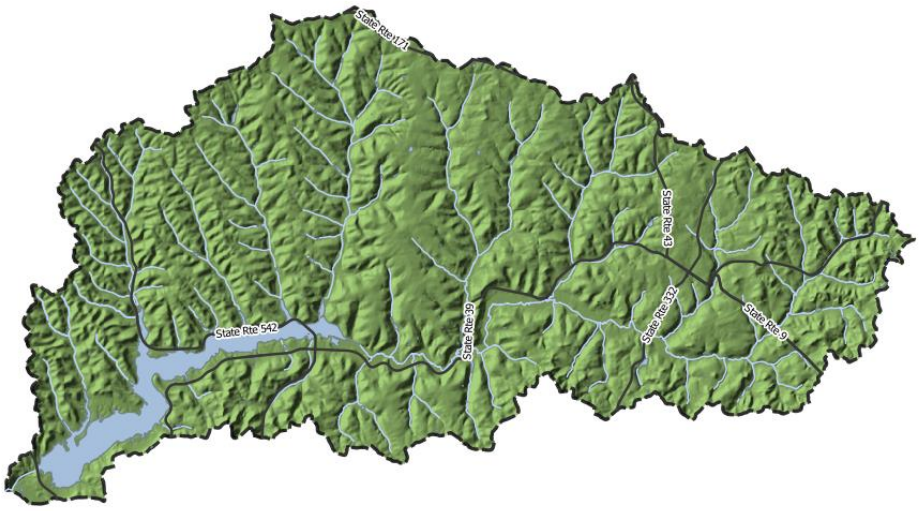
ATWOOD LAKE



9/30/2014

RAPID WATERSHED INVENTORY

Profile Contents

INTRODUCTION

The 44,976 acres of the Atwood Lake Watershed in eastern Ohio are composed of two 12-digit hydrologic units, Pleasant Valley Run-Indian Fork (HUC 050400010802) and Cold Spring Run-Indian Fork (HUC 050400010801). The majority of the watershed is located in Carroll County with a small portion crossing in to Tuscarawas County. The watershed had a population of 7,833 people as of 2010. The watershed is largely forested, with 26,210 acres of forest, followed by 12,768 acres of agricultural land, and 4,396 acres of urban areas.

Atwood Lake

RAPID WATERSHED INVENTORY

PHYSICAL DESCRIPTION

The area defined in this report as the Atwood Lake Watershed includes two 12-digit hydrologic units, Pleasant Valley Run-Indian Fork (HUC 050400010802) and Cold Spring Run-Indian Fork (HUC 050400010801). The farthest upstream reaches of the watershed are the eastern parts of the Cold Spring Run-Indian Fork Watershed. From there Friday Creek, Town Creek, Cold Spring Run, and Pleasant Valley Run drain into Indian Fork. Indian Fork continues eastward into the Pleasant Valley Run-Indian Fork watershed and soon feeds into Atwood Lake, located near the south-west corner of the watershed. Several streams small streams drain into Atwood Lake including Willow Run, Elliot Run, and Dellroy Creek as well as several unnamed tributaries. The United States Army Corp of Engineers (USACE) maintains the dam at the west end of Atwood Lake. From the dams outflow, Indian Fork continues for less than a mile before its confluence with Conotton Creek, which is the end of the watershed.

Land use in the Atwood Lake Watershed is 58% forested land and 28% agricultural use (Figures 1 & 2). Minor land uses are urban (10%), water (4%), and scrub/shrub (<0.1%) (ODNR, 2014). Within the agricultural use, 9,091 acres are in pasture or grassland and 3,836 acres are in crop production (Fry, 2011). Fifty-five percent of the land in the watershed is classified as prime farmland and 91% is classified as highly erodible land (ODNR, 2014). Conservation and recreational land encompass 4,873 acres of land. Ohio Department of Natural Resources' (ODNR) Valley Run Wildlife area accounts for 320 acres of this land, while the rest is owned by Muskingum Watershed Conservancy District.

