



Preserving

Great Miami River Watershed Water Quantity

2025 Report



**THE MIAMI
CONSERVANCY
DISTRICT**

Abstract

The Miami Conservancy District (MCD) monitors water quantity across the 3,630-square-mile Great Miami River Watershed to evaluate long-term trends in precipitation, runoff, groundwater, and water use. This report summarizes hydrologic conditions for 2025 and places them in historical context.

Annual precipitation totaled 41.30 inches—slightly below the 30-year average (1991–2020) but consistent with an observed long-term upward trend. Despite near-average precipitation, annual runoff was 15.01 inches, approximately 1.20 inches below the 30-year average, reflecting variability in watershed response. The MCD flood protection system recorded 21 storage events, aligning with the long-term average and demonstrating continued system performance.

Groundwater levels across most index wells remained relatively stable over the long term, although localized declines persist in select areas, likely influenced by pumping and recent drought conditions. Notably, the watershed experienced abnormally dry to moderate drought conditions in late summer and early fall, highlighting seasonal variability in water availability.

Water use trends continue to show a significant decline from peak withdrawals in the early 2000s, driven largely by reductions in surface water use and changes in industrial demand.

Overall, long-term data indicate increasing precipitation and runoff, stable but locally stressed groundwater conditions, and declining water use. These findings underscore the importance of continued monitoring and adaptive, data-driven management to support regional water supply planning, flood protection, and long-term resilience.

Executive Summary

To track changes in water availability in the Great Miami River Watershed, the Miami Conservancy District (MCD) monitors precipitation, runoff, groundwater levels, and water use across more than 3,630 square miles. The 2025 data, evaluated alongside long-term trends, provide important insights into regional water conditions and system performance.

Precipitation: Annual precipitation in 2025 measured 41.30 inches, slightly below the 30-year average (1991–2020), but consistent with a long-term upward trend. Above-average rainfall in the spring was offset by drier conditions later in the year.

Runoff: Annual runoff totaled 15.01 inches, approximately 1.20 inches below the 30-year average. Despite near-average precipitation, below-average runoff reflects variability in watershed response and highlights the influence of seasonal conditions.

Drought Conditions: The watershed experienced abnormally dry to moderate drought conditions beginning in August and peaking in early October, before partially improving later in the fall.

Flood Protection System Performance: The MCD system recorded 21 storage events in 2025, consistent with the long-term average. Most events occurred between January and June, and none ranked among the system's largest historical events, indicating typical operational performance.

Groundwater: Groundwater levels at most index wells remained relatively stable over the long term. However, 8 of 12 index wells ended the year at slightly lower levels than where they began, and localized long-term declines persist in select wells, likely influenced by pumping and recent drought conditions.

Water Use: Total water withdrawals have declined significantly from a peak of approximately 578 million gallons per day in 2005 to 282 million gallons per day in 2024. This reduction is driven largely by decreased surface water use, particularly following the closure of power-generating facilities, along with more gradual declines in groundwater withdrawals.

Long-Term Trends: Long-term data indicate increasing precipitation and runoff, generally stable groundwater levels with localized areas of stress, and declining overall water use.

These findings reinforce the importance of continued monitoring, regional collaboration, and adaptive management to ensure reliable water resources, effective flood protection, and long-term resilience across the Great Miami River Watershed.

Introduction

The Miami Conservancy District is a conservancy district - a political subdivision of the State of Ohio. Miami Conservancy District works as a regional government agency throughout the Great Miami River Watershed (see figure 1). Formed in 1915, Miami Conservancy District provides flood protection, water stewardship, and recreation opportunities for the area.

To track natural water resource conditions, Miami Conservancy District operates automated and observer precipitation stations as well as extensive stream gaging and observation well networks to record precipitation, streamflow, and groundwater levels.

Miami Conservancy District operates the stream gaging network with the U.S. Geological Survey (USGS) under a cooperative agreement that has been in place since 1931.

Partnering with a variety of federal, state, and local governments, Miami Conservancy District conducts surface water and groundwater quality and quantity studies.

Tracking Water Quantity

The Miami Conservancy District tracks changes in water availability - including precipitation, runoff, and groundwater level data through partnerships with USGS and a network of citizen observers.

Water data from these partnerships provide estimates of water inflows and outflows for the Great Miami River Watershed upstream of the Hamilton stream gaging station (the most downstream gage), an area of 3,630 square miles.

These data also allow for comparisons between current hydrologic measurements and historical measurements to evaluate trends in water quantity entering and leaving the watershed, as well as trends in aquifer storage.

The trends can be useful for planning related to water supply, flood protection, construction, agriculture, commerce, and industry.

Water Cycle

The water cycle describes the movement of water into and out of a watershed. For the Great Miami River Watershed, the water cycle can be broken down into the following steps. All water coming into the watershed arrives as precipitation.

- Precipitation falls on the surface of the Great Miami River Watershed as rain, snow, or ice.
- Some of the precipitation flows by gravity toward streams and rivers and becomes surface runoff which eventually reaches the Great Miami River (see figure 2).
- Some of the precipitation infiltrates the ground and percolates through the soil until it reaches the water table. This water provides groundwater recharge to the aquifers and helps sustain the abundant water resources in the Great Miami River Watershed.
- Water in the aquifer either remains underground and in storage for an extended period or stays close to the ground surface and seeps into nearby streams or rivers as base flow.

As a result, many streams and rivers in the Great Miami River Watershed can sustain flow, even during periods of prolonged drought, because the underlying aquifer systems provide base flow to the streams and rivers.

Observing Precipitation

To track precipitation amounts, Miami Conservancy District maintains a network of 42 stations staffed by citizen observers who record daily precipitation amounts (see figure 3). The observers make daily measurements of precipitation collected in standard National Weather Service rain and snow gages (see figure 4) and send the readings to Miami Conservancy District via mail or electronic submittal. Miami Conservancy District uses the data to calculate annual precipitation for the watershed by averaging annual precipitation totals measured at each of the stations.

Annual Precipitation & Trends

The average annual precipitation recorded by Miami Conservancy District during 2025 was 41.30 inches.

Monthly precipitation in the Great Miami River Watershed was above average during February, March, April, May, June, July, and October (see Figure 5). April recorded the highest monthly precipitation total in 2025 at 6.37 inches. Below average precipitation occurred in January, August, September, November, and December. September recorded the lowest precipitation total in 2025 at 1.40 inches.

The highest annual total precipitation amount of 52.09 inches was recorded at Miami Conservancy District's Ingomar observer station, while the lowest amount of 29.17 inches was recorded at the Union City observer station.

According to the U.S. Drought Monitor, the year 2025 started out with the entire Great Miami River Watershed free of any drought conditions. In February abnormally dry conditions began to creep into northwestern areas of the watershed in Darke and Shelby counties. These conditions persisted until early April. A wetter than normal April relieved all drought conditions and the Great Miami River Watershed remained entirely drought free until mid-August. In August abnormally dry conditions began to appear in northeastern areas of the watershed including Champaign and parts of Shelby counties. By the beginning of September, the entire watershed was abnormally dry. Drought conditions intensified during the month of September and peaked in early October with the entire watershed in moderate to severe drought conditions (see Figure 6). Drought conditions eased somewhat in October and by late October the southern half of the watershed was free of drought. However, abnormally dry to moderate

drought conditions lingered throughout the rest of the year in Champaign, Darke, Logan, Miami, and Shelby counties.

While the year 2025 recorded near normal precipitation, the average annual precipitation is still trending upward (see Figure 7). Average annual precipitation for the 30-year timespan of 1951 – 1980 was 37.29 inches. For the 30-year timespan of 1991 – 2020 average annual precipitation climbed to 41.92 inches showing an increase of 4.63 inches over 40 years.

Measuring Runoff

Miami Conservancy District, in cooperation with USGS, maintains a network of 24 stream gages equipped with telemetry (see Figure 8). Each stream gage transmits data to USGS Water Data for the Nation (WDFN). A streamgage records the water level or stage of the river or stream at the gage location. NWIS estimates discharge for a given water level through a rating which is a mathematical relationship between water level and discharge. USGS derives this mathematical relationship from field measurements of discharge across a range of water levels. The stream gage network allows Miami Conservancy District to estimate annual runoff for the Great Miami River Watershed and track storage events at each of the five Miami Conservancy District flood protection dams.

Estimated Runoff & Trends

Nearly all the water leaving the Great Miami River Watershed exits through the processes of evapotranspiration and runoff. Miami Conservancy District does not measure evapotranspiration directly but does measure runoff. Runoff includes all the water that flows across the land and enters streams, as well as water discharged from aquifers into streams.

Miami Conservancy District estimates annual runoff amounts by the following process:

- Determine the average daily flow (ft³/sec) for the Great Miami River at Hamilton gage for a particular month;
- determine the monthly flow volume of water (ft³) by multiplying the average daily flow (ft³/sec) for the month times the number of days in that month using a conversion factor to convert days into seconds;
- divide the monthly volume of water (ft³) by the entire watershed area (3,630 mi²) upstream of the gage using a conversion factor to determine water depth in inches;

- sum the water depths for each month of the year to get total annual runoff in inches.

Estimated runoff for the Great Miami River in 2025 was 15.01 inches. This amount is 1.20 inches less than the 30-year (1991 to 2020) average for the watershed.

Runoff was significantly above average in the month of April. Runoff was below average for 9 of the 12 months in 2025 (see Figure 9).

Like precipitation, the 30-year average annual runoff is trending upward (see Figure 10). The average annual runoff for the 30-year timespan of 1951 - 1980 was 12.23 inches. For the 30-year timespan of 1991 - 2020 average annual runoff climbed to 16.22 inches showing an increase of 3.99 inches over 40 years.

Flood Storage Events

The five Miami Conservancy District dams have a combined peak storage capacity of 841,000 acre-feet, or about 274 billion gallons of water (see Figure 11).

During times of high precipitation and runoff, the dams reduce downstream flows on the Stillwater, Great Miami, and Mad rivers and on Loramie and Twin creeks. This allows the channels and levees downstream to safely accommodate the river flow. The dams accomplish this by temporarily storing floodwater on land behind the dams.

A storage event occurs when the pool elevation behind the dam reaches a minimum stage at which the conduits begin to reduce the flow of water downstream of the dam (see Table 1). The storage event continues until the pool elevation drops below that minimum stage. Miami Conservancy District records storage events at each of the dams separately. If all five dams are in storage at the same time, Miami Conservancy District records five storage events.

