OVEC IKEC

OHIO VALLEY ELECTRIC CORPORATION
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WRITER'S DIRECT DIAL NO:
(740) 897-7768

October 17, 2018

Mr. Bruno Pigott
Commissioner
Indiana Department of Environmental Management
100 N. Senate Avenue
Mail Code 50-01
Indianapolis, IN 46204-2251

Re: Indiana-Kentucky Electric Corporation
Clifty Creek Station
Notification of CCR Location Restrictions Posting

Dear Mr. Pigott:

In accordance with 40 CFR 257.107(e), the Indiana-Kentucky Electric Corporation (IKEC) is providing notification to the Commissioner (State Director) of the Indiana Department of Environmental Management that Coal Combustion Residual (CCR) units located at Clifty Creek Station in Madison, Indiana have undergone assessment by a qualified professional engineer and have been certified to be in compliance with the location restrictions outlined in 40 CFR 257.60 through 40 CFR 257.64. Reports documenting the process employed and final results of each assessment have been certified and posted to the facility's publically accessible internet site, as well as placed in the facility's operating record on October 17, 2018.

This information can be viewed at IKEC's publically accessible internet site at:

https://www.ovec.com/CCRCompliance.php

If you have any questions, or require any additional information, please call me at (740) 897-7768.

Sincerely,

Tim Fulk

Tim Fulk
Engineer II

TLF:klr

Stantec Consulting Services Inc.
11687 Lebanon Road, Cincinnati OH 45241-2012

October 16, 2018
File: 175534018
Revision 0

Indiana-Kentucky Electric Corporation
3932 U.S. Route 23
P.O. Box 468
Piketon, Ohio 45661

RE: Location Restrictions Compliance Demonstrations
West Boiler Slag Pond
EPA Final Coal Combustion Residuals (CCR) Rule
Clifty Creek Station
Madison, Jefferson County, Indiana

1.0 PURPOSE

This letter documents Stantec's certification of the location restrictions compliance demonstrations for the Indiana-Kentucky Electric Corporation (IKEC) Clifty Creek Station's West Boiler Slag Pond. Included in these demonstrations for the West Boiler Slag Pond are assessments of a) Placement Above the Uppermost Aquifer, b) Wetlands, c) Fault Areas, d) Seismic Impact Zones, and e) Unstable Areas.

2.0 LOCATION RESTRICTION ASSESSMENTS

2.1 PLACEMENT ABOVE THE UPPERMOST AQUIFER

An existing CCR surface impoundment must be assessed to demonstrate that it meets the minimum location requirements for placement above the uppermost aquifer as per 40 CFR 257.60(a)-(d).

2.2 WETLANDS

An existing CCR surface impoundment must be assessed to demonstrate that it meets the location requirements for wetlands as per 40 CFR 257.61(a)-(d).

2.3 FAULT AREAS

An existing CCR surface impoundment must be assessed to demonstrate that it meets the minimum location requirements for fault areas as per 40 CFR 257.62(a)-(d).

2.4 SEISMIC IMPACT ZONES

An existing CCR surface impoundment must be assessed to demonstrate that it meets the minimum location requirements for seismic impact zones as per 40 CFR 257.63(a)-(d).

2.5 UNSTABLE AREAS

An existing CCR surface impoundment must be assessed to demonstrate that it meets the minimum location requirements for unstable areas as per 40 CFR 257.64(a)-(e).

3.0 SUMMARY OF FINDINGS

The attached compliance demonstration reports outline the relevant project setting and technical elements considered for each of the location restriction demonstrations noted above in Section 2.0. Based on these assessments, the Clifty Creek West Boiler Slag Pond is in compliance with the location restriction requirements in the Final CCR Rule.

4.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Stan A. Harris, being a Professional Engineer in good standing in the State of Indiana, do hereby certify, to the best of my knowledge, information, and belief:

1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;
2. that the information contained herein is accurate as of the date of my signature below; and
3. that the IKEC Clifty Creek Station's West Boiler Slag Pond meets all requirements specified for locations restrictions outlined within the EPA CCR Final Rule.

SIGNATURE Stan A. Harris

DATE 10/16/18

STAN A. HARRIS
No. PE-19700150
10/16/18

ADDRESS: Stantec Consulting Services Inc.
11687 Lebanon Road
Cincinnati, Ohio 45241

TELEPHONE: (513) 842-8200

ATTACHMENTS:

A. Placement Above the Uppermost Aquifer Compliance Demonstration Report
B. Wetlands Compliance Demonstration Report
C. Fault Areas Compliance Demonstration Report
D. Seismic Impact Zones Compliance Demonstration Report
E. Unstable Areas Compliance Demonstration Report

ATTACHMENT A

PLACEMENT ABOVE THE UPPERMOST AQUIFER COMPLIANCE DEMONSTRATION REPORT

Placement Above the Uppermost Aquifer Demonstration

West Boiler Slag Pond
Clifty Creek Station
Madison, Indiana

Prepared for:
Indiana-Kentucky Electric Corporation
Piketon, Ohio

Prepared by:
Stantec Consulting Services Inc.
Cincinnati, Ohio

October 12, 2018

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LIST OF FIGURES

1.0 INTRODUCTION

On April 17, 2015, the "Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" (EPA Final CCR Rule) was published in the Federal Register. Stantec Consulting Services Inc. (Stantec) was contracted by the Indiana-Kentucky Electric Corporation (IKEC) to provide a compliance demonstration report and certification of the Placement Above the Uppermost Aquifer (UMA) Location Restriction for the West Boiler Slag Pond (WBSP) CCR unit at the Clifty Creek Station as required by the EPA Final CCR Rule § 257.60.

1.1 OBJECTIVE

As required by §257.60 of the EPA Final CCR Rule, an owner or operator of new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units is required by October 17, 2018 to demonstrate whether the unit is located no less than five feet above the upper limit of the UMA. The objective of this report is to demonstrate compliance with the location restriction for placement above the uppermost aquifer. Relevant sections of the EPA Final CCR Rule are cited below to provide context and additional detail regarding the objective (EPA, 2016).

The EPA Final CCR Rule § 257.53 provides definitions of CCR and CCR surface impoundments.

> *"Coal combustion residuals (CCR) means fly ash, bottom ash, boiler slag, and flue gas desulfurization materials generated from burning coal for the purpose of generating electricity by electric utilities and independent power producers." (257.53)*
>
> *"CCR surface impoundment means a natural topographic depression, manmade excavation, or diked area, which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR." (257.53)*

The EPA Final CCR Rule § 257.60 (a) requires that the CCR unit is constructed:

> *"…with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table)." (257.60 (a))*

IKEC must demonstrate that that the requirements of paragraph (a) of section 257.60 are met, and the demonstration must be certified to meet the requirements by a qualified professional engineer (P.E.) (§ 257.60 (b)). If the demonstration cannot be met, IKEC will be required to cease placing CCR and non-CCR wastestreams into the WBSP and close the unit within the time specified in § 257.101(b)(1). The demonstration and certification must be completed no later than October 17, 2018 (§ 257.60 (c)(1)).

1.2 UNIT DESCRIPTION

The Clifty Creek Station is a coal-fired, electric-generating plant. The plant is located in Jefferson County, near the town of Madison, Indiana. The Ohio River is located directly southeast of the plant, and the Clifty Creek Plant is located to the east of the WBSP.

The WBSP is located southwest of the Clifty Creek Station and is approximately 510 acres in size (Figure 1; Figure 2). The WBSP was built in 1955 to serve, and still currently serves, as a settling facility for sluiced boiler slag produced at the plant. The pond is formed by natural grade to the north, east and west and a southern dike that runs along the bank of the Ohio River. A limestone ridge known as Devil's Backbone borders the western side of the WBSP. The WBSP consists of two primary areas separated by a vegetated delta. (AEP, 2017).

The WBSP at the Clifty Creek Station meets the EPA definition of a CCR surface impoundment because it is a manmade area designed to hold CCR and liquids and is used to treat, store or dispose of CCR.

1.3 APPROACH AND METHODS

The following methods were used to determine whether the WBSP meets the requirements for placement above the UMA:

- Desktop review of historical documents; and
- Assessment of compliance with the EPA Final CCR Rule.

2.0 UPPERMOST AQUIFER (UMA)

2.1 CERTIFIED GROUNDWATER MONITORING NETWORK

Stantec prepared a letter dated October 16, 2017 (Stantec, 2017) including a qualified professional engineer certification which stated that:

"…the groundwater monitoring system for the IKEC Clifty Creek Station's CCR Landfill, West Boiler Slag Pond, and Landfill Runoff Collection Pond have been designed and constructed to meet the requirements specified in 40 CFR 257.9(a), (b), (c), and (e)." (Stantec, 2017).

A copy of this certification is available on the IKEC CCR Rule Compliance Data and Information website (IKEC, 2018).

2.2 DEFINITION

The EPA Final CCR Rule § 257.53 provides the following definitions of aquifer and uppermost aquifer (UMA):

> *"Aquifer means a geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of groundwater to wells or springs."*
>
> *"Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season."*

2.3 IDENTIFICATION

The stratigraphic sequence in the regional area of the Clifty Creek Station consists of widespread discontinuous layers of Quaternary deposits of alluvial and glacial origin overlying sedimentary rocks. The exposed sedimentary rocks range in age from Mississippian to Ordovician. The Quaternary deposits are largely of glacial origin and consist of loess, till and outwash. Glacial outwash is present in nearly all of the stream valleys north of and including the Ohio River valley. The outwash is covered, in some cases, by a veneer of recent alluvial deposits from active streams (AGES, 2007).

Unconsolidated alluvial deposits are the major source of groundwater in the Ohio River basin. Overbank from the Ohio River, the alluvial deposits usually form a discontinuous blanket twenty (20) to thirty (30) feet thick within the river valley and some of its tributaries. These deposits range from an upper silty clay to a lower silty sand and gravel. Groundwater yield from these deposits varies greatly depending on their nature and occurrence. The upper silty clay deposits are a poor source of groundwater and do not yield adequate quantities of water to wells. However, in some areas, yields of five (5) to 25 gallons per minute (gpm) can be developed from the lower silty sand and gravel deposits (AGES, 2007).

AGES prepared a Monitoring Well Installation Report (AGES, 2018) which indicated that:

> "Soil and well borings indicated that a layer of gray silt with fine sand, becoming more coarse-grained further to the north & northeast…is the uppermost aquifer beneath the WBSP." (AGES, 2018).

Based on information presented in the AGES report, and for the purpose of this demonstration, the UMA was identified as an interval of gray silt with sand and course-grained alluvium.

2.4 UPPER LIMIT

According to the EPA Final CCR Rule, the upper limit of the UMA is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season. For a confined aquifer the top of the UMA is defined based on the structure of the top of the aquifer.

Recent groundwater elevation data collected from monitoring wells completed in the UMA was reviewed to evaluate if groundwater within the UMA is generally present under confined or unconfined conditions. Water levels were measured at ten monitoring wells completed in the UMA at Clifty Creek Station during three groundwater monitoring events between January 2016 and May 2016. Based on an August 2016 Monitoring Well Installation Report, groundwater elevations measured during these gauging events ranged from approximately 422 to 478 feet above mean sea level (ft amsl) (AGES, 2018). The measured groundwater elevations were above the elevation of the top of the UMA at the gauging locations, indicating confined conditions.

The review of groundwater elevation data indicates that groundwater within the UMA is generally present under confined conditions; therefore, the top of the UMA beneath the WBSP is defined based on the structure of the top of the UMA, when present. For this demonstration, the top of the UMA was identified as the transition from finer grained material consistent with the alluvium that is present above the UMA to material consistent with the UMA. In areas where material consistent with the UMA was not present beneath the Unit, the UMA was conservatively identified as either the stratigraphic top of bedrock (as discussed in section 2.2), or the first encountered intermittent sand seam or lens.

2.5 DESKTOP REVIEW OF UMA ELEVATIONS

Stantec reviewed the boring logs of ten, certified groundwater monitoring well network locations that were completed at Clifty Creek Station. These borings and associated monitoring well locations (which are located around the perimeter of the WBSP) are presented on Figure 3.

The following generalized sequences were identified based on the review of available boring logs:

- Fine-grained alluvium overlying course-grained alluvium (WBSP-15-04 through WBSP-15-06);
- Fine grained alluvium overlying bedrock (WBSP-15-01 through WBSP-15-03); and
- Fine-grained alluvium overlying finer grained alluvium with sand seams and lenses (WBSP-15-07 through WBSP-15-10).

In locations where borings indicated the presence of bedrock overlain by fine-grained alluvium, the UMA was conservatively identified as the stratigraphic top of bedrock. In locations where borings indicated the presence of fine-grained alluvium with intermittent sand seams and lenses overlain by clay, the UMA was conservatively identified as the first encountered sand seam or lens.

The estimated elevation of the top of the UMA at WBSP certified monitoring wells locations ranged from 397.3 to 471.9 ft amsl. The groundwater monitoring well locations and associated estimated elevations of the top of the UMA at each location are presented on Figure 3.

Stantec also reviewed historic documents that referenced soil borings and well logs in the vicinity of the WBSP; however, supporting documentation included well construction logs, with limited information associated with the boring soil stratigraphy.

3.0 AFFECTED BOUNDARY (BASE OF CCR UNIT)

To determine if the CCR unit meets the requirement for placement above the UMA, the affected boundary (base elevation of the CCR material) must be identified.

Stantec estimated the elevation of the affected boundary at each certified monitoring well location using a preconstruction topographic map (USGS, 1938), where applicable (Figure 4). Based on the proximity to the steep grade of the Devil's Backbone formation, interpolated elevations at two monitoring well locations west of the WBSP were inconsistent with surveyed ground surface elevations.

A historic report indicated that the WBSP is formed by natural grade to the north, east and west (AGES, 2018). Additionally, a History of Construction Report indicated that the diking system for the WBSP was constructed on the natural soils, and the abutment consists of the Devil's Backbone to the west and natural ground to the east (AEP, 2016). Based on the natural grade to the west, and proximity to the Devil's Backbone formation, surveyed ground surface elevations were used to estimate the affected boundary at locations west of the WBSP (WBSP-15-01 and WBSP-15-02). The stratigraphy of the borings located west of the WBSP consisted of bedrock overlain by fine-grained material, primarily clay. Based on a hydrogeological study, the fine-grained material and bedrock were both identified as aquicludes; and therefore, were not considered to be an aquifer (AGES, 2017).

4.0 AQUIFER SEPARATION

4.1 COMPARISON OF ELEVATIONS

The estimated elevations representing the top of the UMA (Section 2.6 and Figure 3) were subtracted from the estimated base of the CCR unit (Section 3.0 and Figure 4) at each certified monitoring well location to represent the separation of the base of the CCR unit from the top of the UMA. Within the extent of the WBSP, the estimated separation between the base of the CCR unit and the UMA was greater than five (5) feet.

4.2 DISCUSSION

The following factors were considered to determine whether the WBSP located at the Clifty Creek Station meets the requirements for placement above the UMA:

- Identification of the UMA at the WBSP.
    - Regional aquifer (alluvial deposits of sand and gravel) (AGES, 2018).
- Identification of the upper limit of the UMA at the WBSP.
    - Gauging data indicates that groundwater within the regional aquifer is confined (AGES, 2018). The top of the UMA was identified as the transition from finer grained material consistent with the alluvium that is present above the UMA to material consistent with the UMA, when present.
    - In areas where intermittent sand seams and lenses within fine-grained alluvium were overlain by fine-grained alluvium, the UMA was conservatively identified as the first encountered sand seam or lens.
    - In areas where alluvial deposits of sand and gravel were not present, the UMA was conservatively identified as the stratigraphic top of bedrock.
- Estimated elevation of the top of the UMA within the extent of the WBSP.
    - The estimated elevation of the top of the UMA ranges from 397.3 to 471.9 ft amsl within the extent of the WBSP based on data from available boring logs (Sections 2.3 through 2.6).
- Estimated elevation of the base of the CCR unit within the extent of the WBSP.
    - Within the extent of the WBSP, elevations representing the base of the CCR were estimated based on the comparison to a historic topographic map.
    - Based on information presented in a previous report, elevations representing the base of the CCR at two locations west of the WBSP were determined using surveyed surface elevations.
- Comparison of the elevations of the base of the CCR unit and the top of the UMA within the extent of the WBSP.
    - The thickness of the deposits separating the CCR material from the top of the UMA indicates that the separation distance between the base of the CCR unit and the UMA is greater than five feet (Section 4.1).

5.0 CONCLUSIONS

Based on this assessment of the UMA and the CCR unit, the requirements of §257.60 of the EPA Final CCR Rule for placement above the UMA at the WBSP at KCGP have been met.

6.0 LIMITATIONS

Boring logs, and reports completed by others have been furnished to Stantec by IKEC which Stantec has used, as furnished, in preparing this demonstration report. For identification of the UMA at Clifty Creek Station, Stantec relied on the certification of the monitoring well network by a professional engineer which was included in the Stantec letter as discussed above (Stantec, 2017). Identification of separation distance relies of interpolation and estimation of data between data points.

7.0 REFERENCES

American Electric Power (AEP) (2017). 2017 Annual Dam and Dike Inspection Report, West Boiler Slag Pond and Landfill Runoff Collection Pond, Clifty Creek Plant, Madison, Indiana

American Electric Power (AEP) (2016). History of Construction, West Boiler Slag Pond, Clifty Creek Plant, Madison, Indiana

Applied Geology and Environmental Science, Inc. (2016), Revision 1.0 (2018). Coal Combustion Residuals Regulation (CCR) Monitoring Well Installation Report, Indiana-Kentucky Electric Corporation, Clifty Creek Station, Madison, Indiana.

Applied Geology and Environmental Science, Inc. (2007). Hydrogeologic Study Report, Clifty Creek Coal Ash Landfill, Clifty Creek Station, Madison, Indiana, (Revision No. 1).

Environmental Protection Agency (EPA) (2016). Federal Register, Vol. 80, No. 74, Part II. 40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule.

Ohio Valley Electric Corporation CCR Rule Compliance Data and Information, Clifty Creek Station (https://www.IKEC.com/CCRClifty.php)

Stantec Consulting Services Inc. (2017). Groundwater Monitoring System, CCR Landfill, West Boiler Slag Pond, and Landfill Runoff Collection Pond, EPA Final Coal Combustion Residuals (CCR) Rule, Clifty Creek Station, Madison, Jefferson County, Ohio.

Stantec Consulting Services Inc. (2016). Report of CCR Rule Stability Analyses, AEP Clifty Creek Power Plant, Boiler Slag Pond Dam and Landfill Runoff Collection Pond, Madison, Jefferson County, Indiana

United States Geological Survey (USGS) (1939). Madison West Quadrangle, IND-KY. Scale 1:24000

FIGURES

0 2,000 4,000
Feet

1:48,000 (At original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 2011 StatePlane Indiana East FIPS 1301 Ft US
2. Basemap Data Source: Copyright:© 2013 National Geographic Society, i-cubed

Stantec

Prepared by CNK on 2018-07-18
Technical Review by ABC on 2014-01-21
Independent Review by ABC on 2014-01-21

Client/Project
Ohio Valley Electric Corporation
Clifty Creek Generationg Station

Figure No.
1

DRAFT

Title
SITE LOCATION MAP
CLIFTY CREEK

Q:\active\175534018\03_data\gis_cad\2018_08\fig1_Site_Location_Map_Clifty_Creek_20180720_Clifty_Creek.mxd Revised: 2018-10-10 By: ckwiatkowski

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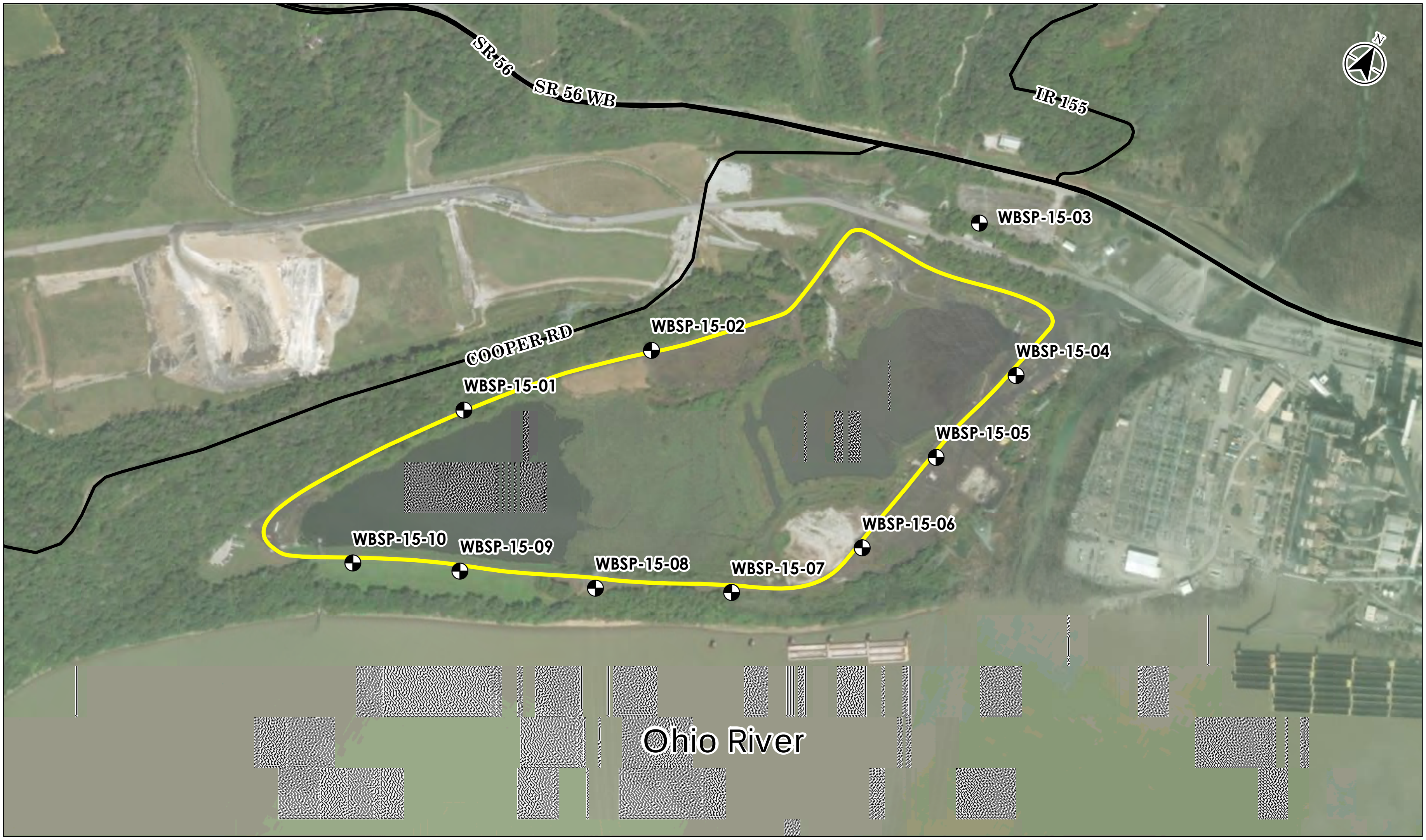

Legend

● Monitoring Well

— Road

— Site Boundary

0 400 800
Feet

1:9,000 (At original document size of 8.5x11)

Notes

1. Coordinate System: NAD 1983 2011 StatePlane Indiana East FIPS 1301 Ft US
2. Basemap Data Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Prepared by CNK on 2018-08-28
Technical Review by ABC on 2014-01-21
Independent Review by ABC on 2014-01-21

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Ohio Valley Electric Corporation
Clifty Creek Generationg Station

