NUTRIENT ASSESSMENT REDUCTION PLAN

December 2024

MIDDLE FORK SHOAL CREEK

CITY OF HILLSBORO, ILLINOIS

WASTEWATER TREATMENT PLANT

NPDES Permit No. IL0029203

PREPARED BY: NORTHWATER CONSULTING

PREPARED FOR: CITY OF HILLSBORO, ILLINOIS

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Cover page: Middle Fork Shoal Creek looking upstream at site MSCD

LIST OF ACROYNMS

AFT	American Farmland Trust
CFS	Cubic Feet Per Second
CWA	Clean Water Act
DAF	Design Average Flow
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
ECHO	Enforcement and Compliance History Online
FOIA	Freedom of Information Act
HUC	Hydrologic Unit Code
INLRS	Illinois Nutrient Loss Reduction Strategy
MCSWCD	Montgomery County Soil and Water Conservation District
MGD	Million Gallons per Day
NARP	Nutrient Assessment Reduction Plan
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
NPS	Nonpoint Source
NWS	National Weather Service
NH_3	Ammonia
NO_3^-	Nitrate
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
STEPL	Spreadsheet Tool for Estimating Pollutant Loads
SWCD	Soil and Water Conservation District
SWPP	Source Water Protection Plan
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
RCPP	Regional Conservation Partnership Program
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

The City of Hillsboro Wastewater Treatment Plant (WWTP) has a design average flow of 1.045 million gallons per day (MGD) and discharges treated effluent to Middle Fork Shoal Creek, part of the Kaskaskia River watershed. Upstream from the outfall are two reservoirs, Glenn Shoals and Lake Hillsboro, which profoundly impact water quality and quantity in the stream. The plant is subject to a Nutrient Assessment and Reduction Plan (NARP) Special Condition in its National Pollutant Discharge Elimination System (NPDES) permit. The NARP was triggered by an Illinois EPA-designated aquatic life impairment caused by total phosphorus (TP) on the receiving stream segment (IL_OIL-HB-C1). Hillsboro undertook a water quality monitoring program on Middle Fork Shoal Creek with continuous sensors and grab samples for six months during 2024 to better understand the impairment status and potential risk of eutrophication conditions relevant to NARP requirements.

The NARP assessment indicates that nonpoint sources (NPS) of nutrients and the two upstream reservoirs are the dominant contributors causing water quality issues in Middle Fork Shoal Creek. The Hillsboro WWTP contributes only a minor phosphorus load to the stream, which will be further reduced in coming years. Low dissolved oxygen (DO) is not related to point source phosphorus. Rather, it is a result of the reservoir-altered flow regime and high levels of oxygen demand in the stream environment during low flow conditions.

To mitigate downstream water quality issues and to protect source water, Hillsboro is working to implement a recently completed watershed plan focused on reducing NPS nutrients and sediment. In addition, the Hillsboro WWTP is being upgraded at an estimated cost of $38.9 million, which will further reduce the point source phosphorus load to the watershed.

Stream Impairment and Risk of Eutrophication Status:

- The effluent-receiving segment of Middle Fork Shoal Creek has been listed as impaired with a cause of TP since at least 2012, the oldest 303(d) list examined. This segment has also been impaired with cause of DO, though Illinois EPA indicates the low DO is not related to a pollutant.
- The next downstream segment (IL_OIL-03) has also been impaired with cause of DO since at least 2012, but the impairment designation was removed beginning with the 2020/2022 303(d) list.
- The 2024 monitoring program did not show evidence of an impairment related to phosphorus in segment IL_OIL-HB-C1.
- The low DO issue is related to altered flow regime due to the two upstream reservoirs as well as high levels of oxygen demand in the stream.
- Significant risk of eutrophication criteria exceedances were not observed in monitoring.
    - No DO + pH criteria exceedances
    - No sestonic chlorophyll exceedances
    - 3 pH exceedances upstream; 2 pH exceedances downstream

Summary of Monitoring Program Results:

- Continuous monitoring and grab sampling occurred from May - October 2024.
- Monitoring took place at one site upstream of the WWTP outfall (MSCU), and one site downstream (MSCD).

- Continuous monitoring identified DO below the instantaneous water quality standard 51% of monitored days upstream and 53% downstream of the plant.
- The patterns and range of DO and pH are very similar upstream and downstream, indicating WWTP effluent is not driving water quality in Middle Fork Shoal Creek.
- Continuous monitoring did not identify risk of eutrophication.