Construction of the five flood protection dams in the Miami Conservancy District flood protection system was completed by 1922. Since that time, Miami Conservancy District has recorded each of the storage events that have occurred.

Miami Conservancy District recorded a total of 21 storage events during 2025. The average number of annual storage events for the five retention basins, over the entire life of the dams, is 21. None of the storage events that occurred in 2025 were large enough to exceed Miami Conservancy District's top 10 storage event ranking.

Of the 21 storage events that occurred in 2025, 20 of the events occurred between the months of January and June (see Figure 12). This six-month span is when most storage events tend to occur within the Miami Conservancy District flood protection system.

The total number of storage events per decade has increased in recent decades (see Figure 13). Miami Conservancy District recorded 175 storage events during the decade of the 1980s. Since that time Miami Conservancy District recorded 242, 273, and 324 storage events respectively during the decades of the 1990s, 2000s, and 2010s.

Groundwater Levels in the Buried Valley Aquifer System

Miami Conservancy District maintains a network of 101 observation wells in the Great Miami River Watershed. Of these wells, 60 are installed in the buried valley aquifer system.

The Ohio Department of Natural Resources (ODNR) Division of Water Resources also supports a network of observation wells in the Great Miami River Watershed system which includes 26 wells.

To track groundwater levels, 12 observation wells (8 Miami Conservancy District and 4 ODNR) were selected as index wells for the buried valley aquifer system between the mouth of the Great Miami River and as far north as Miami County (see Figure 14). An index well is installed in a representative part of the surrounding buried valley aquifer system that can allow for measuring and interpreting hydrologic responses at local scales. Data trends in index wells provide a strong indication of buried valley aquifer responses to changes in human water use as well as shifts in local climate.

The depths of each of the index wells are displayed on Table 2. All the index wells are equipped with vented or non-vented pressure transducers for logging groundwater levels and telemetry. The pressure transducers measure the depth-to-water below ground surface every hour and send the data to NWIS allowing the data to be accessed in near real-time.

Groundwater levels measured at 8 of the 12 index wells in 2025 ended the year at slightly lower levels than at the beginning of the year (see Figure 15). The exceptions were BU-32, MT-6, MT-49, and MI-43 where groundwater levels rose by 0.02 to as much as 2.33 feet from the beginning to the end of the year. However, average groundwater levels for 2025 were higher in 11 of the 12 wells when compared with 2024 averages. The lowest groundwater levels (greatest depths to groundwater) tend to occur in September through November. Highest groundwater levels occurred in April or May.

It should be noted groundwater levels at MT-6 fell below the bottom of the well from July 27 through October 27. MT-6 is in an area of Dayton with a high density of open loop geothermal systems that pump groundwater for cooling buildings. This area experiences large declines in groundwater levels during the summer cooling season.

Average annual groundwater levels have been relatively stable at most index wells over the long-term showing an even balance between groundwater recharge and groundwater discharge (see Figure 16). The exceptions are BU-32, MT-6, and MT-49 where average annual groundwater levels have been declining in recent years. Average annual groundwater levels in MT-6 have declined by 17 feet since 1990. Average annual groundwater levels at BU-32 and MT-49 have declined by 6 feet and 5 feet respectively. Recent drought cycles combined with increases in groundwater pumping are the likely causes for these downward trends.

Water Use in the Great Miami River Watershed

Through its water withdrawal facilities registration program, ODNR tracks water use in the Great Miami River Watershed. The Ohio Revised Code requires any owner of a facility, or combination of facilities, with the capacity to withdraw water at a quantity greater than 100,000 gallons per day (GPD) to register such facilities with the Ohio Department of Natural Resources (ODNR) Division of Water. Facilities that withdraw less than 100,000 GPD are not required to register, therefore estimates of water use in this report do not capture water withdrawals from smaller facilities. It's possible that water withdrawals from clusters of small water withdrawal facilities could be significant in certain areas of the watershed. Water use information for 2025 was not available at the time of this report and so 2024 water use information is reported instead. Given recent water use trends, it's likely the differences between 2024 and 2025 water use data are negligible.

In 2024, surface water withdrawals from the Great Miami River Watershed averaged 24 million gallons of water per day. Groundwater withdrawals averaged 258 million gallons of water per day. Groundwater withdrawals make up 91 percent of total water use in the Great Miami River Watershed. Total groundwater withdrawn during 2024 was approximately 94 billion gallons of water. Most of this water was returned to the Great Miami River and its tributaries by discharge from water reclamation facilities.

Water withdrawn by public water suppliers accounted for 75 percent of total groundwater use (see Figure 17). The remaining groundwater withdrawals included

industry, miscellaneous (mainly for open loop geothermal systems), mineral extraction, and agricultural irrigation.

Water use trends in the Great Miami River Watershed show total water withdrawals peaked during the decade of the 2000s at around 600 million gallons of water per day (see Figure 18). Since that time, total water withdrawals have declined to approximately 282 million gallons of water per day. Surface water withdrawals declined more than groundwater.

Surface water withdrawals peaked at 261 million gallons of water per day in 2005 and declined to 24 million gallons of water per day in 2024. About 72 percent of this decrease occurred because of the closure of four power-generating stations which used surface water for cooling. Groundwater withdrawals peaked in 2002 at 330 million gallons of water per day. In 2024, groundwater use was down to 258 million gallons of water per day.

Conclusions

The analysis of water quantity data for 2025 confirms the Great Miami River Watershed continues to experience long-term increases in precipitation and runoff, while groundwater levels in most areas remain stable. Despite annual variability, the overall trends suggest a resilient hydrologic system supported by effective water management practices. The MCD flood protection system functioned as designed, preventing significant flood damage by storing high water 21 times throughout the year.

Groundwater level stability at most observation wells shows a balance between aquifer recharge and discharge. However, declining groundwater levels at observation wells BU-32, MT-6, and MT-49 may be indicative of localized areas of groundwater stress.

These findings emphasize the need for ongoing monitoring, adaptive management, and regional collaboration to ensure water availability, flood protection, and ecological balance in the face of climate variability. MCD remains dedicated to leveraging scientific data and strategic planning to support informed decision-making and long-term sustainability in the Great Miami River Watershed.

Acknowledgements

This report compiles and summarizes Miami Conservancy District data along with information supplied by the United States Geological Survey (USGS) and the Ohio Department of Natural Resources (ODNR).

Streamflow, Runoff, and Groundwater Level Data - USGS, *Ohio Kentucky and Indiana*
Water Science Center

Groundwater Level and Water Use Data - ODNR, *Division of Water Resources*

Tables and Figures

Tables and Figures

Table 1 – River stage at which storage begins at the Miami Conservancy District dams.

Dam	USGS Streamgage ID	Stage Where Storage Begins (ft.)
Germantown	03272000	12
Englewood	03266000	11.6
Lockington	03262000	12
Taylorville	03263000	15
Huffman	03270000	11

Table 2 – Depths of index wells used in this report.

Index Well	Well Depth (ft.)
BU-32	234
BU-70	54
BU-179	43
BU-282	74
CL-11	180
H-1	124
MI-3A	130
MI-43	140
MT-6	60
MT-49	220
MT-73	95
W-10	51

Figure 1 – Map of the Great Miami River Watershed, Ohio.

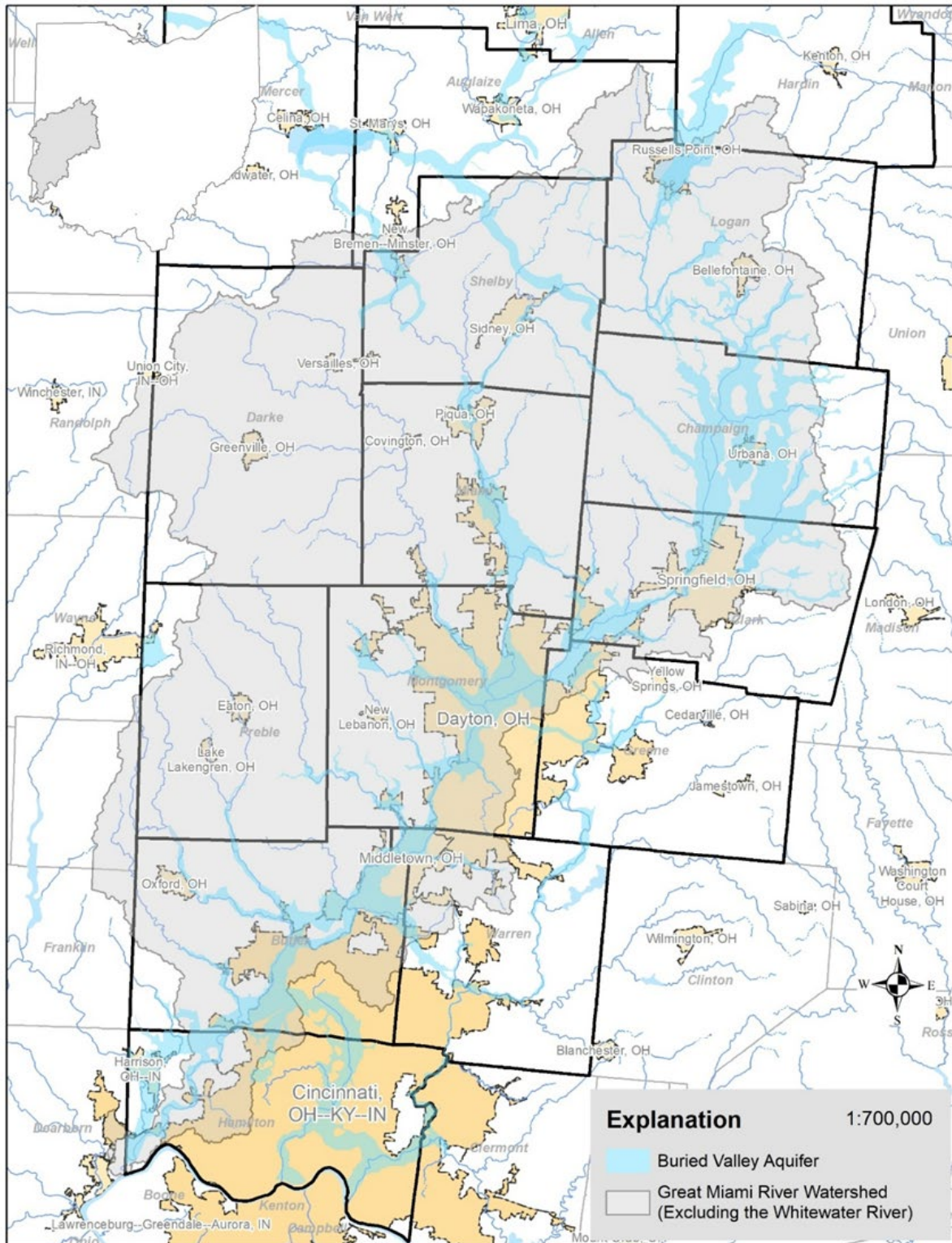


Figure 2 – Movement of water through the water cycle.

