MUSKINGUM RIVER BASIN

The Muskingum River is the largest stream in the state and drains 8,038 square miles, or about one-fifth of Ohio. Within the basin, the physiographic, geologic, and soil conditions vary greatly. The Muskingum River forms at the junction of the Walhonding and Tuscarawas rivers near Coshocton, and flows 109 miles to the south and east to enter the Ohio River at Marietta. The northern and western edges of the basin are glaciated.

Physiography

The basin is entirely within the Allegheny Plateaus province. The line of glaciation marking the farthest southward advance of the ice sheets extends west from northern Tuscarawas County to the vicinity of Loudonville, thence almost directly south, leaving the basin in Perry County. The glaciated area is generally gently rolling with some flat topography, and the unglaciated plateau is generally rough and well dissected.

Geology

The bedrock formations dip generally to the southeast about 20 to 40 feet to the mile. The rocks are of Mississippian, Pennsylvanian, and Permian ages, and consist of interbedded sandstones and shales, with some coal and clay beds and occasional thin limestone formations. Several of the sandstone beds are important sources of ground water, but generally the rocks have little direct influence upon streamflow. The productive sandstones are at depth below stream drainage.

The glacial deposits vary from thin and relatively impermeable till to thick sand and gravel beds. The melt water deposits, such as valley train deposits, kames and kame terraces are generally well sorted and permeable. Such beds, where extensive, have a profound influence on streamflow particularly in buried valleys filled with permeable material with a present-day stream flowing over the top of the ancient valley.
The valleys of Sandy Creek and Nimishillen Creek in the vicinity of Canton, for example, have enormous ground-water storage in the thick permeable gravels and are one of the best areas in the state from this standpoint. In nearby areas the till is thin and impervious, and there is little natural storage in the ground. Every county that is in the glaciated part of the Muskingum River Basin has some thick valley deposits, but detailed surveys are required to determine the extent of such fills.

Soils

The soils in the glaciated area of this basin are generally developed from late Wisconsin drift. Over large areas of the upland in the north the soils are predominantly the well drained and moderately permeable Wooster and the moderately well drained, slowly permeable Canfield. Moderately large areas of slowly permeable Rittman and Wadsworth silt loams occur in the northern part of the glaciated area. Amanda and Alexandria silt loams and associated soils are prevalent along the western part of the glaciated area. The permeability of these soils varies from moderate to slow. More permeable soils are found in the valleys. Chili, Chagrin, and Tioga loams and silt loams are the more important soils there. Below the glacial boundary, the principal upland soils are the Gilpin, Brownsville, Berks, Westmoreland, Coshocton, Keene, and Wellston

loams and silt loams, with Upshur in some areas of reddish clay shale in the southern part of the basin. These are moderately deep or deep residual soils developed on a variety of contrasting bedrock. Their profile characteristics depend almost entirely on the kind of parent rock on which the soils developed. Generally these soils are moderately to slowly permeable. In the broader valleys, there are areas of alluvial and terrace soils which are well drained and permeable.

Water Development

In 1938, the Corps of Engineers completed 14 flood control reservoirs in the Muskingum River Basin for the Muskingum Conservancy District. This system of reservoirs is the most important water development in the basin. In 1960, the Corps of Engineers completed Dillon Reservoir on the Licking River for flood protection at Zanesville. Canal Era locks and dams on the Muskingum River facilitated commercial navigation as far as Dresden, 91 miles above the mouth, but now serve recreational watercraft needs. Some flow from the upper reaches of the Tuscarawas River (Portage Lakes) is diverted into the Cuyahoga River by a feeder canal. Buckeye Lake, in Licking River drainage, was formed to provide water for the summit level of the old Ohio Canal, but it is now used for recreational purposes only.

Flow Characteristics

The gaging stations on the Tuscarawas River at Clinton and Massillon have high indices of dry-weather flow. The effect of the Portage Lakes during the low-flow period is probably small. The effect of the Barberton Reservoir on Wolf Creek is negligible on the overall flow of Tuscarawas River above Massillon. It is believed that the high sustained flow in this part of the basin is derived from the kame moraine area east of the Portage Lakes. The morainal material is highly permeable and absorbs large quantities of rainfall. Associated with the morainal material are buried valley deposits and high-level outwash material. Discharge of ground water in this area supports the dry-weather flow in the Tuscarawas River. As a whole the Tuscarawas River flows over relatively thick glacial deposits. A buried valley that contains about 200 feet of fill underlies the flood plain between Clinton and Massillon. This valley extends to the northwest under Chippewa Creek. Although Chippewa Creek may contribute some flow to the sustained flow of the Tuscarawas, it is quite likely that the high index of flow of the Tuscarawas is the result of ground-water contribution from glacial deposits associated with the Tuscarawas valley in Summit and Stark counties.