Watershed Conditions and Nonpoint Source Nutrient Modeling:

- Upstream of the plant are two public water supply reservoirs which alter downstream flow and water quality.
- The watershed consists primarily of agricultural and urban land uses and is comprised of four twelve-digit Hydrologic Unit Code (HUC12) subwatersheds.
- Plant effluent monitoring and NPS modeling indicates the current annual watershed loading of phosphorus from these two sources is approximately 123,453 lbs/yr.
    - The WWTP contributes 10,161 lbs/yr (8% of Total).
    - Nonpoint sources contribute 113,292 lbs/yr (92% of Total).

NARP Actions:

- WWTP upgrades currently scheduled to begin construction in early 2025 will increase treatment capacity to 3.7 MGD design average flow and allow the plant to meet an interim TP effluent limit of 1.0 mg/L and a future limit of 0.5 mg/L, with typical concentrations and flow substantially below that level.
    - Point source phosphorus loads will be substantially reduced after meeting the 0.5 mg/L TP effluent limit by 2030, from 10,161 lbs/yr to less than 5,635 lbs/yr.
- Hillsboro will work to implement the recommendations of the recently completed Glenn Shoals Lake and Lake Hillsboro Watershed-Based Plan, focusing on NPS and in-lake nutrient and sediment reductions.
    - Not only will this work protect source water for Hillsboro, but it will also improve downstream water quality.
- Hillsboro will continue to partner with stakeholders, local organizations and agencies on watershed work to amplify investments by the city and partners.
    - One notable example of this type of work is the recent submission of a $10 million United States Department of Agriculture (USDA) Regional Conservation Partnership Program (RCPP) grant application focused on the Middle Fork Shoal Creek watershed upstream of the lakes.
- If necessary, Hillsboro will continue to periodically monitor Middle Fork Shoal Creek to observe the impacts of management activities and plant upgrades.

1. INTRODUCTION & BACKGROUND

In 2018, the Illinois EPA instituted nutrient reduction permit requirements applicable to WWTPs with effluent discharges greater than 1-million gallons per day (MGD). The nutrient reduction approach for WWTPs supports a pathway to establish site-specific permit limits for phosphorus at each facility that requires them, in lieu of instituting a statewide limit. The NARP requirement resulted from negotiations with environmental organizations, Illinois EPA, and the Illinois Association of Wastewater Agencies. A copy of the current NPDES Permit for the City of Hillsboro WWTP is included in Appendix C.

A NARP Special Permit Condition is now included in a NPDES permit if a receiving stream segment or downstream segment is on the Illinois Clean Water Act (CWA) 303(d) list as impaired with phosphorus-related causes or if there is a "risk of eutrophication" as defined by meeting any of the three conditions outlined in Table 1. The NARP requirement is in the Hillsboro NPDES permit due to a downstream TP impairment on Middle Fork Shoal Creek.

Table 1 - Illinois EPA Risk of Eutrophication Criteria

Risk of Eutrophication if any of these Conditions Met:		
pH	**Median Sestonic Chlorophyll α**	**On any Two Days During Illinois EPA Monitoring Week, Daily Max**
> 9	> 26 µg/L	pH > 8.35 and DO saturation > 110%

Whether the NARP special permit condition is triggered by a CWA 303(d) impairment listing, or eutrophication risk criteria, the designation is based on limited data. For example, the risk of eutrophication justification for sites is based on only two non-consecutive weeks of continuous DO and pH data collection performed by the Illinois EPA. In some cases, the data is over 10 years old.

The NPDES permittee should undertake additional data collection and assessment, which can confirm or refute the NARP triggering conditions. If sufficient evidence indicates no phosphorus-related impairment or risk of eutrophication, it is possible that mitigation measures may not be necessary. The following actions have been proposed to comply with the NARP permit condition:

- Examine if sufficient data exists to fully characterize a phosphorus-related impairment or assess risk of a future impairment in the receiving watershed.
  - If data is insufficient, create a water quality monitoring plan and collect data.
- If existing or new data indicates phosphorous-related impairment is present, potential steps include:
  - Undertake watershed characterization.
  - Model watershed and instream processes.
  - Establish defensible site-specific water quality criteria.
  - Define scenarios and strategies to achieve water quality targets.
  - Implement NARP recommended actions and engage stakeholders.

This report constitutes the NARP for the City of Hillsboro WWTP and provides details of the monitoring program implemented to support it. Section 2 provides an overview of the NARP's water quality triggers. Section 3 describes the monitoring program, methods, and results with interpretation. Section 4 presents the NARP and Work Plan following a watershed characterization.