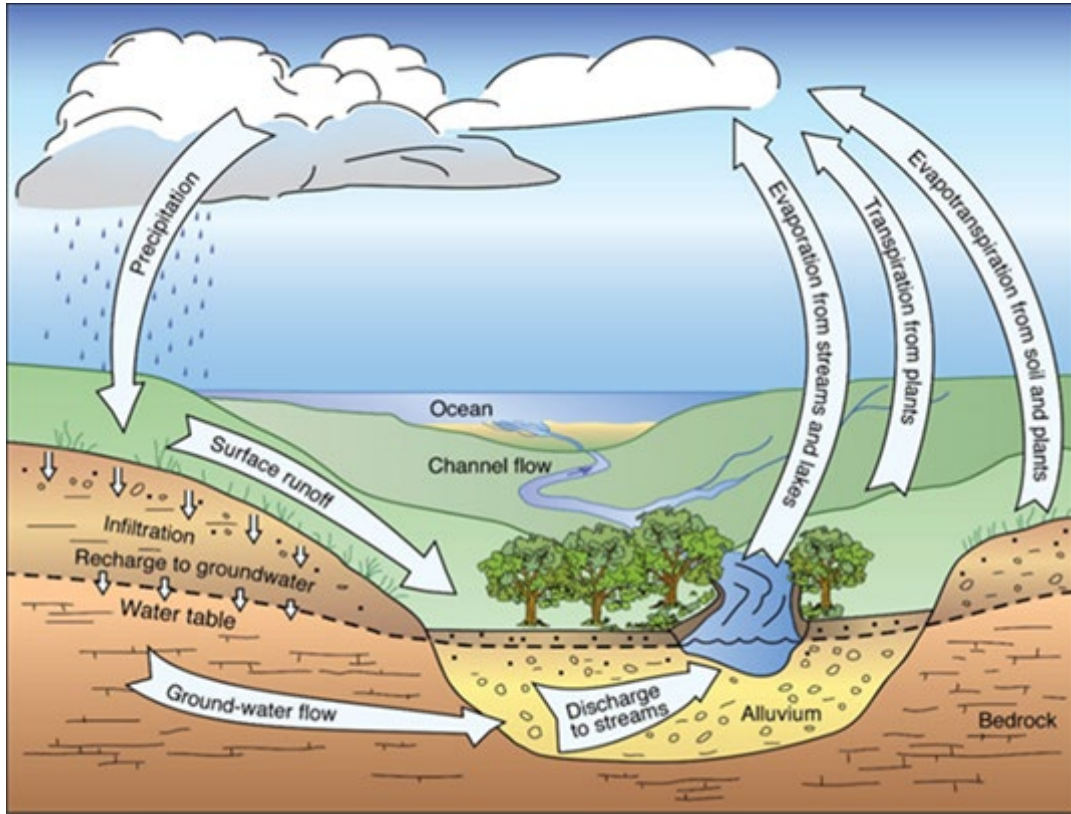


Figure 3 – Map showing locations of Miami Conservancy District precipitation observer stations.

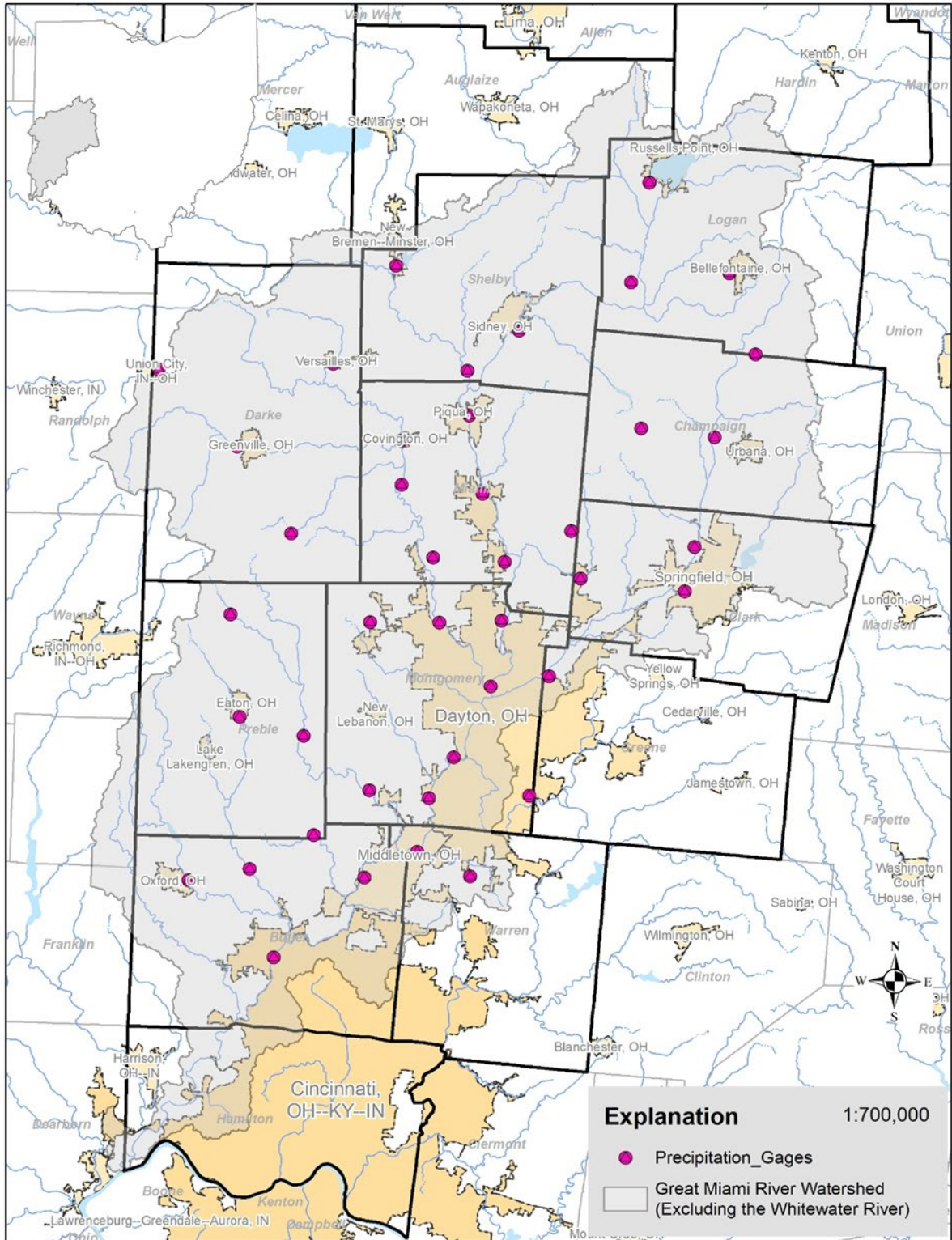


Figure 4 – A typical National Weather Service rain gage.



Figure 5 – Monthly precipitation compared to 30-year average for the Great Miami River Watershed.

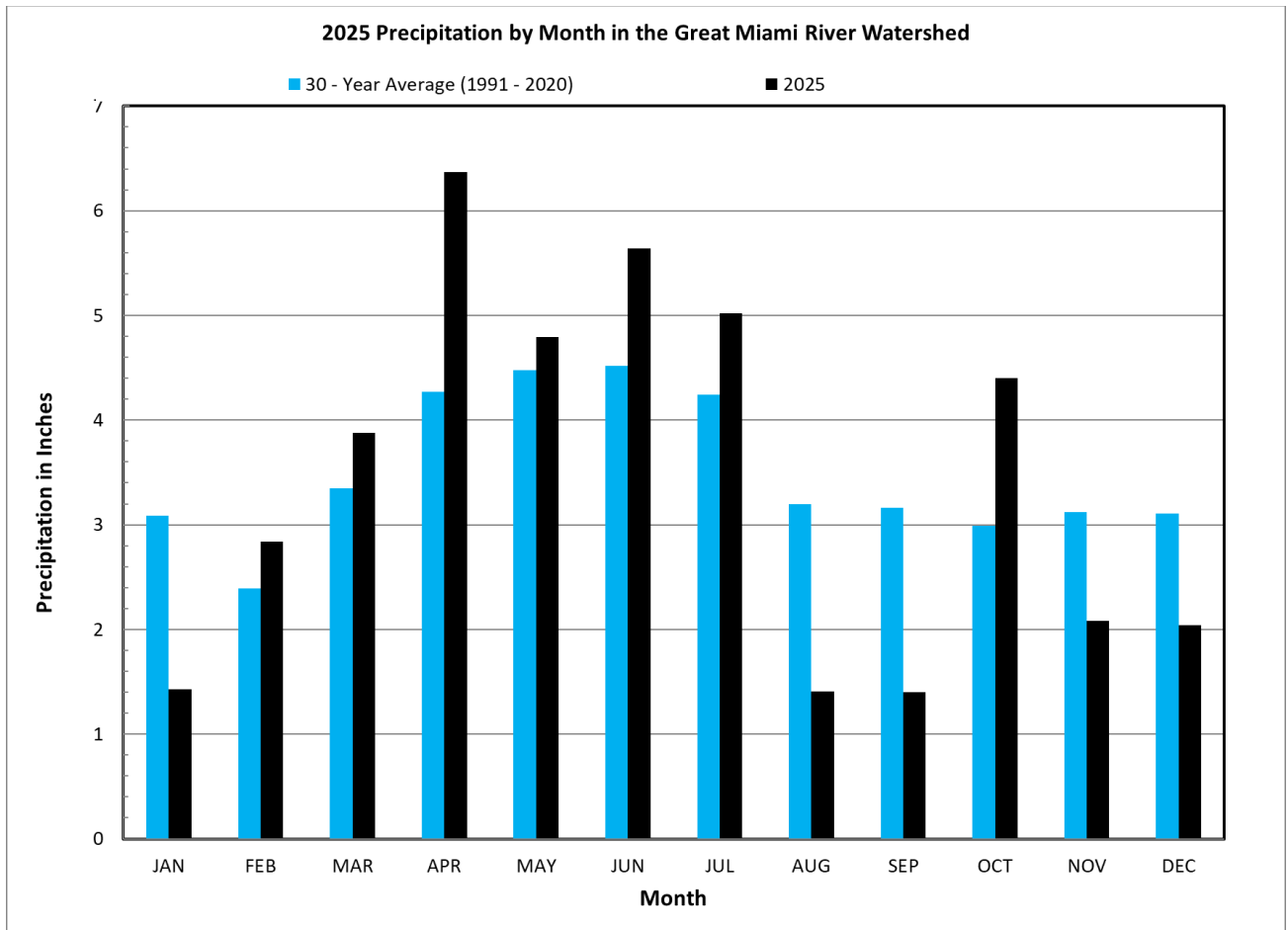


Figure 6 – U.S. Drought Monitor map of Ohio for October 6, 2025.

