U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division

Lincoln Boyhood National Memorial

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Lincoln Boyhood National Memorial

libo_geology.pdf

Version: 9/26/2011

Geologic Resources Inventory Map Document for Lincoln Boyhood National Memorial

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Geologic Resources Inventory Map Document

Lincoln Boyhood National Memorial, Indiana

Document to Accompany Digital Geologic-GIS Data

libo_geology.pdf

Version: 9/26/2011

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Lincoln Boyhood National Memorial, Indiana (LIBO).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

National Park Service (NPS) Geologic Resources Inventory (GRI) Program staff have assembled the digital geologic-GIS data that accompanies this document.

For information about the status of GRI digital geologic-GIS data for a park contact:

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About the NPS Geologic Resources Inventory Program

Background

Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the Earth is vital to understanding, managing, and protecting natural resources. The Geologic Resources Inventory (GRI) helps make this connection by providing information on the role of geology and geologic resource management in parks.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The Geologic Resources Inventory aims to raise awareness of geology and the role it plays in the environment, and to provide natural resource managers and staff, park planners, interpreters, researchers, and other NPS personnel with information that can help them make informed management decisions.

The GRI team, working closely with the Colorado State University (CSU) Department of Geosciences and a variety of other partners, provides more than 270 parks with a geologic scoping meeting, digital geologic-GIS map data, and a park-specific geologic report.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm

Geologic Reports: Park-specific geologic reports identify geologic resource management issues as well as features and processes that are important to park ecosystems. In addition, these reports present a brief geologic history of the park and address specific properties of geologic units present in the park.

For a complete listing of Geologic Resource Inventory products and direct links to the download site visit the GRI publications webpage http://www.nature.nps.gov/geology/inventory/gre_publications.cfm

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: http://irma.nps.gov/App/Reference/Search. To find GRI data for a specific park or parks select the appropriate park

(s), enter “GRI” as a Search Text term, and then select the Search Button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: http://www.nature.nps.gov/geology/inventory, or contact:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division.

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Lincoln Boyhood National Memorial, Indiana (LIBO) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., PNs - Staunton Formation). Units are listed from youngest to oldest. Information about each geologic unit is also presented in the Geologic Unit Information (UNIT) table included with the GRI geology-GIS data.

Geologic Map Units

Mesozoic Era

Pennsylvanian Period

Racoon Group

PNs - Staunton Formation
PNscb - Staunton Formation, coal bed

PNbbc - Brazil Formation, Buffaloville Coal Member

PNbm - Brazil Formation and Mansfield Formation, undivided
PNbmcb - Brazil Formation and Mansfield Formation (undivided), coal bed

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below. Unit descriptions were retrieved from the Indiana Geological Survey Geologic Names Information System (2010): http://igs.indiana.edu/GNIS/search.cfm

PNs - Staunton Formation

Raccoon Creek Group, Staunton Formation (Pennsylvanian System)

Type locality, history of name, and related nomenclature: The Staunton Formation was named by Cumings (1922, p. 525) for rocks exposed near Staunton, Clay County. As defined by Cumings, this formation consisted of the interval from the disconformity above Coal II to the disconformity above Coal IV (Survant Coal Member) and therefore also included the Seelyville Coal Member and the Colchester Coal Member. As restricted by Wier (1960), however, the Staunton Formation consisted of those rocks in the interval between the disconformity above Coal II and the disconformity above the Seelyville. Still later, the upper boundary of the Staunton was changed to the top of the Seelyville (Wier and Gray, 1961), and the lower boundary was changed to the top of the Minshall Coal Member (Hutchison, 1976, p. 18). The Perth Limestone Member, which formerly belonged to the underlying Brazil Formation, was therefore reassigned to the Staunton Formation. In the same report by Hutchison, the poorly defined and miscorrelated Coal II was abandoned as a stratigraphic name.

Description: The Staunton Formation consists of 75 to 150 feet (23 to 46 m) of sandstone and shale and as many as eight coalbeds. These coalbeds are generally of little areal extent and variable in quality and thickness. Three lithologies characterize the roof of the coals: (1) black fissile shale overlain by limestone, (2) gray soft silty or sandy shale and interbedded fossiliferous shale or limestone, and (3) gray massive to shaly hard to friable sandstone. The floor of the coals is underclay, clay shale, or sandy shale. The four named members of the Staunton are the Perth, Holland, and Silverwood Limestone Members and the Seelyville Coal Member. The Perth limestone lies at or near the base of the Staunton, the Silverwood and Holland limestones are in the middle part of the formation, and the Seelyville, a commercially mined coalbed, is at the top of the formation.