Figure No.
2

DRAFT

Title

SITE MAP
WEST BOILER SLAG POND

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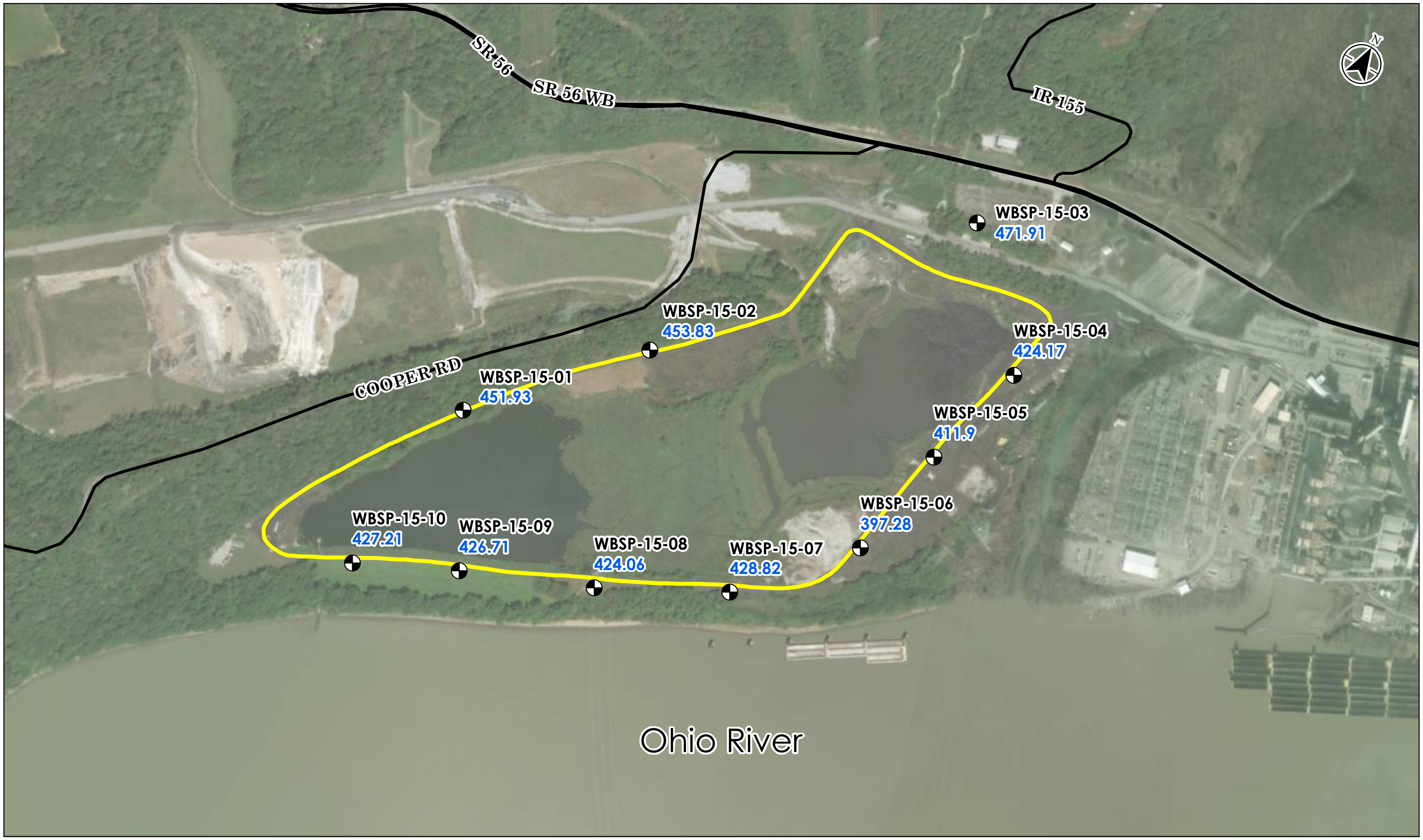

Legend

- ● Monitoring Wells
- — Road
- — Site Boundary

Notes

1. Coordinate System: NAD 1983 2011 StatePlane Indiana East FIPS 1301 Ft US
2. Basemap Data Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
3. Top of uppermost aquifer interpolated from boiring logs
4. 472.21 Uppermost Aquifer Level (FT AMSL)

0 400 800 Feet

1:9,000 (At original document size of 8.5x11)

Stantec

Prepared by CNK on 2018-08-28
Technical Review by ABC on 2014-01-21
Independent Review by ABC on 2014-01-21

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Clifty Creek Generationg Station

Figure No.
3

DRAFT

Title

ESTIMATED TOP OF THE UPPER MOST AQUIFER WEST BOILER SLAG POND

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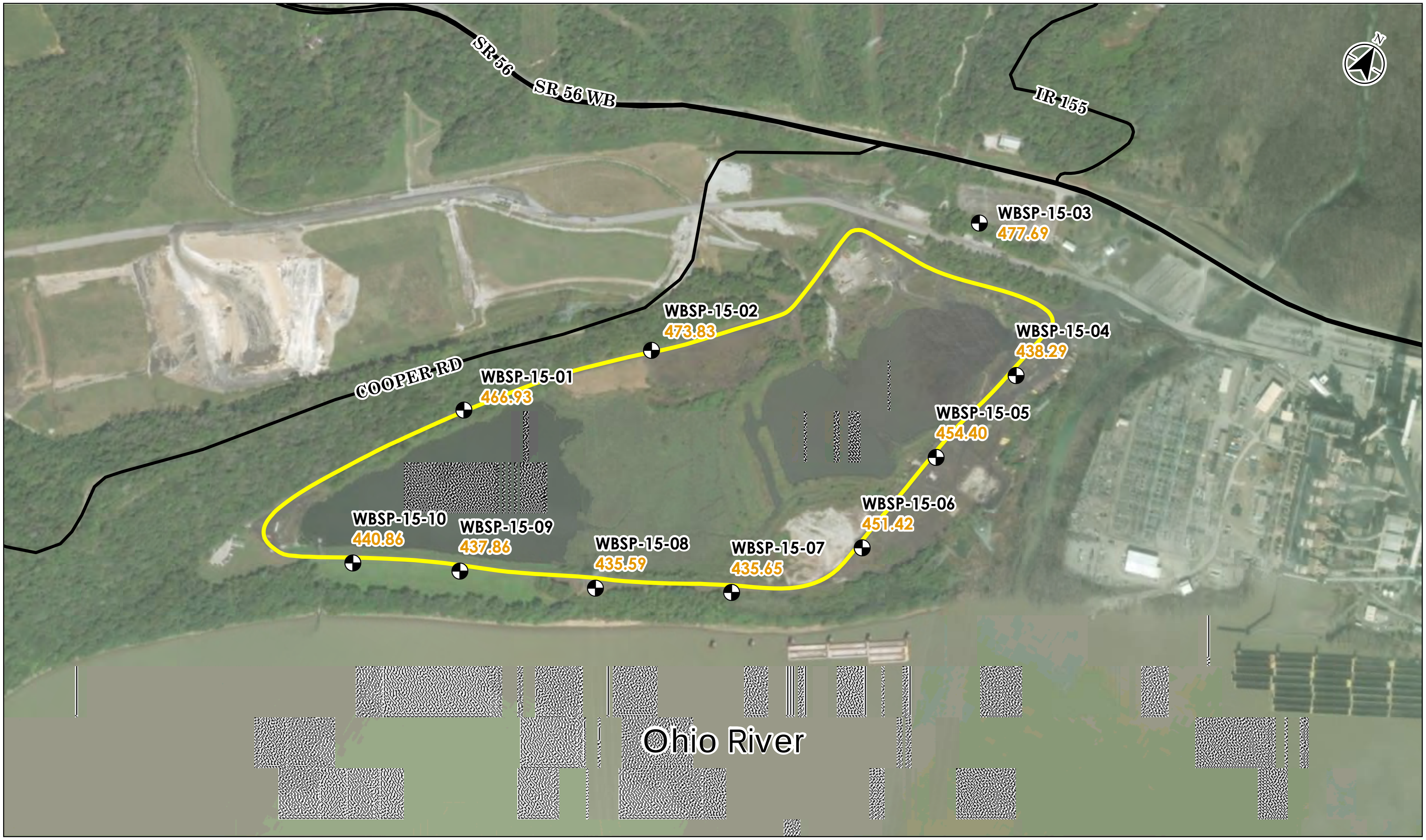

Legend

◐ Monitoring Well

— Road

— Site Boundary

Notes

1. Coordinate System: NAD 1983 2011 StatePlane Indiana East FIPS 1301 Ft US
2. Basemap Data Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
3. Pre-Construction Ground Surface Contours from: United States Geological Survey (USGS) (1938). Madison Quadrangle for Madison West, IN. - KY. Scale 1:24000
4. 440.855 Base of the CCR Unit Elevation (FT AMSL)

0 400 800 Feet

1:9,000 (At original document size of 8.5x11)

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Prepared by CNK on 2018-08-28
Technical Review by ABC on 2014-01-21
Independent Review by ABC on 2014-01-21

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Clifty Creek Generationg Station

Figure No.
4

DRAFT

Title

ESTIMATED AFFECTED BOUNDARY (BASE OF CCR UNIT) WEST BOILER SLAG POND

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ATTACHMENT B
WETLANDS COMPLIANCE DEMONSTRATION REPORT

Compliance Demonstration Report – Wetlands
West Boiler Slag Pond
Clifty Creek Station

Indiana-Kentucky Electric Corporation
Madison, Jefferson County, Indiana

Prepared for:
Indiana-Kentucky Electric Corporation
Piketon, Ohio

Prepared by:
Stantec Consulting Services Inc.
10509 Timberwood Circle
Louisville, Kentucky 40223

October 16, 2018

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LIST OF FIGURES

1.0 PROJECT BACKGROUND

On April 17, 2015, the "Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" (EPA Final CCR Rule) was published in the Federal Register. Stantec Consulting Services Inc. (Stantec) was contracted by the Indiana-Kentucky Electric Corporation to demonstrate proficiency regarding wetlands at the applicable CCR units at the Clifty Creek Station and evaluate compliance with §257.61 of the CCR Rule.

As required by §257.61 of the EPA Final CCR Rule, an owner or operator of a new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit is required by October 17, 2018 to demonstrate that the unit is not located in a wetland, as defined in §232.2 of this chapter, unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that the CCR unit meets the requirements of paragraphs (a)(1) through (5) of this section.

Wetlands are defined under Section 404 of the Clean Water Act (CWA) as:

> "Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Wetlands are further defined under §232.2 as a water having a "significant nexus" when any single function or combination of functions performed by the water, alone or together with similarly situated waters in the region, contributes significantly to the chemical, physical, or biological integrity of the nearest water of the U.S.

The U.S. Army Corps of Engineers, as described in the Corps of Engineers Wetland Delineation Manual (1987), provides further guidance in the identification of jurisdictional wetlands as:

> "Explicit in the definition is the consideration of three environmental parameters: hydrology, soil, and vegetation. Positive wetland indicators of all three parameters are normally present in wetlands. Although vegetation is often the most readily observed parameter, sole reliance on vegetation or either of the other parameters as the determinant of wetlands can sometimes be misleading. Many plant species can grow successfully in both wetlands and non-wetlands, and hydrophytic vegetation and hydric soils may persist for decades following alteration of hydrology that will render an area a non-wetland. The presence of hydric soils and

> wetland hydrology indicators in addition to vegetation indicators will provide a logical, easily defensible, and technical basis for the presence of wetlands. The combined use of indicators for all three parameters will enhance the technical accuracy, consistency, and credibility of wetland determinations."

Per §257.61(a), this provision prohibits the location of new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units in wetlands unless the requirements of Sections 257.61(a)(1) through (5) are demonstrated to be met. If the unit is not in a wetland, no further analysis needs to be performed. The demonstration can be written based on evidence used to conclude that the unit is not in a wetland.

The following factors have been considered to determine whether the West Boiler Slag Pond located at the Clifty Creek Station is in a wetland:

- Desktop review of available data,
- Field reconnaissance, and
- Experience in similar industrial settings.

2.0 UNIT DESCRIPTION

The Clifty Creek Station is located on the north shore of the Ohio River downstream of Madison, Indiana. The station consists of six coal-fired electric generating units, each nominally rated at 217 megawatts. The Clifty Creek Station is directly accessible from State Route 56. A plan view of the station is included in Attachment A.

The West Boiler Slag Pond is located southwest of the station. It is formed by natural grade to the north, east, and west and a dam on the south that runs along the bank of the Ohio River. The West Boiler Slag Pond serves as a settling basin for sluiced bottom ash produced at the station and receives stormwater runoff from approximately 510 acres (Stantec, 2010). The pond contains two primary areas: the eastern portion near the sluice pipes that is actively dredged and a western portion with minimal deposition or dredging activities. A vegetation delta separates the two as a natural filtering zone. The pond discharges to the Ohio River through a principal spillway at the southern edge of the impoundment. Attachment A presents an overview of the West Boiler Slag Pond study area boundary.

3.0 DESKTOP REVIEW

A desktop review of available data was performed to determine the likelihood of the unit being sited in a wetland by evaluating the potential for wetlands within the CCR unit boundary, as defined by the outside toe of slope of the exterior dike. The desktop review of publicly available data for the facility included:

- U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) Mapping,
- U.S Geologic Survey Topographic Mapping,
- Natural Resources Conservation Service's (NRCS) Web Soil Survey, and
- FEMA Flood Maps.

Stantec reviewed available data for the presence or absence of wetlands within the West Boiler Slag Pond boundary. The NWI mapping identified two wetlands within the unit boundary; however, one of the identified wetlands is within the treatment pond and not considered a wetland for the purposes of this demonstration. The other identified wetland, though shown in the NWI maps, did not appear to be present during the field investigation.

The USGS topographic mapping indicates that no tributaries to the Ohio River, a traditional navigable water, originate in or near the Unit boundary. Clifty Creek, a tributary to the Ohio River, flows from the north to south into the Ohio River just east of the impoundment dike for the West Boiler Slag Pond.

The NRCS Soils Survey for Jefferson County, Indiana identifies three soil types within the study area. These include Dumps, Eden-Caneyville complex, and Udorthents. The soil units are all listed as non-hydric.

A review of the FEMA flood maps indicates that the West Boiler Slag Pond is designated Zones X AE. Much of the study area resides within Zone AE, the 100-year floodplain for the Ohio River, while the remainder lies within Zone X, the 500-year floodplain.

4.0 FIELD RECONNAISSANCE

Following the desktop data review, Stantec qualified biologists performed a field reconnaissance to assess the potential for jurisdictional features.

The reconnaissance investigation was conducted on May 7, 2018. Stantec biologists conducted a pedestrian survey to ascertain whether any areas of potential wetlands were present within the West Boiler Slag Pond CCR Unit boundary (as shown on Attachment A). Upland plant communities typical of the region were the main species observed. Two locations were examined for potential wetland presence (TP-01 and TP-02), but were found to be uplands. No wetland indicators were observed within the West Boiler Slag Pond study area.

5.0 CONCLUSIONS

The desktop review provided no indication that the subject ash pond is located within wetlands.

It is Stantec's professional opinion that the current conditions of the subject ash pond meet the wetlands location requirements of the EPA Final CCR Rule §257.61.

6.0 REFERENCES

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U.S. Geologic Survey Topographic Mapping, U.S. Geological Survey, https://www.usgs.gov/products/maps/topo-maps, September 28, 2018.

Attachment A: Site Reconnaissance Study Area Map

Attachment A

Title
CCR Wetlands Analysis
Site Reconnaissance Study Area Map
West Boiler Slag Pond

Client/Project
Clifty Creek Station
IKEC
CCR Analysis

Project Location
Madison, Jefferson County, Indiana

175534018
Prepared by SPK on 2018-10-10
Technical Review by BW on 2018-10-10
Independent Review by RVD on 2018-10-10

0 500 1,000
Feet
1:6,000 (At original document size of 11x17)

🟥 Study Area
○ Test Pit

Notes
1. Coordinate System: NAD 1927 StatePlane Indiana East FIPS 1301
2. ImagerySource: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
3. No hydric soils are located within the project area

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\us1268-f01\workgroup\1755\active\175534018\gis\mxd\CCR_Wetlands_Analysis_West_Boiler_Slag_Pond.mxd Revised: 2018-10-10 By: skelley

ATTACHMENT C
FAULT AREAS COMPLIANCE DEMONSTRATION REPORT

Compliance Demonstration Report - Fault Areas
West Boiler Slag Pond
Clifty Creek Station

Indiana-Kentucky Electric Corporation
Madison, Jefferson County, Indiana

Prepared for:
Indiana-Kentucky Electric Corporation
Piketon, Ohio

Prepared by:
Stantec Consulting Services Inc.
11687 Lebanon Road
Cincinnati, Ohio 45241

October 16, 2018

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COMPLIANCE DEMONSTRATION REPORT -
FAULT AREAS
WEST BOILER SLAG POND
CLIFTY CREEK STATION

October 16, 2018

1.0 INTRODUCTION AND RULE REQUIREMENTS

1.1 OBJECTIVE

The objective of this document is to present an assessment and engineering conclusions regarding the subject CCR unit's compliance with the Environmental Protection Agency (EPA) Final Coal Combustion Residual (CCR) Rule, 40 CFR 257.62(c) regarding fault areas.

1.2 RULE REQUIREMENTS

As required by §257.62 (a) of the EPA Final CCR Rule:

> *New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit.*

2.0 ASSESSMENT

The Fault Areas demonstration was comprised of two phases: a literature survey/review and a Neotectonic analysis. A literature survey/review using available published data was performed, and the results are reported in "Literature Survey and Discussion of the Geology and Seismicity near Clifty Creek Fossil Plant, Southeastern Indiana". The result of this survey is included in Appendix A.

The Neotectonic analysis, a compilation of a lineament analysis and drainage analysis, was performed in the vicinity of and including the Landfill Runoff Collection Pond. The results of the neotectonics analysis are reported in "Neotectonics Analysis, CCR Unit Location Restrictions Demonstrations – Clifty Creek Station, Madison, Indiana". This report is included in Appendix B.

3.0 CONCLUSIONS

Based on this assessment, the West Boiler Slag Pond located Clifty Creek Station meets the requirements of §257.62 of the EPA Final CCR Rule.

4.0 REFERENCES

Stantec Consulting Ltd. (2018). Neotectonic Analysis, CCR Unit Location Restrictions Demonstrations – Clifty Creek Plant, Madison, Indiana. April.

Dr. Robert D. Hatcher, Jr. (2018). Literature Survey and Discussion of the Geology and Seismicity near Clifty Creek Fossil Plant, Southeastern Indiana. April.

APPENDIX A
LITERATURE SURVEY

Literature Survey and Discussion of the Geology and Seismicity near Clifty Creek Fossil Plant, Southeastern Indiana

Robert D. Hatcher, Jr., Ph.D., P.G.
Department of Earth and Planetary Sciences
and Science Alliance Center of Excellence
University of Tennessee–Knoxville

Robert D. Hatcher, Jr.

Introduction

The purpose of this report is to provide a literature survey and discussion of known active or potentially active faults in the vicinity of the Ohio Valley–Indiana-Kentucky Electric Corporation Clifty Creek Fossil Plant on the Ohio River floodplain immediately west of Madison and northeast of Hanover in southeastern Indiana (38°44'16.8" N, 85°25'8.4" W) (Fig. 1). The site is located ~80 mi (~130 km) southeast of Bloomington, Indiana, some 65 mi (~100 km) northwest of Frankfort, Kentucky, and ~35 mi (57 km) northeast of New Albany, Indiana. The Clifty Creek Plant is capable of producing 1,300 MW of electric power (Wikipedia). Concern is for seismic or other geologic hazards related to the West Boiler Slag Pond, Landfill Runoff Collection Pond, and Coal Combustion Residuals Landfill sites.

The references cited in this report are those considered critical for understanding the geology, paleoseismology, and seismicity of the region and near the Clifty Creek Fossil Plant in southeastern Indiana. Many of the papers, maps, and reports cited here contain a wealth of additional citations in their own references that provide much greater detail about the surface and subsurface geology and seismicity in the region. Several of these reports and publications include Swadley (1978), McDowell et al. (1981), Gray et al. (1987), Obermeier et al. (1991), Wheeler (1996), Marshak et al., (2016), McBride et al. (2002), and Petersen et al. (2014).

A useful definition of an active fault could be:

An active fault (or earthquake fault) is one that has been demonstrated to have moved during the Holocene (last 11,000 years). This would include the zone of deformation (damage zone) on either side of the fault, which would include geologic structures (folds, subsidiary faults, joints and shear fractures, etc.) that would have been produced as coseismic features during movement on the fault that produced seismicity (California Geological Survey, 2007).

Regional Geology and Seismicity

The Clifty Creek site is located immediately west of Madison and east of along the Ohio River in southeastern Indiana (Fig. 1). Surface geology consists of Pleistocene to Recent glaciogenic and river sediments on the Ohio River floodplain that overlie Ordovician to Devonian sedimentary rocks west and east of the river (Gibbons, 1978; Swadley, 1978; McDowell et al., 1981; Gray, 1972; Gray et al., 1987; Reed et al., 2005; Marshak et al., 2016).

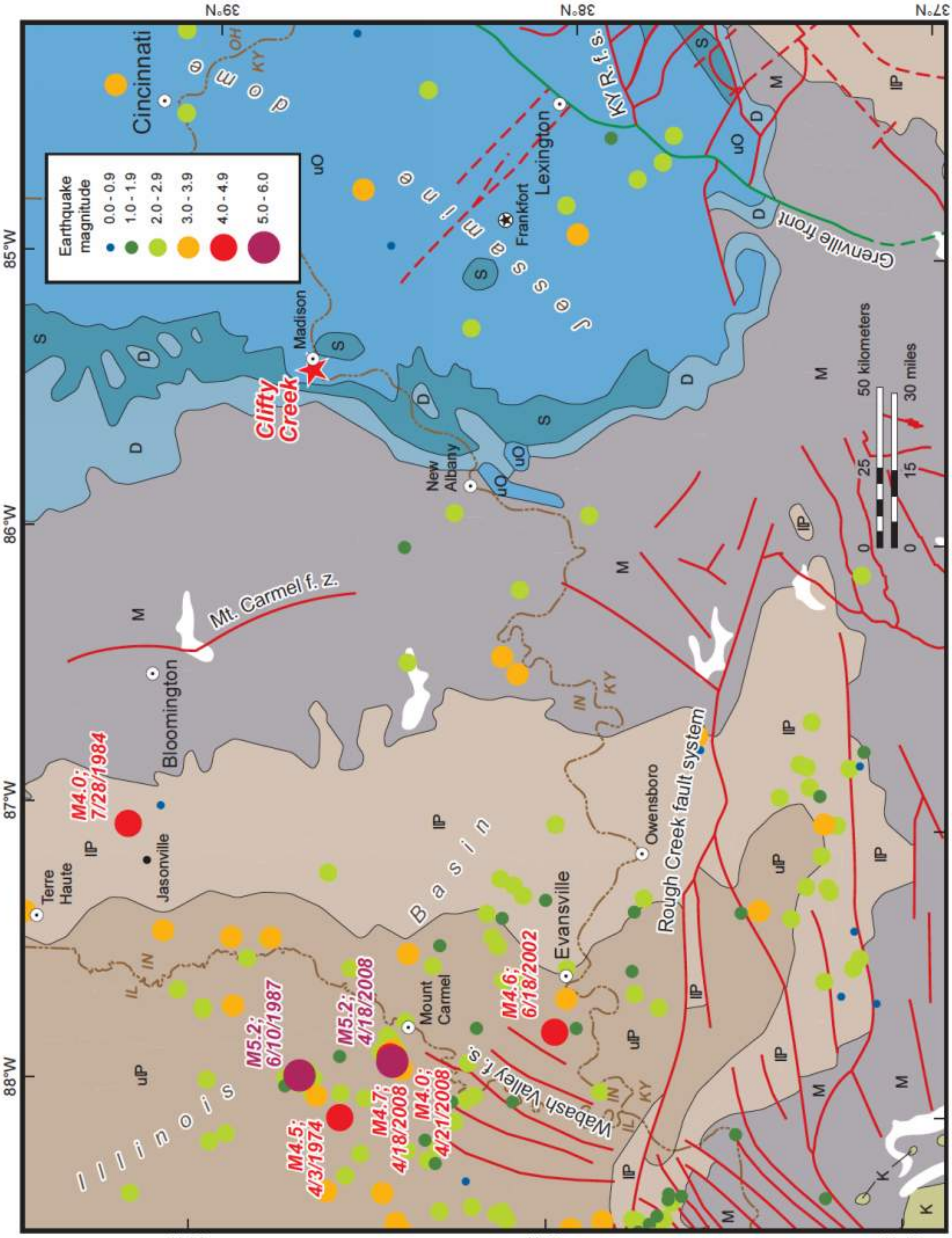

Figure 1. Simplified geologic map of region around the Clifty Creek Fossil Plant (red star) in southeastern Indiana. Locations of historic earthquakes are also shown, along with Paleozoic faults (red), and the Grenville front (green, not exposed). f.s.—fault system. uO—Upper Ordovician rocks. S—Silurian rocks. D—Devonian rocks. M—Mississippian rocks. IP—lower Pennsylvanian rocks. uP—upper Pennsylvanian rocks. Sources of data: Political boundaries - National Atlas Data; Geology - Garrity, C. P., and Soller, D. R., 2009, Database of the Geologic Map of North America; adapted from Reed et al. (2005), U.S. Geological Survey Data Series 424, 1:5,000,000 [https://pubs.usgs.gov/ds/424/]. Earthquakes - USGS Earthquake Hazards Program, NEIC. Northern California Earthquake Data Center (NCEDC), 2014, ANSS (Advanced National Seismic System) Dataset: UC Berkeley Seismological Laboratory. doi:10.7932/NCEDC. Catalog of Ohio Earthquakes of 2.0 or Greater Magnitude, 2017, Ohio DNR Division of Geologic Survey [http://geosurvey.ohiodnr.gov/earthquakes-ohioseis/quakes-felt-in-ohio/catalog-of-past-ohio-quakes/catalog-home].