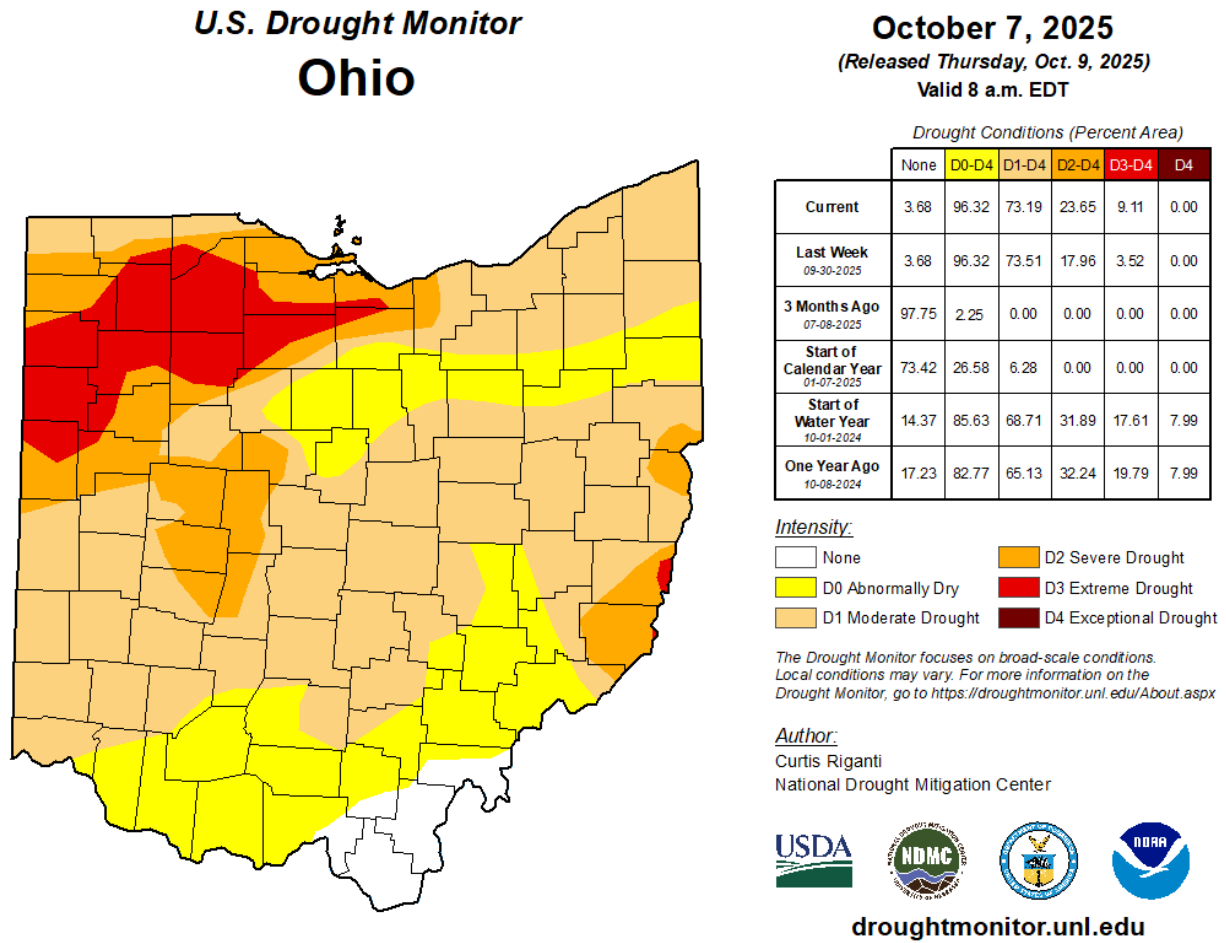


Figure 7 – Moving 30-year mean annual precipitation for the Great Miami River Watershed.

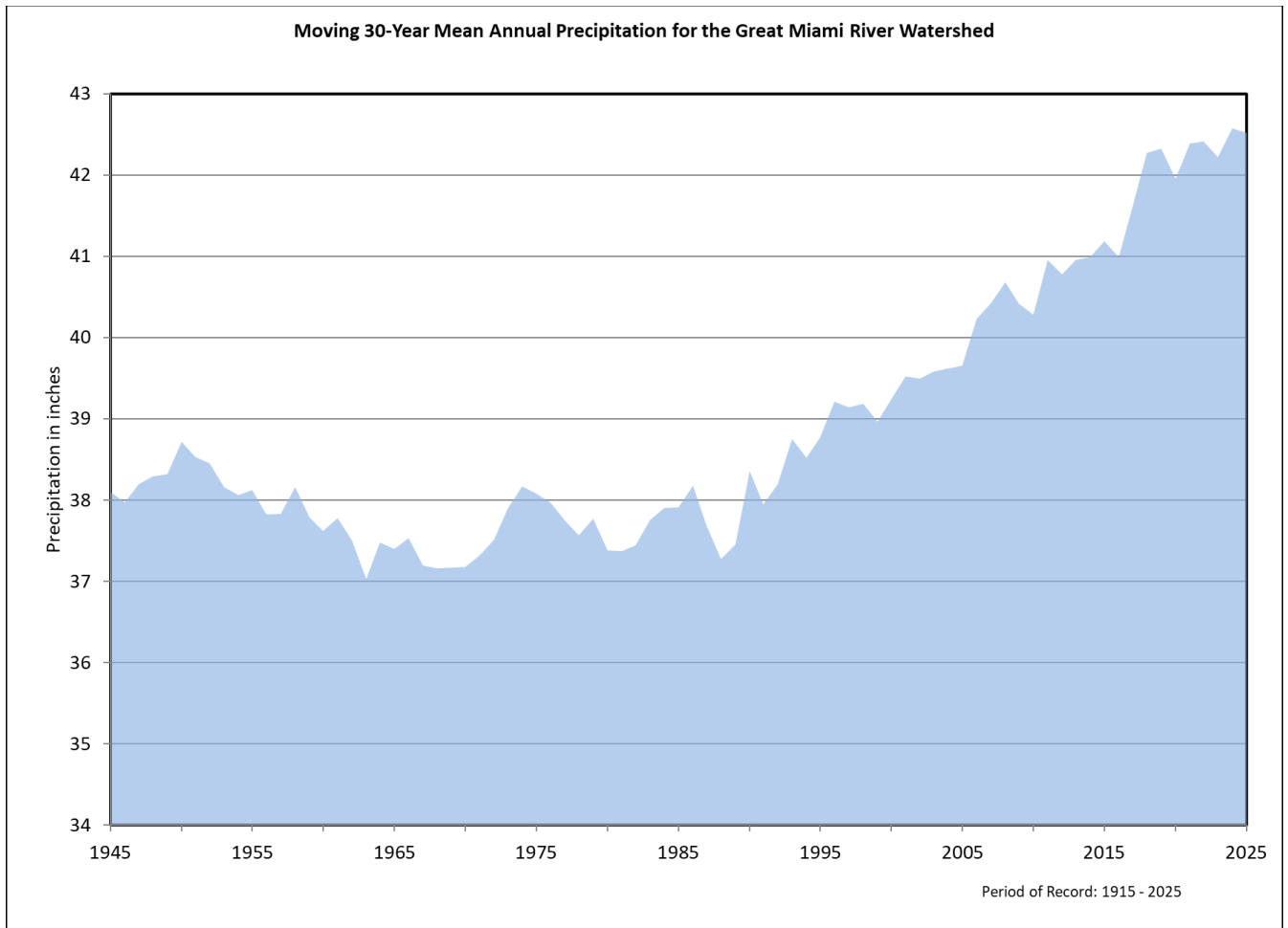


Figure 8 – Map showing the locations of MCD-USGS cooperative streamgages.