Correlation: The Staunton Formation is considered to consist of basal rocks of the Desmoinesian Series in Indiana and is recognizable throughout the Indiana coalfield. Probable equivalents of the Staunton Formation are the uppermost part of the Tradewater Formation and the lowermost part of the Carbondale Formation of western Kentucky and part of the Spoon Formation of Illinois. According to Shaver and Smith (1974, p. 18) and Shaver (1984), the Atokan-Desmoinesian series boundary should be placed at the base of the Staunton Formation, that is, below the Perth Limestone Member in western Indiana and the limestone next above the Buffaloville Coal Member (Brazil Formation) in southern Indiana. This limestone contains microfaunas characterized by an unidentified species of *Fusulinella*, *F. iowensis*, and the ostracod *Amphissites centronotus*. Indiana Geological Survey Geologic Names Information System (2010): http://igs.indiana.edu/GNIS/search.cfm

** unit includes coal beds (PNscb) mapped as linear/line features in the GRI digital data in the Linear Geologic Units (Coal Beds) LIBOGLN data layer. Some of these coal beds within this unit may be the Buffaloville Coal Member of the Brazil Formation, especially if mapped within a mine area and near the Staunton-Brazil contact.

PNbbc - Brazil Formation, Buffaloville Coal Member

Racoon Group, Brazil Formation, Buffaloville Coal Member (Pennsylvanian System)

Type section: The Buffaloville Coal Member was first named, simply as the Buffaloville Coal, by Franklin and Wanless (1944, p. 89, 90) for the coal that was surface mined near Buffaloville, Spencer County, Ind. Although not specifically designated as type, the originally described section was in a surface mine in the center of the NE¼NW¼ sec. 9, T. 5 S., R. 5 W. The Buffaloville Coal was assigned member rank by Gray, Wayne, and Wier (1970).

Description: According to Franklin and Wanless, the Buffaloville coal is blocky and has a floor of underclay some 3 feet (0.9 m) thick. The roof of the coal is black sheety unfossiliferous shale, half a foot (0.2 m) thick, which is overlain by dark-gray shale that is soft, calcareous, fossiliferous, and slightly silty and which is overlain in turn by dark-blue to black argillaceous and fossiliferous limestone as much as 2 feet (0.6 m) thick. In some areas the shale is absent, and the limestone rests directly on the coal.

Correlation: The Buffaloville coal was tentatively correlated by Franklin and Wanless (1944) with Coal II of Ashley (1909), but the Buffaloville was later assigned to the Brazil Formation by Hutchison (1959), who considered that it was continuous with the Minshall Coal Member of Clay and Parke Counties. If this correlation is correct, a single coalbed, called both the Buffaloville and the Minshall, is present from the Ohio River to Warren County at the north end of the Indiana coalfield. According to Thompson and Shaver (1964, p. 20, 21), the limestone in the roof of the Buffaloville marks the lowest known Indiana position containing microfaunas that are characterized by the fusulinid Fusilinella and ostracods Amphissites centronotus and A. girtyi. (See the Perth Limestone Member for a discussion of the coal and the associated limestone). Indiana Geological Survey Geologic Names Information System (2010): http://igs.indiana.edu/GNIS/search.cfm

** unit is mapped as linear/line feature in the GRI digital data in the Linear Geologic Units (Coal Beds) LIBOGLN data layer. Some of these coal beds are interpreted to be the Buffaloville Coal Member of the Brazil Formation if mapped within the Staunton Formation, in a mine area, and near the Staunton-Brazil contact.

PNbm - Brazil Formation and Mansfield Formation, undivided

Racoon Group, Brazil Formation (Pennsylvanian System)

Type locality and history of name: The Brazil Formation as originally named by Fuller and Ashley (1902, p. 2) for Brazil, Clay County, Ind., included the rocks in the interval between the top of the Mansfield Sandstone and the bottom of the Petersburg Coal (Springfield Coal Member of present usage). Cumings (1922, p. 525) amended the Brazil Formation to include only the rocks in the interval between the base of the Lower Block Coal Member and the unconformity above what was then called Coal II. Hutchison (1976, p. 22-23) further amended the Brazil to include only those rocks between the top of the Minshall Coal Member and the base of the Lower Block Coal Member.