Seismicity in this region is varied both geographically and temporally, with most seismic activity concentrated in both states along the Indiana-Illinois border. Obermeier et al. (1991) discussed the seismic hazard of the Wabash Valley fault zone along the Illinois-Indiana border, indicating that there have been significant earthquakes in this area in the prehistoric past, but with a recurrence interval of thousands of years. All of the largest earthquakes (>M 5.0) that have occurred in this region in the past several decades have occurred in the Wabash Valley seismic zone (Fig. 1). McBride and Nelson (2001) and McBride et al. (2002) recognized numerous faults in southwestern Illinois that cut young sediments there, and may pose a seismic hazard. There are, however, no known active faults within at least a hundred miles of the Clifty Creek Fossil Plant.

Clifty Creek Site Geology and Potentially Active Faults within Two Miles of the Site

The Clifty Creek site is located on the west flank of the Jessamine dome in the transition between Upper Ordovician and Silurian rocks of the dome and the younger Pennsylvanian rocks of the Illinois basin to the west (Fig. 1). Ordovician rocks consist mostly of limestone, with some shaly limestone and shale in the upper part of the section; Lower Silurian rocks consist of limestone, while Middle Silurian rocks consist of limestone and shale; and Lower and Middle Devonian rocks (all in Indiana) consist of limestone; and Upper Devonian rocks farther west are predominantly shale (New Albany black shale). Sediments on the Ohio River floodplain consist of Pleistocene glacial outwash (and reworked glacial sediments) and drift, while Quaternary alluvium consists of sands, clays, and gravels (Swadley, 1978).

Neither available detailed geologic maps of the Madison East or Madison West 7.5-minute quadrangles in Kentucky nor the exploratory studies of geology (Gibbons, 1978; Swadley, 1978) nor the geotechnical/hydrologic investigation in the area around the ash ponds by Miller and King (2016) identified any faults or active faults within 200 feet or several miles of the Clifty Creek site.

Conclusions

1. The Clifty Creek site is located east of the western flank of the Jessamine dome in northeastern Kentucky, resting on Pleistocene and Holocene Ohio River and tributary stream alluvium, and glacial outwash (and reworked sediments). The underlying bedrock consists of Upper Ordovician limestone and shale, with Silurian and Devonian rocks located a very short distance to the west in Indiana.

2. The Clifty Creek power plant is located in a region of low seismicity. The only significant historic seismic events in the region are several M 4.5 to 5.2 earthquakes that occurred from 1974 to 2008 in or near the Wabash Valley seismic zone along the border between Indiana and Illinois.

3. None of the literature reviewed, including published papers and reports from other organizations, have indicated the existence of any active faults within two miles of the Indiana-Kentucky Electric Corporation Clifty Creek Station and associated ash ponds.

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APPENDIX B
NEOTECTONIC ANALYSIS

CCR Unit Location Restrictions Demonstrations – Clifty Creek Station, Madison, Indiana

Neotectonics Analysis

October 12, 2018

Prepared for:

Indiana-Kentucky Electric Corporation

Prepared by:

Stantec Consulting Ltd.
500 – 4730 Kingsway
Burnaby, British Columbia
V5H 0C6

Revision	Description	Author		Quality Check		Independent Review	
A	Draft	M. Verpaelst	2018-04-30	S. Tsang	2018-04-30	R. Guthrie	2018-04-30
0	Final	M. Verpaelst	2018-10-12	S. Tsang	2018-10-12	R. Guthrie	2018-10-12

Sign-off Sheet

This document entitled CCR Unit Location Restrictions Demonstrations – Clifty Creek Station, Madison, Indiana was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Indiana-Kentucky Electric Corporation (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by ____

(signature)

Manuel Verpaelst, M.Sc.

Reviewed by ____

(signature)

Sid Tsang, P.Geo. (AB, BC, MB)

Approved by ____

(signature)

Richard Guthrie, M.Sc., Ph.D., P.Geo. (AB, BC)

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LIST OF FIGURES

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by the Indiana-Kentucky Electric Corporation (IKEC) to conduct a Phase 1 Assessment for a fault area demonstration of the Clifty Creek Station in Madison, Indiana. The demonstration is required by the U.S. Environmental Protection Agency (EPA) Disposal of Coal Combustion Residuals (CCR) from Electric Utilities rule. In accordance with the Stantec proposal dated August 25, 2017, this investigation was to include:

- A literature review of publicly available data of known active or potentially active (last 11,000 years) faults in the vicinity of the CCR Landfill, West Boiler Slag Pond (WBSP) and Landfill Runoff Collection Pond (LRCP).
- A neotectonics analysis within a two-mile radius of the CCR Landfill, WSBP and LRCP sites, hereafter referred to as the study area (Figure 1-1).

The neotectonics analysis was conducted to support the fault area demonstration only and the conclusions are not valid for other applications. The neotectonics analysis is based on a literature review of cited references, desktop lineament and drainage mapping based on interpretation of LiDAR hillshade and aerial photographs, and no fieldwork was conducted to verify actual conditions within the study limits.

1.1 SCOPE OF WORK

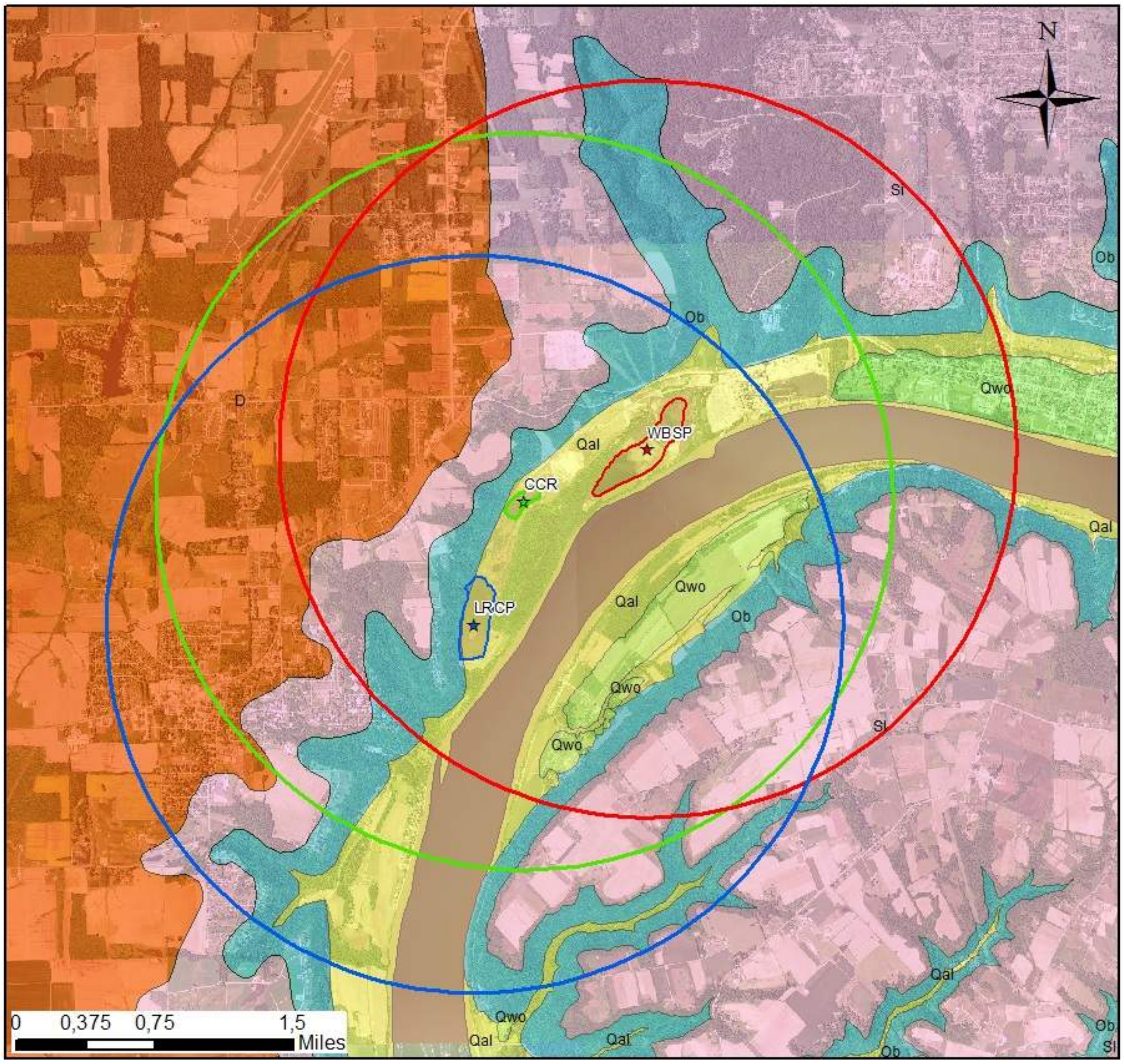
For this investigation, we define neotectonics as the study of geologically recent (last 11,000 years) movement and deformation of the earth's crust and measurement of its local effects on the creation of geomorphological features observed at the surface. The scope of work for this neotectonics analysis comprises three tasks:

Task 1 builds on the literature review findings by utilizing the online USGS seismic hazard map, the USGS online interactive faults map, the U.S. Department of Agriculture soil survey website, the Indiana Geological Survey map website, and the Kentucky Geological Survey geologic map information service website. Publicly available maps, reports, and scientific literature relevant to the terrain conditions in the vicinity of Clifty Creek Station were also reviewed.

Task 2 involves a lineament analysis where lineaments are mapped from air photographs and hillshade imagery built from Light Detection and Ranging (LiDAR) and Digital Elevation Model (DEM), within at least a two-mile radius of the CCR Landfill, WSBP and LRCP sites. The mapping was carried out in ESRI ArcGIS® software to facilitate plotting of maps and viewing spatial data.

Task 3 involves a drainage analysis of well-defined patterns (dendritic, parallel, trellis, rectangular, radial, annular, and contorted), which are not redirected by anthropogenic activity.

Figure 1-1 Geologic map of the study area[1]



CCR - Coal Combustion Residuals Landfill; LRCP - Landfill Runoff Collection Pond; WBSP - West Boiler Slag Pond

Map Symbol	Age	Description
Qal	Quaternary	Alluvial - Clay, silt, sand, and gravel
Qwo	Quaternary	Glacial outwash - Gravel, sand, silt, and clay
D	Devonian	Dolomite, limestone, sandstone, and gypsum
Si	Middle Silurian	Limestone, dolomite, and shale
Ob	Ordovician	Limestone, dolomite, shale, and sandstone

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[1] Modified from Bedrock geology of Indiana (1:250,000) and Swadley (1978) (1:24,000 scale). Ordovician shales and limestones are inferred to be overlain by Quaternary alluvial and outwash deposits mapped along the Ohio River (Swadley 1978).

2.0 BACKGROUND INFORMATION

2.1 DATA SOURCES

Readily available background information relevant to the neotectonics analysis and geological conditions was gathered and reviewed. This information included (but was not limited to):

- The Physiographic Regions of Indiana (Gray and Sowder 2002)
- USGS National Seismic Map (Petersen et al. 2014)
- Kentucky Geological Survey (KGS) geologic map information service website
- Indiana Geological Survey (IGS) - map website
- United States Department of Agriculture - web soil survey
- U.S. Quaternary Faults and Folds Database (USQFFD)
- IGS - glacial information available on the Indiana University Bloomington website
- Geological and geophysical maps (Abert et al. 2016)
- Jefferson Country aeromagnetic survey (Henderson and Meuschke 1951)
- Hydrogeologic study report of the Clifty Creek Coal Ash Landfill (AGES 2006)
- 1: 24,000 scale Geologic map of Madison West Quadrangle, Kentucky (Swadley 1978)
- 1:500,000 scale geology map of Indiana (Gray et al. 1987)
- 2014 and 2016 aerial photographs from the USGS National Map office
- 2012 LiDAR[2] (5 foot-grid) from the USGS National Map office
- DEM[3] (30 foot-grid) from the USGS National Map office
- Publicly available literature relevant to the terrain conditions in the area (Homoya et al. 1985; Nickell 1985; Fullerton 1986; Parola et al. 2007)

2.2 PROJECT SETTING

Physiography

The study area is located within the Muscatatuck Plateau, Deadborn Upland, and Outer Bluegrass physiographic sub-regions of Indiana and Kentucky. The Muscatatuck Plateau (west of the study area) is a relatively flat plain with steep-walled canyons entrenched by major streams (Homoya et al. 1985). The Deadborn Upland (northeast of the study area) is characterized by deeply dissected rolling uplands, and, even though the region was glaciated, bedrock is near the surface and unconsolidated deposits are thin or absent (Homoya et al. 1985). The Outer Bluegrass region (southeast of the study area) is characterized by rolling to undulating hills with deep valleys and very little flat land (Parola et al. 2007).

The southerly flowing Ohio River dissected the study area. The range in relief in the study area is 465 feet from 425 feet (Ohio River) to 890 feet (southeast of WBSP) above sea level. The CCR, WBSP and LRCP sites are located at approximately 505 feet, 450 feet and 490 feet above sea level, respectively. The LRCP and CCR appear to be

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[2] Covers the Indiana State section of the study area

[3] Covers the Kentucky State section of the study area

located on a dammed back-channel of the Ohio River and the WBSP is on a low terrace of the Ohio River (artificially dammed).

Bedrock Geology

Regional bedrock geologic mapping shows the study area lies east of the western flank of the Jessamine dome within the Cincinnati arch, and is underlain by Ordovician to Devonian Formations comprising carbonate and other horizontally-bedded sedimentary rocks that have been only slightly tilted by development of regional structures (Figure 1-1). With the presence of carbonate rocks in the study area the potential for karstification is high.

No recent or Quaternary faults and folds were recorded within the vicinity of the study area. The closest faults and folds were recorded 20 miles to the south and southeast, and about 40 miles to the west (KGS, IGS, and USQFFD online websites; Figure 2-1). Published geophysical data for the region show that the Clifty Creek site is in a magnetic low with small variations of amplitude (Henderson and Meuschke 1951; Abert 2016).

The Clifty Creek Station is located far from recorded earthquake epicenters (Figure 2-1). The 2014 USGS National Seismic Hazard Model contours probabilistic seismic hazard with a 2-percent probability of exceedance in 50 years (Figure 2-2). The map was derived from information on potential earthquake hazards based on probabilistic risk assessment, and incorporates new findings on earthquake ground shaking, faults, seismicity, and geodesy (Petersen et al. 2014). The seismic hazard map shows a low hazard for the Clifty Creek Station.

Figure 2-1 Fault and fold traces (left), and earthquakes epicenters (right) of the Illinois Basin-Ozark Dome region (Abert et al. 2016)

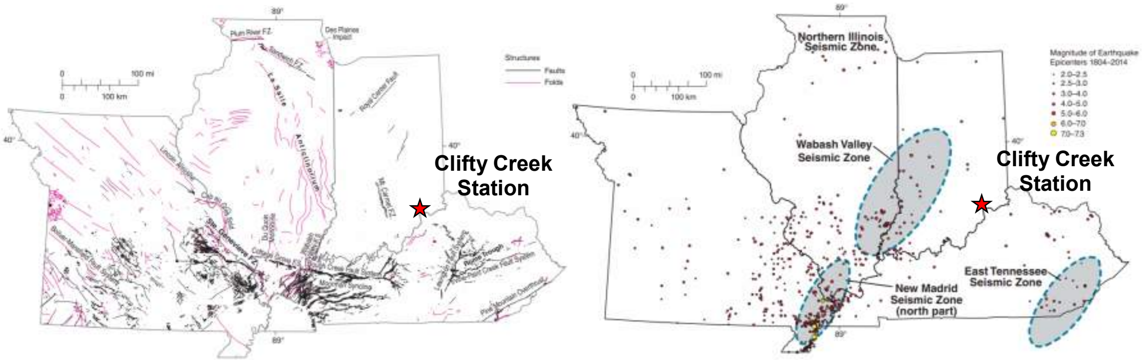
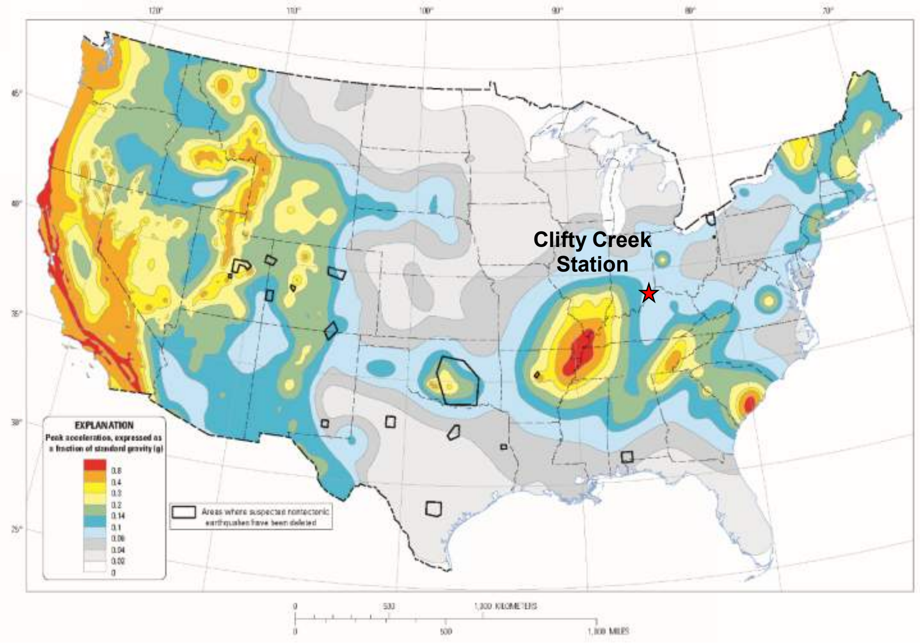


Figure 2-2 2014 USGS National Seismic Hazard Map, two-percent probability of exceedance in 50 years map of peak ground acceleration



Quaternary and Surficial Geology

During the Pleistocene (2.6 M to 12,000 years before present (ybp)), ice sheets coming from the north covered a large portion of Indiana. Two glacial boundaries of major significance mark the glacial history of the region. The outer boundary, results from the Illinoian (300,000 to 130,000 ybp) and pre-Illinoian glaciations and reaches the southernmost regions of Indiana and northern Kentucky, determining the course of the present-day Ohio River; the study area is found within this boundary. The inner boundary demarcates the late Wisconsinan glacial maximum (24,000 to 12,000 ybp) and reaches the middle of Indiana (Fullerton 1986; and online publications from Indiana University) but did not reach the study area.

These glacial advances carved the landscape and deposited till (morainal material) throughout the region. As the ice sheets stagnated and melted, large accumulations of meltwater eroded and sculpted channels across the landscape. Remnants of this epoch are still observed in the many incised canyons of the region.

Regional (1:500,000) scale Quaternary geology maps of Indiana (IGS map website), provide an overview of surficial geology within the study area. In the uplands, bedrock is unconformably overlain by silt to sandy silt till deposits dating from the pre-Wisconsinan epoch, and by a Wisconsinan loess complex. The loess complex (generally two to four feet-thick) mantles the till and was formed from windblown silt derived from the alluvial deposits along the Ohio River and other major rivers (Nickell 1985). Soils along the valley side-slopes mostly formed from the weathering of bedrock. Alluvial and glacial outwash deposits are mapped locally along the banks of the Ohio River.

Historical borehole drillings near the CCR Landfill and LRCP sites, indicate a depth to bedrock ranging from 9 to 91 feet below the surface (AGES 2006).

3.0 LINEAMENT ANALYSIS

The desktop lineament analysis utilizes 2014 and 2016 aerial photographs and hillshade imagery built from DEM and 2012 LiDAR. The aerial photographs and hillshade imagery, along with readily available GIS layers (faults and earthquakes epicenter inventory, geology, surficial material, drainage flowlines), were viewed and interpreted in ESRI ArcGIS® software.

The lineament analysis is based on visible interpretation of mappable linear, rectilinear, or curvilinear surface features that are suspected to reflect subsurface phenomena. Changes in elevation, slope gradients and surface patterns are also used to identify lineaments. Without local geophysical data the mapping of these surface features is subjective at best[4].

Eleven lineaments were mapped within the study area (L1 to L7, L11 to L14) and four were mapped outside (L8, L9, L10, L15) (Figure 3-1). Lineaments L1 to L10 were interpreted as the result of stream erosion of residual soils overlying soft sedimentary bedrock. However, it is possible that the streams exploited weaknesses in the bedrock (such as pre-Holocene faults or joint sets). In this situation, considering the geological setting, glacial history and topography of the region, these linear features would not be associated with active faults.

