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Surficial Geology of the Findlay 30 x 60 Minute Quadrangle

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
Map SG-2 Findlay
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INTRODUCTION

This map provides a three-dimensional framework of the area's surficial geology and depicts four important aspects of surficial geology:

1) the geologic deposits, indicated by letters which represent the major lithologies;
2) the thickness of the individual deposits, indicated by numbers and modifiers;
3) the lateral extent of the deposits, indicated by map-unit area boundaries;
4) the vertical sequence of deposits, shown by the stack of symbols within each map-unit area.
In effect, each stack represents a generalized cross section for each area.

Letters represent geologic deposits (lithologic units) and are described in detail below. Lithologic units may be a single lithology such as sand (S) or clay (C), or a combination of related lithologies that are found in specific depositional environments, such as sand and gravel (SG) or ice-contact deposits (IC). The bottom symbol in each stack indicates the bedrock lithologies that underlie the surficial deposits. The detailed lithologic unit descriptions below summarize:

1) geologic characteristics such as range of textures, bedding, and age;
2) engineering properties or concerns attributed to the unit;
3) depositional environment;
4) geomorphology or geomorphic location;
5) geographic location within the map area, if pertinent.

Numbers (without modifiers) that follow the lithology designator represent the average thickness of a lithologic unit in tens of feet (for example, 3 represents 30 feet). If no number is present, the average thickness is implied as 1 (10 feet). These unmodified numbers correspond to a thickness range centered on the specified value, but may vary up to 50 percent. For example, T4 indicates the average thickness of till in a map-unit area is 40 feet, but thickness may vary from 20 to 60 feet.

Modifiers provide additional thickness and distribution information:

1) Parentheses indicate that a unit has a patchy or discontinuous distribution and is missing in portions of that map-unit area. For example, (T2) indicates that till with an average thickness of 20 feet is present in only part of that map-unit area.

2) A minus sign following a number indicates the maximum thickness for that unit in areas such as a buried valley or ridge. Thickness decreases from the specified value, commonly near the center of the map-unit area, to the thickness of the same lithologic unit and vertical position specified in an adjacent map-unit area. For example, an SG9- map-unit area adjacent to an SG3 area indicates a sand and gravel unit having a maximum thickness of 90 feet that thins to an average of 30 feet at the edge of the map-unit area. If the material is not present in an adjacent area, it decreases to zero at that boundary.

These letters, numbers, and modifiers are arranged in stacks that depict the vertical sequence of lithologic units for a given map-unit area. A single stack of symbols occurs in each map-unit area and applies only to the volume of sediments within that particular map-unit area. Figure 1 illustrates mapping conventions.

The small scale of this reconnaissance map generalizes the great local variability within surficial deposits. That variability is explained in the lithologic unit descriptions and by the use of thickness ranges. Some areas and lithologies are too small to delineate at 1:100,000 scale and have been included in adjacent areas. This map should serve only as a regional predictive guide to the area's surficial geology and not as a replacement for subsurface borings and geophysical studies required for site-specific characterizations.

DATA SOURCES

Data were collected from numerous sources (see References). The concentration of data was greatest near the surface and decreased with depth. County soil survey maps, which described the top 5 feet of surficial materials, provided an initial guide to map-unit areas. These areas were modified through interpretation of local geomorphic settings and other data which indicated change of deposits at depth, such as Ohio Department of Natural Resources water-well logs, Ohio Department of Transportation and Ohio EPA test-boring logs, theses, and published or unpublished geologic reports, maps, and field notes. These data also provided the basis for lithologic unit descriptions, which summarize, as accurately as possible, recognized associations of genetically related materials. The total thickness of surficial deposits was calculated from Division of Geological Survey open-file bedrock-topography maps, which are available for each 7.5-minute quadrangle in the map area. The bedrock units were summarized from Division of Geological Survey bedrock-geology maps, also available for each 7.5-minute quadrangle. Land-surface topography was derived from LiDAR data collected as part of the Ohio Statewide Imagery Program. These data were converted into a 12.5 x 12.5-foot resolution digital elevation model (DEM) and shaded-relief model by the Ohio Environmental Protection Agency.