Description: In the Brazil area the formation consists of shale, sandstone, underclay, and coal and ranges from 40 to 90 feet (12 to 27 m) in thickness (Hutchison, 1960, p. 13). The Brazil Formation consists in ascending order of the Lower Block, Upper Block, and Minshall Coal Members and other rocks unnamed to member. In places a thin coalbed referred to as the rider of the Upper Block Coal Member is present in the interval between the Upper Block and the Minshall Coal Members.

Irregularity, both in thickness and in persistence of recognizable beds, is characteristic of the Brazil Formation in much of its area of outcrop from Warren County on the north (Hutchison, 1961) to Spencer

County (Hutchison, 1959) on the Ohio River. North of southern Parke County, for example, the Lower Block coal is absent or untraceable, so that it is nearly impossible to separate the Brazil and Mansfield Formations in southern Indiana, in Daviess (Hutchison, 1971a), Dubois (Hutchison, 1964), and Spencer (Hutchison, 1959) Counties, coalbeds believed to be equivalent to the block coals are present over most of the area but are difficult to distinguish from upper Mansfield coals. Numerous drill holes penetrate the Brazil in the subsurface in Indiana, but detailed information on the character of the coals and other marker beds is wanting in extreme western and southwestern Indiana because of lack of coring or detailed mapping.

Correlation: The rocks assigned to the Brazil Formation in Indiana are equivalent to the upper and lower parts respectively of the Abbott and Spoon Formations of Illinois and part of the Tradewater Formation in western Kentucky (Kosanke and others, 1960, pl. 1).

The Brazil Formation was assigned by Wanless (1962) to the upper part of what was then called the Pottsvillian Series in the Appalachian area, but later it was assigned to the Atokan Series in the North American Pennsylvanian standard by Shaver and Smith (1974, p. 17-20), Shaver (1984), and Shaver and others (1985). Much of the basis for the Atokan assignment is the occurrence of a species of the fusulinid genus *Fusulinella* (identified by M. L. Thompson) in an unnamed limestone between the Lower and Upper Block coals in Clay County, Ind. Its stratigraphic position is below the lowest occurrence in Indiana of the lower type Desmoinesian indicator *Fusulinella iowaensis* and above the known occurrences of the Morrowan indicators that are discussed in the articles on the Lead Creek Limestone Member and its Ferdinand and Fulda Beds. Indiana Geological Survey Geologic Names Information System (2010): http://igs.indiana.edu/GNIS/search.cfm

Racoon Group, Mansfield Formation (Pennsylvanian System)

Type area and use of name: The Mansfield Formation was originally named the Mansfield Sandstone by Hopkins (1896, p. 199-200) for rocks exposed at Mansfield, Parke County, Ind. Cumings (1922, p. 527-528) amended the Mansfield to include all the rocks between the base of the Pennsylvanian System and the base of the Lower Block Coal Member, and this is the current definition. Kottlowski (1959), recognizing that the unit contains much shale and thin beds of coal, clay, and limestone, designated the unit as the Mansfield Formation.

Description and related nomenclature: The Mansfield rests unconformably, with as much as 150 feet (46 m) of local relief, on Mississippian rocks that are generally progressively older northward. Progressive northward overlap is also suggested by the 50- to 300-foot (15- to 91-m) range in thickness of the exposed Mansfield. The lowermost part of the Mansfield commonly consists of sandstone, generally crossbedded and containing a quartz-pebble and chert conglomerates in places, but it also includes dark carbonaceous shale in many places. The quartz-pebble conglomerate is also found in higher parts of the formation.

In the Shoals area of southwestern Indiana, the Mansfield has two broad, more or less distinct, vertically separate divisions the lower consists mostly of sandstone, and the upper consists dominantly of shale and mudstone (Gray, Jenkins, and Weidman 1960, p. 23). The divisional boundary is at the position, or inferred position, of the Pinnick Coal Member, which near Shoals lies 50 to 185 feet (15 to 56 m) above the base and 200 feet (61 m) below the top of the formation. Three lithologies, passing laterally into one another, also have been recognized in southwestern Indiana (Gray, 1962, p. 28-33). The Cannelton Lithofacies, nearest the Ohio River, consists dominantly of siltstone and mudstone the Shoals Lithofacies, well exposed near Shoals, Martin County, has many cross-stratified sandstones and the Bloomfield Lithofacies, named for that town in Greene County, is characterized by an abundance of gray shales.