Analysis of flow in Sandy Creek reveals the effect of the sands and gravels on dryweather flow. For the most part the Sandy Creek basin lies below the glacial boundary;only the extreme upper part drains the terminal moraine area. However, the floodplain of Sandy Creek and several of its tributaries such as Little Sandy Creek, Hugle Run, and Middle Branch are underlain by sand and gravel deposits of outwash origin. The gaging stations at Waynesburg and Sandyville show indices of dry-weather flow well above average.

There is a wide difference in the indices of flow between Middle Branch of Nimishillen Creek at Canton and Nimishillen Creek at North Industry. The entire area is glaciated,

the drift consisting of end moraine that varies from tight till to gravel, ground moraine of varying character, kames and kame terraces and outwash and valley train gravel. With such surface features, high sustained flows should be expected. The discrepancy between the two stations is the result of ground-water pumpage at the Canton northeast well field where up to 11 million gallons per day has been pumped from the gravel formation underlying the flood plain of Middle Branch. Field studies have shown that recharge to the well field is derived from river infiltration.

Below Massillon, the gaging stations on the Tuscarawas River are affected by regulation of the Muskingum Watershed Conservancy District reservoirs. Prior to the regulation, however, records indicate a high sustained flow. Throughout most of its course, the Tuscarawas River flows on extensive valley train gravels.

The record on Home Creek near New Philadelphia is significant in that it shows the small influence of ground-water storage in bedrock on streamflow in the basin. Home Creek is in the unglaciated area and flows on bedrock of Pennsylvanian age.

Stillwater Creek at Uhrichsville, although regulated at present, has a low index of dryweather flow as determined by the record from 1923 to 1936, prior to regulation. Ground-water contribution from the rock strata is almost negligible in this basin. Underlying the floodplain of Stillwater Creek is 100 feet or more of valley fill. This material is largely silt, clay, or fine sand and thus adds little to streamflow. Similar conditions prevail in Wills Creek.

The Walhonding River and all of its major tributaries have high indices of dry-weather flow. The tributary system in this basin follows essentially the Deep Stage drainage system, which was inaugurated in interglacial times. Thus, the Walhonding and its principal tributaries flow through valleys that are underlain by deep valley fill. Headwaters of the Kokosing River, Mohican River, and Killbuck Creek extend well into the glaciated area where a variety of surface conditions prevail. End moraines of Wisconsin and Illinoian glacial stages are present and the material ranges from tight till to porous gravel. The ground moraine is chiefly till although locally it may be sandy or gravelly. High-level outwash gravels are present locally and some areas have extensive kame and kame terrace deposits. As a whole the Walhonding Basin has a high percent of permeable glacial deposits capable of absorbing and releasing large quantities of water. Furthermore, the extensive sandstone of the Blackhand formation of Mississippian age lies at or near the surface in places in Knox and Richland counties and undoubtedly contributes ground water to the flow of the Kokosing and Mohican tributaries.

Of the records available in the Walhonding Basin, two streams, Mill Creek near Coshocton and Jerome Fork at Jeromesville, show relatively low indices compared with other streams in the basin. Mill Creek is cut into impermeable Pennsylvanian strata except in the lower three miles of its course where it flows on unconsolidated valley fill. Above Jeromesville, Jerome Fork drains an area in which the surface materials are chiefly dense ground moraine.

The moderately sustained flow of Wakatomika Creek near Frazeysburg is influenced by conditions in both glacial deposits and bedrock. Wakatomika Creek had its inception during Illinoian glaciation and it has not changed greatly since that time. The stream in places flows over deep valley fill and over bedrock in other portions of its course. It drains an area partly occupied by the terminal moraine of Illinoian age. The morainal material varies from dense till to loose porous gravel. Additional sand and gravel deposits are present in the form of valley train and high-level outwash. Underlying the drift cover in the headwater area is the sandstone of the Blackhand formation that has a large ground-water storage capacity and undoubtedly contributes somewhat to the flow of Wakatomika Creek.