1.1 TREATMENT PLANT BACKGROUND

The City of Hillsboro owns and operates a WWTP with a design average flow (DAF) of 1.045 MGD located in the City of Hillsboro, in Montgomery County (NPDES Permit No. IL0029203). The WWTP was constructed in the early 1980s. It serves a population of approximately 5,902 according to the 2020 census. Treatment consists of grit removal, equalization, excess flow treatment, Imhoff tanks, trickling filters, final clarifiers, rapid sand filtration, anaerobic sludge digestion and sludge drying beds. The plant discharges to Middle Fork Shoal Creek, which joins the West Fork Shoal Creek to become Shoal Creek (Figure 1). Shoal Creek is tributary to the Kaskaskia River, a major tributary of the Mississippi River. Upstream of the outfall, are two public water supply reservoirs, Glenn Shoals Lake and Lake Hillsboro. The watershed area of Middle Fork Shoal Creek upstream of the outfall is 88.5 mi^2, including the reservoirs. Streamflow upstream from the point of discharge is characterized by seven-day once in ten-year low flow (7Q10) of 0 cubic feet per second (CFS). The plant is subject to a NARP special permit condition with a revised deadline of December 31, 2024.

The City of Hillsboro has proposed a major upgrade to the WWTP that will expand the DAF to 3.7 MGD and will provide improved treatment, minimizing the use of the excess flow outfall. The upgrades will also allow the plant to meet an interim permitted effluent phosphorus limit of 1.0 mg/L and eventually 0.5 mg/L, using a combination of biological and chemical nutrient removal. The project is currently in the bidding phase and construction is expected to begin in 2025.

2. NARP TRIGGERS & ACTIONS

According to the 2022 NPDES permit renewal, the NARP special condition was triggered by a phosphorus-related impairment on Middle Fork Shoal Creek segment OIL-HB-C1, which receives treated effluent from the WWTP. The impairment was for aquatic life with potential causes of TP and non-pollutant DO. Data obtained from Illinois EPA supporting the TP impairment that triggered the NARP was limited and not considered adequate to fully characterize water quality, nor whether the impairment designation was still supported by conditions observed in the stream.

Data mining was undertaken to compile any other informative and relevant nutrient, DO, pH or chlorophyll data beyond that provided by Illinois EPA in a Freedom of Information Act (FOIA) request. Little additional data of relevance was found, with only a few samples collected at several sites since 2002. With only limited data available, a water quality monitoring plan and data mining report was created (Appendix A) and executed to further evaluate the impairment status. Monitoring was also designed to evaluate potential risk of eutrophication, which would still require a NARP to be completed, even if the impairment was found to be inappropriate.