The seven named members of the Mansfield in ascending order are the French Lick, St. Meinrad,

Pinnick, Blue Creek, and Mariah Hill Coal Members the Lead Creek Limestone Member and the Shady Lane Coal Member.

Other member and bed names having limited, colloquial, or outdated use are the Cannelton Sandstone, which was the name applied by Hopkins (1896, p. 314) to the massive sandstone that crops out in the bluff of the Ohio River behind Cannelton, Perry County; the Cannelton Coal of Logan (1922, p. 623), which was probably applied to both the Upper and Lower Cannelton Coals, especially the upper nearer Tell City and the lower near Cannelton, Perry County; the Lower Huntingburg Coal, which is Franklin and Wanless's (1944, p. 87) designation for what is also the Mariah Hill Coal Member; the Shoals Coal (Logan, 1922, p. 623), which is near the base of Pennsylvanian rocks in the railroad cut west of Shoals, Martin County; the Kirksville Coal (Logan,1922, p. 623-624), which is found in the southwestern part of Monroe County near Kirksville; and the Grandview Limestone of Franklin and Wanless (1944, p. 89-90), which is probably coextensive with the Ferdinand Limestone Bed.

The term Coal I was intended to apply to the lowest Mansfield coalbed, but as used by Ashley (1899) it actually refers to the lowest commercial coal at any given place. The name, therefore, applied to more than one bed, and it has not been widely used. The French Lick Coal Member is the lowest named member and is overlain by about 50 feet (15 m) of mudstone, siltstone, and fine-grained sandstone of remarkably even bedding. These silty rocks, best exhibited and formerly quarried near French Lick in Orange County, were called the Hindostan Whetstone Beds as early as 1838 by Owen (1859, p. 16) and were described in detail by Cox (1876, p. 6-8). The Pinnick Coal Member lies some 50 feet (15 m) above the French Lick in the French Lick area. The Upper and Lower Cannelton Coals were extensively mined near Cannelton, Perry County, and were first described by Lesley (1862, p. 343-344). Apparently, these coals are the same coals described as the Troy Coal and the Upper Troy Coal at Troy, Perry County, by Franklin and Wanless (1944, p. 86-87).

The Upper Troy Coal of Franklin and Wanless (1944, p. 88) appears to be the same as the St. Meinrad Coal Member, which is sufficiently thick to be extensively mined near St. Meinrad, Spencer County, and throughout northwestern Perry County.

North of southern Parke County the Lower Block Coal Member (Brazil Formation) is absent or unidentifiable, so that it is nearly impossible to separate the Brazil and Mansfield Formations in southern Indiana, in Daviess (Hutchison, 1971a), Dubois (Hutchison, 1964), and Spencer (Hutchison, 1959) Counties, coalbeds believed to be the equivalent of the block coals are present over most of the area but are difficult to distinguish from coals in the upper Mansfield.

Correlation: The rocks assigned to the Mansfield Formation are equivalent to the Caseyville Formation and the lower part of the Abbott Formation of Illinois, the Caseyville Formation and the lower part of the Tradewater Formation of western Kentucky, part of what has commonly been called the Pottsvillian Series of the Appalachian area, and to the Morrowan Series of the midcontinent area. The Hindostan flora was described by Read (1947) as early Pottsvillian in age. Unnamed Mansfield limestones in Parke County are in the ostracod Zone of *Amphissites rothi,* and unnamed Mansfield limestones near Troy and Cannelton, Spencer and Perry Counties, contain the fusulinid *Profusulinella*, the *Amphissites rothi* fauna, and the ostracod *Cavellinella casei*, all of which are thought to indicate a Morrowan age. (see Thompson and Shaver, 1964, Shaver and Smith, 1974, and Shaver, 1984, and for additional faunal evidence see the article on the Lead Creek Limestone Member). Indiana Geological Survey Geologic Names Information System (2010): http://igs.indiana.edu/GNIS/search.cfm

** unit includes coal beds (PNbmcb) mapped as linear/line features in the GRI digital data in the Linear Geologic Units (Coal Beds) LIBOGLN data layer. Differentiating coal beds wasn't possible given that the Brazil and Mansfield formations was not divided on the source maps. See unit descriptions above for information on coal beds mapped within the Brazil and Mansfield formations, undivided.