SURFICIAL UNITS

m — Made land. Large areas of cut and fill such as dams, landfills, and urban areas; may include reclaimed strip mine areas. Underlain by bedrock or other lithologic units.

o — Organic deposits, Holocene age. Muck and peat, may contain clay at depth. Generally less than 20 feet thick. Formed in undrained depressions. Organic deposits too small to map at 100K-scale indicated by an asterisk (*) and underlain by material shown in surrounding map-unit area. Occupies depressions between beach ridges, dunes, and on the lacustrine plain; throughout the map area; very prevalent in marshy estuarine areas flanking Sandusky Bay. Considered to thin to zero at contact with adjacent polygons.

a — Alluvium, Holocene age. Includes a wide variety of textures from silt and clay to boulders; commonly includes organic material; generally not compacted; rarely greater than 20 feet thick, unit considered to thin to zero at contact with adjacent polygons. Present in floodplains of modern streams throughout entire map area or in manmade water retention features. Mapped only where areal extent and thickness are significant.

Al — Alluvial terraces, Wisconsinan age. Old floodplain remnants along streams that flowed into high, proglacial lake predecessors of Lake Erie. Highly variable textures; commonly positioned tens of feet above modern floodplains. Unit considered thinning to zero at contact with adjacent polygons.

C — Clay, Wisconsinan age. Massive to laminated; may contain interbedded silt, and fine sand; clay content can exceed 80%. Laminated clay commonly contains thin silt or sand partings. Carbonate-cemented concretions occur in some areas. Distributed throughout the Findlay map area as lowland surface deposits, terraces, and as deep-water deposits of high, proglacial predecessors of Lake Erie.

L — Silt, Wisconsinan age. Massive or laminated, commonly contains thin sand partings. Carbonate-cemented concretions occur in some areas. May contain localized clay, sand, or gravel layers. Present throughout the map area as lowland surface deposits, terraces, and thick, deltaic deposits of proglacial predecessors of Lake Erie.

SL — Sandy Silt, Wisconsinan to Holocene age. Massive or laminated, commonly contains thin sand partings. Present throughout the map area in depressions, as beach deposits, drapes on flanks of beach ridges and dunes, and capping deltaic deposits.

S — Sand, Wisconsinan age. Contains minor amounts of disseminated gravel or thin lenses of silt or gravel; grains well to moderately sorted, moderately to well rounded; finely stratified to massive, may be cross bedded; locally may contain organics. In deep buried valleys, may be older than Wisconsinan age. Present as terraces, in buried valleys, as nearshore dune and beach ridge deposits of proglacial predecessors of Lake Erie, and in association with deltaic deposits or outwash throughout map area.

SG — Sand and gravel, generally Wisconsinan age. Intermixed and interbedded sand and gravel commonly containing thin, discontinuous layers of silt and clay; grains well to moderately sorted, moderately to well rounded; finely stratified to massive, may be cross bedded; locally may contain organics. In deep buried valleys, may be older than Wisconsinan age. Present as valley wall terraces and in buried valleys throughout the map area, and as beach ridge deposits of proglacial predecessors of Lake Erie.

G — Gravel, Wisconsinan age. Contains intergranular sand, some sand and silt beds or lenses; unit well to moderately sorted, *subangular* to well rounded; may be massive, cross-bedded, or horizontally bedded. Larger clasts and majority of gravel of variable lithology but are commonly derived from bedrock within the immediate area. In deep buried valleys, may be older than Wisconsinan age. Mapped only near the border with the Lorain/Put-in-Bay map.

GA — Basal gravel. Highly variable, poorly sorted gravel and sand, with significant amounts silt and clay. Deposited at or near the front of the ice sheet directly on bedrock. Presumably of Wisconsinan age. Mapped only in the southeast corner of map..

T — Unsorted mix of silt, clay, sand, gravel, and boulders, variable carbonate content, fractures common, Wisconsinan age. May contain silt, sand, and gravel lenses. Deposited directly from several separate ice advances. Undifferentiated and non-specified age in buried valleys or where separated by intervening non-till units from an overlying designated till. Surface may be wave-planed or modified by lacustrine erosion and deposition

BEDROCK UNITS

Sh — Shale. Antrim Shale, Upper Devonian age, brownish black, dark brown to black, carbonaceous. Present in the northwest corner of map area, unit not exposed, occurs beneath undifferentiated Quaternary and Neogene (?) deposits; data from core holes.