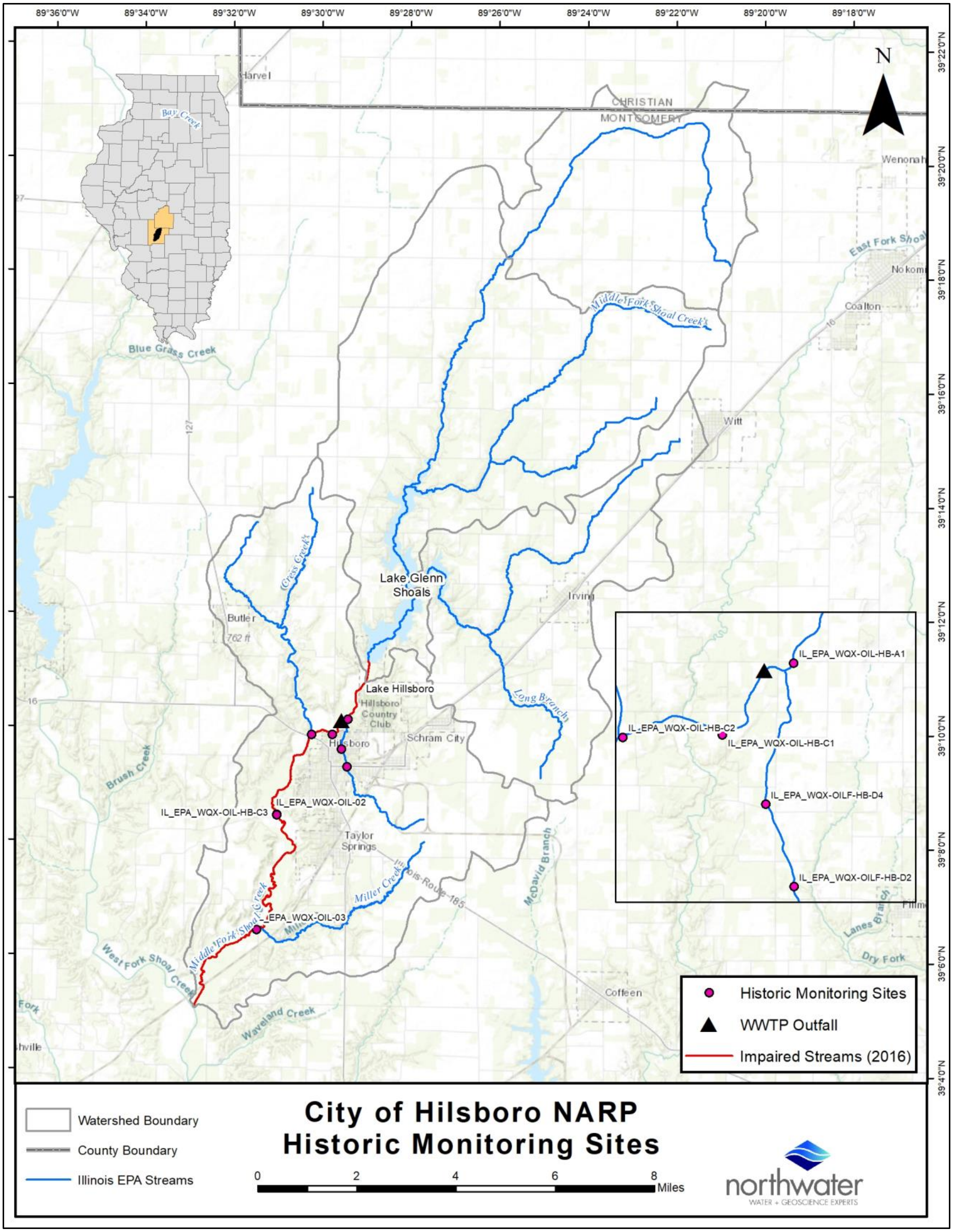

Figure 1 - Historic Monitoring Site Locations, Stream Segments with Nutrient-Related Impairments and Risk of Eutrophication Segments

3. WATER QUALITY MONITORING PROGRAM & RESULTS

Based on the monitoring plan, the program was carried out with three main objectives:

1. Collect data to confirm or contest if there is a significant ongoing phosphorus-related impairment or risk of eutrophication associated with the WWTP’s discharge on Middle Fork Shoal Creek.
2. Improve understanding of nutrient dynamics and water quality to inform next steps of the NARP including potential for establishment of site-specific phosphorus limits and/or phosphorus input reductions.
3. Provide data to guide equitable implementation of nutrient reduction measures among contributors if the NARP determines such reductions are necessary to protect water quality and eliminate the phosphorus-related impairment or risk of eutrophication conditions that could lead to future impairment.

The City of Hillsboro retained Northwater Consulting to develop the monitoring plan and support implementation of the monitoring program. The NARP and Work Plan presented in Sections 4.2 and 4.3 are guided by the monitoring results and are the foundation of next steps in the NARP process.

3.1 NARP MONITORING STATIONS & INFRASTRUCTURE

Middle Fork Shoal Creek is a mid-sized stream, fed primarily by the flow from two reservoirs, the 106-acre Lake Hillsboro, and the 1,092-acre Glenn Shoals Lake. The catchment of Glenn Shoals is highly agricultural, and Lake Hillsboro is moderately agricultural with more urban and natural areas. Both experience significant nutrient issues, including annual release of legacy nutrients from lake-bottom sediments. Water quality in Middle Fork Shoal Creek is highly influenced by the lakes. During wet conditions, water flows from Lake Hillsboro over the primary spillway, and on Glenn Shoals through a drop box conduit spillway structure. During dry weather a small 4” outlet below the elevation of the main spillway on Glenn Shoals provides the creek with base flow. The creek itself is highly channelized, though there is good canopy cover and adequate riparian buffer.

The monitoring program was designed in an upstream/downstream configuration. The upstream site was established close to the outfall to capture the influence of as much of the watershed as possible before the addition of treated effluent. The downstream site was located far enough downstream to ensure that the immediate impacts from treated effluent were captured in the monitoring, while minimizing the amount of additional downstream watershed influence (Figure 2 and Table 2). Data collection began May 2024 and continued through the end of October 2024.

Table 2 – NARP Monitoring Stations

Station ID	Name	Lat, Long (decimal degrees)	Approximate Distance from Outfall (mi)	Watershed Area (mi^2)	Type of Sampling	Monitoring Periods
MSCU	Middle Fork Shoal Creek Upstream	39.169406, -89.488709	*NA - Upstream*	88.5	Continuous, Biweekly Grab	May - October 2024
MSCD	Middle Fork Shoal Creek Downstream	39.165343, -89.493118	0.37 mi	88.8	Continuous, Biweekly Grab	May - October 2024