GRI Source Map Citations

The GRI digital geologic-GIS maps for Lincoln Boyhood National Memorial, Indiana (LIBO) were compiled from the following sources:

Hutchinson, H.C., 1959, Distribution, Structure, and Mined Areas of Coal in Spencer County, Dale Quadrangle, IN, Indiana Geological Survey, unpublished working maps, 1:24000 scale (unpublished working map, Dale Quadrangle). (*GRI Source Map ID 75484*)

Hutchinson, H.C., 1959, Distribution, Structure, and Mined Areas of Coal in Spencer County, Holland Quadrangle, IN, Indiana Geological Survey, unpublished working maps, 1:24,000 scale (unpublished working map, Holland Quadrangle). (*GRI Source Map ID 75485*)

Hutchinson, H.C., 1959, Distribution, Structure, and Mined Areas of Coal in Spencer County, Santa Claus Quadrangle, IN, Indiana Geological Survey, unpublished working maps, 1:24,000 scale (unpublished working map, Santa Claus Quadrangle). (*GRI Source Map ID 75486*)

Hutchinson, H.C., 1959, Distribution, Structure, and Mined Areas of Coal in Spencer County, Chrisney Quadrangle, IN, Indiana Geological Survey, unpublished working maps, 1:24,000 scale (unpublished working map, Chrisney Quadrangle). (*GRI Source Map ID 75487*)

Weber, Licia, Meyer, Becky, Eaton, Nathan and Irwin, Paul, 2010, Surface Coal Mines in Indiana (Indiana Coal Mine Information System or CMIS), Indiana Geological Survey and Indiana Department of Natural Resources, vector digital data, 1:24,000 scale. (*GRI Source Map ID 75587*)

Additional information pertaining to each source map is also presented in the Source Map Information (MAP) table included with the GRI geology-GIS data.

Unit descriptions were retrieved from the Indiana Geological Survey Geologic Names Information System (2010): http://igs.indiana.edu/GNIS/search.cfm

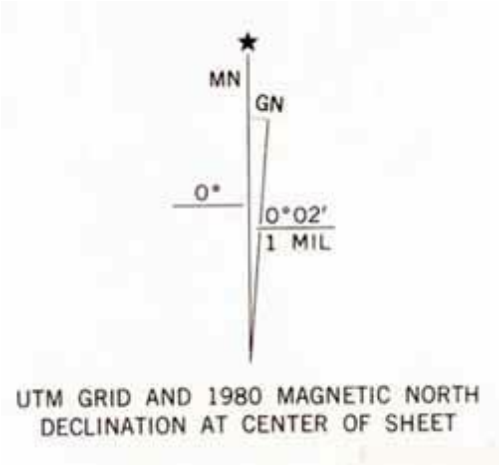
Unpublished Working Map, Dale Quadrangle

Hutchinson, H.C., 1959, Distribution, Structure, and Mined Areas of Coal in Spencer County, Dale Quadrangle, IN, Indiana Geological Survey, unpublished working maps, 1:24000 scale (unpublished working map, Dale Quadrangle). (*GRI Source Map 75484*)

Quadrangle Location

Extracted from: (unpublished working map, Dale Quadrangle).

Declination



Extracted from: (unpublished working map, Dale Quadrangle).

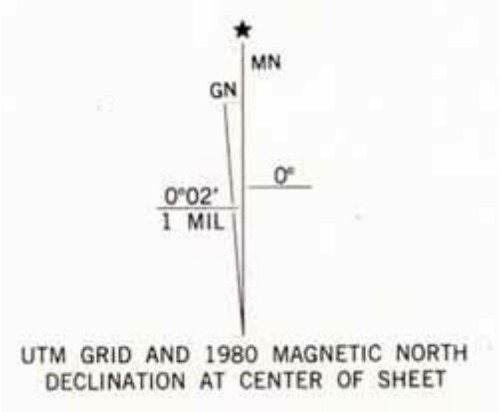
Unpublished Working Map, Holland Quadrangle

Hutchinson, H.C., 1959, Distribution, Structure, and Mined Areas of Coal in Spencer County, Holland Quadrangle, IN, Indiana Geological Survey, unpublished working maps, 1:24,000 scale (unpublished working map, Holland Quadrangle). (*GRI Source Map 75485*)

Quadrangle Location

Extracted from: (unpublished working map, Holland Quadrangle).

