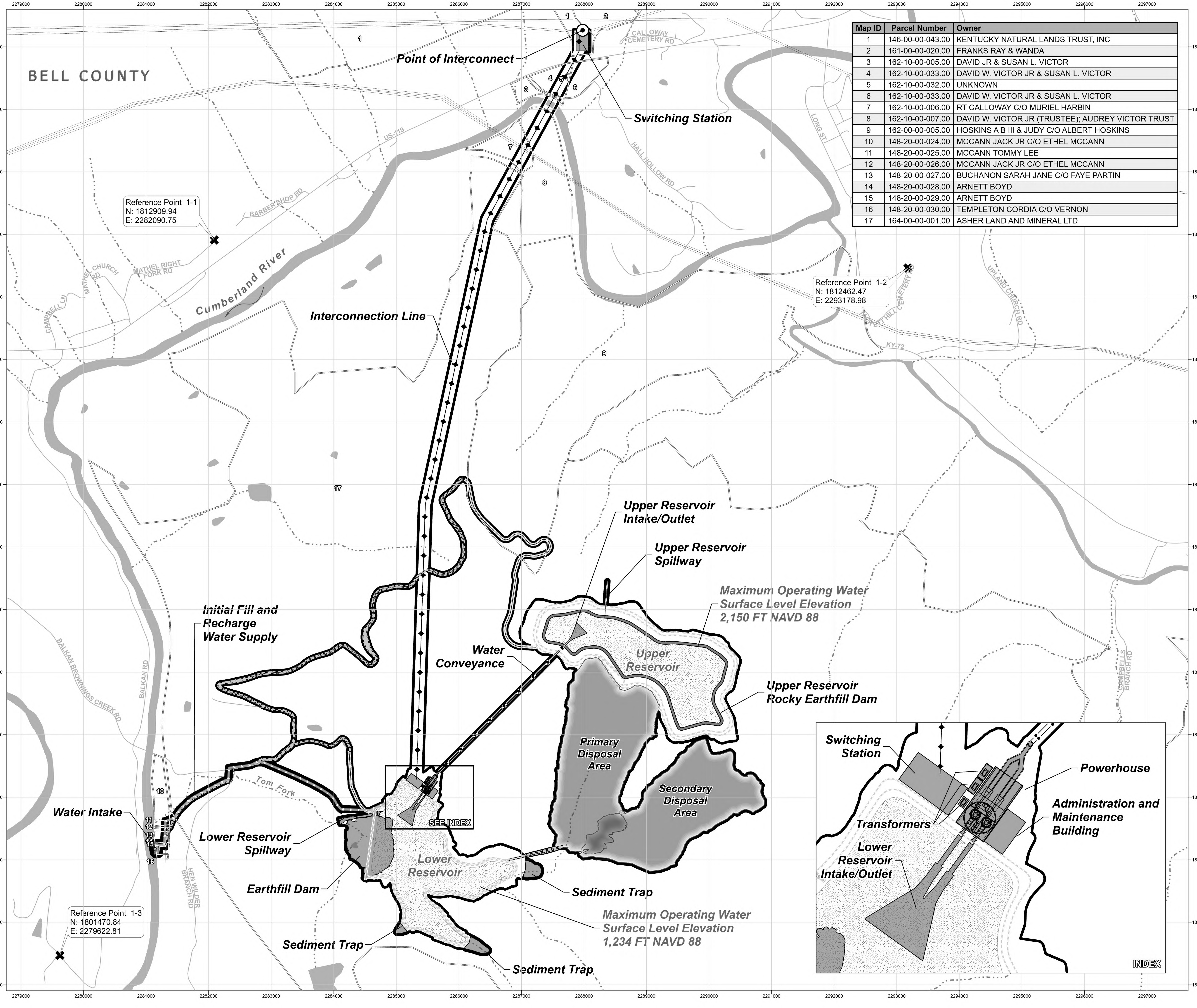
– Do Not Release –

EXHIBIT F

PRELIMINARY SUPPORTING DESIGN REPORT

LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

EXHIBIT G
PROJECT BOUNDARY MAP



Map ID	Parcel Number	Owner
1	146-00-00-043.00	KENTUCKY NATURAL LANDS TRUST, INC
2	161-00-00-020.00	FRANKS RAY & WANDA
3	162-10-00-005.00	DAVID JR & SUSAN L. VICTOR
4	162-10-00-033.00	DAVID W. VICTOR JR & SUSAN L. VICTOR
5	162-10-00-032.00	UNKNOWN
6	162-10-00-033.00	DAVID W. VICTOR JR & SUSAN L. VICTOR
7	162-10-00-006.00	RT CALLOWAY C/O MURIEL HARBIN
8	162-10-00-007.00	DAVID W. VICTOR JR (TRUSTEE); AUDREY VICTOR TRUST
9	162-00-00-005.00	HOSKINS A B III & JUDY C/O ALBERT HOSKINS
10	148-20-00-024.00	MCCANN JACK JR C/O ETHEL MCCANN
11	148-20-00-025.00	MCCANN TOMMY LEE
12	148-20-00-026.00	MCCANN JACK JR C/O ETHEL MCCANN
13	148-20-00-027.00	BUCHANON SARAH JANE C/O FAYE PARTIN
14	148-20-00-028.00	ARNETT BOYD
15	148-20-00-029.00	ARNETT BOYD
16	148-20-00-030.00	TEMPLETON CORDIA C/O VERNON
17	164-00-00-001.00	ASHER LAND AND MINERAL LTD

TN
MN
6.45°w
6/12/2025

- ▬ Proposed Project Boundary
- ◉ Point of Interconnect
- ✖ Reference Point
- ═ Regional Transmission Line
- ⋯ Stream
- ⋯ Other Hydrography
- — Public Road

Project Features

- -●- Water Conveyance
- ✦ Interconnection Line (161 kV)
- – – Permanent Access Road (Existing)
- – – Permanent Access Road (New)
- ○–○ Initial Fill and Recharge Water Supply

- ▨ Project Features
- ▨ Project Reservoir
- ▭ Disposal Area
- ▭ Parcels Intersecting the Proposed Project Boundary
- ■ River/Waterbody

Map notes:
1. The Lewis Ridge Project is located in the Commonwealth of Kentucky in Bell County.
2. Reference Point coordinates are shown in NAD 1983 StatePlane Kentucky South FIPS 1602 Ft US.