The Licking River is formed by the confluence of North Fork, Raccoon Creek, and South Fork at Newark. The flows equaled or exceeded 90 percent of the time in North Fork at Utica and Raccoon Creek at Granville are both about 0.05 cubic feet per second per square mile. Flow equaled or exceeded 90 percent of the time in South Fork near Millersport is about 0.06 cubic feet per second per square mile. Flow equaled or exceeded 90 percent of the time in the Licking River at Newark, however, is about 0.13 cubic feet per second per square mile. Miscellaneous measurements at low water indicate varying rates of increase in flow below the North Fork gage at Utica, and the 90 percent of the time flow in North Fork near Newark is about 0.12 cubic feet per second per square mile.

Study of glacial geology in the Newark area, aided by soil maps, provides an explanation for the streamflow characteristics. The tributaries forming the Licking River flow through areas of ground moraine and end moraine largely composed of till. The lower part of North Fork and the main stem of the Licking River at Newark flow through an area of kame terraces, valley train, and outwash plains. A marked increase in flow at Vanatta north of Newark is explained by the presence of a low outwash fan upon the main valley train.

On average, the dry-weather flow of streams in the Muskingum River Basin is higher than that of any other large area in the state, equaling the Miami River average. Medianflow indices are also relatively high. High-flow indices are correspondingly low, on average, but large floods have occurred at intervals in the basin. The reservoir system significantly attenuates floods on the major streams, but tends to increase the 10-percent duration flow indices, by increasing the duration of medium high flows.