Declination



Extracted from: (unpublished working map, Holland Quadrangle).

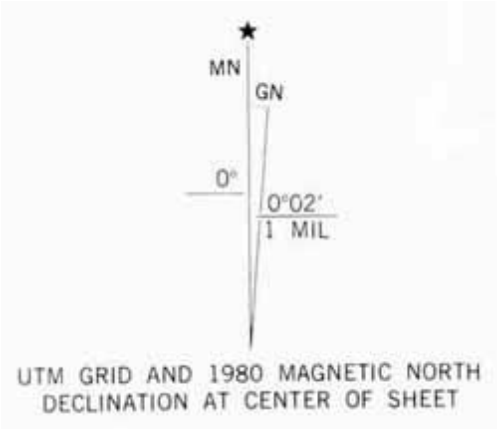
Unpublished Working Map, Santa Claus Quadrangle

Hutchinson, H.C., 1959, Distribution, Structure, and Mined Areas of Coal in Spencer County, Santa Claus Quadrangle, IN, Indiana Geological Survey, unpublished working maps, 1:24,000 scale (unpublished working map, Santa Claus Quadrangle). (*GRI Source Map 75486*)

Quadrangle Location

Extracted from: (unpublished working map, Santa Claus Quadrangle).

Declination



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Unpublished Working Map, Chrisney Quadrangle

Hutchinson, H.C., 1959, Distribution, Structure, and Mined Areas of Coal in Spencer County, Chrisney Quadrangle, IN, Indiana Geological Survey, unpublished working maps, 1:24,000 scale (unpublished working map, Chrisney Quadrangle). (*GRI Source Map 75487*)

Quadrangle Location

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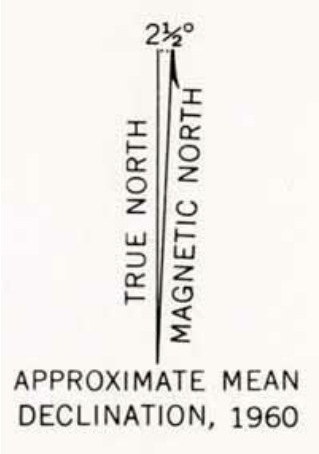
Declination



Extracted from: (unpublished working map, Chrisney Quadrangle).

Surface Coal Mine Data for Indiana

Weber, Licia, Meyer, Becky, Eaton, Nathan and Irwin, Paul, 2010, Surface Coal Mines in Indiana (Indiana Coal Mine Information System or CMIS), Indiana Geological Survey and Indiana Department of Natural Resources, vector digital data, 1:24,000 scale. (*GRI Source Map ID 75587*)

**Data was clipped/extracted from the digital data to a four 7.5' quadrangle extent that corresponds with the GRI Digital Geologic Map of Lincoln Boyhood National Memorial and Vicinity, Indiana. This data is provided in the GRI Digital Surface Coal Mine Map for Lincoln Boyhood National Memorial and Vicinity, Indiana (*GRI LBSC Map*).

Indiana Geological Survey link to digital data: http://coalminemaps.indiana.edu/index.html

GRI Digital Data Credits

This document was developed and completed by Georgia Hybels (National Park Service) and Stephanie O'Meara (Colorado State University) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory(GRI) Program. Quality control of this document by Stephanie O'Meara (Colorado State University).

The information contained here was compiled to accompany the digital geologic-GIS map(s) and other digital data for Lincoln Boyhood National Memorial, Indiana (LIBO) developed by Georgia Hybels and Stephanie O'Meara.

GRI finalization by Stephanie O'Meara.

GRI program coordination and scoping provided by Bruce Heise and Tim Connors (NPS GRD, Lakewood, Colorado).

**Thanks to Todd Thompson of the Indiana Geological Survey (IGS) for providing clarification and information on geologic units and coal beds mapped in the map area.