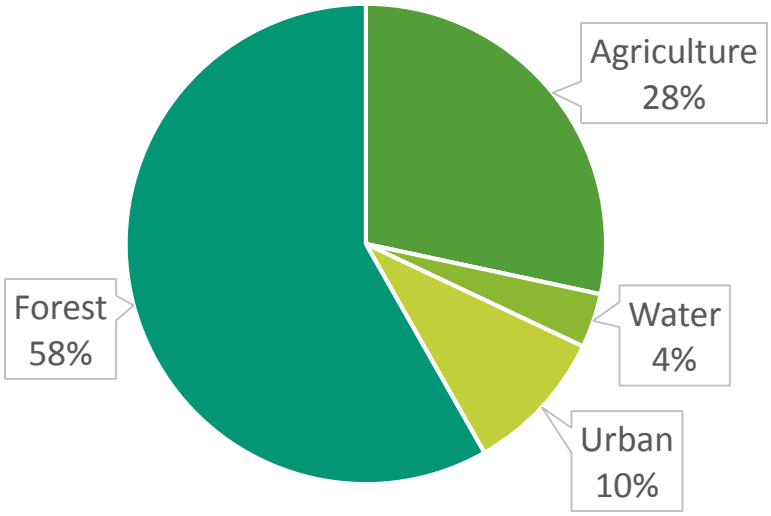


FIGURE 1: Breakdown of Land use in Atwood Lake Watershed

Annual precipitation in the watershed is between 40 and 41 inches, with May, June, and July being the wettest months, receiving 4.5 inches per month. Meanwhile, October, December, January, February, and March receive 2.5 inches per month (ODNR, 2014). The average annual maximum temperature is 84.5° F and the average annual low temperature is 19° F (ODNR, 2014).

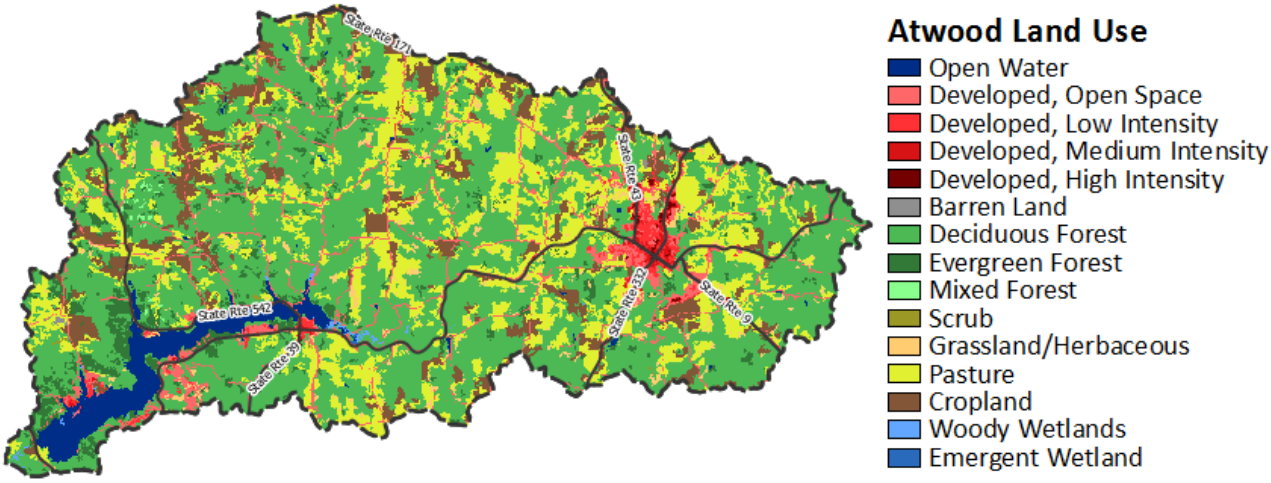


FIGURE 2: Map of Land Use within Atwood Lake Watershed

Atwood Lake Watershed is positioned in the Unglaciated Muskingum River Basin ecoregion of the Western Allegany Plateau. This region is defined by hilly terrain with

extensive forested areas, historically mixed oak and mixed mesophytic forests. Broad, silt filled valleys hold low gradient streams and rivers which are underfit to the wide valleys. Agricultural use in the Western Allegany Plateau is focused in these valleys, with dairy, livestock, hay, and row crop operations occurring in the lowlands while the hillsides remain largely forested. The ecoregion has sedimentary bedrock layers and has been mined for coal (US EPA, 1998).

RESOURCE CONCERNS

TABLE 1: Ohio EPA Watershed Impairments **(ODNR, 2014)**

CAUSES	SOURCES
DIRECT HABITAT ALTERATIONS	agriculture
LOW FLOW ALTERATIONS	channelization
NUTRIENTS	loss of riparian habitat
ORGANIC ENRICHMENT(SEWAGE) BIOLOGICAL INDICATORS	municipal (urbanized high density area)
SEDIMENTATION/SILTATION	sanitary sewer overflows (collection system failures)

Ohio Environmental Protection Agency (OEPA) has noted several potential watershed impairments in the Atwood Lake watershed (Table 1). These are typical of most streams traversing rural communities in the state and have had little examination within the watershed due to limited OEPA sampling within the watershed. The most recent US Environmental Protection Agency (EPA) Water Quality Assessment Report for the two watersheds lists most uses as not assessed (Table 2).