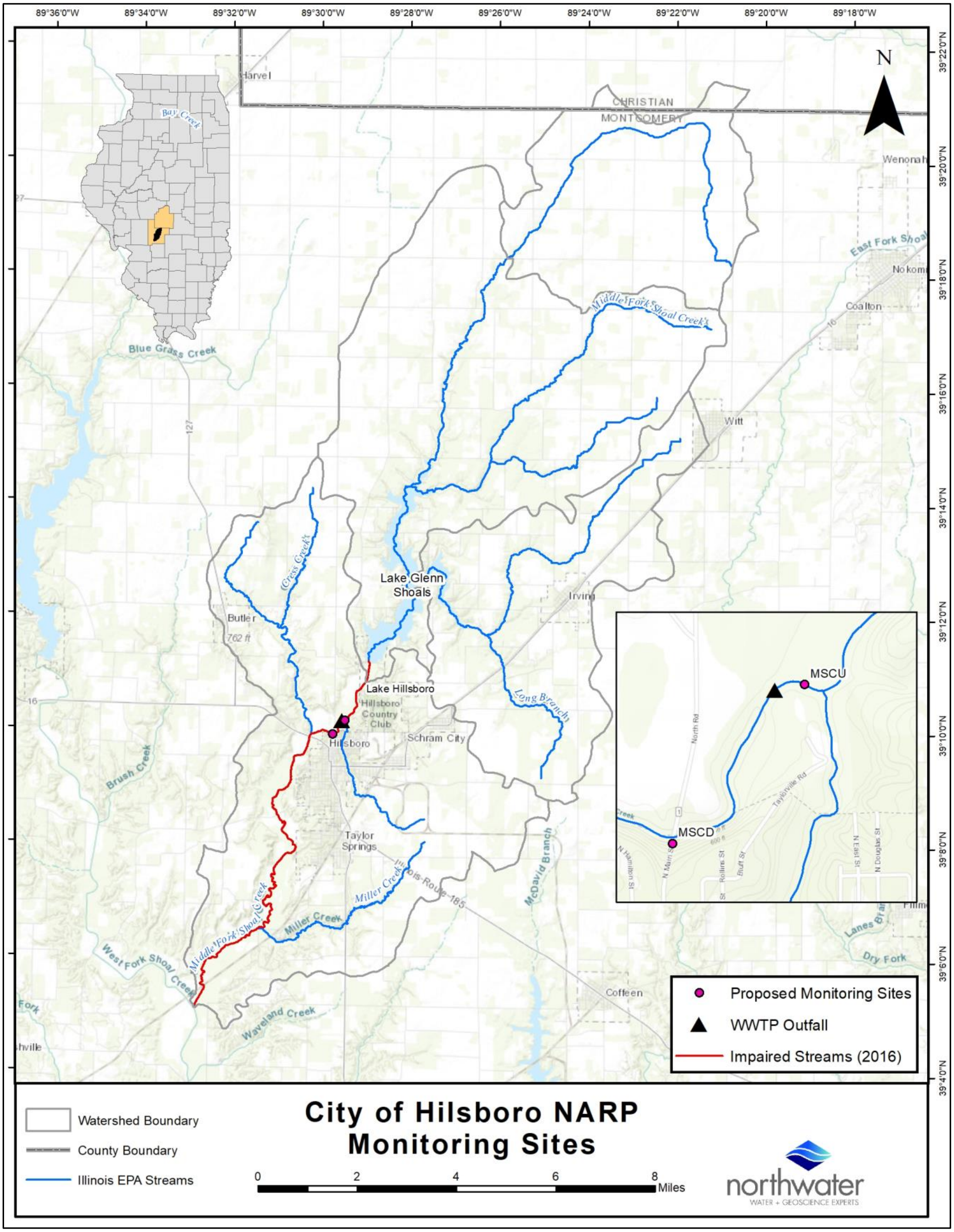

Figure 2 - NARP Monitoring Locations

3.2 MONITORING PERIOD & METHODS

Sampling parameters were selected to be directly responsive to the NARP triggering criteria, with a combination of continuous monitoring, spot checks with handheld meters, and grab samples submitted for lab analysis. Table 3 summarizes all parameters and other details including methods and sampling frequency. Sondes were placed in 3" perforated PVC pipes that extended from the bank as close as practical to the channel thalweg. The sondes were positioned so that they were in flowing water and not influenced by stagnant or non-flowing backwater conditions.