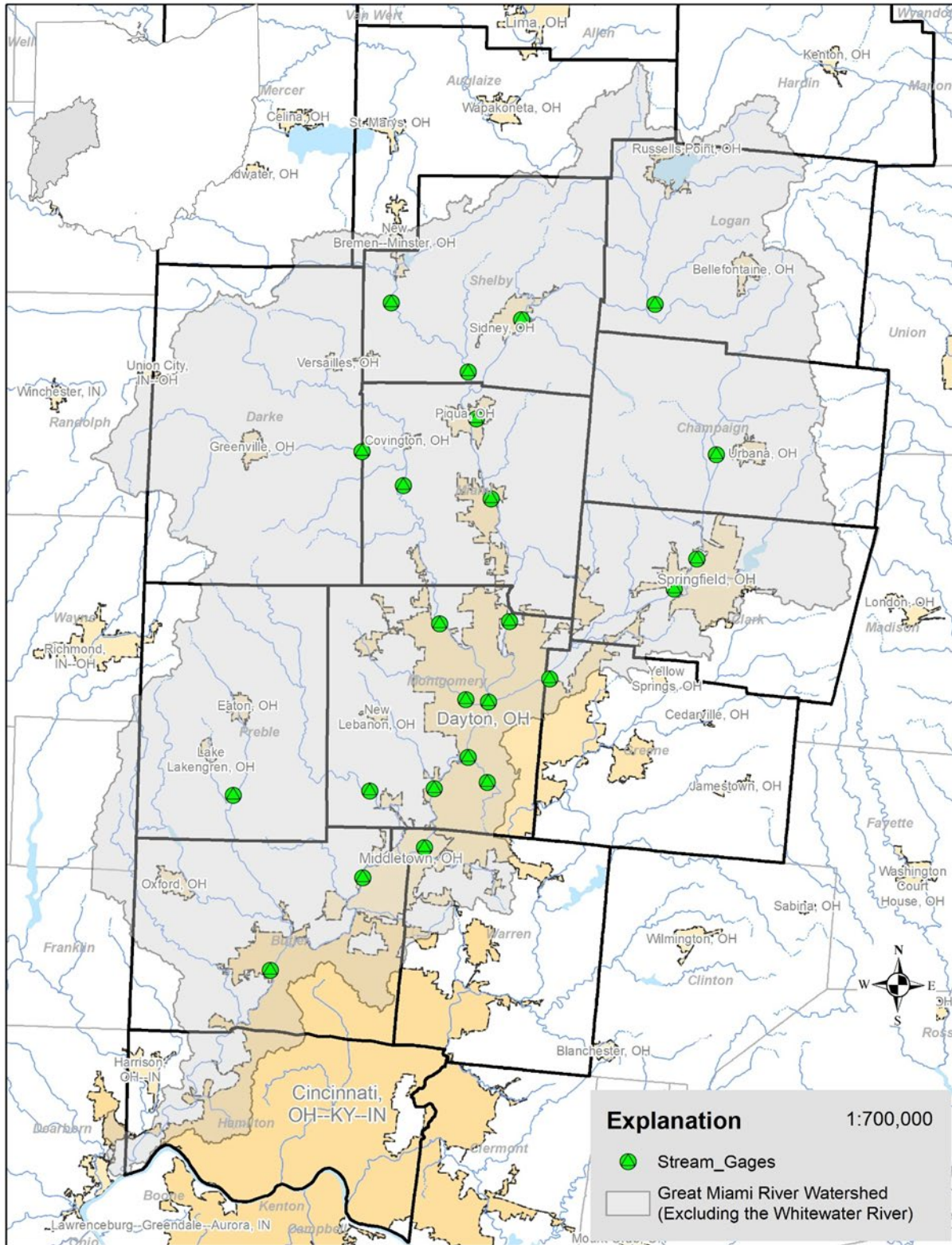


Figure 9 – Monthly runoff compared with 30-year average for the Great Miami River Watershed.

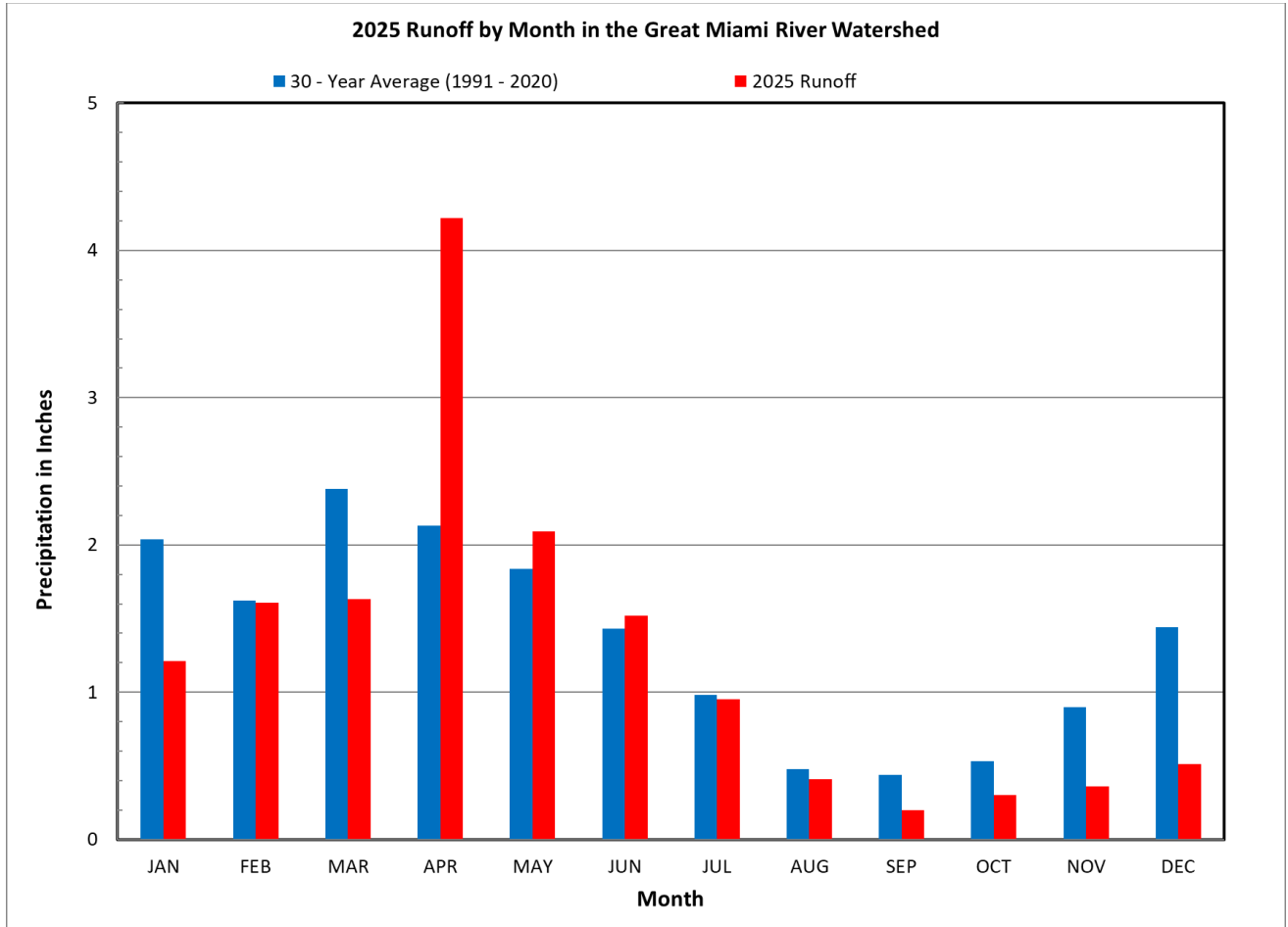


Figure 10 – Moving 30-year mean annual runoff for the Great Miami River Watershed.

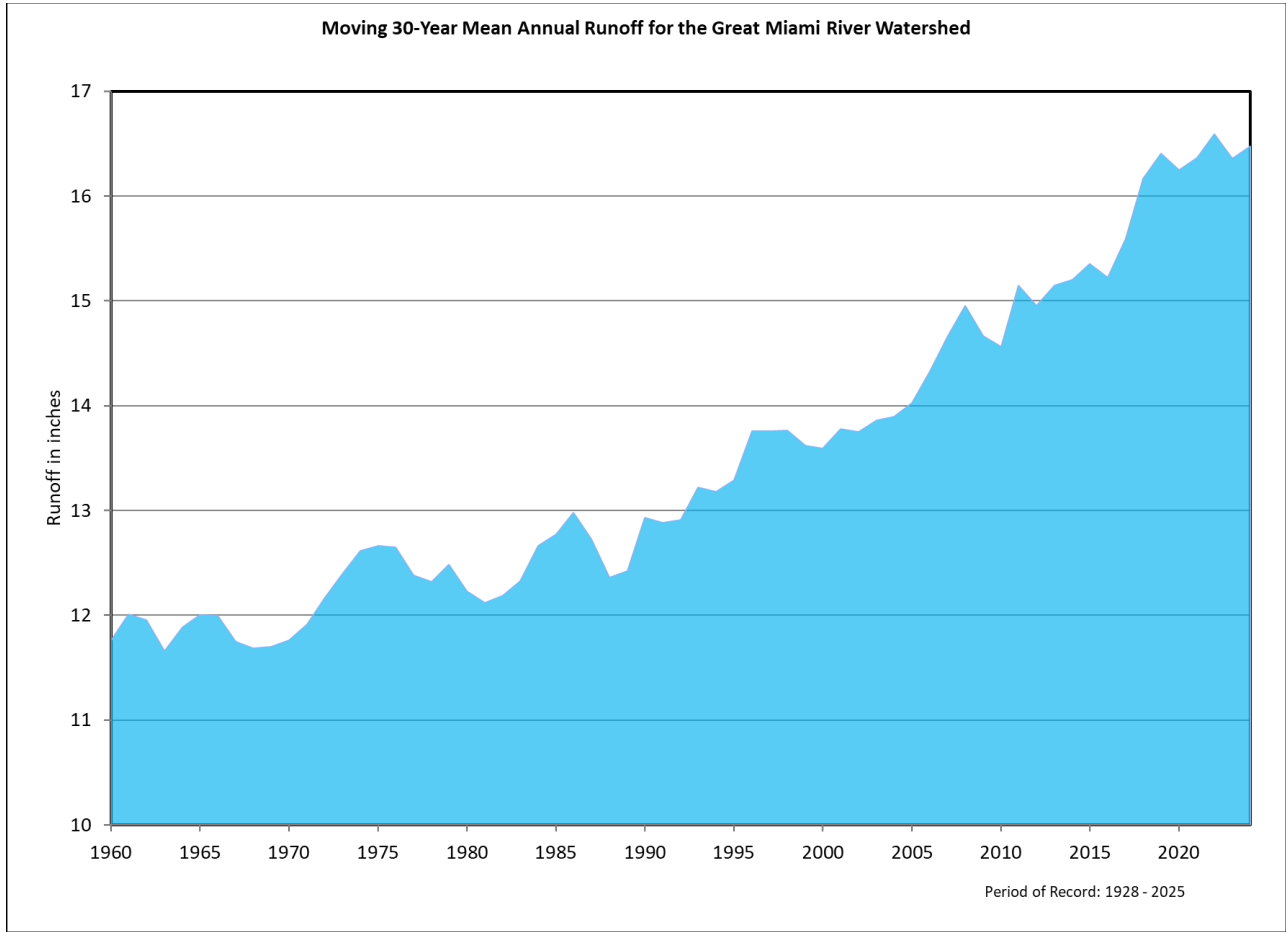


Figure 11 – Map showing locations of Miami Conservancy District flood protection dams, storage basins, and levees.