TABLE 2: Assessment of 2010 Designated Uses from EPA Water Quality Assessment Report (USEPA)

DESIGNATED USE	PLEASANT VALLEY RUN-INDIAN FORK	COLD SPRING RUN-INDIAN FORK
Aquatic Life Use	Not Assessed	Not Assessed
Human Health Use	Not Assessed	Not Assessed
Public Drinking Water Supply Use	Good	Not Assessed
Recreational Use	Not Assessed	Not Assessed

Nutrient Enrichment & Algal Blooms

One of the primary concerns for the health of the watershed is eutrophication of the streams and Atwood Lake. The concerns have arisen from problems occurring at other locations around the state including Lake Erie and Grand Lake Saint Mary's. Sampling conducted by the Ohio Lake Management Society has found low levels of both microcystin and cylindrospermopsin, two of the major toxins associated with HABs, in Atwood Lake during the summer of 2013 (OLMS, 2013). Numerous possible sources of nutrient pollution exist within the watershed. Human waste systems are one source and included the waste water treatment plant (WWTP) in Carrollton as well as poorly functioning or non-functioning septic systems. Additionally, improper storage of animal waste from livestock operations or unsuitable field applications of manure can result in heavy runoff of nutrients. Heavy use of fertilizers also contributes to nutrient pollution and occurs at homes, businesses, parks, golf courses, and in agriculture within the watershed.

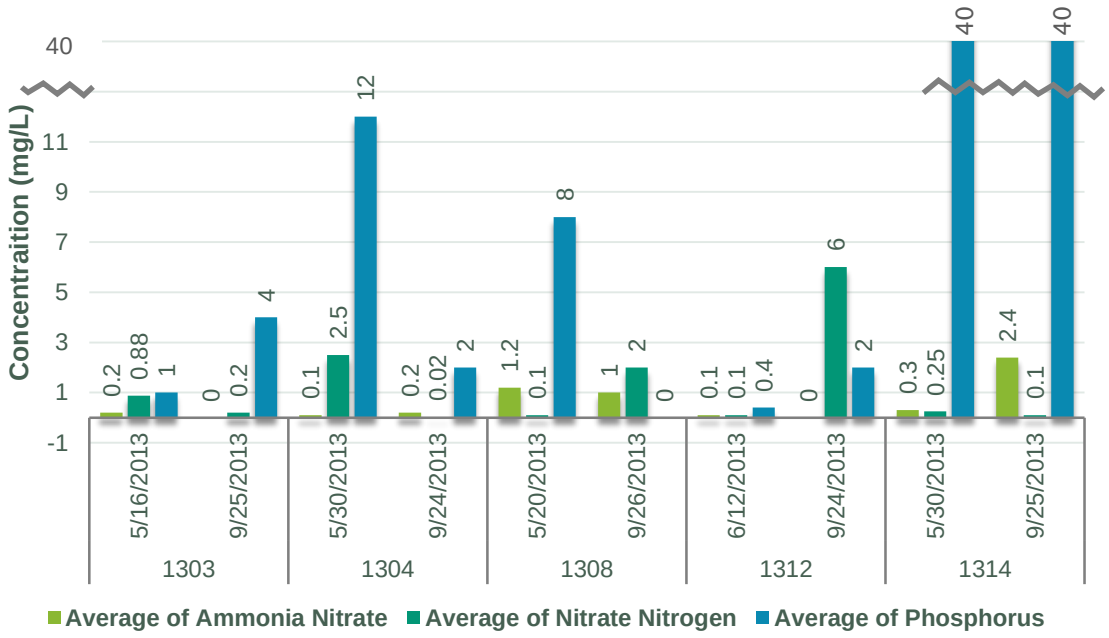


FIGURE 3: Phosphorous, ammonia and nitrate concentrations in water samples from Cold Spring Run-Indian Fork Watershed, 2013 (Carroll SWCD).

Oil and Gas Industry

The oil and gas industry has recently grown rapidly in the region. Currently, two practices becoming much more widespread across the watershed. The first is the drilling of

horizontal wells and hydraulic fracturing. There are currently permits issued for 21 wells located at 9 different well pads within the Atwood Lake Watershed (Figure 4). Nine wells are currently producing product, 8 others are drilled, and 4 are permitted, but yet to be drilled. Public concern for these wells include worries about contamination to groundwater supplies, excessive use of surface/groundwater resources for fracking operations, and runoff/erosion from pad sites, particularly during the construction process or an accidental spill.