ShL — Interbedded shale and limestone, shale dominant. Mapped only in the very southeastern corner of the Bloomville Quadrangle to indicate the Olentangy Shale. Olentangy Shale, Middle and Upper Devonian age, greenish-gray, calcareous, sparsely fossiliferous, clay shale; disseminated pyrite; locally contains lenses and nodules and layers of limestone.

Ls — Limestone. Used to designate the Delaware and Columbus Limestones present in the southeast corner of the map area and the Silica Formation and Dundee Limestone present in the northwest corner of the map area. Delaware Limestone, Middle Devonian age, medium brown, fine to medium crystalline, fossiliferous, cherty limestone containing shale laminae. Columbus Limestone, Middle Devonian age, light to medium gray to brown, fine to coarse crystalline, fossiliferous, and cherty in the upper portion, sparsely fossiliferous and contains quartz grains in the lower portion This unit is susceptible to dissolutioning and contains significant areas of well-developed karst topography. Dundee Limestone, Middle Devonian age, shades of blue, gray, and brown; occurs in thin to massive beds; upper part very fossiliferous; lower part contains cherty dolomite. The Silica Formation, Middle Devonian age, a calcareous clayey shale and limestone; bluish gray; very fossiliferous.

D — Dolomite is the dominant bedrock stack unit present in the map area except in northwest and southeast corners. Stratigraphic names of the dolomites in descending stratigraphic order: Ten Mile Creek Dolomite, Detroit River Group, the Salina Group undifferentiated, Tymochtee, Greenfield, and Lockport Dolomites. Ten Mile Creek Dolomite, Middle Devonian age, shades of gray; mostly in thin to medium beds; contains some irregular layers and nodules of chert. Detroit River Group, Middle and Lower Devonian, consists generally of three formations, in descending stratigraphic order: Lucas and Amherstburg Dolomites and Sylvania Sandstone. Salina Group undifferentiated, Upper and Lower Silurian age, comprised of dolomite shades of gray and brown; very finely crystalline; mostly in thin to medium beds and laminae; locally includes shale, anhydrite, and/or gypsum beds and laminae; Tymochtee and Greenfield Dolomites undivided, Upper and Lower Silurian age, dolomite and shale. Tymochtee Dolomite shades of gray and brown; very finely crystalline; occurs in thin to massive beds with carbonaceous shale laminae and beds. Greenfield Dolomite shades of gray and brown; very finely to coarsely crystalline; occurs as massive beds to laminae; argillaceous; locally brecciated in lower portion. Lockport Dolomite, Upper and Lower Silurian age, variegated white to shades of gray; finely to coarsely crystalline; mostly in medium to massive beds; fossiliferous; vuggy; locally cherty in lower portion of unit.

KEY TO LITHOLOGIC COLORS*

- m — Made land, larger pits, quarries, or mines
- o — Organic deposits, Holocene age
- a — Alluvium, Holocene age
- Al — Alluvial terrace, Wisconsinan age
- C — Clay, Wisconsinan age
- L — Silt, Wisconsinan age
- SL — Sandy silt, Holocene age
- S — Sand, Wisconsinan age
- SG — Sand and gravel, Wisconsinan age
- G — Gravel, Wisconsinan age
- T — Clay loam to loamy till, variable carbonate content, Wisconsinan age

Bedrock Units

- D — Dolomite or Dolostone and associated colluvium, Devonian and Silurian age
- Ls — Limestone, Devonian age

* The colors on the map correspond to the uppermost continuous map units and serve to assist in visualizing the geology of the area. Discontinuous units (in parentheses) and subsurface-only units are not assigned colors.

EXPLANATION

- ★ — Small area of organic deposits
- × — Quarry, mine, or strip mine; floored in bedrock.; may contain reclaimed areas
- × — Sand and gravel pit. Pit bottom generally underlain by unconsolidated lithologic units of surrounding polygon(s). May contain reclaimed areas.
- ——— Boundary between map-unit areas having different uppermost continuous lithologies or significant bedrock lithology change; *underlying* lithologies may or may not differ.
- ····· Boundary between map-unit areas having the same uppermost continuous lithology but different thickness or different underlying lithologies.