Continuous Monitoring

- In-Situ Inc. AquaTroll 600 multiparameter continuous monitoring sondes with anti-fouling wiper, internal logging, and battery were deployed at both stations.
    - Bi-weekly site visits to download data, calibrate and maintain the sensors and infrastructure. All instrument calibrations and maintenance followed manufacturer's recommended practices and calibration logs were saved.
- The sondes were equipped with pH, DO, temperature, conductivity, chlorophyll α optical fluorescence, and depth sensors.
- Data collection frequency was 15-minutes to enable the capture of daily maxima and minima of parameters such as pH and DO saturation and concentration, which is relevant to Illinois EPA eutrophication risk criteria.
- Chlorophyll α optical fluorescence data was collected to better understand its occurrence and variability through the monitoring period as it is a eutrophication risk criterion (a median of 26 µg/L is the NARP threshold). The sensor data is considered a qualitative measurement and not reliable to make conclusive determinations of NARP triggers.
- A manufacturer firmware update caused the instruments to malfunction and resulted in missing data at both sites in September.

Spot Checks and Field Water Quality Data

- Water quality spot checks were performed bi-weekly for DO, pH, temperature, conductivity, and turbidity using calibrated handheld water meters (YSI ProQuatro and YSI ProDSS).
- Flow was measured bi-weekly at all sites using a measuring tape, top set wading rod and electromagnetic flowmeter. The United States Geological Survey (USGS) midsection method was applied to measure flows using a Hach FH-950 electromagnetic velocity meter.
- Spot checks, flow measurement, and instrument calibration were performed by Northwater Consulting.

Laboratory Analysis

- Nutrient grab samples were collected on a bi-weekly schedule at all stations.
- Parameters included TP, orthophosphate, chlorophyll α, total nitrogen (TN), ammonia (NH_3), total Kjeldahl nitrogen (TKN), and nitrate + nitrite (NO_3^- + NO_2^-). See Table 3.
    - Nitrogen analysis supports an improved understanding of in-steam chemistry processes and may be used for future analysis.

- Laboratory analysis for nutrients was performed by an accredited contract laboratory (TekLab, Inc., Collinsville, IL). Chlorophyll was sent to an accredited contract laboratory (First Environmental Laboratories, Inc., Naperville, IL).

WWTP Effluent

Effluent data is collected as part of the Illinois EPA-required Discharge Monitoring Report (DMR). Parameters relevant to the NARP study include daily discharge and once monthly TP.

- The average effluent flow during the May-October 2023 monitoring period was 1.10 MGD.
- The average TP concentration in monthly effluent samples during the monitoring period was 2.7 mg/L.

Table 3 - Water Quality Monitoring Parameters and Methods

Parameter	Collection Type	Frequency	Method	Method Identifier	Sonde Calibration Method
Dissolved Oxygen (saturation and concentration)	Continuous Probe	Continuous	Optical	EPA-approved In-Situ method	100% Air Saturation
	Handheld Meter	Bi-Weekly	Membrane Electrode	SM 4500-O G	-
pH	Continuous Probe	Continuous	Potentiometric	EPA 150.2	2 Point 7 & 10 pH
	Handheld Meter	Bi-Weekly	Potentiometric	SM 4500 H^+ B	-
Water Temperature	Continuous Probe	Continuous	Thermistor	EPA 170.1	Factory Calibration
	Handheld Meter	Bi-Weekly	Thermistor	SM 2550	-
Chlorophyll-α	Grab	Bi-Weekly	Lab Spectrophotometric	SM 10200H	-
Total Phosphorus	Grab	Bi-Weekly	Colorimetry	EPA 365.4	-
Orthophosphate	Grab	Bi-Weekly	Colorimetry	SM 4500 P E	-
Ammonia	Grab	Bi-Weekly	Ion Selective Electrode	EPA 350.1	-
Nitrate + Nitrite	Grab	Bi-Weekly	Colorimetry	EPA 353.2 R2.0	-
Total Kjeldal Nitrogen	Grab	Bi-Weekly	Colorimetry	EPA 351.2	-
Total Nitrogen	Calculated	-	-	-	-
Conductivity	Continuous Probe	Continuous	Resistor Network	EPA 120.1	1 Point 1,413 µS/cm
	Handheld Probe	Bi-Weekly	Resistor Network	SM 2510	-

3.3 MONITORING RESULTS

This section presents results of the monitoring program and is organized based on site and relevant parameters. The observations of flow/precipitation and chlorophyll apply to both sites. Next, data and observations specific to the upstream sampling location are presented, followed by data and observations specific to the downstream sampling location.

STREAMFLOW & PRECIPITATION

Figure 3 presents a summary of monthly total precipitation data from the National Weather Service station at Hillsboro during the monitoring period compared to the 2000-2024 average. Three of the six months were below average, two were near average, and one was well above average.