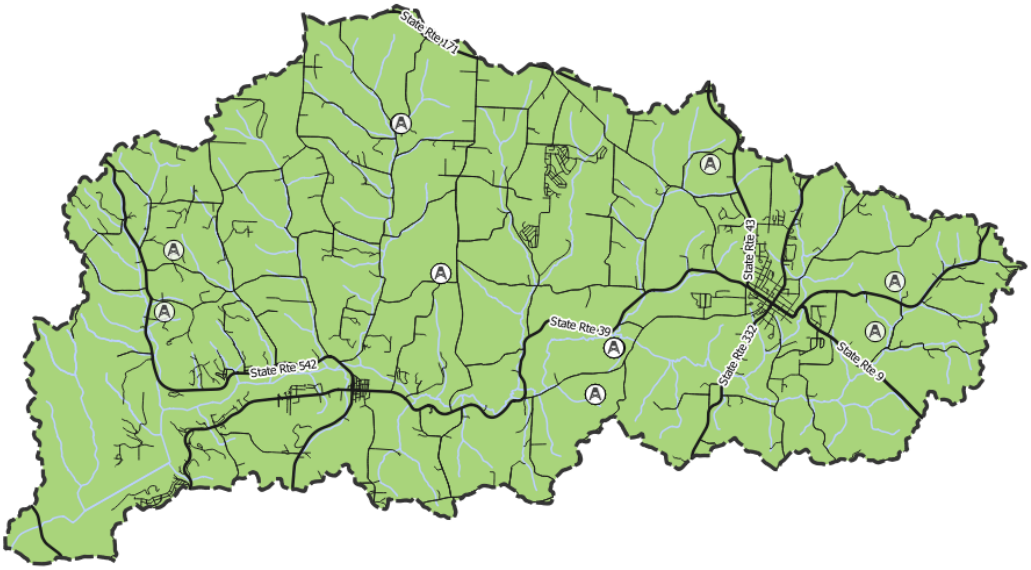


FIGURE 4: Locations of permitted Utica shale well pads in Atwood Lake Watershed (Note: some locations have multiple wells at a single pad) (ODNR DMRM, 2009-2012)

The second practice is the construction of pipelines across the watershed and surrounding counties. Currently, the largest water quality concern with pipelines is the disturbance of soil during the construction process and the potential increase in runoff and sedimentation into streams and the lake. The second concern associated with the increasing miles of pipeline across the region is the possibility of future breaks or malfunction in the lines causing gas or oil to release into the air or water supply.

Sedimentation

While sedimentation is one portion of the concern surrounding the oil and gas activity in the watershed, it is also a concern for other land uses, primarily agriculture and

construction sites. Historically, sedimentation from erosion from cropland, overgrazed pastures, and construction sites has been one of the largest issues within the region (Palone, 1992, Stillwater) and it remains a top priority. Data collected over the past 22 years by Ohio Lake Management Society's (OLMS) Citizen Lake Awareness and Monitoring (CLAM) program shows very little change in the turbidity of Atwood Lake. While there is fluctuation between years, no long term trends are readily apparent in the data (Figure 5).