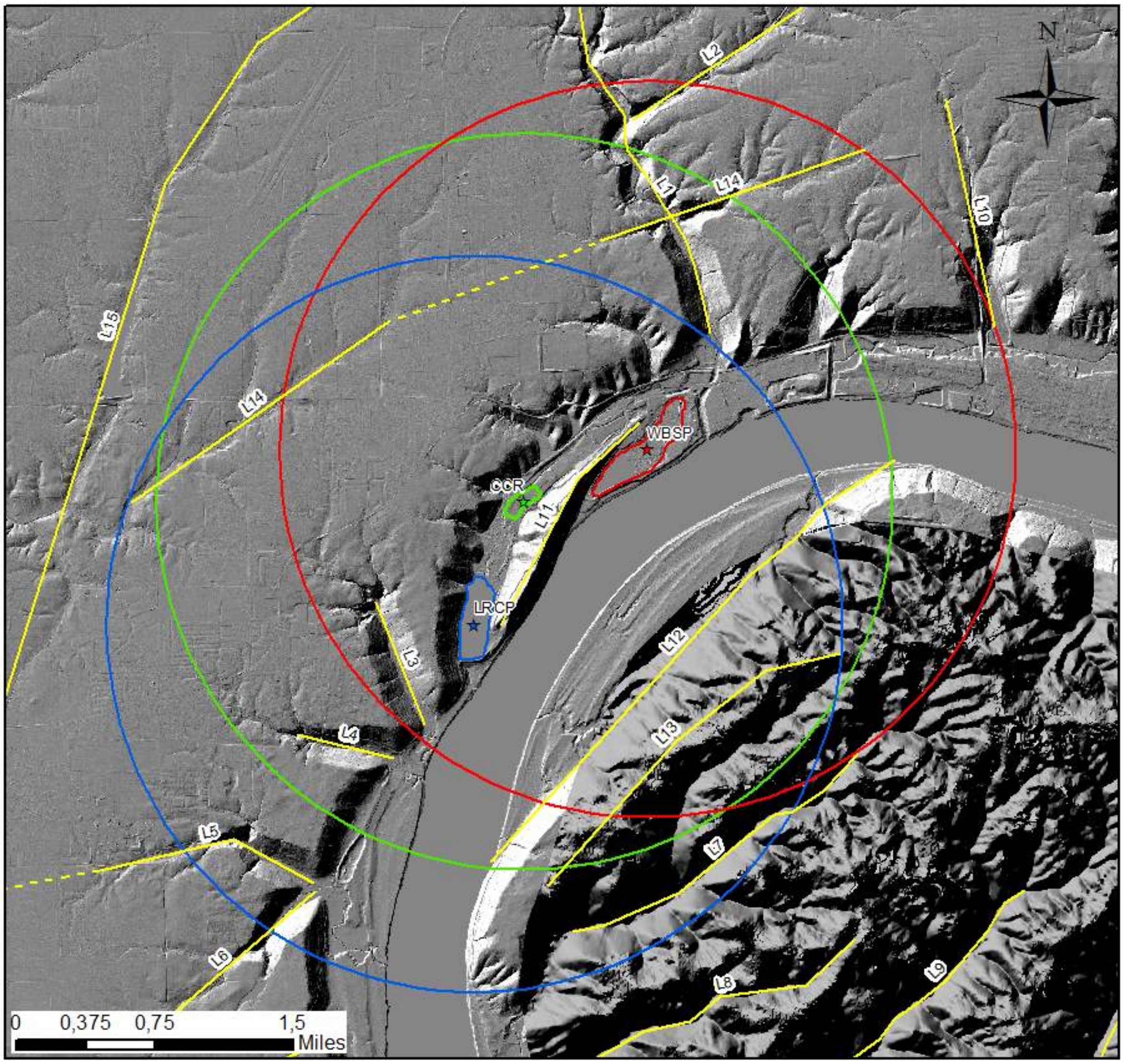
Lineaments L14 and L15 show a northeast-southwest trend and may be faults. However, being covered by till and loess dating from the pre-Wisconsinan and Wisconsinan era (300,000 to 12,000 ybp) these linear features would not be associated with active faults.

Based on hydrogeologic study report AGES (2006), lineament L11 is a bedrock-controlled feature (Devil's Backbone) that is likely a remnant of fluvial erosion that pre-dates the Holocene. Lineaments L12 and L13 were interpreted as a legacy of stream erosion on a bedrock-controlled ridge. These features are not likely to have developed from an active fault.

---

[4] Publicly available geophysical data include a 1:500,000-scale map (Abert et al. 2016) and a 1:63,360-scale aeromagnetic survey map from 1951 (Henderson and Meuschke 1951). These maps show no anomalies for the study area.

Figure 3-1 Mapped lineaments (yellow) overlain on LiDAR and DEM hillshade image



CCR - Coal Combustion Residuals Landfill; LRCP - Landfill Runoff Collection Pond; WBSP - West Boiler Slag Pond

4.0 DRAINAGE ANALYSIS

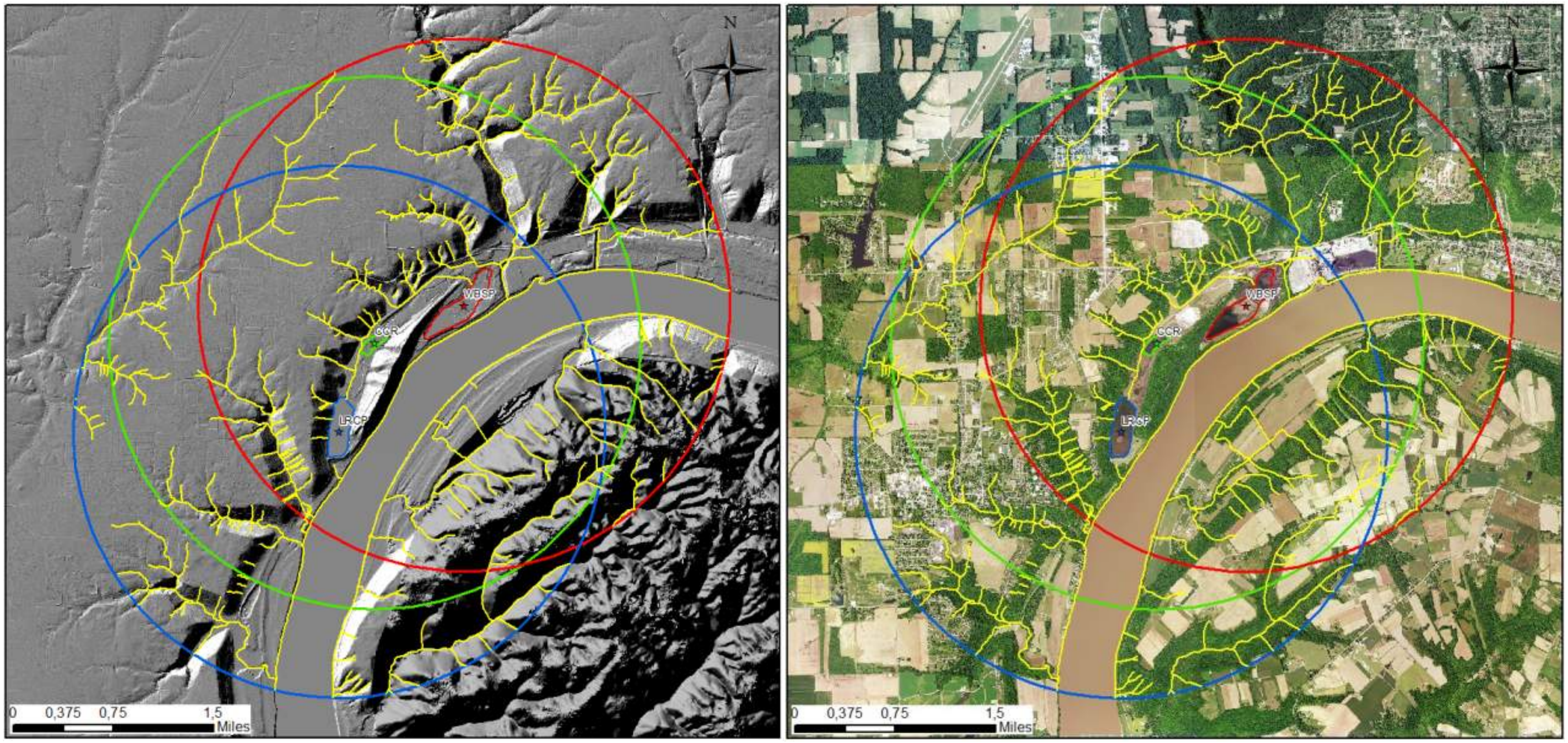
Drainage analysis is useful in structural geology interpretation - it includes consideration for drainage patterns, drainage texture, individual stream patterns and drainage anomalies. Deviations from an expected pattern, such as flow in a direction that is oblique from the regional topographical gradient, could be related to structural or lithologic discontinuities.

The drainage analysis was conducted using ESRI ArcGIS® software and carried out through the interpretation of aerial photographs, hillshade imagery, and the IGS map services hydrologic features dataset. The hillshade was used to delineate the drainage networks of streams at scales ranging from 1:2,000 to 1:5,000 (Figure 4-1). A comparison of the IGS map services hydrologic features dataset and mapping from the drainage analysis is presented in Figure 4-2.

In all CCR Landfill, WBSP and LRCP sites, the drainage network has a predominant dendritic drainage pattern, which is consistent with the underlying horizontal sedimentary strata. A small area with a parallel drainage pattern (northeast-southwest trend) was noted on the southeastern shore of the Ohio River. This pattern is the product of the uplands drainage through a three-mile-long valley-side slope (averages 20° and 320 feet drop).

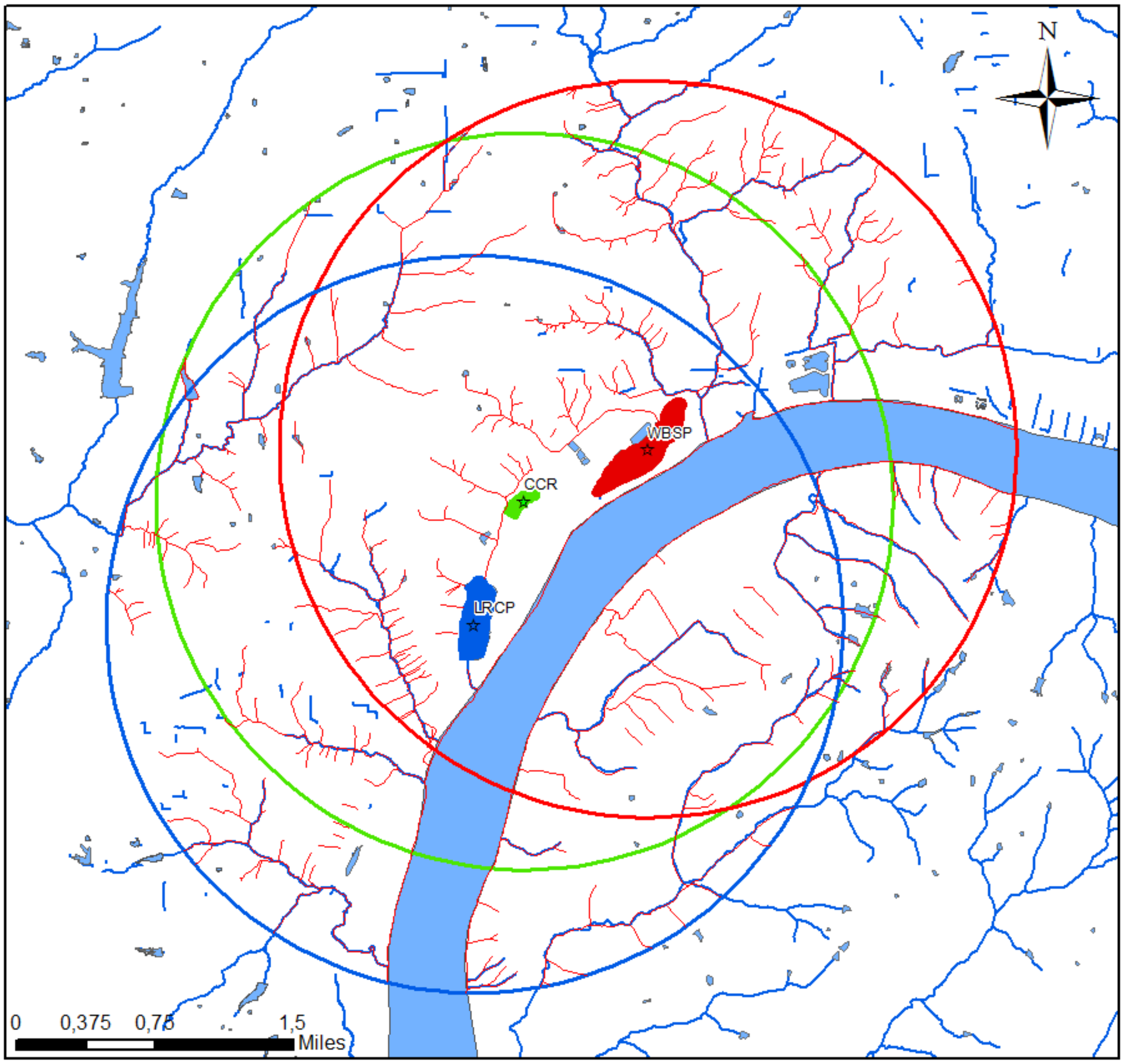
The only abnormal drainage deviations observed are the result of redirection by anthropogenic activity. No fault scarps or other tectonic features associated with active (Holocene-aged) faults were observed within the study area.

Figure 4-1 Drainage network mapping on LiDAR and DEM hillshade image (left) and overlay on aerial photographs (right)



CCR - Coal Combustion Residuals Landfill; LRCP - Landfill Runoff Collection Pond; WBSP - West Boiler Slag Pond

Figure 4-2 Indiana State Geological Survey map services hydrological features dataset (blue) compared with the detailed drainage analysis mapping (red)



CCR - Coal Combustion Residuals Landfill; LRCP - Landfill Runoff Collection Pond; WBSP - West Boiler Slag Pond

5.0 SUMMARY OF KEY FINDINGS

A neotectonics analysis of the Clifty Creek Station in Madison, Indiana, was completed within a two-mile radius centered on the CCR Landfill, WBSP and LRCP sites. The neotectonics analysis involved an extended review of publicly available information (geology, faults, hydrology, seismic hazard, geophysical surveys, Quaternary history, surficial deposits, pedology), lineament analysis, and drainage analysis. The findings from a separate literature review show that the study area is located east of the western flank of the Jessamine dome, an area of low seismicity (Hatcher 2018). None of the literature reviewed have indicated the existence of any active (Holocene-age) fault within two miles of the Indiana-Kentucky Electric Corporation Clifty Creek station and associated ponds (Hatcher 2018).

The lineament analysis identified ten linear features that have been interpreted as the result of stream erosion of residual soils overlying soft sedimentary bedrock. These features are interpreted to not be associated with Holocene-age faults. Two linear features with a northeast-southwest trend were interpreted as potential faults. However, being buried by pre-Holocene surficial deposits, these features were interpreted as inactive. Other lineaments were interpreted as remnants of pre-Holocene stream erosion and as features derived from a bedrock-controlled topography; these lineaments are not likely to have developed from active faults. Lineaments that suggest potential faults (all pre-Holocene) are not within 200 feet from the CCR Landfill, WBSP and LRCP sites.

The drainage analysis shows a predominant dendritic drainage pattern which is consistent with the underlying horizontal sedimentary strata. A parallel drainage pattern, observed on the southeastern shore of Ohio River, was interpreted as the result of the upland drainage through a three-mile-long valley-side slope. The only abnormal drainage deviations observed are the result of redirection by anthropogenic activity (e.g., ditches, river training).

No fault scarps or other tectonic features associated with active (Holocene-age) faults were observed within a two mile-radius of any of the CCR Landfill, WBSP or LRCP sites.

Limitations. The desktop neotectonics analysis presented in this report is based on a review of available aerial photographs and hillshade imagery derived from the LiDAR data and DEM. The LiDAR data date from a 2012 survey and may not represent current terrain conditions. Moreover, LiDAR data did not cover the Kentucky portion of the study areas. A 30-foot-grid DEM was used to cover this section; meaning lineament and drainage analysis may not be as accurate as the (5 foot-grid) LiDAR data. Also, stereoscopic air photo interpretation was not conducted as part of the assessment.

Note that the modification of surficial sediments due to the construction of the LRCP and WBSP can hamper the identification of neotectonics features.

Given that the region as a low seismic hazard and that no active (Holocene-age) fault features within 200 feet of the CCR Landfill, LRCP and WBSP sites were identified during the neotectonics analysis (lineament and drainage network mapping), then no further work is recommended.

6.0 CLOSURE

This report supports the fault area demonstration only for the Clifty Creek Plant and the conclusions are not valid for other applications. This report is based on a literature review of cited references, a desktop lineament and drainage mapping exercise based on interpretation of LiDAR hillshade and satellite imagery, and no fieldwork was conducted to verify actual conditions within the study limits.

We trust that the information contained in this report is adequate for your present purposes. If you have any questions about the contents of the report, or if we can be of any other assistance, please do not hesitate to contact us at your convenience.

This desktop terrain analysis was conducted by Manuel Verpaelst, M.Sc., technically reviewed by Sid Tsang, P.Geo.; and approved by Richard Guthrie M.Sc., Ph.D., P.Geo.

Yours very truly,

STANTEC CONSULTING LTD.

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ATTACHMENT D
SEISMIC IMPACT ZONES COMPLIANCE DEMONSTRATION REPORT

Compliance Demonstration Report – Seismic Impact Zones
West Boiler Slag Pond
Clifty Creek Station

Indiana-Kentucky Electric Corporation
Madison, Jefferson County, Ohio

Prepared for:
Indiana-Kentucky Electric Corporation
Piketon, Ohio

Prepared by:
Stantec Consulting Services Inc.
11687 Lebanon Road
Cincinnati, Ohio 45241

October 16, 2018

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1.0 PROJECT BACKGROUND

On April 17, 2015, the "Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" (EPA Final CCR Rule) was published in the Federal Register. Stantec Consulting Services Inc. (Stantec) was contracted by the Indiana-Kentucky Electric Corporation (IKEC) to demonstrate proficiency regarding seismic impact zones at the Clifty Creek Station and evaluate compliance with §257.63 of the CCR Rule.

As required by §257.63 of the EPA Final CCR Rule, an owner or operator of a new CCR landfill, existing or new CCR surface impoundment, or a lateral expansion of a CCR unit is required by October 17, 2018 to demonstrate that the unit is not located in a seismic impact zone unless the owner or operator demonstrates that all structural components of the CCR unit are designed to resist the maximum horizontal acceleration (MHA) in the lithified material on site.

In support of §257.63 of the EPA Final CCR Rule, §257.53 provides the following definitions:

> *Lithified Earth Material:* all rock, including all naturally occurring and naturally formed aggregates or masses of minerals or small particles of older rock that formed by crystallization of magma or by induration of loose sediments. This term does not include man-made materials, such as fill, concrete, and asphalt, or unconsolidated earth materials, soil, or regolith lying at or near the earth surface.
>
> *Maximum horizontal acceleration in lithified earth material:* the maximum expected horizontal acceleration at the ground surface as depicted on a seismic hazard map, with a 98% or greater probability that the acceleration will not be exceeded in 50 years, or the maximum expected horizontal acceleration based on a site-specific risk assessment.
>
> *Seismic impact zone:* An area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 50 years.
>
> *Structural components:* liners, leachate collection and removal systems, final covers, run-on and run-off systems, inflow design flood control systems, and any other component used in the construction and operation of the CCR unit that is necessary to ensure the integrity of the unit and that the contents of the unit are not released into the environment.

2.0 UNIT DESCRIPTION

The Clifty Creek Station is located on the north shore of the Ohio River downstream of Madison, Indiana. The station consists of six coal-fired electric generating units, each nominally rated at 217 megawatts. The Clifty Creek Station is directly accessible from State Route 56.

The West Boiler Slag Pond is located southwest of the station. It is formed by natural grade to the north, east, and west and a dam on the south that runs along the bank of the Ohio River. The West Boiler Slag Pond serves as a settling basin for sluiced bottom ash produced at the station and receives stormwater runoff from approximately 510 acres (Stantec, 2010a). The pond contains two primary areas: the eastern portion near the sluice pipes that is actively dredged and a western portion with minimal deposition or dredging activities. A vegetation delta separates the two as a natural filtering zone. The pond discharges to the Ohio River through a principal spillway at the southern edge of the impoundment (Stantec, 2016a).

Figure 1 below presents an overview of the Clifty Creek Station and related appurtenances including the main plant and West Boiler Slag Pond.

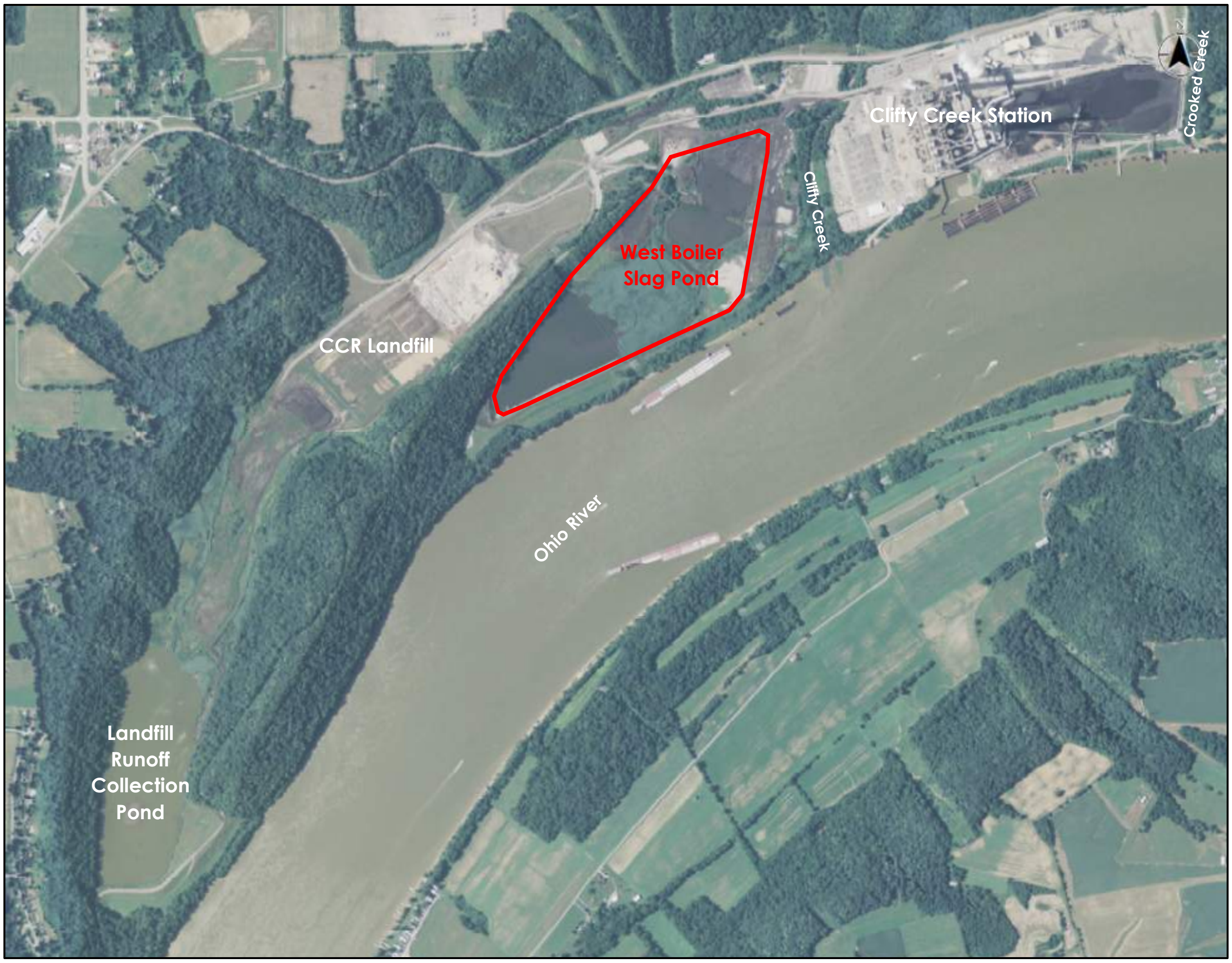

Figure 1. Aerial View of Clifty Creek Station

3.0 SEISMIC IMPACT ZONE DETERMINATION (§257.63(A))

Per §257.63(a) and §257.53, it must first be determined if the West Boiler Slag Pond is located within a seismic impact zone.