3. Elevations shown are referenced to North American Vertical Datum of 1988.
4. Licensee has acquired or plans to acquire rights to occupy and use all lands necessary or appropriate for the construction, maintenance, and operation of the Project. All property records are kept on file with the licensee.
5. There are no federal lands within the Proposed Project boundary.
6. The Proposed Project Boundary description, as required by 18 CFR 4.41, is represented here by a grid of Northings and Eastings around, and graticules within, the map frame. Any position in Northings and Eastings along the Proposed Project boundary can be determined using these references.
7. The Proposed Project Boundary was generated using the following buffers: a 5-ft buffer of Project access roads, a 100-ft buffer of the Project interconnection line, and a 25-ft buffer of other Project features.
8. Asher Land and Mineral LTD parcel boundary was derived from a survey completed in 1998 (estimate). No land has been sold or modified since the time of the survey. All other parcel boundaries were sourced from regrid (2022). Ownership for these parcels were sourced from qPublic (2025)
9. The Proposed Project Boundary encompasses 419.6 acres.

SURVEYORS STATEMENT

I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND DIGITAL REFERENCE SOURCES INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL FIELD SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

STATE OF MAINE
STEPHEN
W.
EVERETT
2161
PROFESSIONAL
LAND SURVEYOR

LEWIS RIDGE PUMPED STORAGE, LLC

LEWIS RIDGE PUMPED STORAGE PROJECT
FERC NO. 15249

PROJECT BOUNDARY MAP

EXHIBIT G
SCALE: 1" = 750'
SHEET NO. 1 OF 1

0 430 860 1,720 2,580 3,440
Feet

DATE: JUNE 2025
FERC DWG. NO. 15249-