ODNR Division of Geological Survey “stack” mapping provides a three-dimensional framework and depicts four important aspects of an area’s surficial geology (refer to the sample cross section below):

1. Geologic deposits, indicated by **letters** that represent the major lithologies.
2. Thicknesses of the individual deposits, indicated by **numbers** and **modifiers**.
3. Lateral extents of the deposits, indicated by map-unit area boundaries (**solid and dashed lines**).
4. Vertical sequence of deposits, shown by the **stack of symbols** within each map-unit area.

**Letters** represent geologic deposits (lithologic units) and are described in detail on the following pages. 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 (IC) deposits. The bottom symbol in each stack indicates the bedrock lithologies that underlie the surficial deposits.

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

**Modifiers** provide additional thickness and distribution information:

- Parentheses indicate that a unit has a patchy or discontinuous distribution and is missing in portions of that map-unit area. For example, (T) indicates that till with an average thickness of 10 ft is present in only part of that map-unit area.

- A negative sign (-) following a number indicates the maximum thickness for that unit in an area, 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, a SG3- map-unit area adjacent to a SG2- area indicates a sand-and-gravel unit having a maximum thickness of 30 ft that thins to an average of 20 ft 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.
**Geologic Mapping Unit Descriptions**

**Surficial Units**

**Water.** Lakes generally larger than 20 acres and not appearing on the base map.

**Made land.** Large areas of cut and fill, such as dams, landfills, and urban areas.

**Organic deposits (Holocene).** Muck and peat; may contain clay at depth. Formed in undrained depressions. Occurs on outwash trains, ice-contact areas, and hummocky moraines. Small areas are indicated with an asterisk (★). Marl deposits also present in the Lorain 30 x 60-minute quadrangle.

**Sand-and-gravel pit.** Pit bottom generally underlain by surrounding unconsolidated lithologic units. May contain reclaimed areas. Small areas indicated by a crossed-shovels symbol (✘).

**Quarry.** Floored in bedrock; may contain reclaimed areas. Includes strip mine benches. Small areas indicated by a crossed-picks symbol (✘).

**Alluvium (Holocene).** Includes a wide variety of textures from silt to clay to boulders. Commonly includes organic material; generally, not compact. Occurs in floodplains of modern streams and mapped only where areal extent and thickness are noteworthy. Also includes alluvial terraces, old floodplain remnants that are positioned tens of feet above modern floodplains.

**Clay (predominantly Wisconsinan).** Massive to laminated; may contain interbedded silt and fine sand. May include till and be older than Wisconsinan-age in deep buried valleys.

**Clay (predominantly Illinoian).** Properties similar to unit C except upper part of unit deeply leached and more deeply jointed where near surface.

**Clay in Teays-age valleys (predominantly pre-Illinoian).** May contain interbedded silt and fine-sand deltaic deposits where main trunk valley joins tributary valleys. Lacustrine deposits occur only in the subsurface in the largest, deeply buried valleys of the classical Teays Valley System. Minford Clay.

**Complexly interbedded deposits of clay, silt, sand, gravel (unspecified age).** Can include till in deeper parts of buried valleys.
**Eolian silt (loess) and fine sand (unspecified age).** Deposited by wind, generally on bedrock and Illinoian till-capped ridges. Mapped where thickness and areal extent noteworthy.

**Gravel (predominantly Wisconsinan).** Contains minor amounts of disseminated sand and thin, discontinuous lenses of silt and thicker, more continuous beds of sand. Well to poorly sorted, angular to well rounded. May be massive, cross bedded, or horizontally bedded. May be older in deep buried valleys. May contain gas in the Defiance 30 x 60-minute quadrangle.

**Gravel (predominantly Illinoian).** Occurs in subsurface only. Properties similar to unit G, except upper part of unit is deeply weathered and leached where near surface.

**Ice-contact deposits (predominantly Wisconsinan).** Highly variable deposits of poorly sorted gravel, sand, silt, and clay. Till lenses common, may be partially covered or surrounded by till.

**Ice-contact deposits (predominantly Illinoian).** Properties similar to unit IC, except upper part of unit is deeply weathered and leached where near surface.

**Silt (predominantly Wisconsinan).** Massive or laminated, commonly contains thin sand partings. May contain localized clay, sand, or gravel layers. Clay content commonly increases with depth. Frequently occurs in lowland surface deposits, in terraces, and as deposits of glacial lakes.