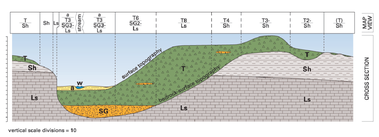

FIGURE 1. – Map view and cross section of a hypothetical stack-unit map. See lithologic-unit descriptions for explanation of symbols. In the map view (top), solid-line boundaries separate map-unit areas having different lithologic units at the surface; underlying lithologic units may or may not differ. Dashed-line boundaries separate map-unit areas having the same surface lithologic unit but different thickness or different underlying lithologic units. The cross section illustrates thickness and mapping conventions. Thickness values are in tens of feet. Values are gross averages that can vary up to 50 percent, except (1) those followed by a minus sign (-), which represent the maximum thickness of a thinning trough- or wedge-shaped sediment body, or (2) units in parentheses ( ), which indicate a discontinuous distribution of that unit. Precise surface topography can be determined from topographic maps that are available from the Division of Geological Survey at several scales; bedrock-surface topography and bedrock geology are available from the Division of Geological Survey as 1:24,000 scale quadrangle maps.

Location of the Findlay
30 x 60 minute quadrangle

Base map derived from the Ohio Department of Transportation data sets. Projection of data is Ohio coordinate system, north zone, North American Datum 1927.

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REFERENCES

Anderhalt, R., and Kahle, C.F., 1984, Glaciolacustrine deltaic deposits in the Oak Openings sand of northwestern Ohio (abs.): Ohio Journal of Science, v. 84, no. 2, p. 17.

Angle, M.P., 1987, Glacial geology of Sandusky County, Ohio: Manuscript map on file at the Ohio Department of Natural Resources, Division of Geological Survey, scale 1:62,500.

Brock, A.R., and Urban, D.R., 1974, Soil survey of Putnam County, Ohio: U.S. Department of Agriculture, Natural Resources Conservation Service, 112 p.

Brockman, C.S., 1998, Physiographic regions of Ohio: Ohio Department of Natural Resources, Division of Geological Survey, page-size map with explanatory text, scale 1:2,000,000.

Coogan, A.H., 1996, Ohio's surface rocks and sediments, modified from Chapter 3 of Fossils of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Bulletin 70, 21 p.

Cumings, E.R., 1929, Silurian reefs near Tiffin, Carey, and Marseilles, Ohio: Indiana Academy of Science, v. 39, p. 199–204.

Dachnowski, Alfred, 1912, Peat deposits of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Bulletin 16, 424 p.

Ernst, J.E., Miller, K.E., and Hunter, R.L., 1980, Soil survey of Seneca County, Ohio: U.S. Department of Agriculture, Soil Conservation Service, 143 p.

Ernst, J.E., and Hunter, R.L., 1987, Soil survey of Sandusky County, Ohio: U.S. Department of Agriculture, Soil Conservation Service, 160 p.

Fernandez, R.L., 1986, Glacial geology of Seneca County, Ohio: Field maps on file at the Ohio Department of Natural Resources, Division of Geological Survey, scale 1:24,000.

Flesher, E.C., Jr., Stone, K.L., Young, L.K., and Urban, D.R., 1974, Soil survey of Henry County, Ohio: U.S. Department of Agriculture, Soil Conservation Service, 128 p.

Forsyth, J.L., 1973, Late-glacial and postglacial history of western Lake Erie: Compass of Sigma Gamma Epsilon, v. 51, no. 1, p. 16–26.

Forsyth, J.L., 1965, Water-modified till of the lake plain of northwestern Ohio: Ohio Journal of Science, v. 65, no. 2, p. 96

Forsyth, J.L., 1959, The beach ridges of northern Ohio: Ohio Department of Natural Resources, Division of Geological Survey Information Circular 25, 10 p.

Fullerton, D.S., 1986, Stratigraphy and correlation of glacial deposits from Indiana to New York and New Jersey: Quaternary science reviews, v. 5, p. 23–52.

Fullerton, D.S., 1980, Preliminary correlation of Post-Erie interstadial events (16,000-10,000 radiocarbon years before the present), central and eastern Great Lakes region, and Hudson, Champlain, and St. Lawrence Lowlands, United States and Canada: U.S. Geological Survey Professional Paper 1089.

Goldthwait, R.P., and Pavey, R.R., comps., 1993, Quaternary geology of Ohio, Marion quadrangle: Ohio Department of Natural Resources, Division of Geological Survey Open-File Map 295, scale 1:250,000.

Hansen, M.C., 1997 (revised), The Ice Age in Ohio: Ohio Department of Natural Resources, Division of Geological Survey Educational Leaflet 7.