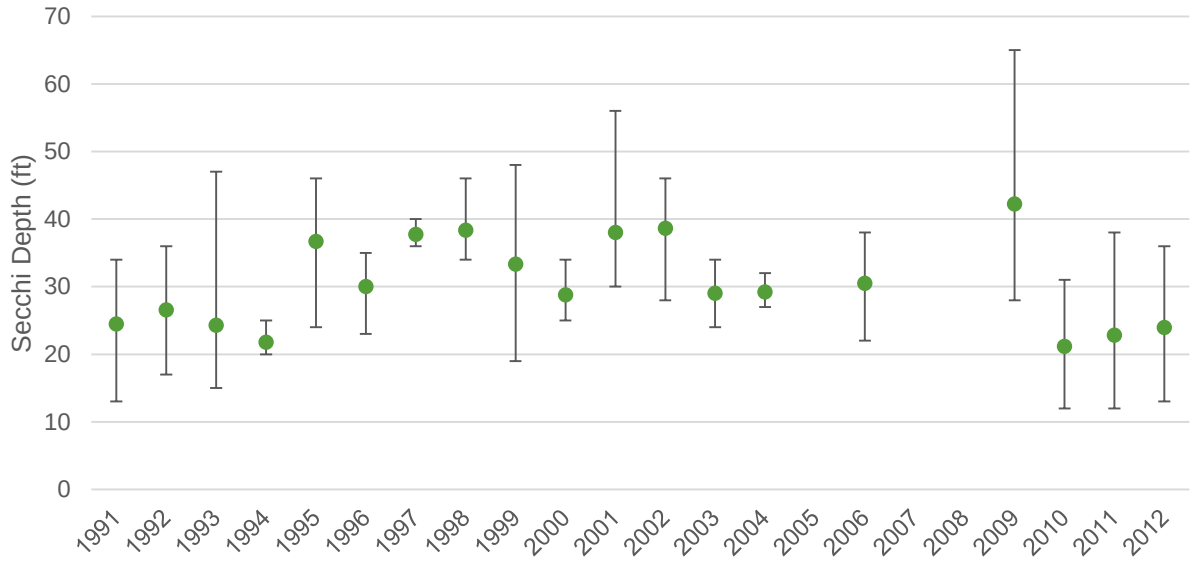


FIGURE 5: Secchi disk measurements from OLMS's CLAM data. Points show average Secchi depth for the year, while error bars represent the highest and lowest recorded Secchi depth that year. No data was available for 2005, 2007, or 2008 (OLMS, 2013).

Acid Mine Drainage & Abandoned Mine Lands

Coal mining began in Carroll County in 1853 (Wise, 2005) and the Atwood Lake Watershed has 10 documented subsurface mine sites and 2 documented surface mine sites within its boundary (ODNR DMRM, 2009-2012). Seepage from these mines can increase the acidity of the streams and inputs heavy metals such as iron and aluminum into the water bodies. Conversely, AMD can result in an increased alkalinity when limestone and similar strata exist. Sulfates may also be leached from rock layers containing sulfide minerals. While Ohio Department of Natural Resources (ODNR) Division of Mineral Resources Management (DMRM) has not conducted an assessment of Acid Mine Drainage (AMD) in this watershed, many nearby areas have identified sites impacted by AMD (Calhoun, 2012).

CENSUS AND SOCIAL DATA

The Atwood Lake Watershed had an estimated population of 7,833 as of 2010. The community was 65% rural and 35% urban according to 2000 census tract data.

STATUS AND HISTORY OF MANAGEMENT EFFORTS

In 2012 Carroll Soil and Water Conservation District (SWCD) began monitoring water quality at 14 sites in the Cold Spring Run-Indian fork sub-watershed. In 2013 the monitoring continued but was limited to only 5 of the original sites (Figure 3). Nitrate values above 1 mg/L exceed the natural levels occurring in most streams. Meanwhile, nitrate concentration above 10 mg/L may impact aquatic life use and human drinking water quality. Ammonia nitrate normally occurs below 0.5 mg/L and phosphorous concentrations greater than 0.1 mg/L can cause significant changes. In 2013 phosphorus was above the recommended threshold during both sampling periods at 4 sites and during spring only at the 5th (Figure 3). Ammonia levels were above the 0.5 mg/L level during one sample at a single site and during both seasons at one other site, while the other 3 sites were within the recommendation both time. Nitrate never exceeded the 10mg/L concentration, but was greater than 1mg/L on one occasion at 4 sites.

MWCD has several monitoring partnerships in place to gather data on the water quality in Atwood Lake. MWCD works with the Water Management Section of the Huntington District of the USACE to sample the lake and its main incoming streams and discharge. Additionally, MWCD has worked with the United States Geological Survey to develop predictive models for a system to estimate bacteria levels and issue swim advisories at Atwood Lake beaches. Through 2014 the models will be tested to determine if the system is functional. MWCD also collaborates with OLMS to fund the CLAM volunteer monitoring program. Through the program turbidity, water temperature, and water color are documented, such as the Secchi data presented if (Figure 5). Recent expansion of the program has trained some volunteers to sample nutrients, total suspended solids, chlorophyll α, dissolved oxygen, and HAB.

OEPA has conducted some sampling within the watershed at various points. Fish tissue was sampled from the lake in 1993 and 1994 as a part of the statewide assessment for fish consumption advisories and no specific advisories were issued. Currently, the

watershed is scheduled to be monitored in 2016 as a part of the statewide Total Maximum Daily Load program.

A 1973 assessment of eutrophic conditions of 20 Ohio lakes was conducted by the United States Environmental Protection Agency (US EPA, 1975) and included Atwood Lake. Atwood Lake was found to have the best water quality of the 20 sampled lakes and also had the lowest levels of phosphorus. The study report lists the Carrollton wastewater treatment plant (WWTP) as the major point source of nutrients into the lake.

The Village of Carrollton completed the $8.5 million construction of an upgraded WWTP in late 2012 (Schaar, 2012). The new treatment systems should remove a large amount of nutrients from entering the watershed.

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