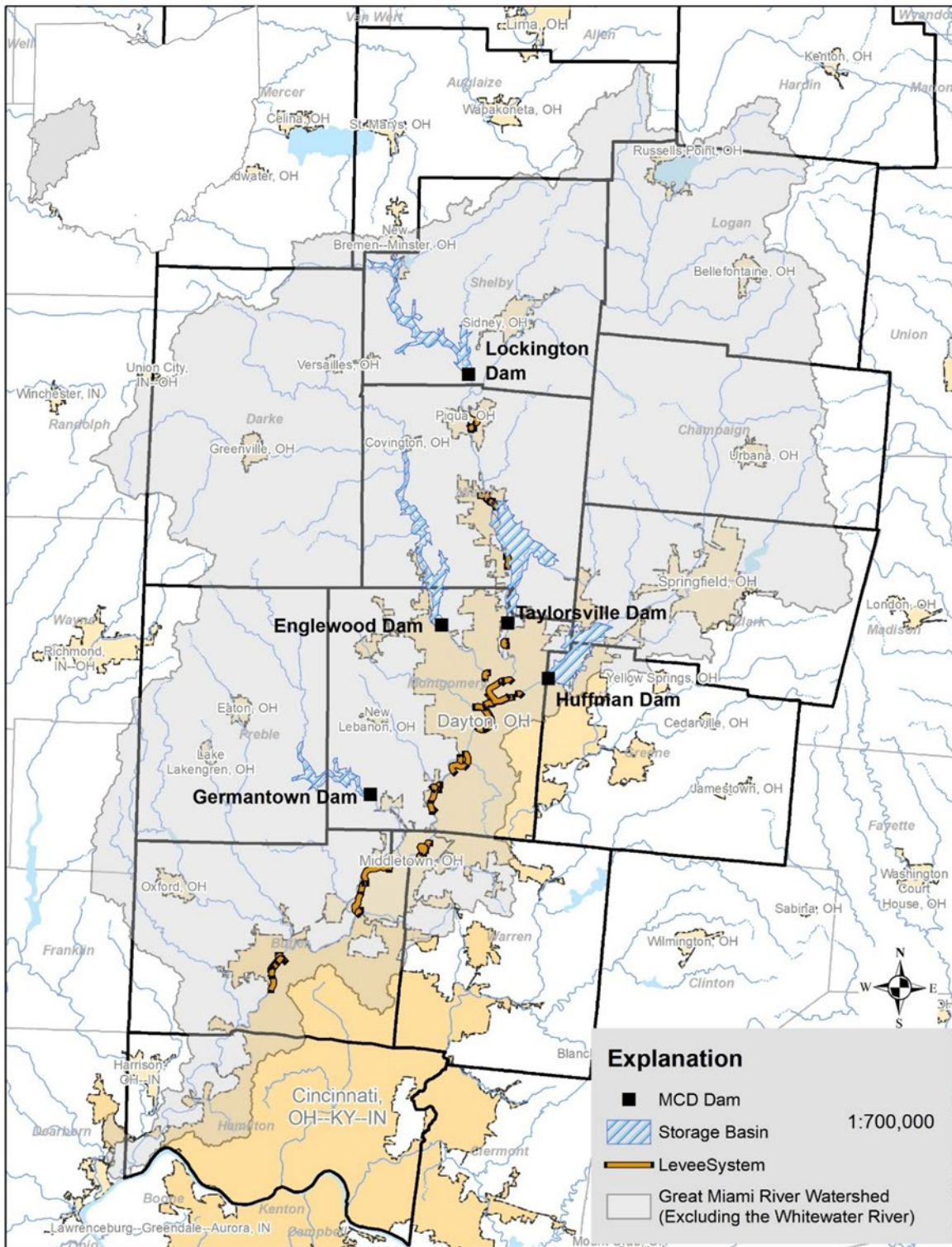


Figure 12 – Number of storage events by month in 2025.

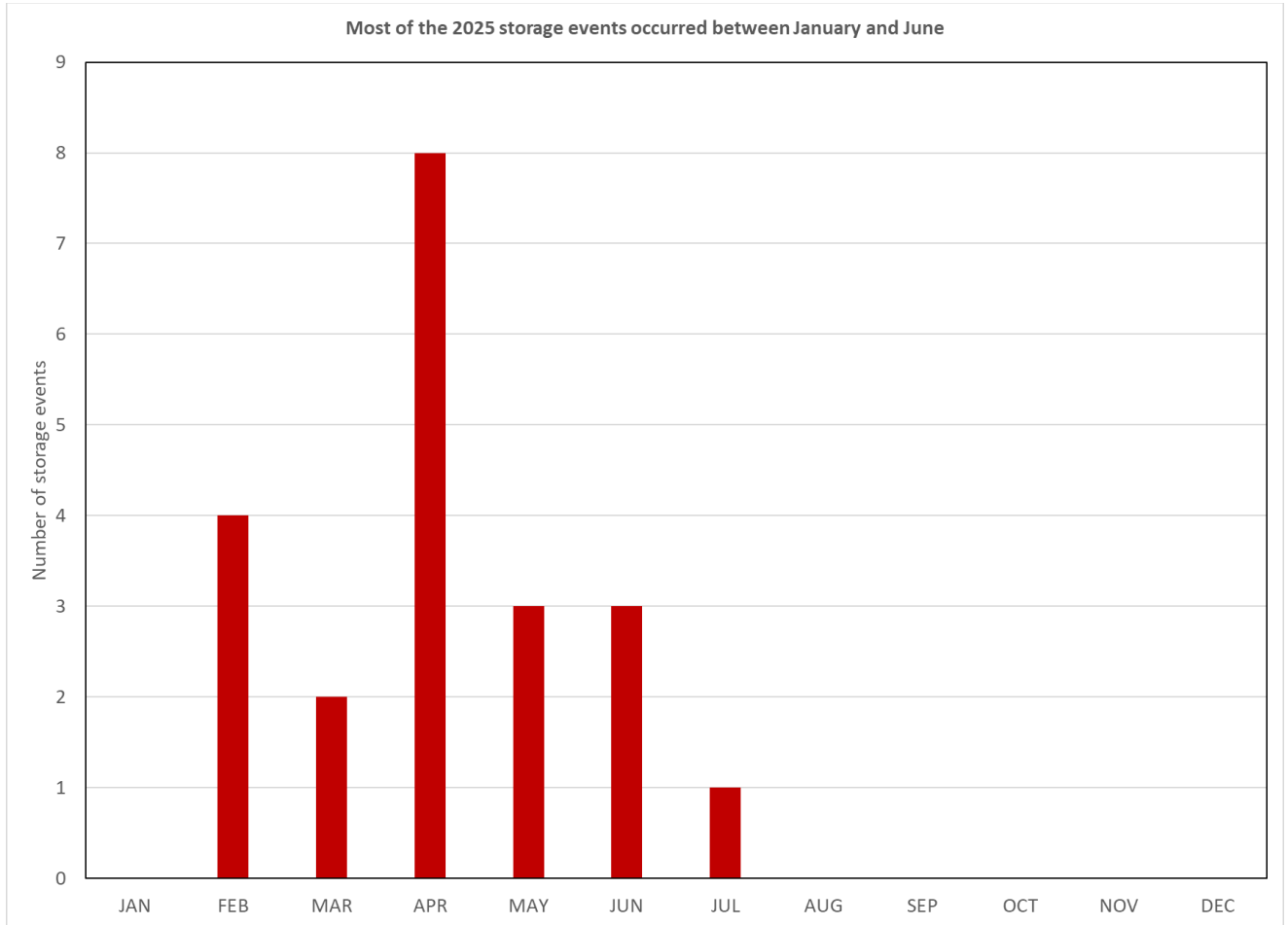


Figure 13 – Number of storage events recorded by Miami Conservancy District for each decade.

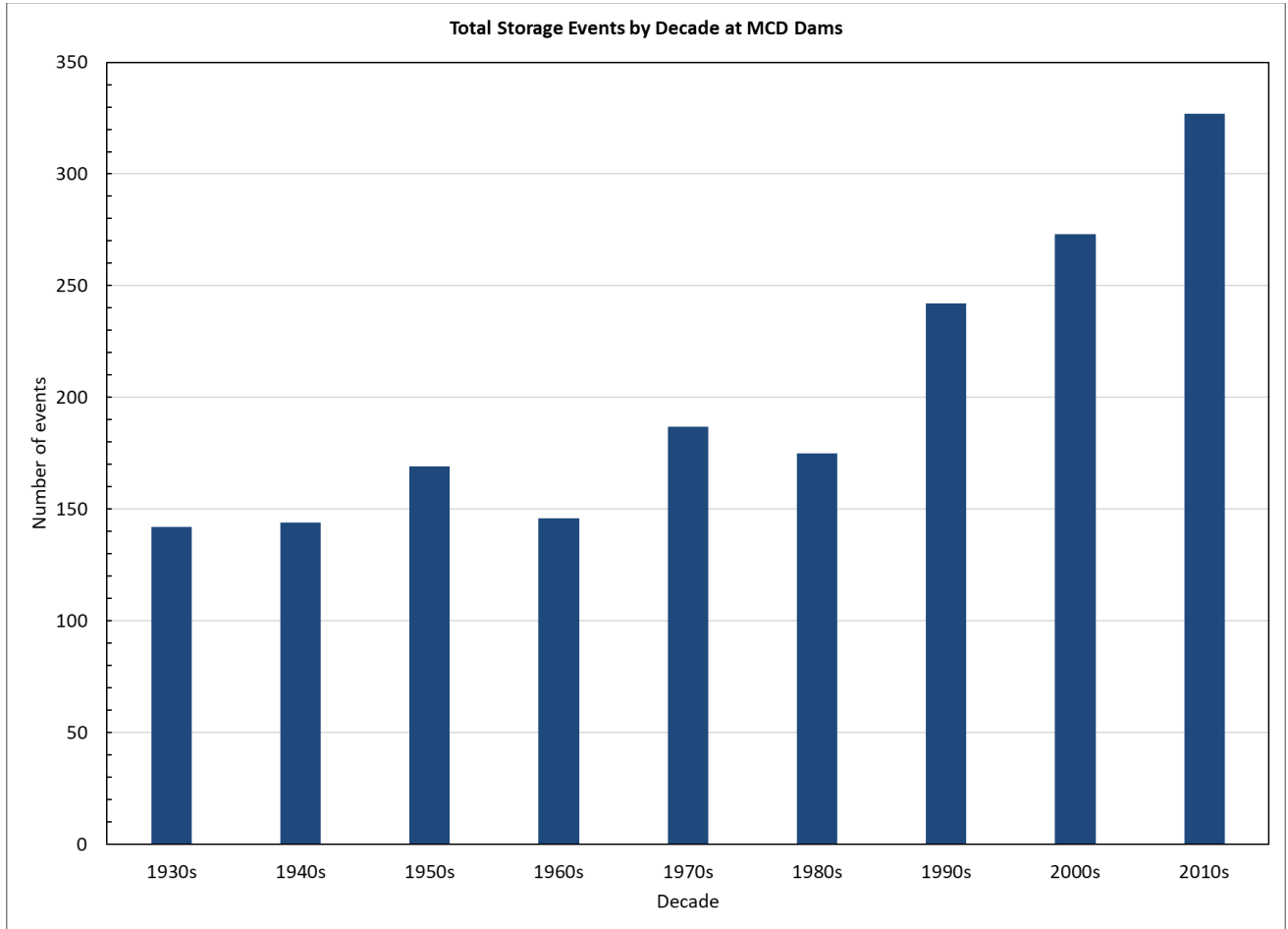


Figure 14 – Map showing the locations of index observation wells.