Hansen, M.C., 1989, The History of Lake Erie: Ohio Department of Natural Resources, Division of Geological Survey, Ohio Geology newsletter, Fall issue, p. 1, and 3–6.

Hull, D.N., 1999, Mapping Ohio's karst terrain: Ohio Department of Natural Resources, Division of Geological Survey, Ohio Geology newsletter, no. 2, p. 1–6.

Hull, D.N., 1982, Guide to the geology along Interstate 75 between Toledo and Cincinnati: Ohio Department of Natural Resources, Division of Geological Survey Educational Leaflet 13.

Kaatz, M.K., 1955, The Black Swamp: A study in historical geography: Annals of the Association of American Geographers, v. 55, no. 1, p. 1–35.

Klotz, J.A., and Forsyth, J.L., 1993, Late glacial origin of the Maumee Valley Terraces, northwestern Ohio: Ohio Journal of Science, v. 93, no. 5, p. 126–133.

Larsen, G.E., 1998, Generalized correlation chart of bedrock units in Ohio, Ohio Department of Natural Resources, Division of Geological Survey Open-File Report 98-2, 1 pl.

Larsen, G.E., 1991, Development of Silurian and Devonian lithostratigraphic nomendature, central-western and northwestern Ohio: Ohio Department of Natural Resources, Division of Geological Survey, Open-File Report 91-1, chart.

Larsen, G.E., Shrake, D.L., and Swinford, E.M., in press, Surficial geology of the Toledo 30 x 60 minute quadrangle: Ohio Department of Natural Resources, Division of Geological Survey Map SG-2 Toledo, scale 1:100,000.

Limbird, Arthur, 1975, Identification of an Aeolian flat environment, Wood County, Ohio: Ohio Journal of Science, v. 75, no. 8, p. 132–137.

McDonald, James, Pavey, R.R., Venteris, E.R., and Wells, J.G., in press, GIS tools for 3D surficial mapping in Ohio, in Digital Mapping Techniques '07-Workshop Proceedings, Columbia, South Carolina, May 20–23, 2007. U.S. Geological Survey Open-File Report.

Musgrave, D.K., and Derringer, G.D., 1985, Soil survey of Ottawa County, Ohio: U.S. Department of Agriculture, Soil Conservation Service, 104 p.

Norris, S.E., 1975, Geological structure of the near-surface rocks in western Ohio: Ohio Journal of Science, v. 75, no. 5, p. 225–228.

Ohio Department of Natural Resources, Division of Geological Survey, 2003, Shaded bedrock-topography map of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map BG-3, scale 1:500,000.

Pavey, R.R., Glacial geology of Erie County, Ohio: Field maps on file at the Ohio Department of Natural Resources, Division of Geological Survey, scale 1:24,000.

Pavey, R.R., Larsen, G.E., Swinford, E.M., Vorbau, K.E., Powers, D.M., and Wells, J.G., in press, Surficial geology of the Lorain and Put-in-Bay 30 x 60 minute quadrangle: Ohio Department of Natural Resources, Division of Geological Survey Map SG-2 Lorain and Put-in-Bay, scale 1:100,000.

Pavey, R.R., Hull, D.N., Brockman, C.S., Schumacher, G.A., Stith, D.A., Swinford, E.M., Sole, T.L., Vorbau, K.E., Kallisz, K.D., Evans, E.E., Slucher, E.R., and Van Horn, R.G., with cartography by Powers, D.M., 1999, (revised 2002, 2004, and 2007), Known and probable karst in Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map EG-1, scale 1:500,000.

Pavey, R.R., Goldthwait, R.P., Brockman, C.S., Hull, D.N., Swinford, E.M., and Van Horn, R.G., 1999, Quaternary geology of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map No. 2, scale 1:500,000.

Powers, D.M., and Swinford, E.M., 2004, Shaded drift-thickness of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map SG-3, scale 1:500,000.

Powers, D.M., Laine, J.F., and Pavey, R.R., 2002 (revised 2003), Shaded elevation map of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map MG-1, scale 1:500,000.

Rapparlie, D.F., and Urban, D.R., 1973, Soil survey of Hancock County, Ohio: U.S. Department of Agriculture, Soil Conservation Service, 94 p.

Rapparlie, D.F., and Urban, D.R., 1966, Soil survey of Wood County, Ohio: U.S. Department of Agriculture, Soil Conservation Service, 96 p.