Figure 65: Muskingum River Watershed

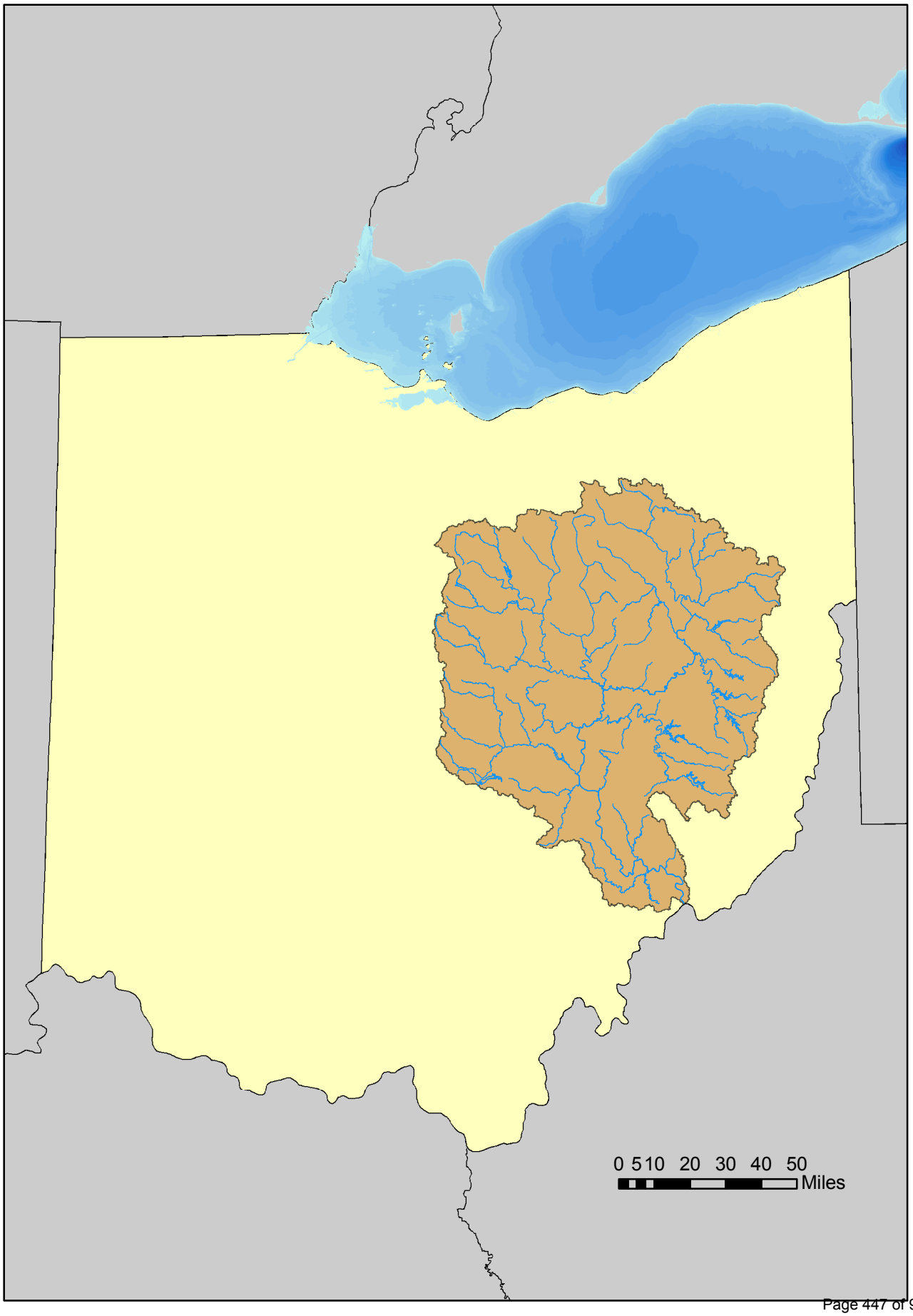

Figure 66: Muskingum Watershed Land Cover