Assessment of the existing surface impoundment was completed considering the following criteria related to the CCR rule:

- Review of the site's peak ground acceleration having a 2% or greater probability of being exceeded in 50 years as defined by the United States Geological Survey (USGS), Earthquake Hazard Program.
- Review documentation (including but not limited to geotechnical data reports, construction drawings, and published geologic mapping) containing information that indicate the foundation materials within the top 100 feet of the subsurface.

3.1 BACKGROUND

The West Boiler Slag Pond is located at approximately 38˚ 44' 2.1372" (latitude) and -85˚ 25' 48.63" (longitude). This converts to 38.733927, -85.430175 decimal degrees.

Boring logs and geotechnical laboratory testing are available for the original ash pond design (AEPSC, 2016) and for the ash pond embankment during the initial safety factor assessment for the EPA Final CCR Rule (Stantec, 2016b).

The West Boiler Slag Pond is classified as an existing, unlined CCR surface impoundment (IKEC, 2016). The pond's dam forms the southern boundary for the pond. It is an earthen dam with a crest length roughly 2,500 feet, a crest elevation of 475 feet mean sea level (MSL), and a structural height of about 42 feet. The minimum dam crest elevation is 469 mean sea level (MSL). The dam is not currently registered with the Indiana Department of Natural Resources (IDNR), but has been identified as a significant hazard structure by AEPSC (Stantec, 2010).

The West Boiler Slag Pond's dam has a crest width of 20 feet. The upstream embankment has a slope of 1.5H:1V to 2H:1V. The downstream embankment has a slope of approximately 2.5H:1V with a break in the slope around elevation 446 feet. Below elevation 446 feet, the downstream embankment flattens until the river edge where it transitions to 4.5H:1V down to the river (GZA, 2009).

The dam's primary spillway is a reinforced concrete box riser structure. One side of the structure has a 3-foot wide opening that acts as a weir with water level adjusted using stop logs. The riser structure outlets to the Ohio River at elevation 426.8 feet through a 36-inch diameter, 450-foot long reinforced concrete pipe (Stantec, 2010).

The inflow design flood control demonstration indicates that the surface impoundment does not overtop and maintains adequate freeboard (Stantec, 2010).

The initial safety factor assessment analyzed the critical cross section of the West Boiler Slag Pond dam for seismic conditions. The pseudo-static analysis used a horizontal seismic coefficient of 0.085g and estimated a factor of safety of 1.30 (Stantec, 2016b). Conventional guidelines for pseudo-static analyses assume a horizontal seismic coefficient (k_h) equal to one-half of the PGA on rock (Hynes-Griffin and Franklin, 1984). The referenced initial safety factor assessment conservatively assumed the full PGA on rock.

3.2 ASSESSMENT

The United States Geological Survey (USGS), Earthquake Hazard Program publishes seismic hazard maps to allow preliminary site assessments based on current understanding of:

- Known faults and historic earthquakes,
- The behavior of seismic waves as they propagate between a source and a site, and
- The near-surface conditions at specific locations of interest.

The National Hazard Maps referenced in the EPA Final CCR Rule show the distribution of earthquake shaking levels that have a certain probability of occurring in the United States (USGS, 2018). They are created to provide preliminary information to assist in the design of infrastructure (e.g. buildings, roads, utilities) to withstand shaking from earthquakes. The USGS provides probabilistic ground motion maps depicting earthquake hazard using contours to illustrate the earthquake ground motions of a particular frequency that have a given probability of being exceeded in a given time period (USGS, 2018).

For this demonstration, the ground motion used for seismic impact zone determination corresponds to predicted motion with a 2% or greater probability of exceedance in 50 years. Appendix A contains the 2014 National Hazard Map with the site located and a site-specific unified hazard report for the West Boiler Slag Pond based on an input of latitude and longitude into the interactive Unified Hazard Tool. As established by the USGS reference, the peak ground acceleration (PGA) ground motion is estimated as 0.0884g. It should be noted that the USGS mapping referenced assumes a return period of 2,475 years (equivalent to 2% probability of exceedance in 50 years).

3.3 CONCLUSION

The preamble of the EPA Final CCR Rule (p. 21366, Vol. 80, No. 74 of the Federal Register) discusses the data determining seismic impact zone as being mapped and readily available through the USGS. This implies that the intended methodology was to determine seismic impact zone based on PGA $_{B/C}$ (USGS, 2018). The referenced USGS mapping indicates the West Boiler Slag Pond has a PGA $_{B/C}$ of 0.0884g, which is below the 0.10g specified as a seismic impact zone.

Based on the interpretation of the EPA Final CCR Rule requirements outlined herein, it is Stantec's professional opinion that the subject CCR unit is not located within a seismic impact zone.

4.0 REFERENCES

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Appendix A PEAK GROUND ACCELERATION

U.S. Geological Survey - Earthquake Hazards Program

https://earthquake.usgs.gov/hazards/interactive/
Accessed March 7, 2018

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (v4.1.

Latitude

Decimal degrees

38.733927

Longitude

Decimal degrees, negative values for western longitudes

-85.430175

Site Class

760 m/s (B/C boundary)

Spectral Period

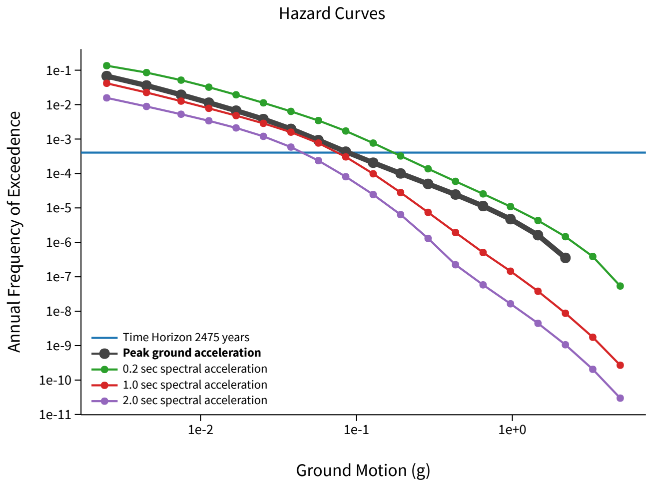
Peak ground acceleration

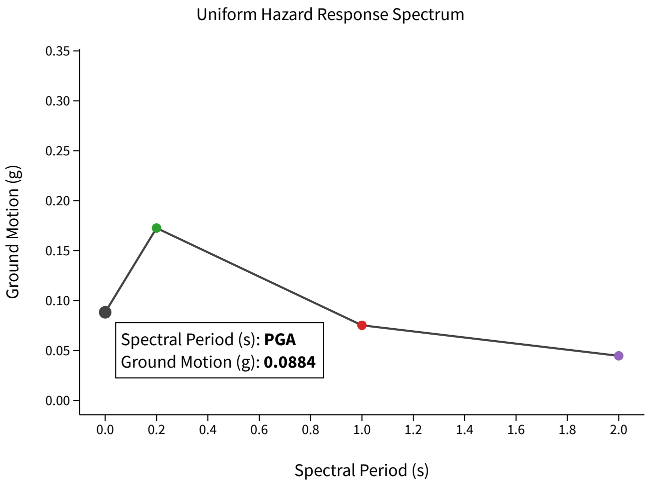
Time Horizon

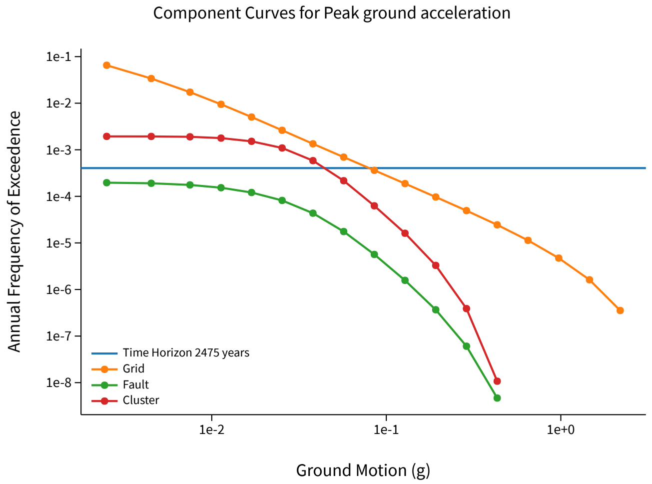
Return period in years

2475

Hazard Curve





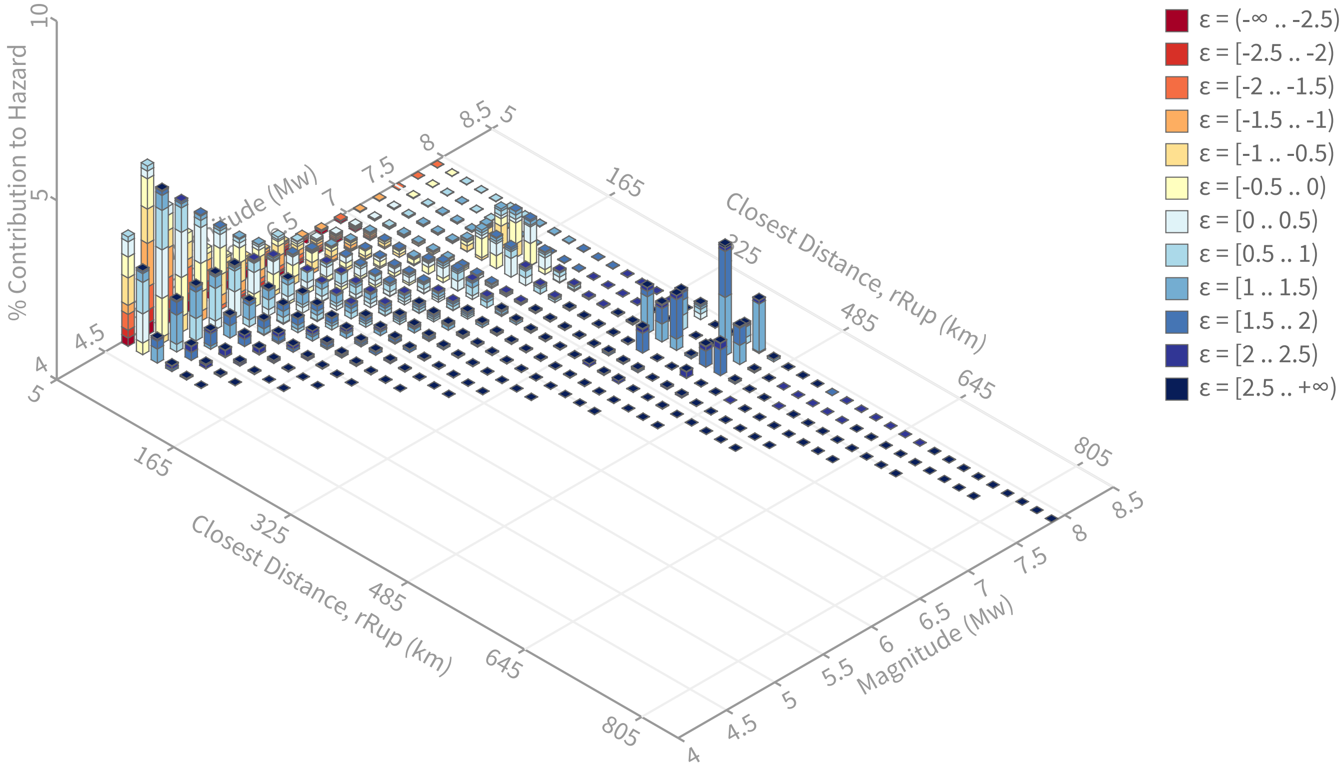


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.08843252 g

Recovered targets

Return period: 2499.4712 yrs
Exceedance rate: 0.00040008463 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 1.72 %

Mean (for all sources)

r: 124.31 km
m: 6.1
ε_0: 0.27 σ

Mode (largest r-m bin)

r: 13.42 km
m: 4.9
ε_0: -1.1 σ
Contribution: 4.71 %

Mode (largest ε_0 bin)

r: 433.72 km
m: 7.78
ε_0: 1.34 σ
Contribution: 1.63 %

Discretization

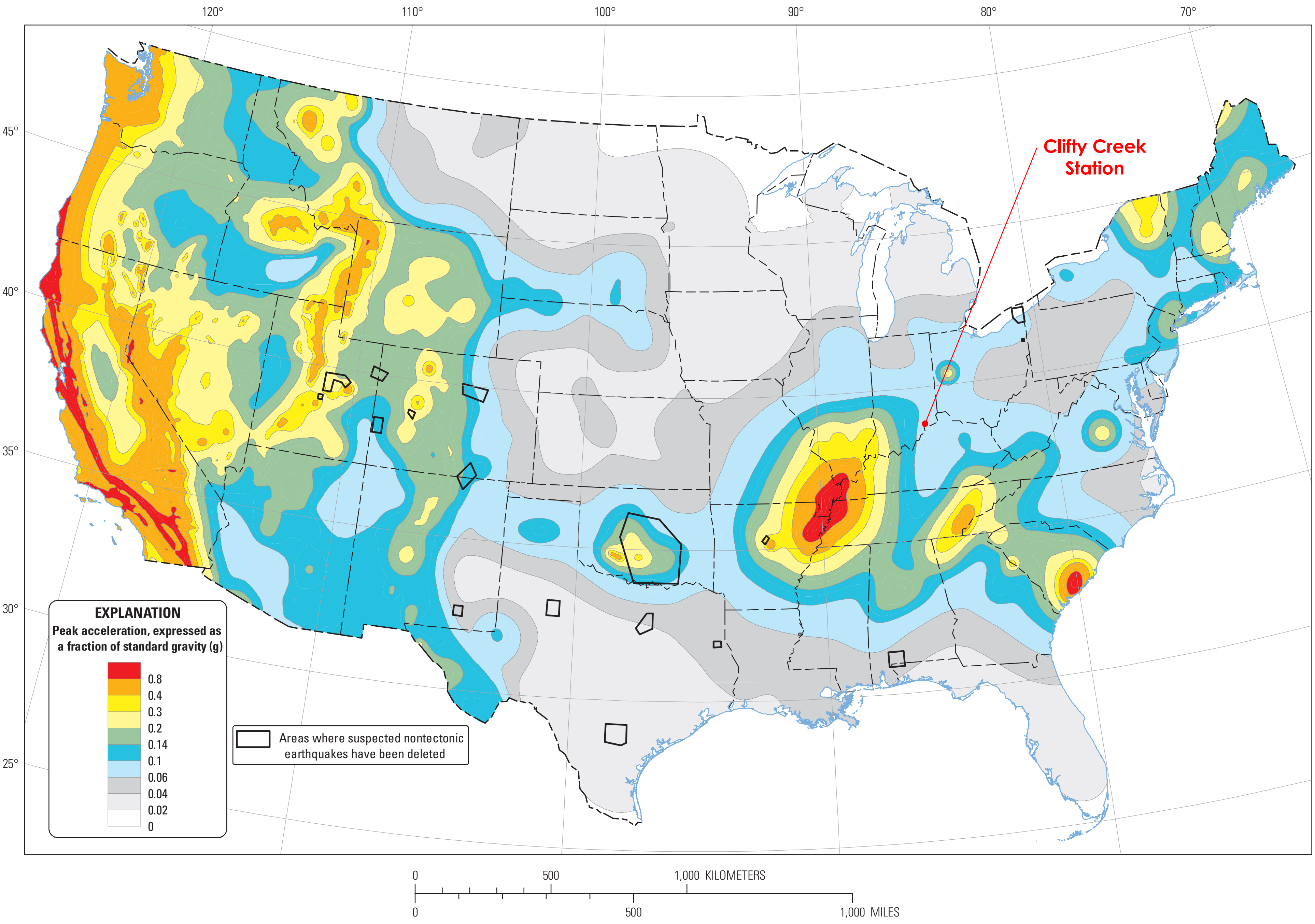
r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
USGS Fixed Smoothing Zone 1 (opt)	Grid							28.09
PointSourceFinite: -85.430, 38.891		17.96	5.20	-0.85	85.430°W	38.891°N	0.00	3.22
PointSourceFinite: -85.430, 38.936		22.72	5.25	-0.49	85.430°W	38.936°N	0.00	2.74
PointSourceFinite: -85.430, 38.981		27.52	5.31	-0.21	85.430°W	38.981°N	0.00	2.32
PointSourceFinite: -85.430, 38.801		8.91	5.14	-2.01	85.430°W	38.801°N	0.00	2.02
PointSourceFinite: -85.430, 39.116		41.93	5.50	0.32	85.430°W	39.116°N	0.00	1.77
PointSourceFinite: -85.430, 39.026		32.33	5.37	0.00	85.430°W	39.026°N	0.00	1.60
PointSourceFinite: -85.430, 39.071		37.14	5.43	0.18	85.430°W	39.071°N	0.00	1.51
PointSourceFinite: -85.430, 39.161		46.72	5.56	0.43	85.430°W	39.161°N	0.00	1.12
SSCn Fixed Smoothing Zone 1 (opt)	Grid							22.69
PointSourceFinite: -85.430, 38.891		17.96	5.20	-0.85	85.430°W	38.891°N	0.00	3.22
PointSourceFinite: -85.430, 38.936		22.72	5.25	-0.49	85.430°W	38.936°N	0.00	2.74
PointSourceFinite: -85.430, 38.981		27.52	5.31	-0.21	85.430°W	38.981°N	0.00	2.32
PointSourceFinite: -85.430, 38.801		8.91	5.14	-2.01	85.430°W	38.801°N	0.00	2.02
PointSourceFinite: -85.430, 39.116		41.93	5.50	0.32	85.430°W	39.116°N	0.00	1.61
PointSourceFinite: -85.430, 39.026		32.33	5.37	0.00	85.430°W	39.026°N	0.00	1.60
PointSourceFinite: -85.430, 39.071		37.14	5.43	0.18	85.430°W	39.071°N	0.00	1.51
Wabash Valley	Grid							9.61
USGS Adaptive Smoothing Zone 1 (opt)	Grid							8.23
SSCn New Madrid	Cluster							8.20
NMFS RLME 1		422.62	7.67	1.56	89.288°W	36.995°N	241.47	2.23
NMFS RLME 5		424.32	7.67	1.57	89.288°W	36.995°N	241.47	1.44
NMFS RLME 4		399.69	7.64	1.54	89.020°W	37.270°N	243.75	1.25
SSCn Adaptive Smoothing Zone 1 (opt)	Grid							6.71
SSCn Fixed Smoothing Zone 8 (opt)	Grid							6.12
USGS New Madrid 500-year	Cluster							2.58
NMSZ: Center Model		405.66	7.65	1.56	89.070°W	37.165°N	242.47	1.82
SSCn Adaptive Smoothing Zone 8 (opt)	Grid							1.77
USGS New Madrid 750-year	Cluster							1.72
NMSZ: Center Model		405.66	7.65	1.56	89.070°W	37.165°N	242.47	1.21
USGS New Madrid 500-year	Fault							1.20

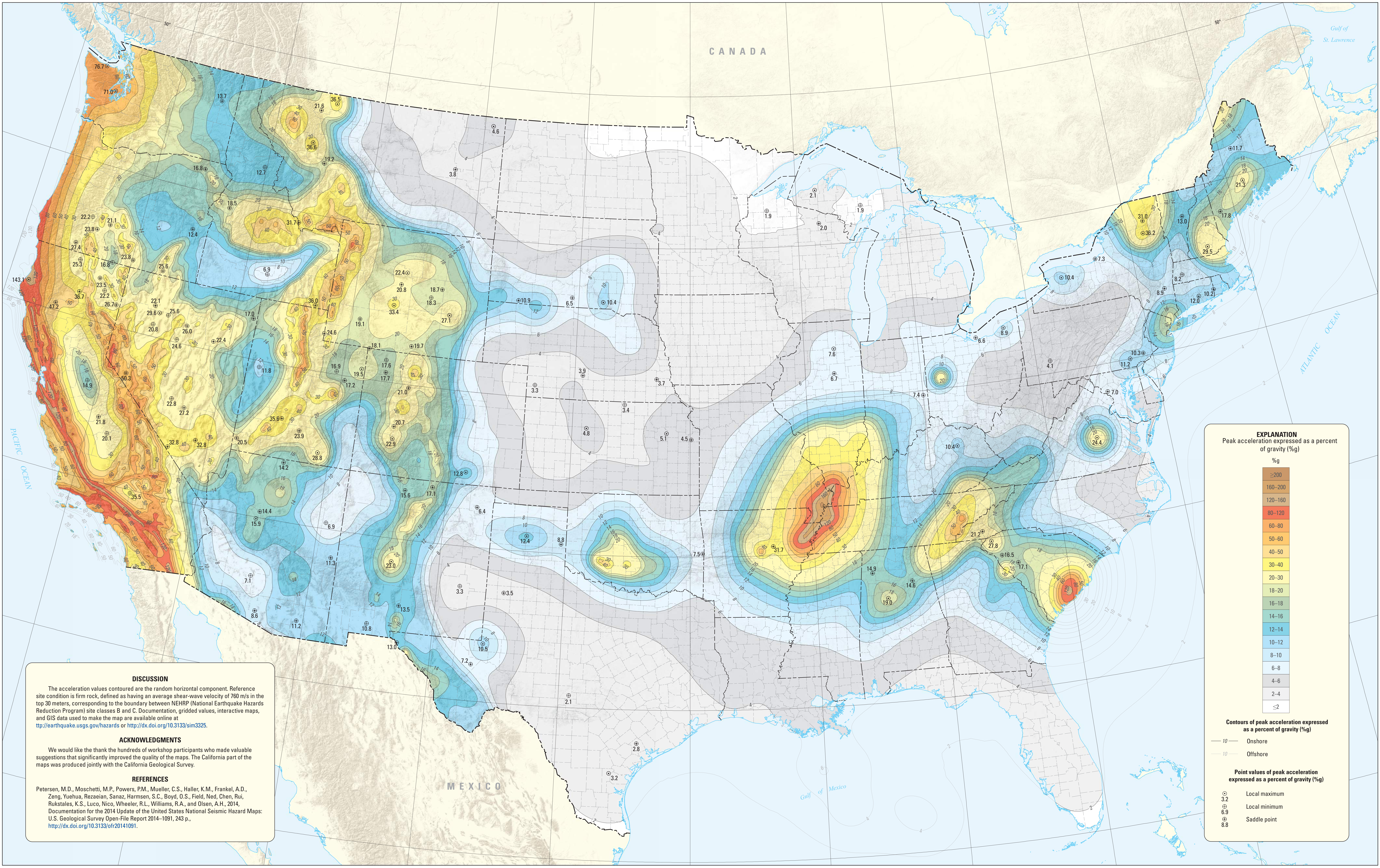


Two-percent probability of exceedance in 50 years map of peak ground acceleration

Source: The 2014 U.S. Geological Survey (USGS) National Seismic Hazard Map
https://earthquake.usgs.gov/static/lfs/nshm/conterminous/2014/2014pga2pct.pdf

U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3325
Sheet 2 of 6



DISCUSSION

The acceleration values contoured are the random horizontal component. Reference site condition is firm rock, defined as having an average shear-wave velocity of 760 m/s in the top 30 meters, corresponding to the boundary between NEHRP (National Earthquake Hazards Reduction Program) site classes B and C. Documentation, gridded values, interactive maps, and GIS data used to make the map are available online at ttp://earthquake.usgs.gov/hazards or http://dx.doi.org/10.3133/sim3325.

ACKNOWLEDGMENTS

We would like the thank the hundreds of workshop participants who made valuable suggestions that significantly improved the quality of the maps. The California part of the maps was produced jointly with the California Geological Survey.