Robbins, R.A., 1995, Analysis of soil parent materials on the western Defiance Moraine, Hancock County, Ohio (abs): Ohio Journal of Science, v. 95, no. 2, p. A-41.

Robbins, R.A., and Lantz, A.M., 2005, Soil survey of Wood County, Ohio, interim report: U.S. Department of Agriculture, Natural Resources Conservation Service (formerly Soil Conservation Service), 678 p.

Robbins, R.A., and Feaner, M.M., 2005, Soil survey of Hancock County, Ohio, interim report: U.S. Department of Agriculture, Natural Resources Conservation Service (formerly Soil Conservation Service), 540 p.

Shaffer, P.R., The Pleistocene geology of the Fostoria quadrangle: Ohio Journal of Science, v. 42, no. 3, p. 103–109.

Shrake, D.L., 1997, Regional bedrock geology of the Marion, Ohio, 30 x 60 minute quadrangle: Ohio Department of Natural Resources, Division of Geological Survey Map 9, scale 1:100,000.

Shrake, D.L., Swinford, E.M., Schumacher, G.A., Larsen, G.E., Venteris, E.R., and Pavey, R.R., 2007, Complete 1:100,000-scale coverage of the surficial geology of Ohio's Lake Erie coast (abs.): Ohio Journal of Science, v. 107, no. 1, p. A-14.

Slucher, E.R., comp., Swinford, E.M., Larsen, G.E., Schumacher, G.A., Shrake, D.L., Rice, C.L., Caudill, M.R., and Rea, R.G., 2006, Bedrock geologic map of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map BG-1, scale 1:500,000.

Stith, D.A., 1973, Areas of shallow bedrock in part of northwestern Ohio: Ohio Department of Natural Resources, Division of Geological Survey Informational Circular 38, map.

Stone, K.L., Jr., McConoughey, E.H., Bottrell, G.D., and Crowner, D.J., 1980, Soil survey of Lucas County, Ohio: U.S. Department of Agriculture, Soil Conservation Service, 139 p.

Strutz, Wilber, VerSteeg, Karl, and Lamb, G.F., 1943, Geology of water in Ohio: Ohio Department of Natural Resources, Division of Geological Survey Bulletin 44, 694 p.

Swinford, E.M., 2001, Bedrock topography of Ohio: Ohio Department of Natural Resources, Division of Geological Survey GeoFacts 1.

VerSteeg, Karl, 1934, The buried topography of north-central Ohio and its origin: Journal of Geology, v. 42, p. 602–620.

Venteris, E.R., 2007, Qualitative and quantitative 3D modeling of surficial materials at multiple scales, in Digital Mapping Techniques '06-Workshop Proceedings, Columbus, Ohio, June 11–14, 2006: U.S. Geological Survey Open-File Report 2007-1285, p. 129–149.

White, G.W., 1926, The limestone caves and caverns of Ohio: Ohio Journal of Science, v. 26, no. 2, p. 73–116.

Wilhelm, P.W., 1984, Draining the Black Swamps: Henry and Wood Counties, Ohio 1870–1920: Northwest Ohio Quarterly, v. 56, no. 3, p. 79–95.

Woods, A.J., Omernik, J.M., Brockman, C.S., Gerber, T.D., Hosteter, W.D., and Azevedo, S.H., 1998, Ecoregions of Indiana and Ohio: U.S. Environmental Protection Agency, Western Ecology Division, map and table.

COLTON	GRAND RAPIDS	BOWLING GREEN NORTH	DUNBRIDGE	PEMBERVILLE	ELMORE	LINDSEY	WOODSTMANS GROVE
MC CLURE	WESTON	BOWLING GREEN SOUTH	JERRY CITY	BRADNER	HELENA	FREMONT WEST	FREMONT EAST
DESHLER	HOYTVILLE	NORTH BALTIMORE	BLOOMDALE	FOSTORIA	BASCOM	TIFFIN NORTH	WATSON
LEIPSIC	MC COMB	FINDLAY	ARCADIA	ALVADA	NEW RIEGEL	TIFFIN SOUTH	BLOOMVILLE

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Mapping responsibility and index to the 7.5-minute (1:24,000 scale) quadrangles in the Ohio portion of the Findlay 30 x 60 minute quadrangle. Mapping completed in 2008.

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