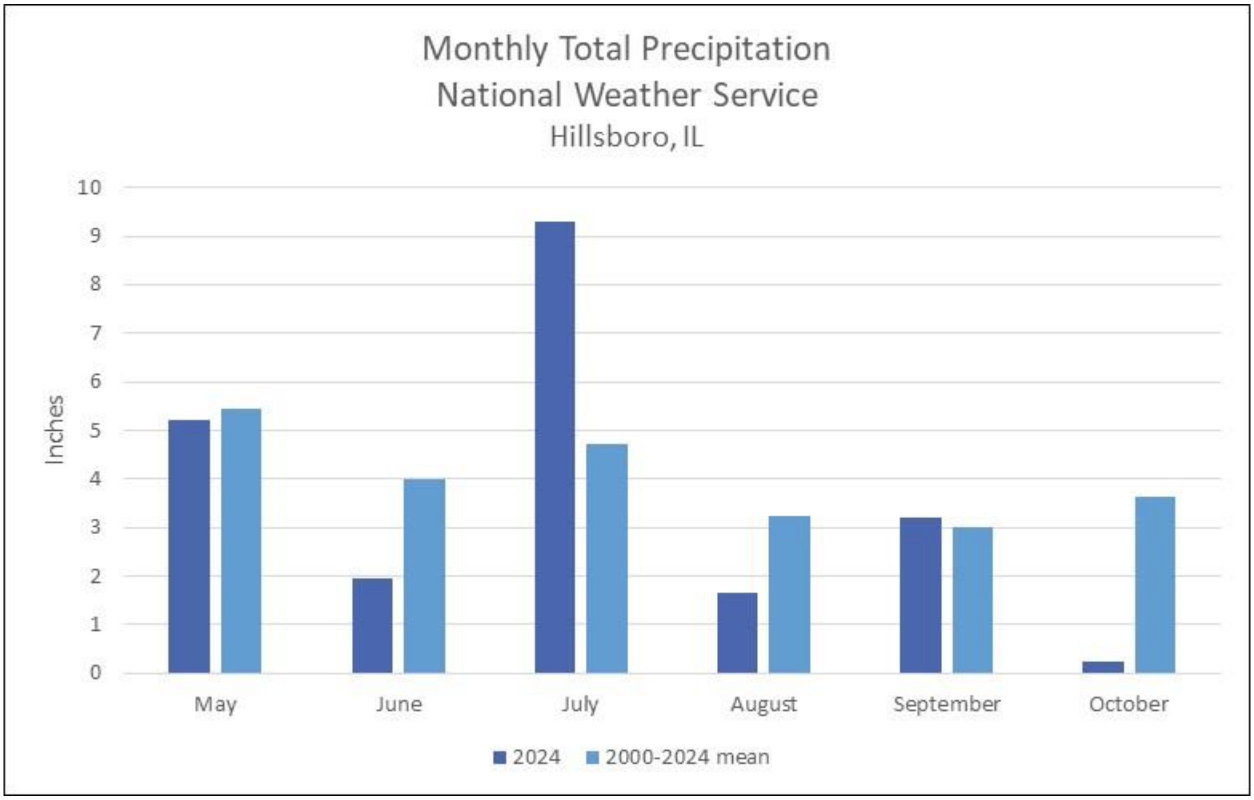

Figure 3 – Total Monthly Precipitation, National Weather Service, Hillsboro, IL

Flow measured using the USGS wading method is plotted in Figure 4, with stage measured by continuous sensor at site MSCD. Flow was unable to be measured during several runoff events due to unsafe wading conditions, including on May 1, and May 28. Flow is typically approximately 1.5 to 2 CFS higher downstream as a result of additional WWTP effluent flow.