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EXPLANATION

Peak acceleration expressed as a percent of gravity (%g)

%g
≥200
160–200
120–160
80–120
60–80
50–60
40–50
30–40
20–30
18–20
16–18
14–16
12–14
10–12
8–10
6–8
4–6
2–4
≤2

Contours of peak acceleration expressed as a percent of gravity (%g)

—10—	Onshore
—10—	Offshore

Point values of peak acceleration expressed as a percent of gravity (%g)

⊙ 3.2	Local maximum
⊕ 6.9	Local minimum
⊕ 8.8	Saddle point

Shaded relief base from Esri Inc., 2008, Data and Maps
All other base map data from Esri Inc., 1993, Digital Chart of the World
United States County base map from the U.S. Geological Survey National Atlas, available at http://nationalatlas.gov/

Projection: Albers equal-area conic
Standard parallels 29.5°N. and 45.5°N., central meridian 95°W

SCALE 1:7 000 000
100 0 100 200 300 400 500 600 700 800 900 1000 MILES
100 0 100 200 300 400 500 600 700 800 900 1000 KILOMETERS

Digital data prepared with ArcGIS 10.1 running under Windows 7

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Seismic-Hazard Maps for the Conterminous United States, 2014

Peak Horizontal Acceleration with 2 Percent Probability of Exceedance in 50 Years

By

Mark D. Petersen,[1] Morgan P. Moschetti,[1] Peter M. Powers,[1] Charles S. Mueller,[1] Kathleen M. Haller,[1] Arthur D. Frankel,[1] Yuehua Zeng,[1] Sanaz Rezaeian,[1]
Stephen C. Harmsen,[1] Oliver S. Boyd,[1] Edward H. Field,[1] Rui Chen,[2] Nicolas Luco,[1] Russell L. Wheeler,[1] Robert A. Williams,[1] Anna H. Olsen,[1] and Kenneth S. Rukstales[1]

2015

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ATTACHMENT E
UNSTABLE AREAS COMPLIANCE DEMONSTRATION REPORT

Compliance Demonstration Report – Unstable Areas
West Boiler Slag Pond
Clifty Creek Station

Indiana-Kentucky Electric Corporation
Madison, Jefferson County, Indiana

Prepared for:
Indiana-Kentucky Electric Corporation
Piketon, Ohio

Prepared by:
Stantec Consulting Services Inc.
11687 Lebanon Road
Cincinnati, Ohio 45241

October 16, 2018

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1.0 PROJECT BACKGROUND

On April 17, 2015, the "Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" (EPA Final CCR Rule) was published in the Federal Register. Stantec Consulting Services Inc. (Stantec) was contracted by the Indiana-Kentucky Electric Corporation (IKEC) to demonstrate proficiency regarding unstable areas at the Clifty Creek Station and evaluate compliance with §257.64 of the CCR Rule.

As required by §257.64 of the EPA Final CCR Rule, an owner or operator of an existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit is required by October 17, 2018 to demonstrate that the unit is not located in an unstable area unless the owner or operator demonstrates that generally accepted good engineering practices have been incorporated into the design of the CCR unit to promote the geotechnical integrity of the unit in such a manner that structural components of the CCR unit will not be disrupted.

The following factors have been considered to determine whether the West Boiler Slag Pond located at the Clifty Creek Station is in an unstable area:

- On-site or local soil conditions that may result in significant differential settling,
- On-site or local geologic or geomorphic features, and
- On-site or local human-made features or events (both surface and subsurface).

2.0 UNIT DESCRIPTION

The Clifty Creek Station is located on the north shore of the Ohio River downstream of Madison, Indiana. The station consists of six coal-fired electric generating units, each nominally rated at 217 megawatts. The Clifty Creek Station is directly accessible from State Route 56.

The West Boiler Slag Pond is located southwest of the station. It is formed by natural grade to the north, east, and west and a dam on the south that runs along the bank of the Ohio River. The West Boiler Slag Pond serves as a settling basin for sluiced bottom ash produced at the station and receives stormwater runoff from approximately 510 acres (Stantec, 2010a). The pond contains two primary areas: the eastern portion near the sluice pipes that is actively dredged and a western portion with minimal deposition or dredging activities. A vegetation delta separates the two as a natural filtering zone. The pond discharges to the Ohio River through a principal spillway at the southern edge of the impoundment.

Figure 1 below presents an overview of the Clifty Creek Station and related appurtenances including the main plant and the West Boiler Slag Pond.

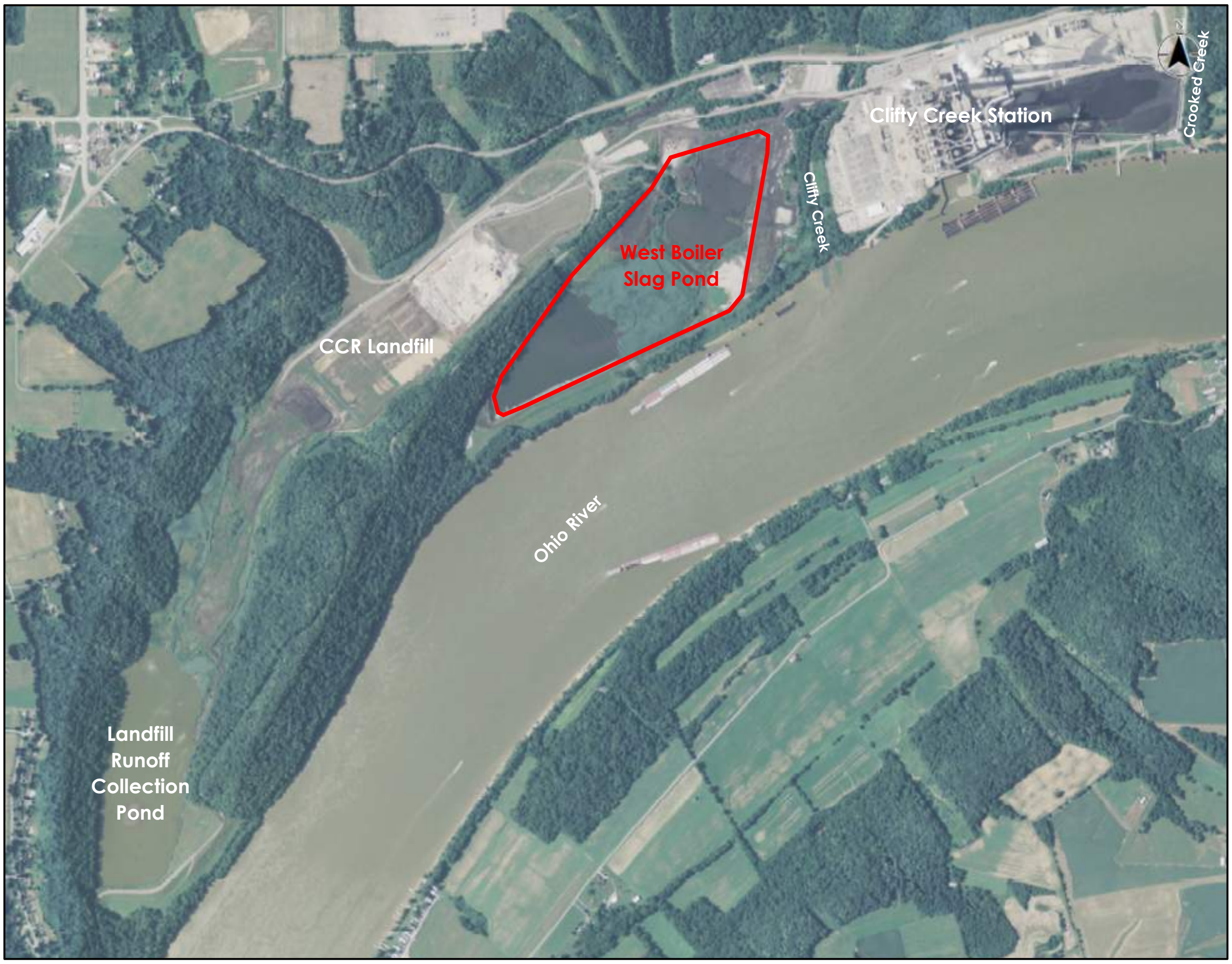

Figure 1. Aerial View of Clifty Creek Station

3.0 SOIL CONDITIONS (§257.64(B)(1))

Per §257.64(b)(1), the unstable areas demonstration must consider on-site or local soil conditions that may result in significant differential settling when determining whether the area is unstable.

Assessment of the soil conditions was completed considering the following criteria related to the CCR rule:

- Review inspection reports of the CCR unit that document deformations in the soils or movement of structural components indicating differential settlement of foundation soils.
- Review published soil surveys that indicate on-site or local presence of soft or compressible soil formation(s).
- Review documentation (including but not limited to geotechnical data reports, construction drawings, and field notes) containing information that may indicate the foundation materials are soft or compressible.
- Review results of existing analyses to confirm that any settlement of the unit would be marginal (within acceptable limits) and would not cause any unpermitted release of CCR into the environment.

3.1 BACKGROUND

Site inspections of the West Boiler Slag Pond have been conducted and documented regularly since 1976 to present (Stantec, 2016). These inspections include observations of vegetative cover, crest and slope conditions, and hydraulic structures for any signs of deformations in the soil or movement of the structural components that would indicate differential settlement of the foundation soils.

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) maintains an online web soil survey tool that provides information of local soils for a user-specified area of interest. The predominant surficial soil unit along the West Boiler Slag Pond perimeter dikes is Udorthents (Ud). These soils are described as loamy with depths greater than 80 inches. The Udorthents (Ud) soil unit has a moderately well-drained drainage class. The depth to water is expected to be more than 80 inches. The soil survey also indicated the side slopes of rock ridge west of the unit (Devil's Backbone) belong to the Eden-Caneyville complex (EgG). These soils are found on steep to very steep slopes ranging from 25 to 60 percent. The Eden-Caneyville complex consists of moderately deep and well-drained soils that formed on slopes facing the Ohio River and on back slopes facing adjacent to tributaries near the river.

The dam was designed by Arthur and Leo Casagrande of Cambridge, Massachusetts in the early to mid-1950s. They were also retained during the construction phase of the embankment and appurtenances. The firm was involved in the foundation preparation for the Landfill Runoff Collection Pond dam and the selection of the borrow soils (GZA, 2009).

Stantec performed a geotechnical exploration in 2010 to characterize the embankment of the West Boiler Slag Pond dike. Stantec advanced six borings along three cross sections (Stantec, 2010b). Piezometers were installed in four of the borings. This exploration indicated that the soils underlying the West Boiler Slag Pond dike consisted primarily of lean clay with sand, sandy silt, or silt with sand.

Two exploratory soil borings were completed south of the West Boiler Slag Pond in 2015 to obtain geologic information specific to designing the CCR Rule monitoring networks (AGES, 2016). An additional 10 monitoring wells were installed in 2015 and 2016 at the West Boiler Slag Pond. The boring logs from the exploratory soil borings and monitoring wells indicate that the West Boiler Slag Pond is underlain by brown and gray silty clay with lenses of silty sand and some gravel as well as limestone bedrock.

Appendix A includes the Web Soil Survey completed for the West Boiler Slag Pond (USDA, 2018). Additional geologic information is included in Section 4.0.

3.2 ASSESSMENT

Inspections of the West Boiler Slag Pond have shown no visual signs of differential settlement or deformations of the structural components (AEPSC, 2017).

Historic soil reports and geotechnical exploration reports were reviewed for evidence of soft and compressible soils that may have been on site prior to the development of the West Boiler Slag Pond. For the purposes of this report, soft and compressible soils are fat clays, elastic silts, organic silts and clays, or highly organic soils (peat).

The subsurface investigations discussed in Section 3.1 did not indicate the presence of the above soil types underlying the West Boiler Slag Pond. However, several investigations indicate the presence of soft foundation clays. These soft foundation clay materials were recognized and considered in the design, construction, and continued operation of the West Boiler Slag Pond dam (GZA, 2009).

3.3 CONCLUSION

Based on the assessment of the soil conditions, the CCR Rule-related criteria listed above have been met.

4.0 GEOLOGIC OR GEOMORPHOLOGIC FEATURES (§257.64(B)(2))

Per §257.64(b)(2), the unstable areas demonstration must consider on-site or local geologic or geomorphologic features when determining whether the area is unstable.

Assessment of the geologic or geomorphologic features was completed considering the following criteria related to the CCR rule:

- Review of published geologic maps that indicate on-site or local geomorphologic features such as:
    - Karst potential,
    - Known sinkhole outlines,
    - Known spring locations, and
    - Known landslide locations.
- Review of inspection reports of the CCR unit that document characteristic features of karstic formation (e.g. sinkholes, vertical shafts, sinking streams, caves, seeps, large springs, or blind valleys).
- Review documentation (including but not limited to geotechnical data reports, construction drawings, and field notes) containing information regarding the on-site or local geology and geomorphology.
- Review of hillshade mapping by the Indiana Geological Survey (IGS) based on 5-foot Digital Elevation Models (DEM) derived from 1.5-meter LiDAR data to identify areas susceptible to mass movement.

4.1 BACKGROUND

Site inspections of the West Boiler Slag Pond have been conducted and documented regularly since 1976 to present (Stantec, 2016). These inspections include observations related to identifying characteristic features of karstic formations.

The Indiana Geological Survey (IGS) and Kentucky Geological Survey (KGS) maintain interactive geologic map information services that provides valuable, relevant information and retrievable data pertaining to geologic or geomorphologic features. Appendix B contains pertinent geologic and geomorphologic features from IGS and KGS mapping.

Physiographic mapping (IGS, 2018) indicates that the Clifty Creek Station is located in the Muscatatuck Plateau of the Southern Hills and Lowlands Region. The Muscatatuck Plateau is described as having broad till-covered uplands entrenched by major valleys.

According to quaternary geology mapping (IGS, 2018), the West Boiler Slag Pond is underlain by alluvium deposited during the Holocene age. The alluvium consists of silt, sand, and gravel deposits of and along present streams and includes some colluvium along valley margins.

Indiana bedrock geologic mapping (IGS) indicates that the bedrock underlying the West Boiler Slag Pond is in the Maquoketa Group of the Ordovician system. Bedrock in this group consists of limestone, dolomite, shale, and sandstone.

4.2 ASSESSMENT

Based on the information presented in the available inspection reports for the West Boiler Slag Pond, there have been no documented characteristic features of sinkholes or karstic formation (AEPSC, 2017).

Sinkhole areas and sinking stream basins associated with karst geology are not located in the footprint of the West Boiler Slag Pond (IGS, 2018). Large areas of known karst features are located in Lawrence, Washington, Orange, Harrison, and Floyd counties in Indiana, west of the Clifty Creek Station. Kentucky karst mapping (KGS, 2018) indicates that the Clifty Creek Station is near areas with low to medium karst potential.

The sinkhole inventory for southern Indiana and northern Kentucky developed by the IGS indicates that one sinkhole has been documented in the footprint of the West Boiler Slag Pond (IGS, 2018). IGS metadata indicates that this sinkhole location was derived from closed contour feature extraction from digital line graphs. Several additional sinkholes are located within a few miles of the West Boiler Slag Pond, as shown in the mapping located in Appendix B. Note that no karst sinkhole areas, cave density, karst springs, or karst dye points are shown within one mile of the unit. The sinkhole inventory was created as a desktop exercise to support a statistical regression analysis of potential sinkhole development areas based on sinkhole density and a sinkhole-development risk layer; it is not based on field inspections.

Three landslides are located within 3 miles of the Clifty Creek Station in Kentucky according to the KGS landslide inventory (KGS, 2018). Similar mapping was not available for Indiana.

Mapping does not indicate any faults or other geologic deficiencies to be present in the vicinity of the impoundment (IGS, 2018; KGS, 2018).

The digital elevations models show no indication of areas susceptible to mass movement within the vicinity of the West Boiler Slag Pond (IGS, 2018).

4.3 CONCLUSION

Based on the assessment of the geologic and geomorphologic features, the CCR Rule-related criteria listed above have been met.

5.0 HUMAN-MADE FEATURES OR EVENTS (§257.64(B)(3))

Per §257.64(b)(3), the unstable areas demonstration must consider on-site or local human-made features or events when determining whether the area is unstable.

Assessment of the human-made features or events was completed considering the following criteria related to the CCR rule:

- Review inspection reports of the CCR unit that document indications of tension cracking, settlement, depressions, or deformation of the unit's structural components (embankments, spillways, outlets, liners, leachate collection systems, or final covers).
- Review of routine operations and inspections to maintain precaution from human-induced events or forces that might impair the integrity of some or all the structural components responsible for preventing unpermitted release of CCR into the environment.
- Review instrumentation installed to monitor the CCR unit to ensure readings are maintained within documented tolerances.
- Review of maps and other resources to confirm that the CCR unit is not located:
    - On previously mined or quarried areas,
    - On areas that have undergone excessive drawdown of groundwater, or
    - On an old landfill.

5.1 BACKGROUND

Site inspections of the West Boiler Slag Pond have been conducted and documented regularly since 1976 to present (Stantec, 2016). These inspections include observations that document indications of human-induced events or forces that could have impaired the integrity of any structural components, which are responsible for preventing the unpermitted release of CCR to the environment.

Ten monitoring wells were installed in 2015 and 2016 at the West Boiler Slag Pond to meet the monitoring network requirements of the CCR Rule (AGES, 2016). The Annual Dam and Dike Inspection Report (AEPSC, 2017) included the maximum instrument readings for four piezometers installed during the 2010 geotechnical exploration.

Appendix C contains maps presenting the locations of mining activity, industrial waste sites, water wells, and oil and gas wells from available data and mapping in Indiana and Kentucky (IGS, 2018; KGS, 2018).

5.2 ASSESSMENT

Inspections of the West Boiler Slag Pond have shown no visual signs of differential settlement or deformations of the structural components (AEPSC, 2017).

Mapping of mining activity in Indiana and Kentucky (IGS, 2018; KGS, 2018) indicates that no mines are located near the Clifty Creek Station. The nearest mine is located approximately 8 miles east of the site. There are no oil and gas wells located in the footprint of the West Boiler Slag Pond. There is one dry petroleum well located approximately 0.3 miles northwest of the impoundment, and a 130-acre gas field is located approximately 3.5 miles west. The nearest industrial waste site is located approximately 1.5 miles east of the Clifty Creek Station. It is not expected that human events related to these industries or their operations pose any negative impact to the structural components of the West Boiler Slag Pond.

According to IGS mapping (ODNR, 2018c), there are no wells shown in the footprint of the West Boiler Slag Pond. There are two documented water wells owned by IKEC approximately 0.3 miles north of the impoundment. These wells were installed in 1957. As discussed in Section 5.1, 10 monitoring wells have been installed to meet the monitoring network requirements for the CCR Rule. Monitoring wells would not typically cause excessive drawdown of groundwater levels, thus posing no significant hazard.

5.3 CONCLUSION

Based on the assessment of the human-made features or events, the CCR rule-related criteria listed above have been met.

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COMPLIANCE DEMONSTRATION REPORT –
UNSTABLE AREAS
WEST BOILER SLAG POND
CLIFTY CREEK STATION

October 16, 2018

Appendix A SOIL CONDITIONS

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Jefferson County, Indiana

Clifty Creek West Boiler Slag Pond

February 21, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

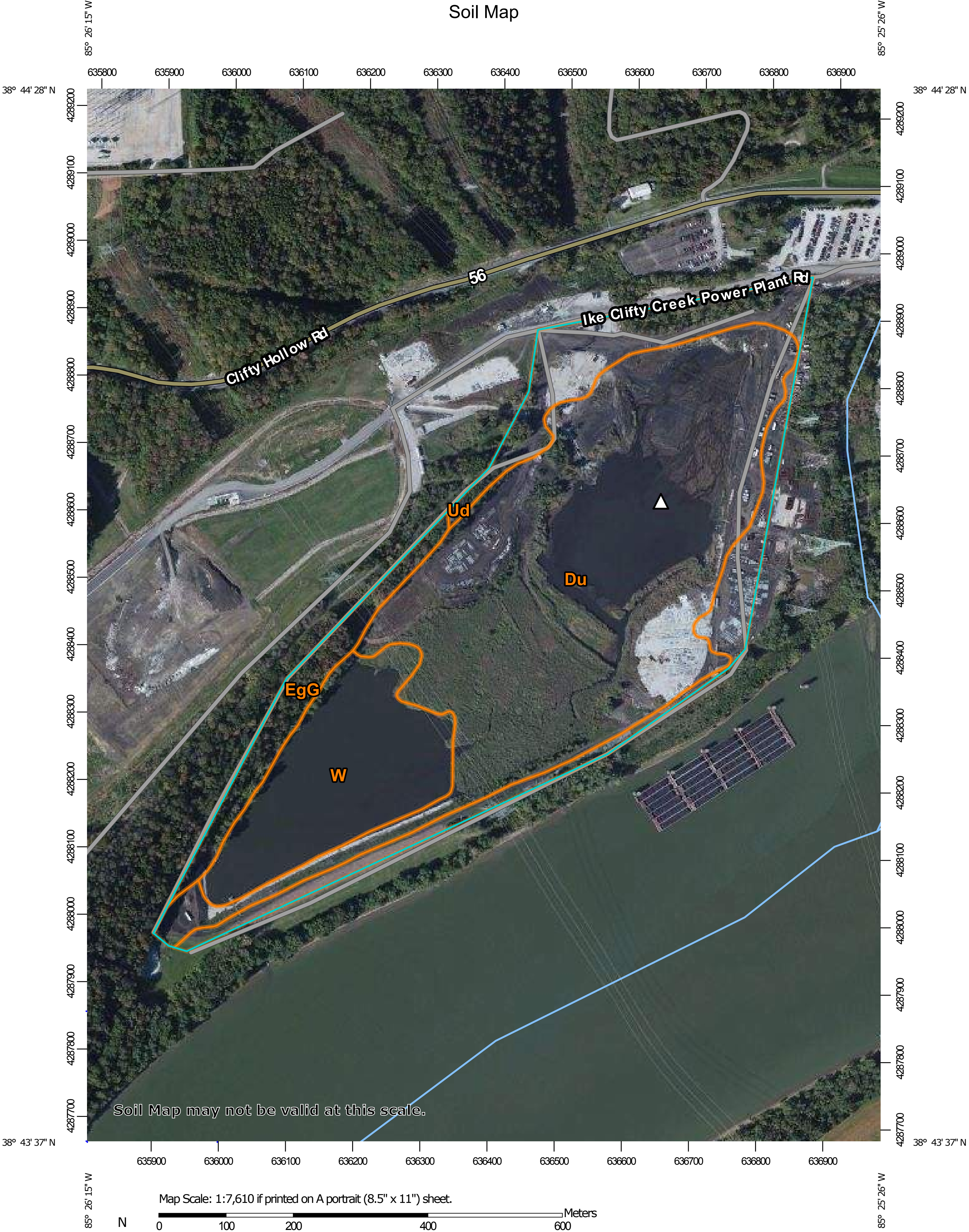
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:7,610 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 100, 200, 400, 600

Feet: 0, 350, 700, 1400, 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- □ Soil Map Unit Polygons
- Soil Map Unit Lines
- ■ Soil Map Unit Points

Special Point Features

- Blowout
- ⊠ Borrow Pit
- Clay Spot
- ◇ Closed Depression
- Gravel Pit
- ∴ Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- ◎ Miscellaneous Water
- ○ Perennial Water
- Rock Outcrop
- + Saline Spot
- ⁘ Sandy Spot
- Severely Eroded Spot
- ◇ Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- △ Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Jefferson County, Indiana
Survey Area Data: Version 19, Oct 2, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 3, 2011—Oct 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Du	Dumps	64.2	61.2%
EgG	Eden-Caneyville complex, 25 to 60 percent slopes	5.8	5.5%
Ud	Udorthents, loamy	17.2	16.4%
W	Water	17.7	16.9%
Totals for Area of Interest		**104.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Jefferson County, Indiana