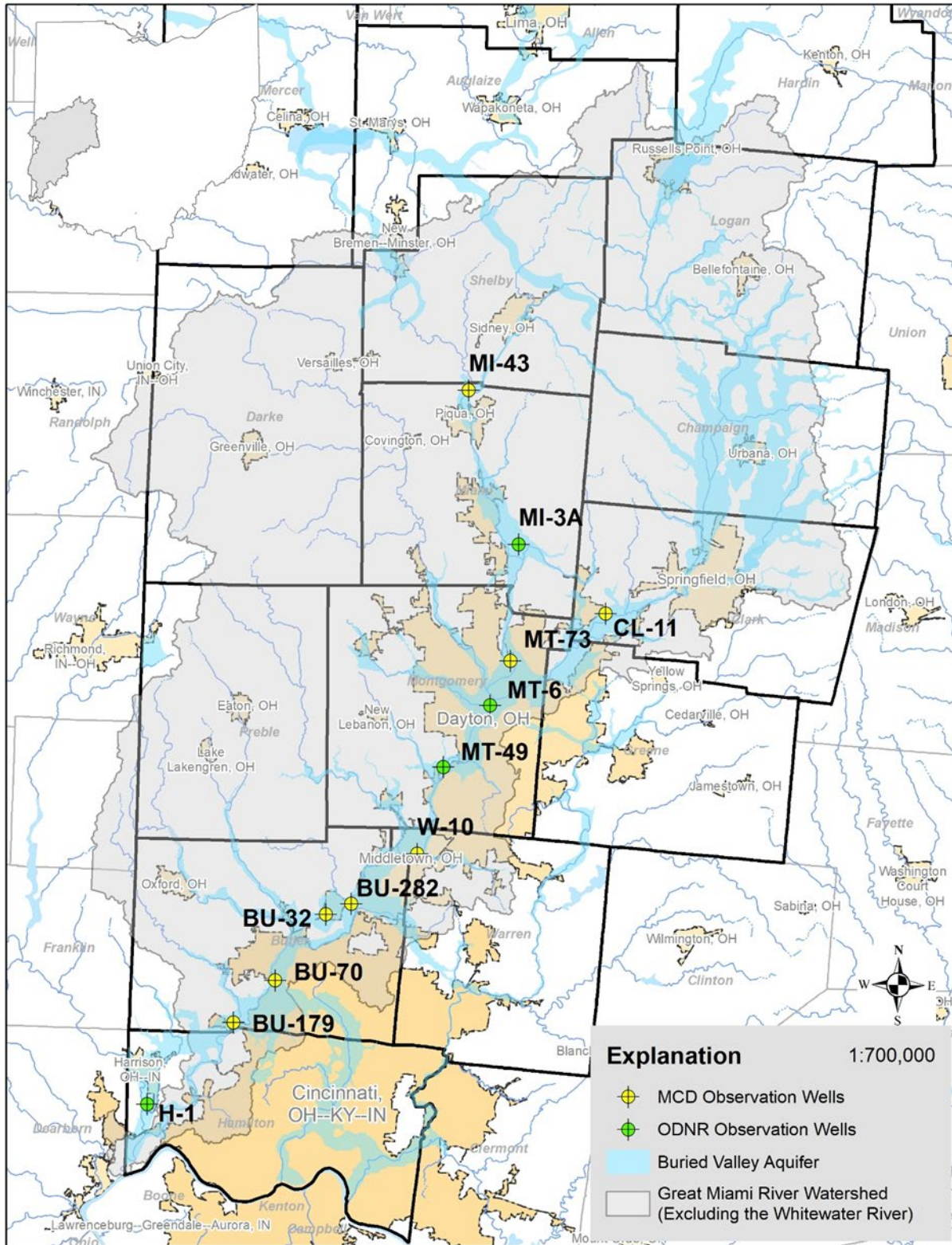


Figure 15 – Depth below ground surface measured at index observation wells in 2025.

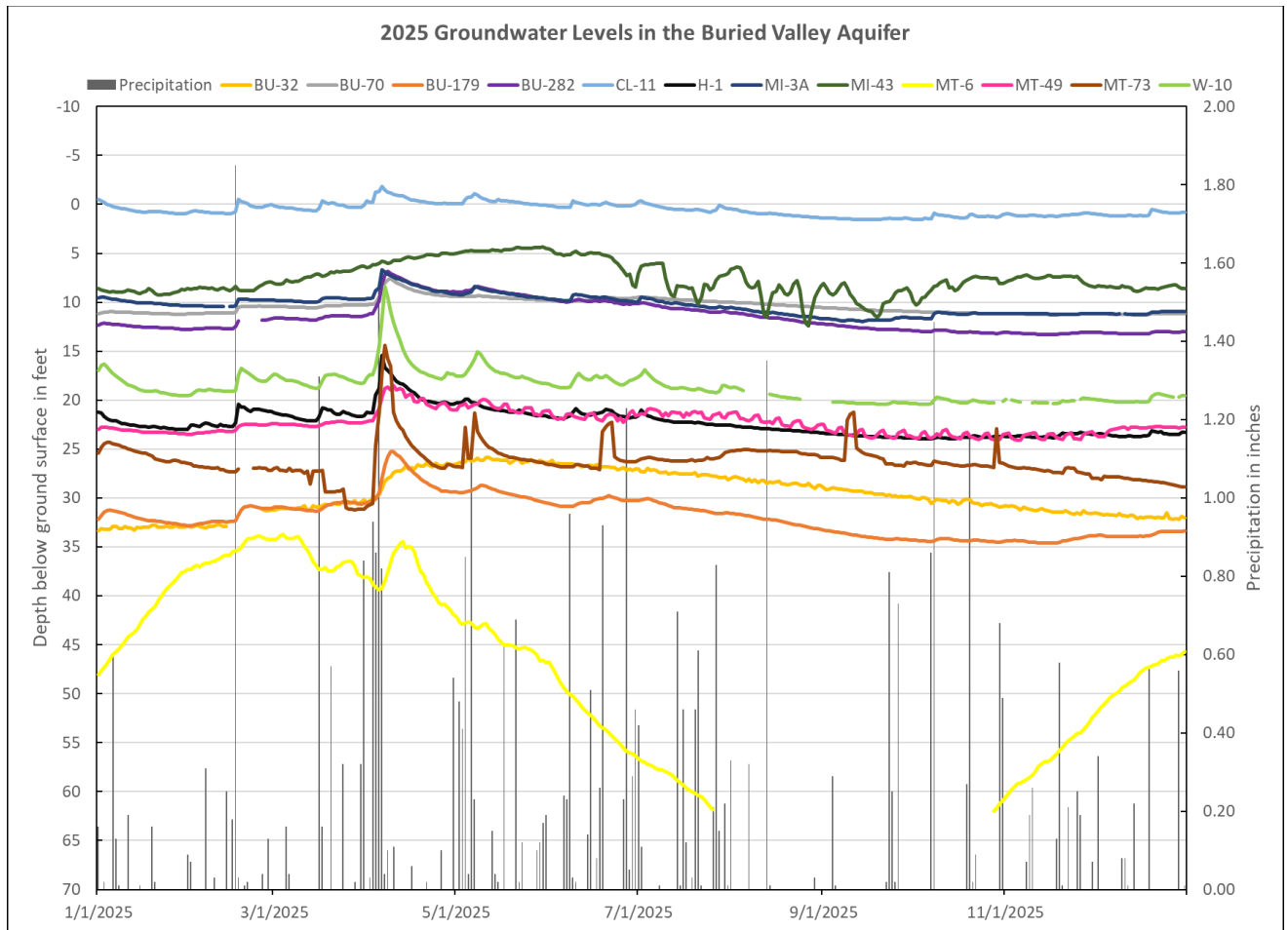


Figure 16 – Average annual depths to groundwater at index observation wells.