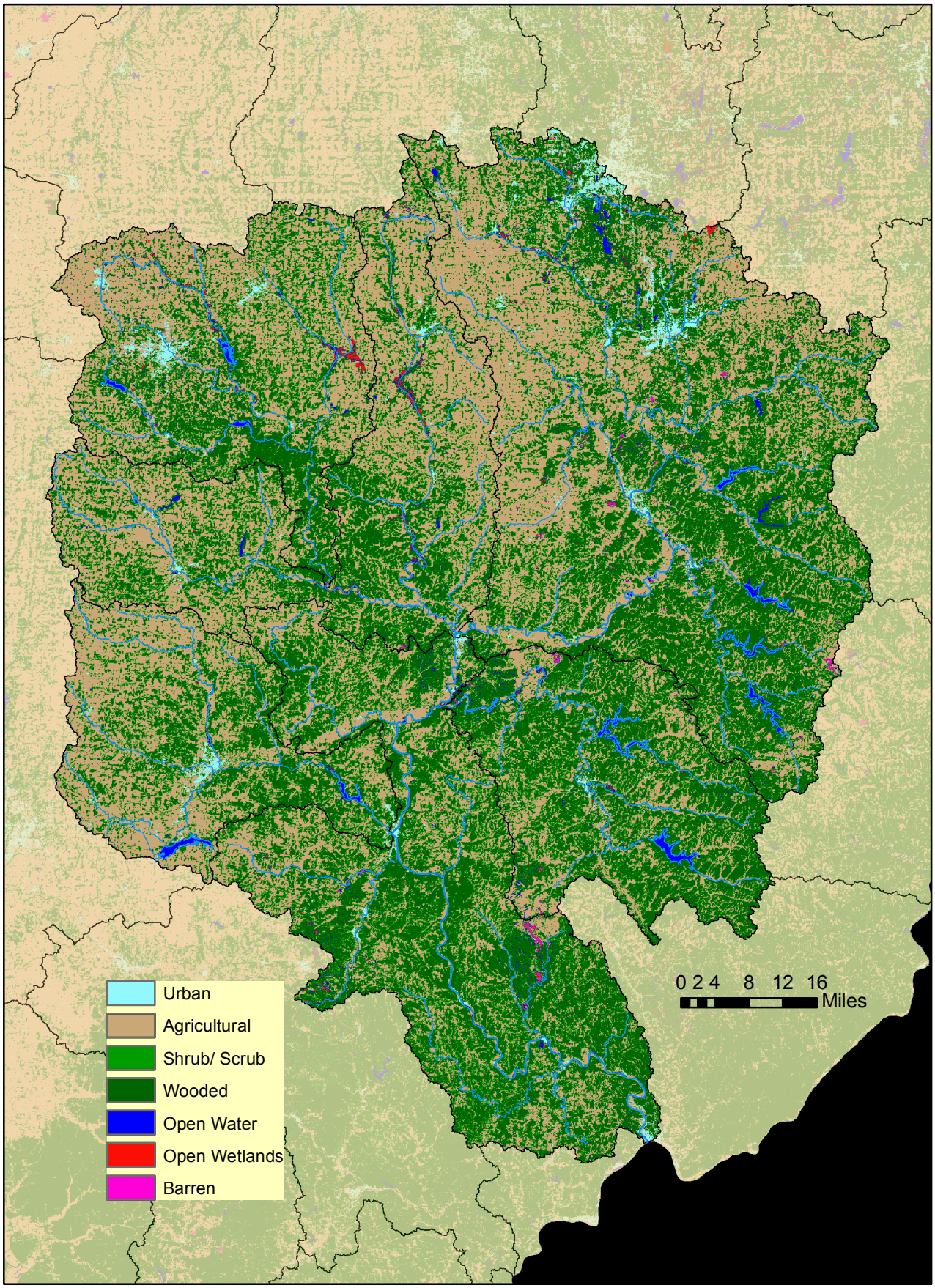
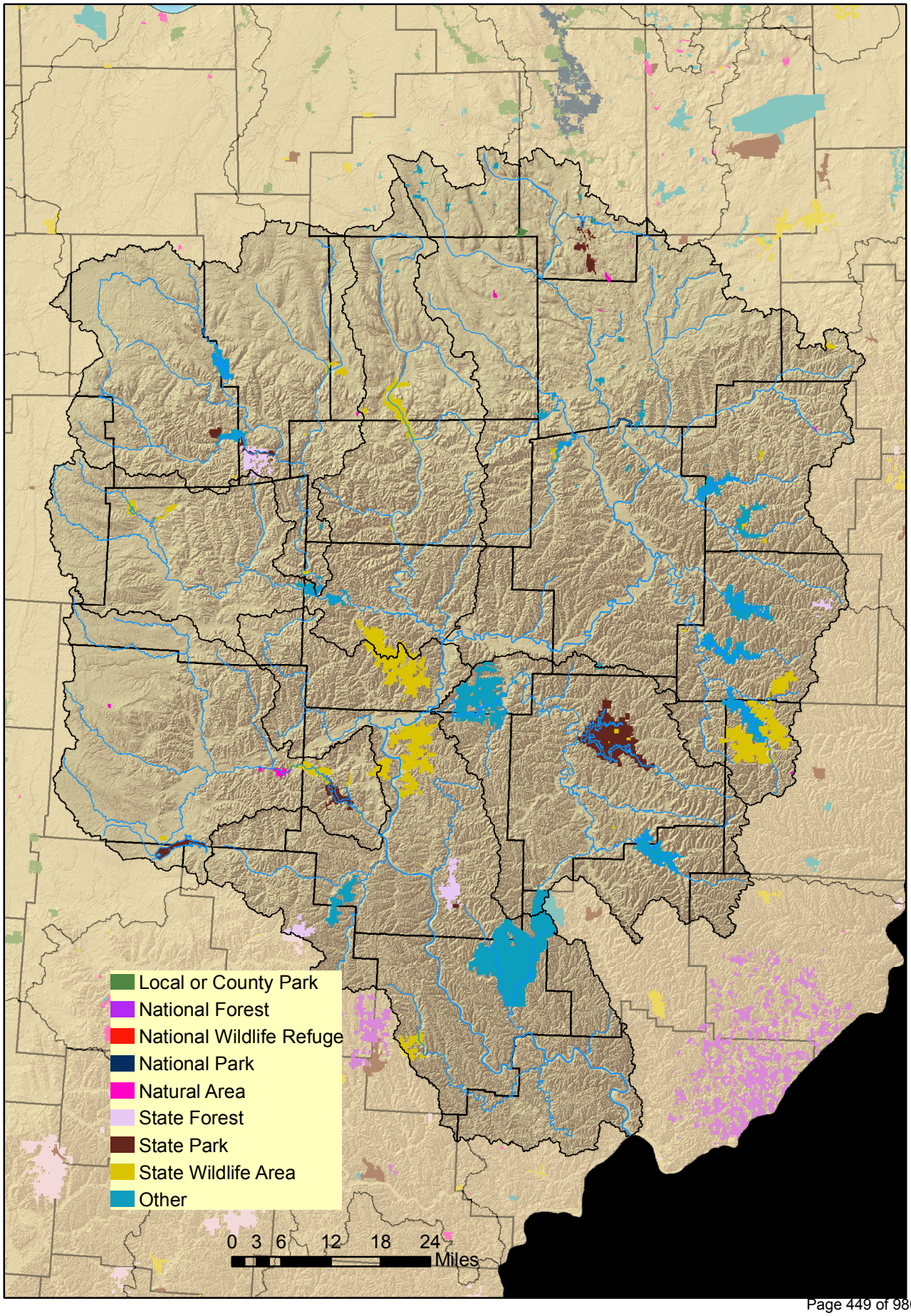
Figure 67: Muskingum River Watershed Protected Lands