Du—Dumps

Map Unit Setting

National map unit symbol: 11csk
Elevation: 350 to 1,020 feet
Mean annual precipitation: 40 to 46 inches
Mean annual air temperature: 51 to 56 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Dumps: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dumps

Interpretive groups

Land capability classification (irrigated): None specified
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

EgG—Eden-Caneyville complex, 25 to 60 percent slopes

Map Unit Setting

National map unit symbol: 11csn
Elevation: 420 to 1,020 feet
Mean annual precipitation: 40 to 46 inches
Mean annual air temperature: 51 to 56 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Eden and similar soils: 75 percent
Caneyville and similar soils: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Eden

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey residuum over ordovician limestone and shale

Typical profile

A - 0 to 6 inches: flaggy silty clay
BA - 6 to 11 inches: flaggy silty clay

Bt - 11 to 39 inches: flaggy silty clay
Cr - 39 to 60 inches: weathered bedrock

Properties and qualities

Slope: 25 to 60 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Description of Caneyville

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey residuum over limestone

Typical profile

A - 0 to 8 inches: silt loam
Bt1 - 8 to 14 inches: silty clay loam
2Bt2 - 14 to 33 inches: clay
2R - 33 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 25 to 60 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Other vegetative classification: Trees/Timber (Woody Vegetation)

Hydric soil rating: No

Ud—Udorthents, loamy

Map Unit Setting

National map unit symbol: 11ctx
Elevation: 350 to 1,020 feet
Mean annual precipitation: 40 to 46 inches
Mean annual air temperature: 51 to 56 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Properties and qualities

Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Interpretive groups

Land capability classification (irrigated): None specified
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

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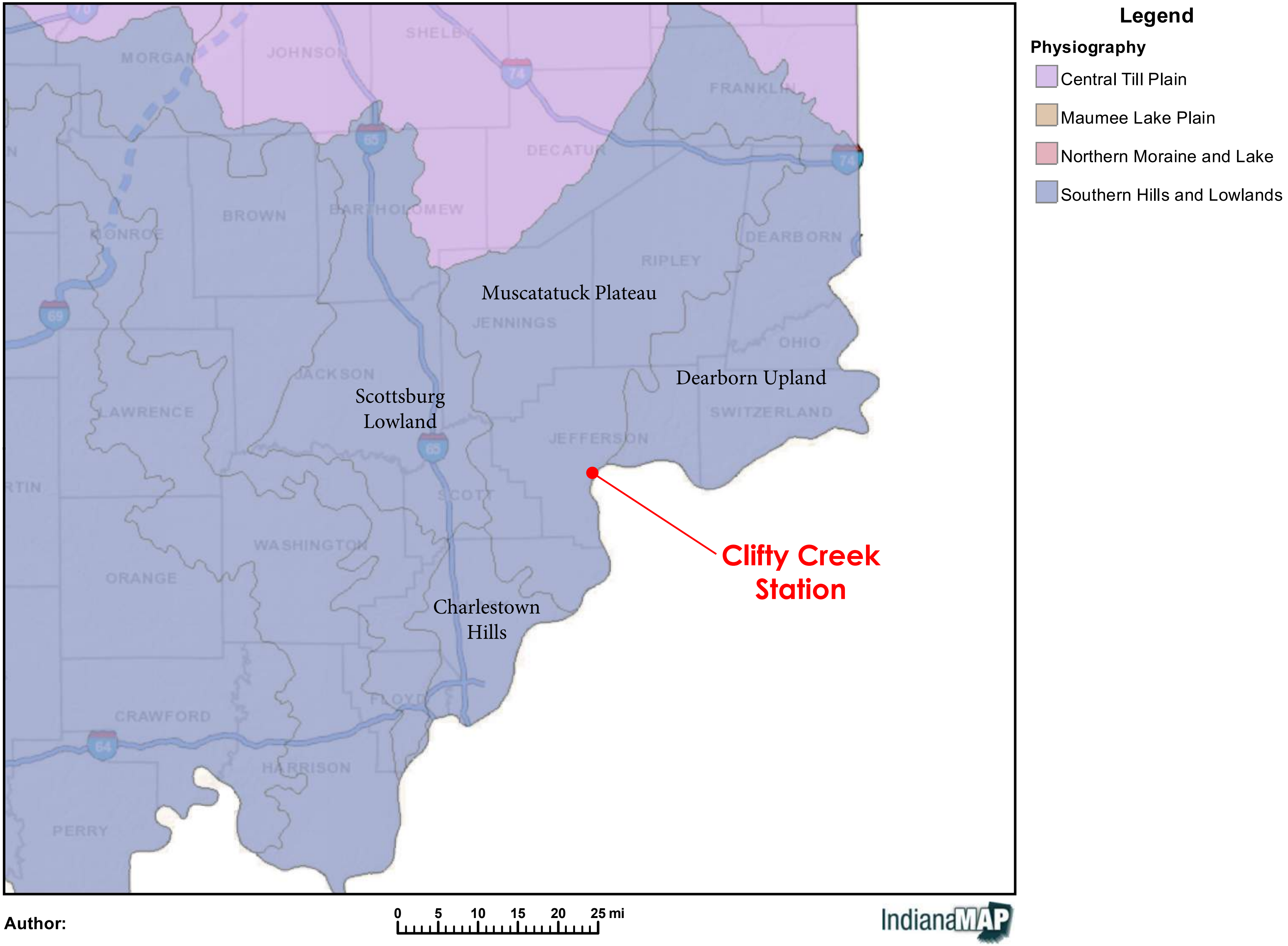
COMPLIANCE DEMONSTRATION REPORT –
UNSTABLE AREAS
WEST BOILER SLAG POND
CLIFTY CREEK STATION

October 16, 2018

Appendix B GEOLOGIC OR GEOMORPHOLOGIC CONDITIONS

Physiographic Regions

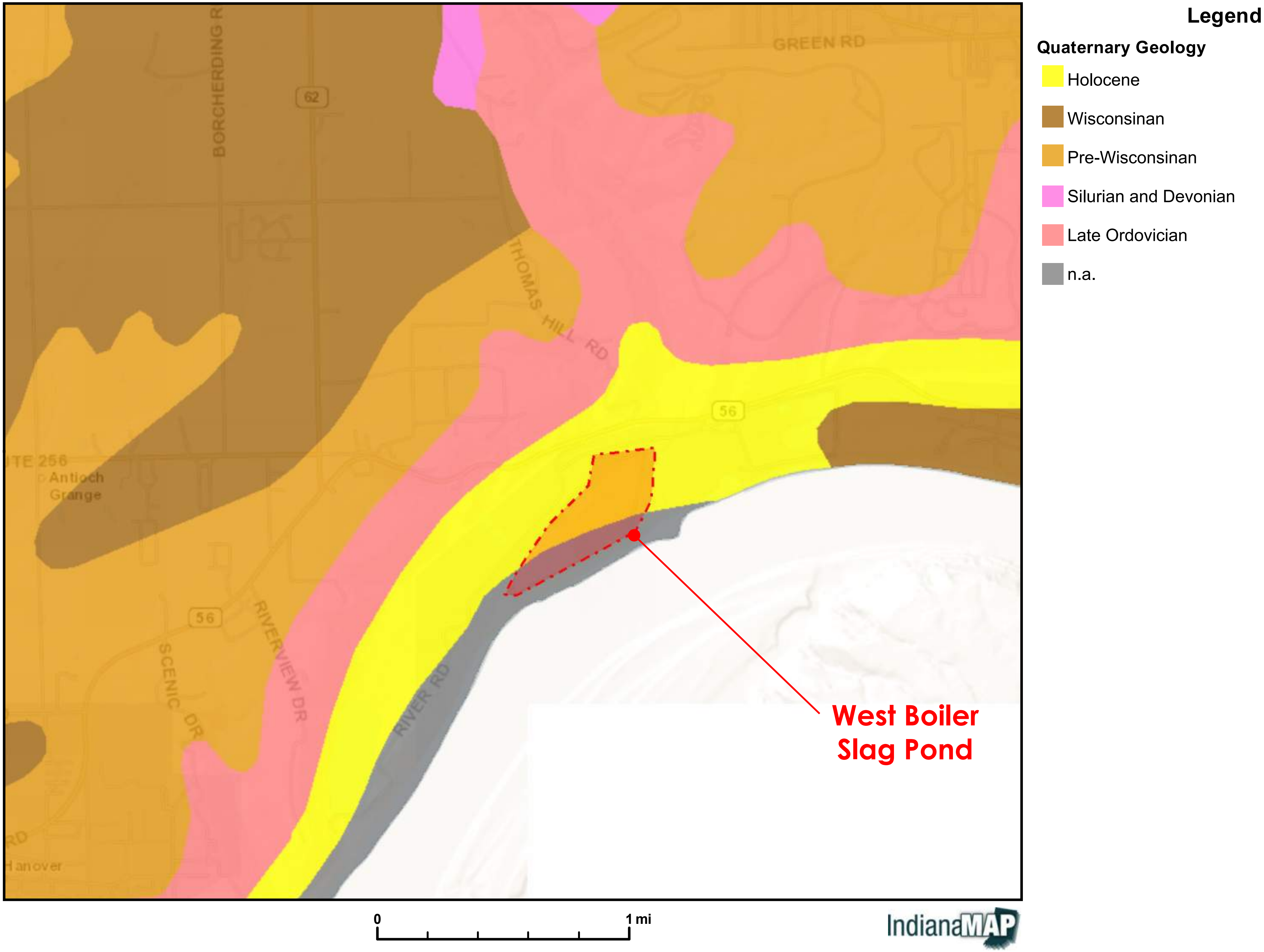
Date: 2/21/2018



Author:

Quaternary Geology

Date: 2/22/2018

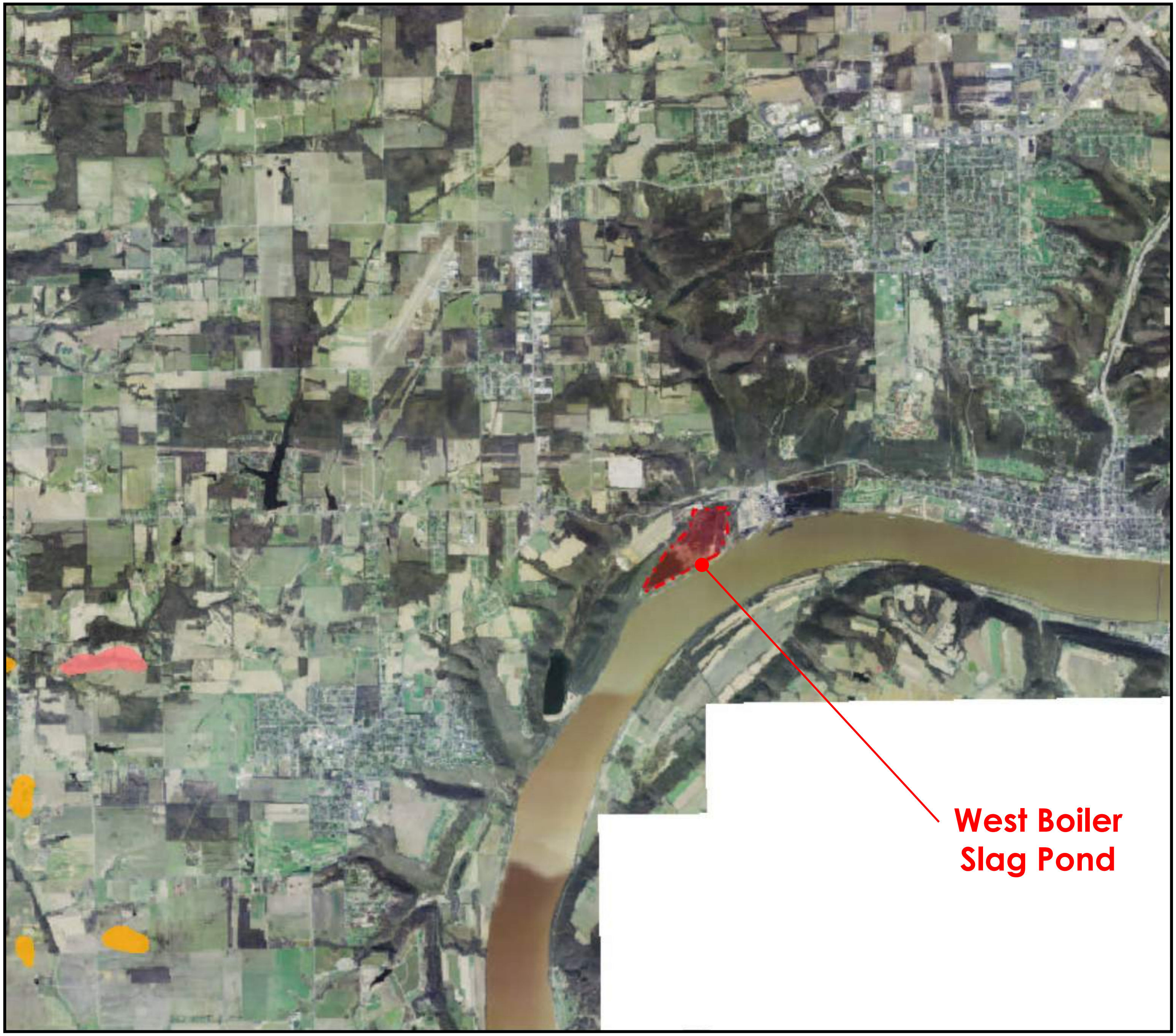


Bedrock Geology

Date: 2/22/2018

Karst Sinkhole Areas

Date: 2/22/2018



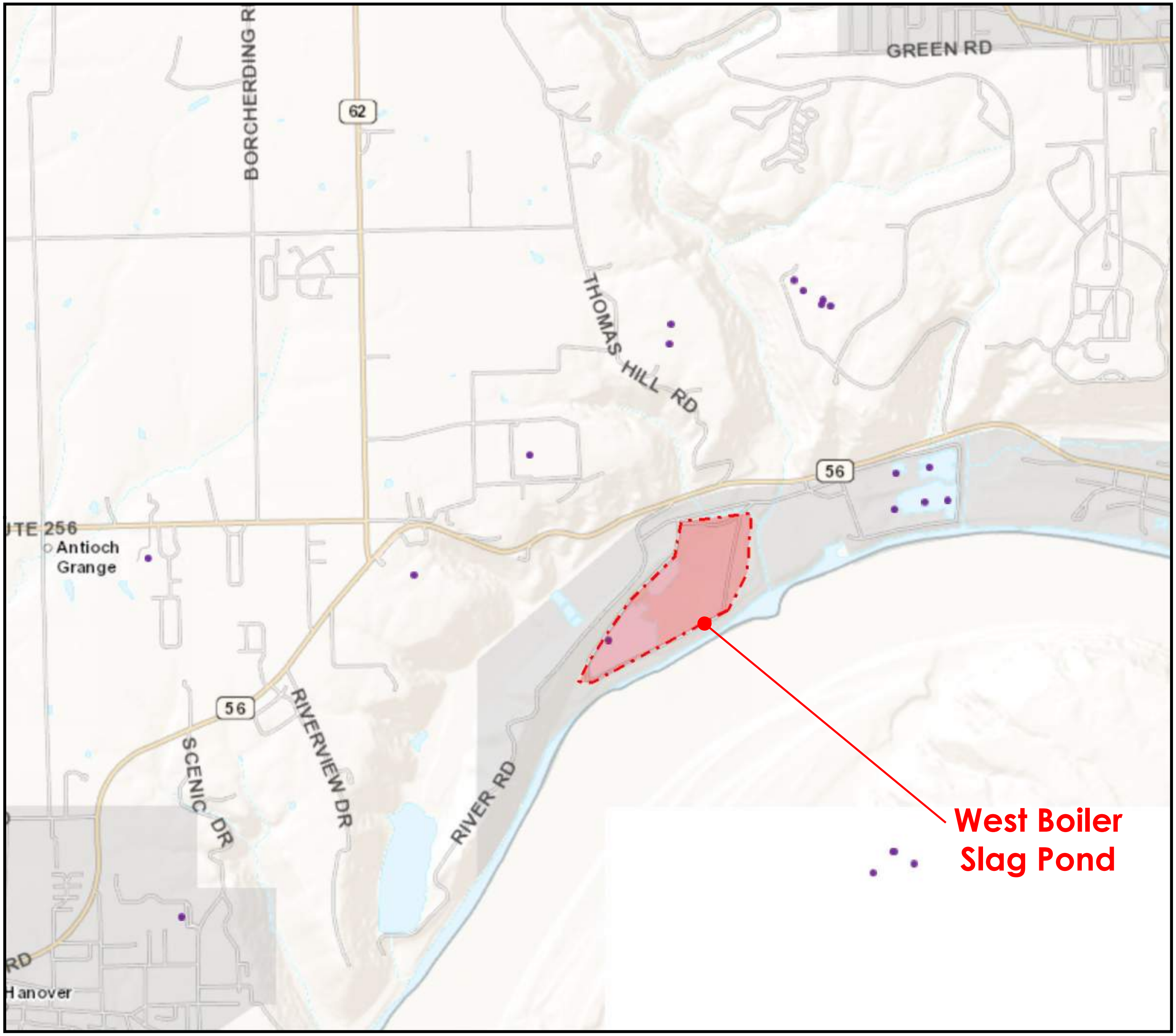
Legend

- 🟧 Sinkhole Area
- 🟥 Sinking Stream Basin

IndianaMAP

Sinkhole Inventory

Date: 2/22/2018

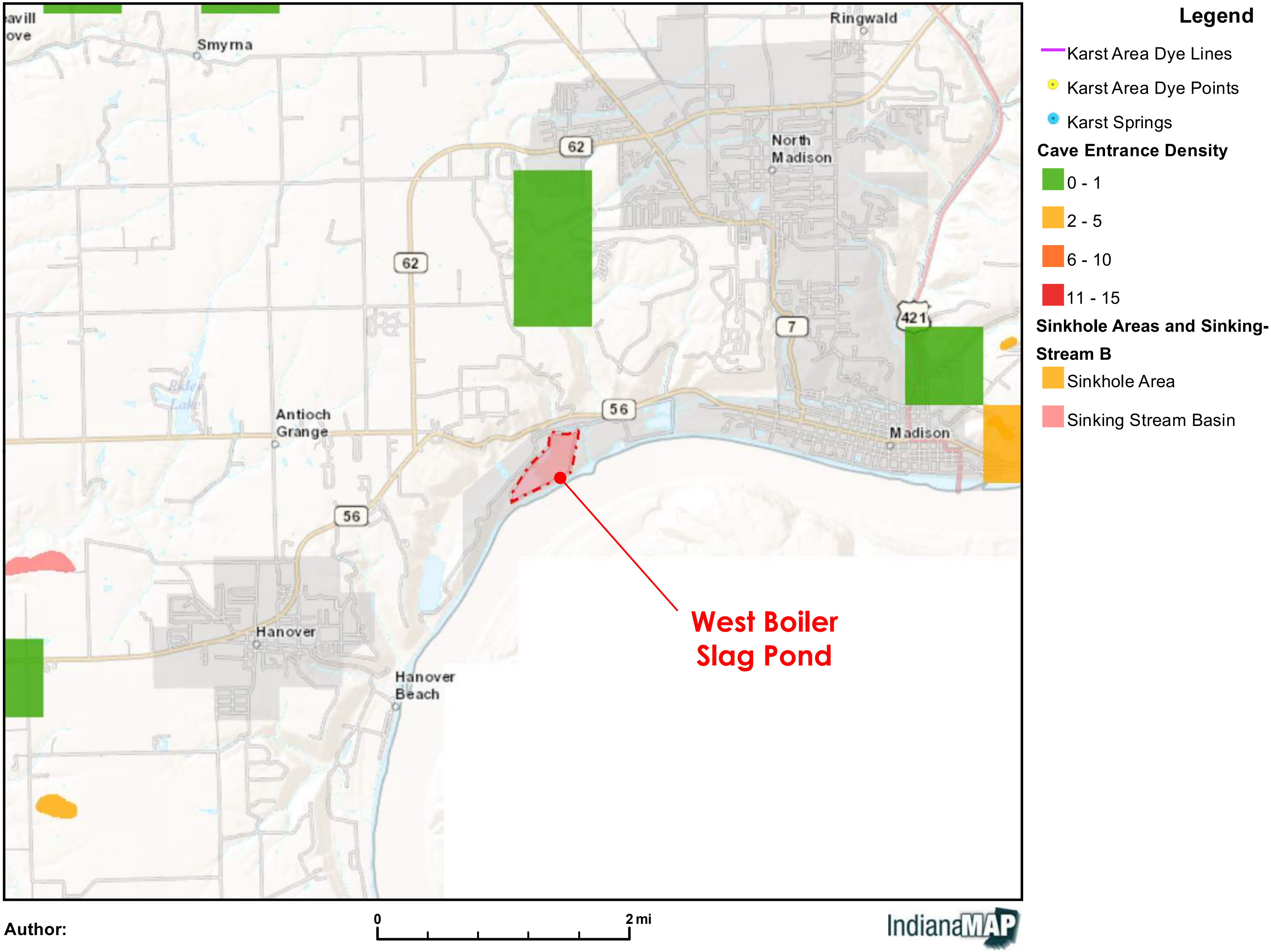


Legend

- Sinkhole Inventory (2011)

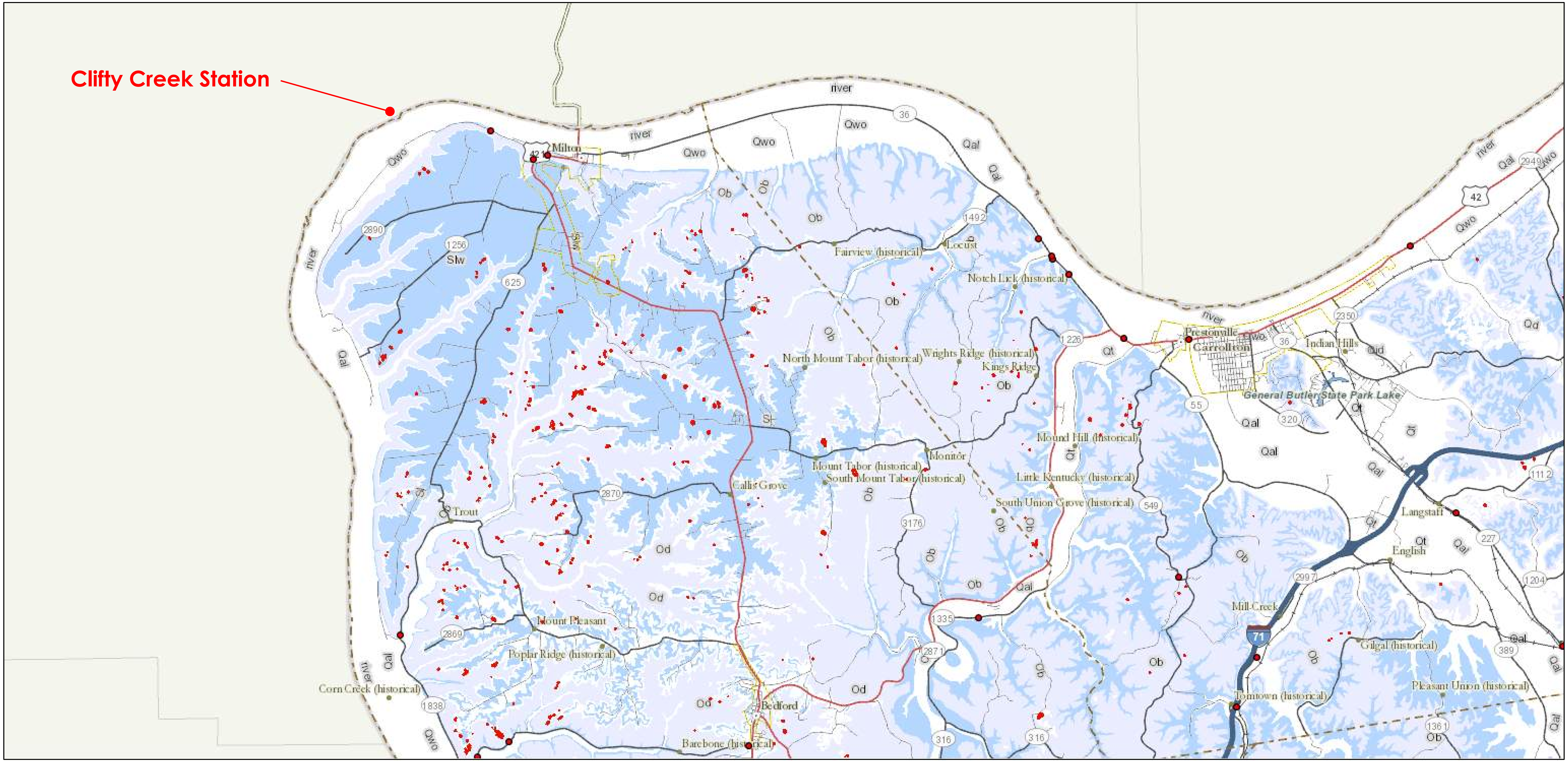
Karst Features

Date: 10/16/2018



Author:

Kentucky Geologic Map Information Service



March 1, 2018

Karst Potential Units

- ■ very high
- ■ high
- ■ medium
- ☐ low
- ☐ non-karst

KGS Landslide Locations

KGS landslide inventory data

● KGS landslide inventory data

1:24,000 geologic map landslides

🟥 1:24,000 geologic map landslides

Landslide areas derived from LiDAR

🟪 Landslide areas derived from LiDAR

Landslide areas derived from aerial photography

🟧 Landslide areas derived from aerial photography

KGS Sinkholes

Kentucky Sinkhole Outlines

▨ Sinkhole

KGS Geology

24K Geologic Faults

- ┈ fault - concealed
- — fault
- — fault - inferred
- ┈ fault - scarp
- — fault - secondary

1:100,000

0 1 2 4 mi

0 1.75 3.5 7 km

Kentucky Geological Survey
Kentucky Division of Geographic Information (DGI)

author: Kentucky Geological Survey

copyright Kentucky Geological Survey

Indiana LiDAR Color Hillshade

Date: 3/1/2018

Legend

High : 1256

Low : 247

Author:

0 0.5 mi

IndianaMAP

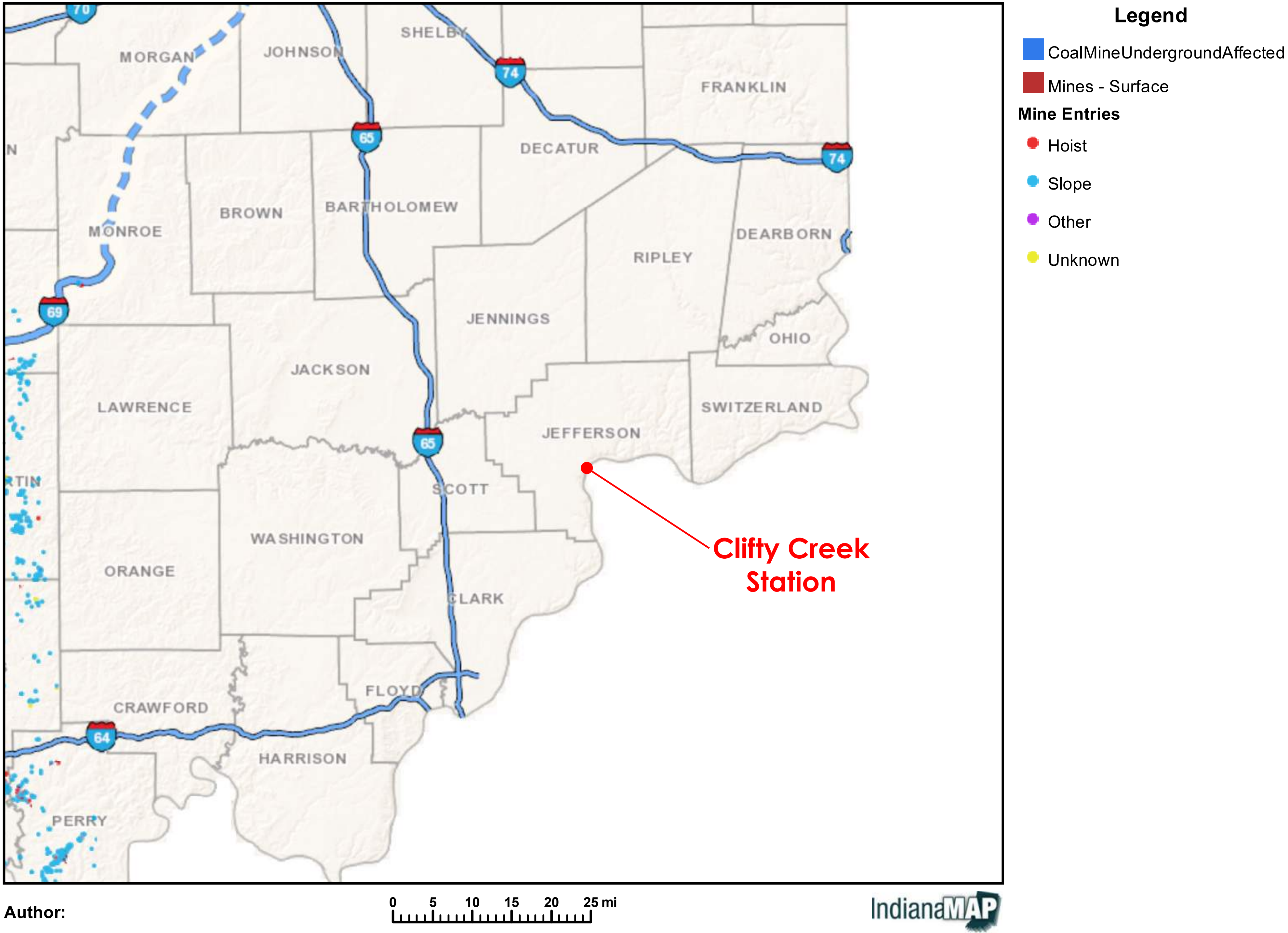
COMPLIANCE DEMONSTRATION REPORT –
UNSTABLE AREAS
WEST BOILER SLAG POND
CLIFTY CREEK STATION

October 16, 2018

Appendix C HUMAN-MADE FEATURES OR EVENTS

Mining

Date: 2/21/2018

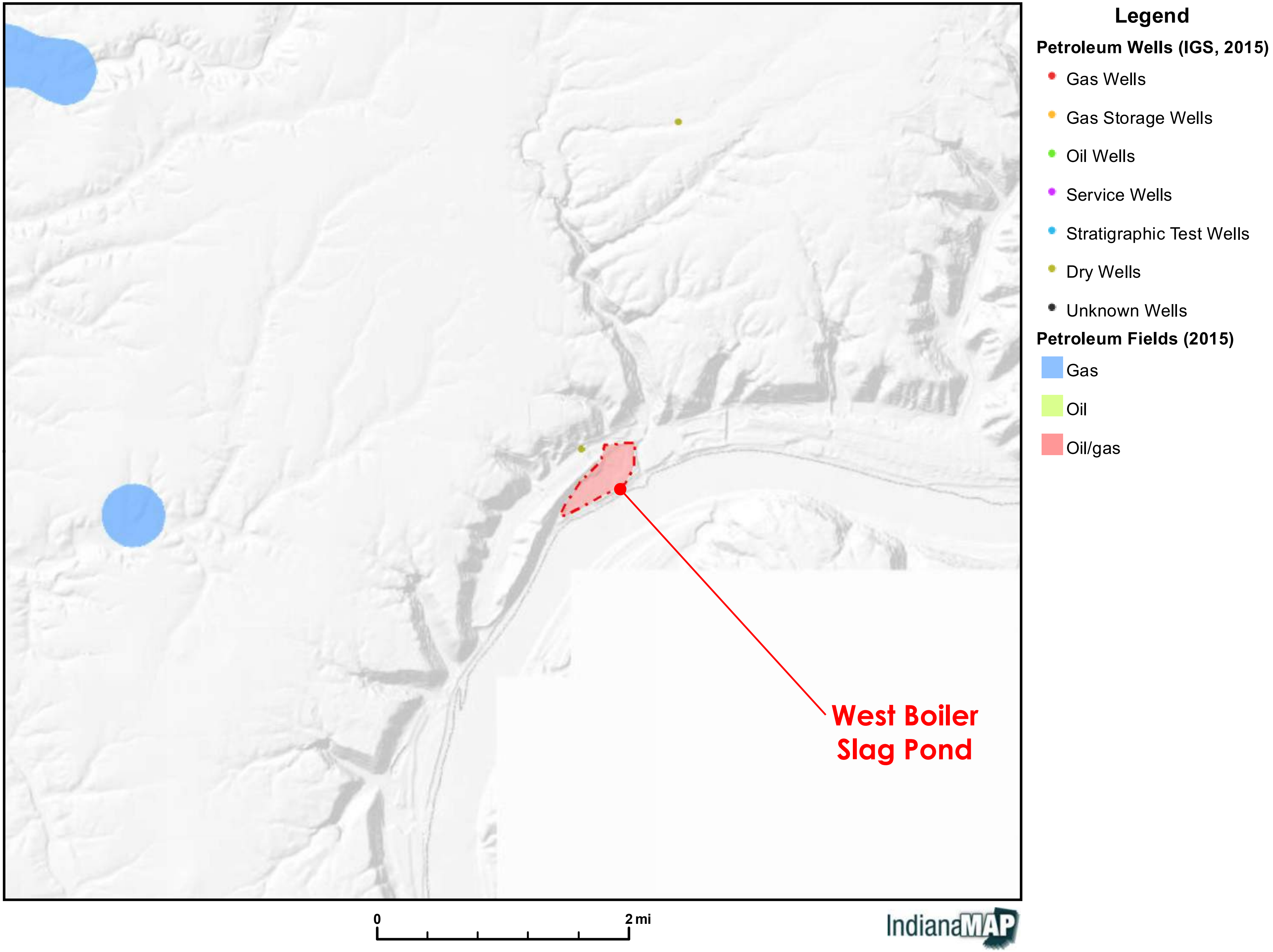


Clifty Creek Station

Author:

Petroleum Wells/Fields

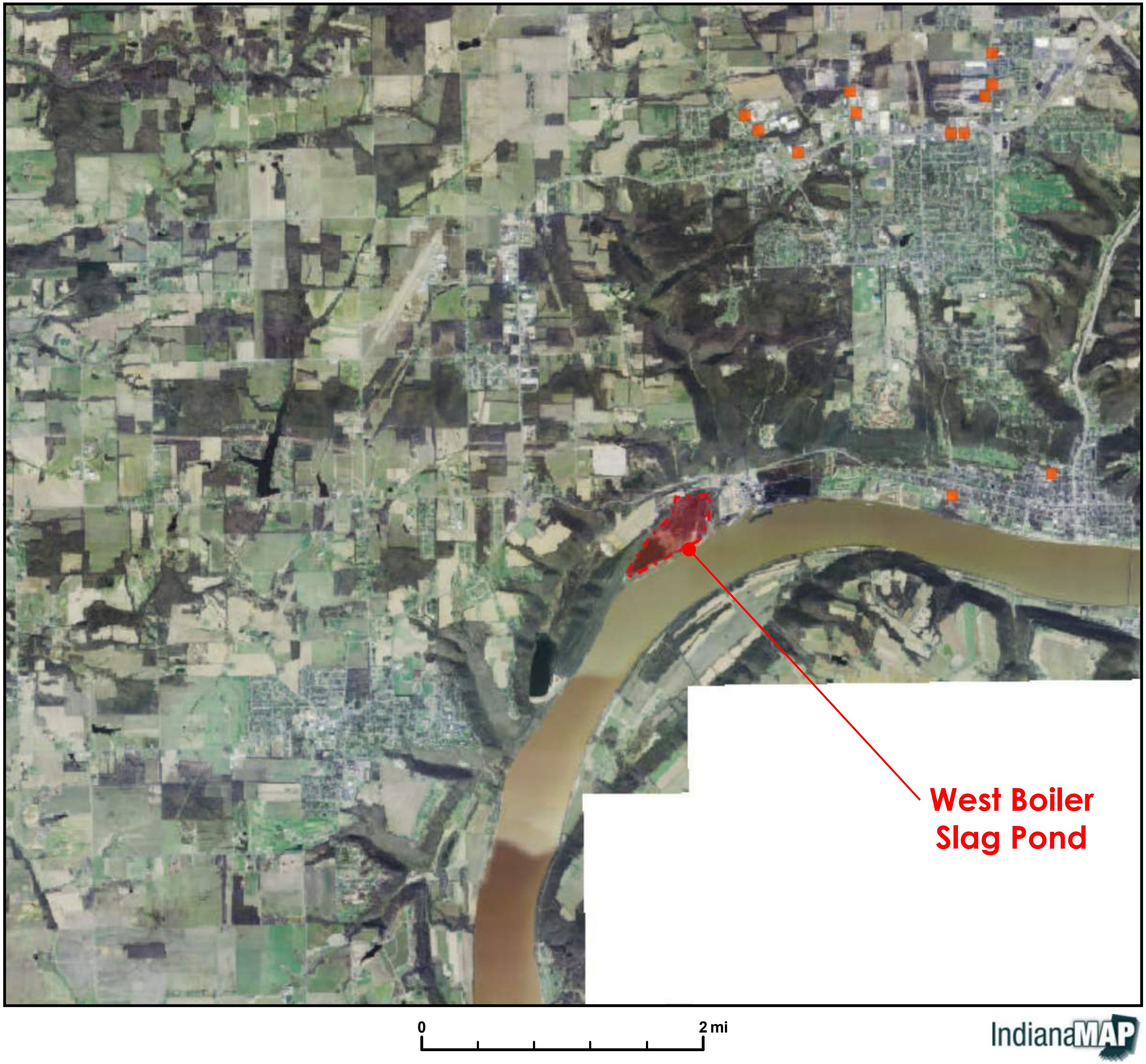
Date: 2/22/2018



IndianaMAP

Industrial Waste Sites

Date: 2/22/2018



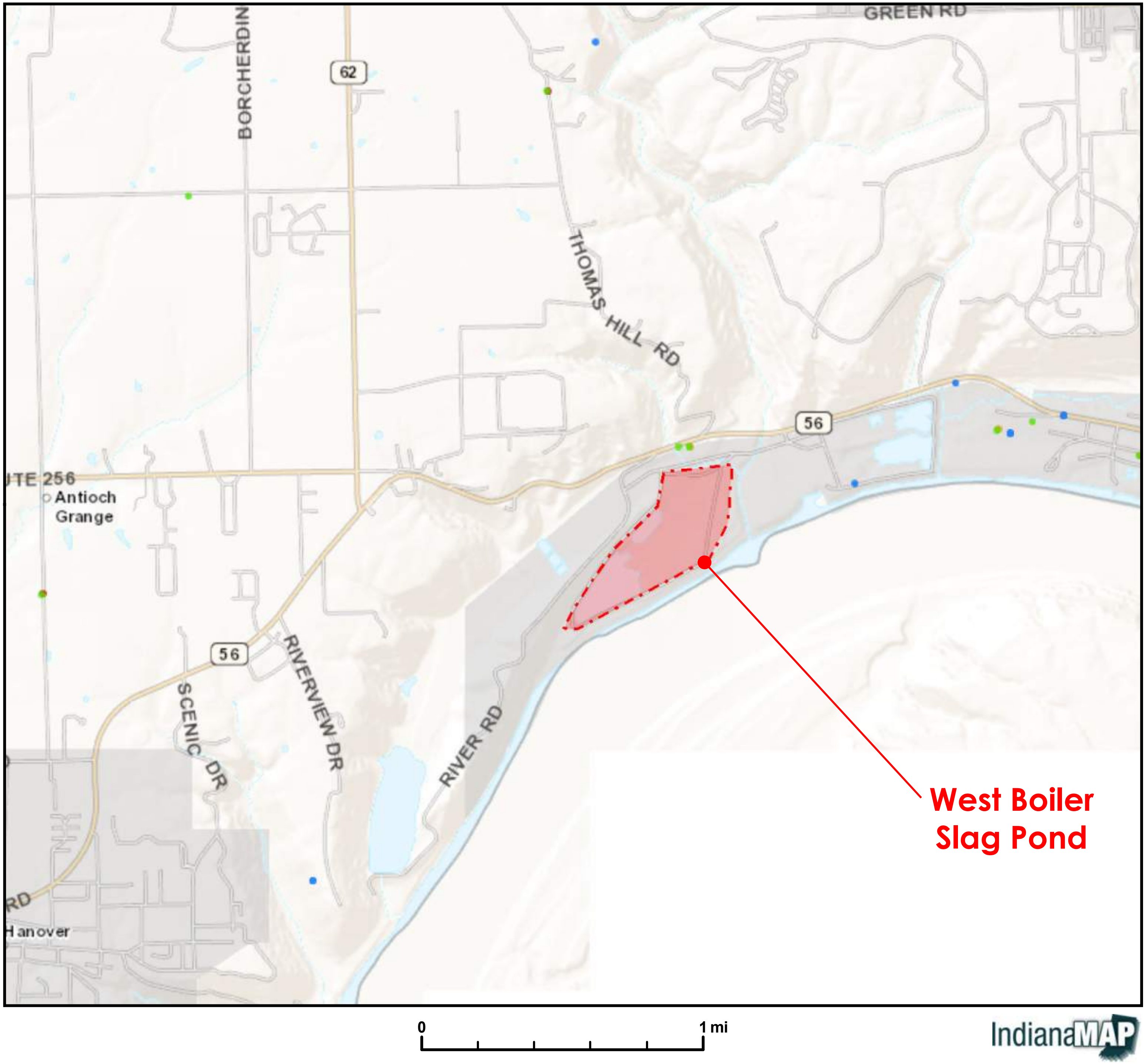
Legend

🟧 Industrial Waste Sites

IndianaMAP

Water Wells

Date: 2/22/2018



Legend

Water Wells (IDNR)

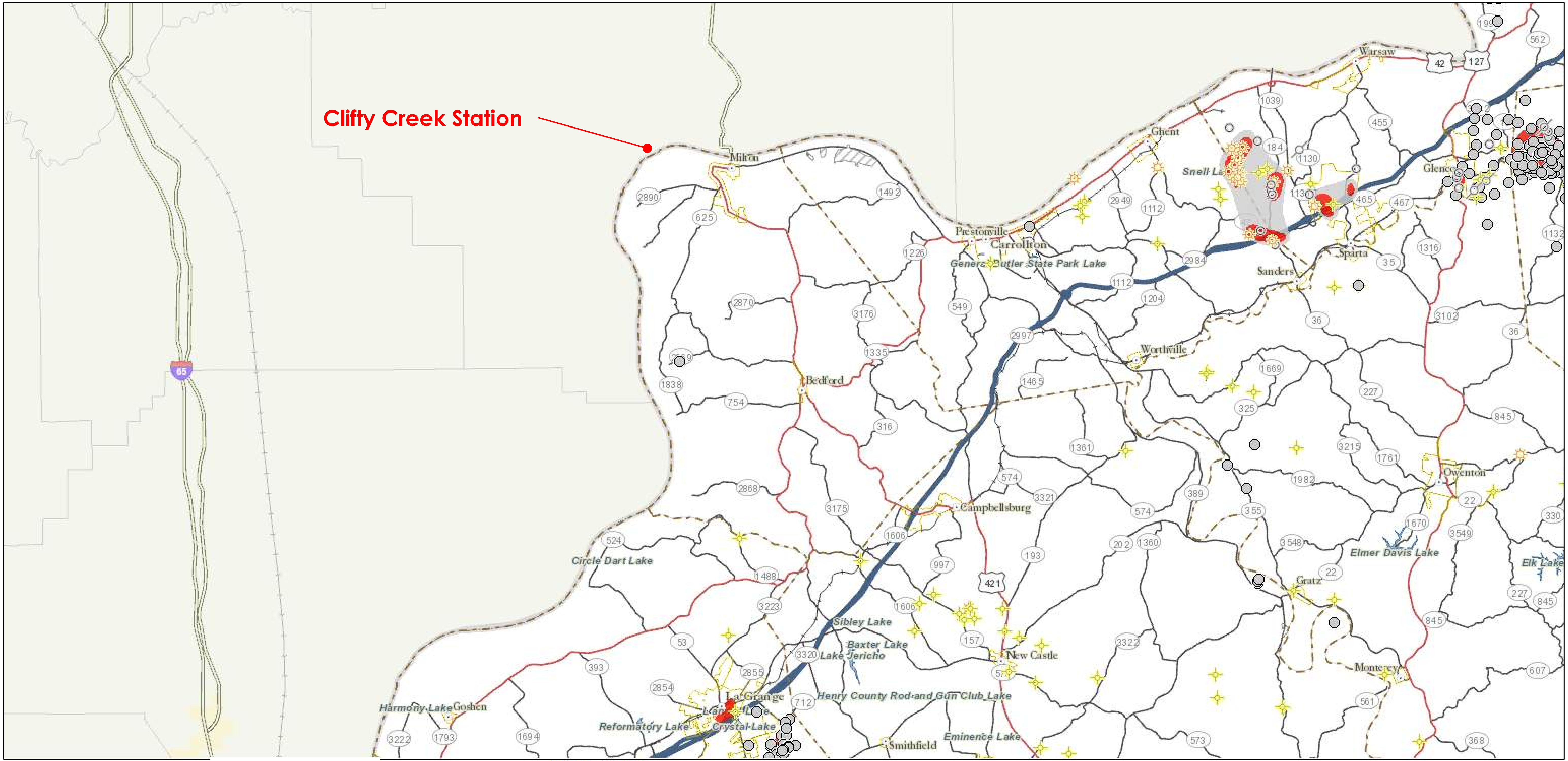
- ● Field Located
- ● Location Estimated

Water Wells (iLITH)

- ● 0 - 100
- ● 101 - 200
- ● 201 - 500
- ● 501 - 1000
- ● 1001 - 10000
- ⬟ Observation Wells (USGS)

IndianaMAP

Kentucky Geologic Map Information Service



March 1, 2018

KGS Oil and Gas Gathering Lines

Oil and Gas Gathering Lines

- Other
- Oil and Gas Flow
- Oil and Gas Gathering
- Gas Flow
- Gas Gathering
- Oil Flow
- Oil Gathering
- Water Injection

KGS Oil and Gas Fields

KY Oil and Gas Fields

- 🟩 Oil
- 🟥 Gas
- 🟪 Waterflood
- ▨ Big Sandy
- ⬜ Consolidated

KY Oil and Gas Wells

- ○ Other Well
- ● Service or Secondary Recovery Well
- ■ Coal Bed Methane Gas Well
- ✧ Dry and Abandoned Well
- ☼ Gas Well
- ○ Location
- ✷ Oil and Gas Well
- ● Oil Well

KGS Deviated Oil and Gas Wells

deviated well points

- • deviated well point

deviated well traces

- approved deviated well (since 2006)

KGS Terminated Oil and Gas Records

KY Oil and Gas Terminated Permit

- Terminated Permit Well

KGS Non Coal Quarries

KY non coal quarries and pits

- ▨ Unknown
- ▨ Abandoned
- ▨ Active

Coal Borehole

- ◆ borehole

1:250,000

0 3 6 12 mi

0 4.75 9.5 19 km

Kentucky Geological Survey; KY Division of Oil and Gas
Kentucky Geological Survey; Kentucky Division of Oil and Gas
Kentucky Geological Survey
Kentucky Division of Geographic Information (DGI)

author: Kentucky Geological Survey
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