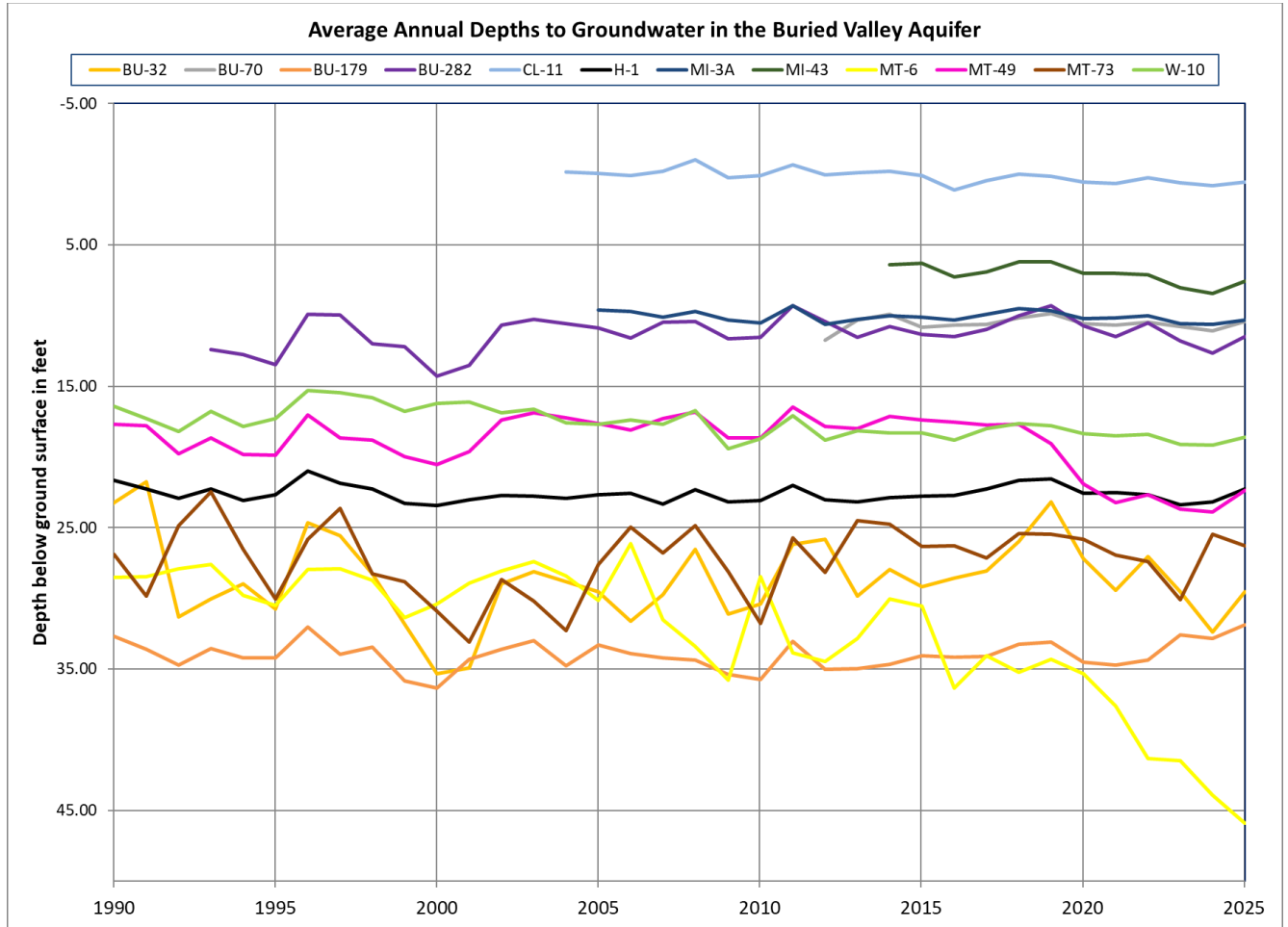


Figure 17 – Groundwater use in the Great Miami River Watershed during the year 2024.

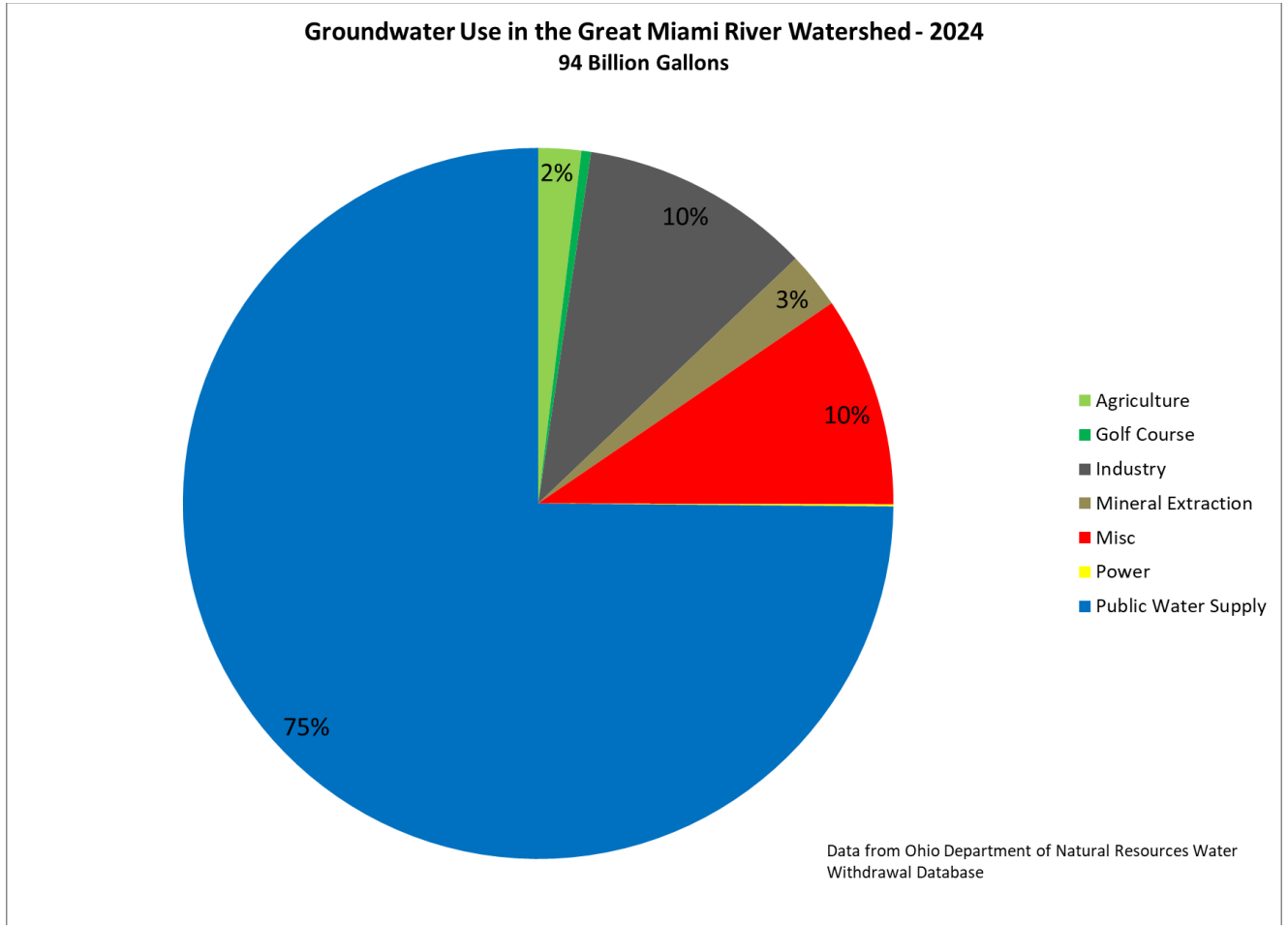
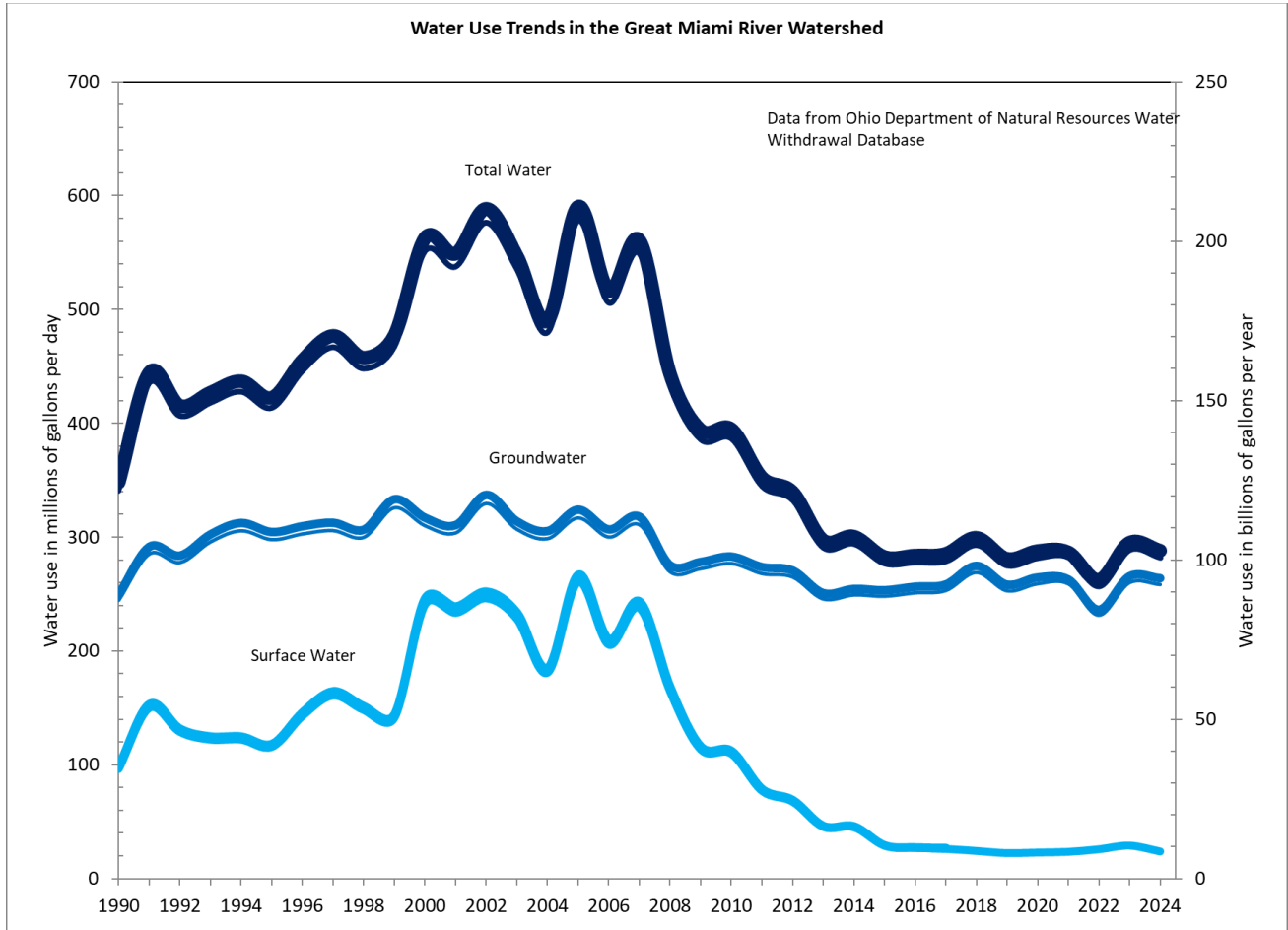


Figure 18 – Water use trends in the Great Miami River Watershed.



Appendix – 2025 Groundwater Data

Keeping the promise since 1915



The Miami Conservancy District protects communities in southwest Ohio from flooding, preserves water through stewardship, and promotes the enjoyment of our waterways.

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