**Silt (predominantly Illinoian).** Properties similar to unit L, except upper part of unit is deeply leached and more deeply jointed where near surface.

**Silt and clay (Minford silt) (predominantly pre-Illinoian).** Present on high terraces or as eroded remnants of lacustrine clays and silts. Finely laminated. Often covered with loess and/or colluvium; sometimes underlain by sand and gravel.

**Silt and clay with occasional sand-and-gravel interbeds (unspecified age).** Present as deltaic deposits, outwash, deposits in upland depressions, intermorainal lake deposits, and backwater lake deposits.

**Sand (predominantly Wisconsinan).** 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; may contain organic material. May be older in deep buried valleys.
**Sand and silt (unspecified age).** Massive or laminated, commonly contains thin sand partings. May contain sand or gravel layers. Present as beach deposits, drapes on flanks of beach ridges and dunes, and capping deltaic deposits.

**Sand (predominantly Illinoian).** Properties similar to unit S, except upper part of unit is more deeply weathered and leached where near surface. Unit occurs in high-level terraces and buried valleys.

**Sand (predominantly pre-Illinoian).** Clayey to pebbly, weathered, and leached. Overlain by loess with sand- to pebble-sized nodules of iron oxide and manganese oxide concentrate near loess/sand contact. Sand mostly quartz and other resistant lithologies. Erodes easily when vegetation removed. Unit fluvial (deposited in high-level “Teays-age” paleovalleys) and eolian (loess and sheet sands in uplands).

**Sand and gravel (predominantly Wisconsinan).** Intermixed and interbedded sand and gravel commonly containing thin, discontinuous layers or silt, clay, and till. Grains well to moderately sorted, moderately to well rounded; finely stratified to massive, may be cross bedded; locally, may contain organic material. Widespread fluvial deposits in terraces and buried valleys. May be older in deep buried valleys. May contain gas in the Defiance 30 x 60-minute quadrangle.

**Sand and gravel (predominantly Illinoian).** Properties similar to unit SG, except upper part of unit is deeply weathered and leached where near surface.

**Till (predominantly Wisconsinan).** Unsorted mix of silt, clay, sand, gravel, and boulders; variable carbonate content, generally grey to light brown when unweathered. Fractures common. May contain silt, sand, and gravel lenses. Deposited directly from several separate ice advances. Undifferentiated and nonspecified age in buried valleys or where separated by intervening nontill units from an overlying till. Surface may be wave-planed or modified by lacustrine erosion and deposition. May contain gas in the Defiance and Adrian 30 x 60-minute quadrangles.

**Loam till (predominantly Illinoian).** Properties similar to unit T. Generally, overlain by loess that becomes thicker along bluffs bordering major rivers.

**Clay-loam till (predominantly pre-Illinoian).** Properties similar to unit T, except overlain by well-weathered loess that has been entirely leached. Till highly weathered and leached; brown to reddish-brown color; thin to absent on slopes. Sand-size voids common.
**Limestone and shale (predominantly Ordovician).** Interbedded limestones and shales of varying dominance. Shale-rich lithologies prone to landslides. Shale is gray; thin to thick bedded. Limestone is medium gray; thin to medium bedded; fossiliferous. Occasionally contains dolomite in the Maysville 30 x 60-minute quadrangle.

**Dolomite and limestone (predominantly Silurian and Devonian).** Carbonate bedrock dominated by dolomites with occasional limestones. Thin to massive bedded. Contains well-developed karst and solution features. Frequently fossiliferous; may be cherty.

**Shale (predominantly Devonian).** Clayey shale with limestone nodules and overlying organic-rich, hard, fissile shale.

**Sandstone (predominantly Mississippian).** Thin to massive bedded; fine to medium grained.

**Sandstone and shale (predominantly Mississippian).** Interbedded shale, siltstone, and sandstone and associated colluvium, with common vertical and horizontal changes in rock type.

**Sandstone, siltstone, shale, clay, limestone, and coal (predominantly Pennsylvanian).** Sandstone nonbedded to massive, medium to coarse grained with abundant rounded quartz pebbles; quartz pebble conglomerate present. Interbeds of shale, sandstone, siltstone, clay, coal, and limestone common in upper portions of unit. Common horizontal and vertical changes in rock type.

**Sandstone, siltstone, shale, and clay (predominantly Permian).** Sandstone fine grained to conglomeratic; thin to massive, crossbedding present. Limestone and coal beds present in lower part of unit.