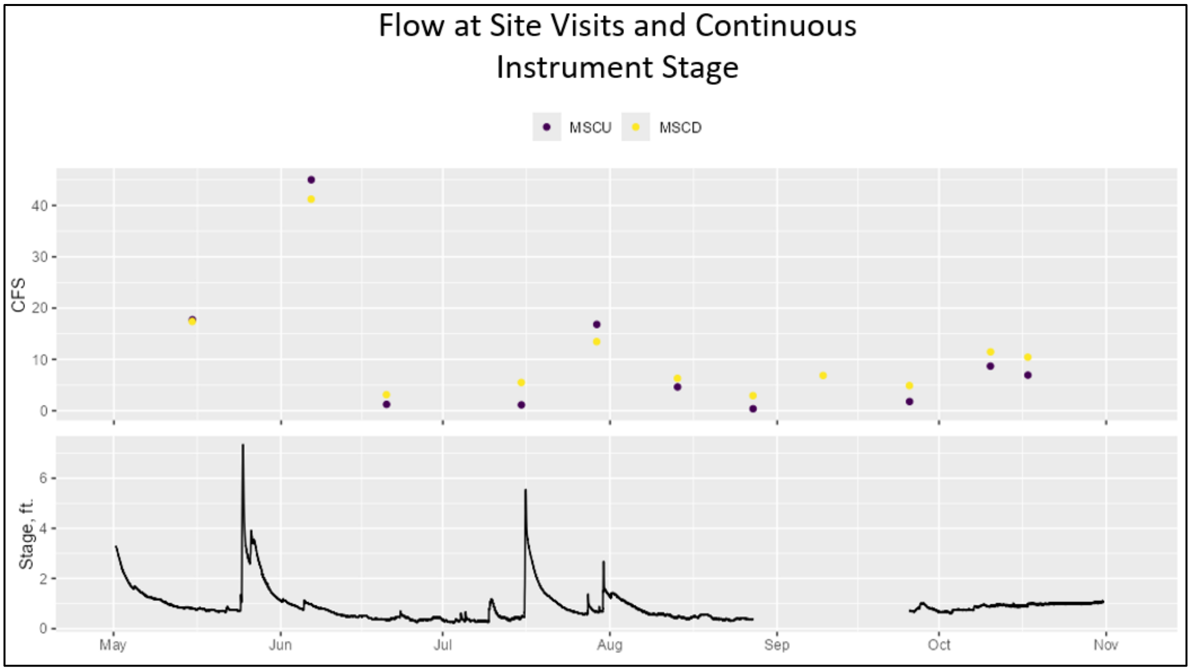

Figure 4 - Measured Flow with Stage for Reference

SESTONIC CHLOROPHYLL A

Boxplots of chlorophyll α results (n=14) are shown in Figure 5 and were typically low throughout the monitoring period at all sites. They are typically far below the median 26 µg/L risk of eutrophication threshold.

- Results are similar at both the upstream and downstream sites.
- Laboratory results are low with medians well below risk of eutrophication threshold. This indicates that sestonic algae concentrations are not symptomatic of a phosphorus impairment or risk of eutrophication in Middle Fork Shoal Creek.
- Benthic algae, or periphyton, was not observed to be abundant at either monitoring site.

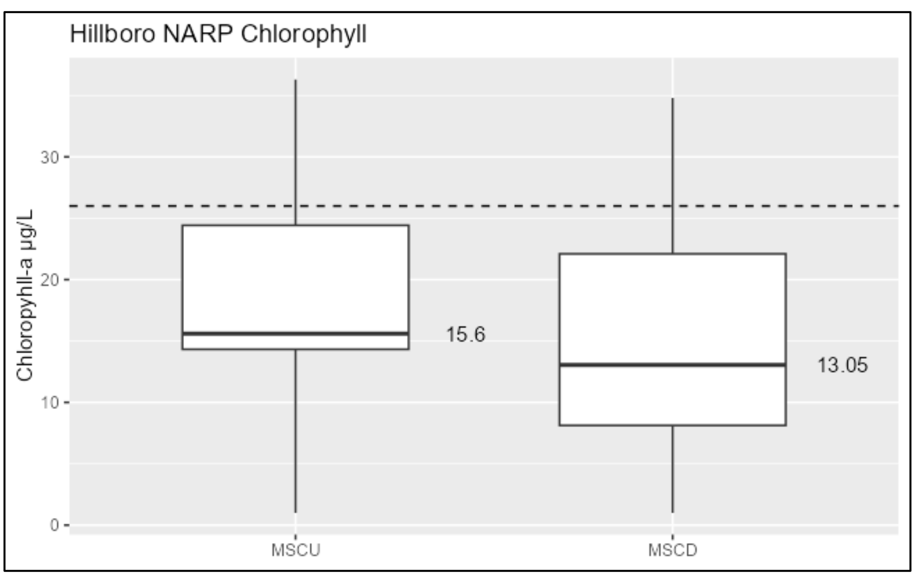

Figure 5 - Chlorophyll α Results (box plots with sample medians annotated)

DO, pH, PHOSPHORUS – UPSTREAM MIDDLE FORK SHOAL CREEK (MSCU)

MSCU Key Takeaways:

- This station is upstream and outside of influence from WWTP effluent.
- This station is downstream from both reservoirs. Water quality issues and flow in the creek are predominantly driven by the lake environment.
- Eutrophication risk was not observed based on the DO + pH criteria.
- Eutrophication risk was observed based on the pH > 9 criteria on three days, directly after a major storm when water was flowing over the reservoir spillways.
- Eutrophication risk was not observed based on the sestonic chlorophyll α criteria of median >26 µg/L.
- Dissolved oxygen concentration was recorded below the March - July 5.0 mg/L instantaneous water quality standard on 58 of 92 days monitored. It was below the August - February 4.0 mg/L enhanced standard on 13 of 48 days monitored, for a combined 51% below the standard.

Middle Fork Shoal Creek upstream of the plant was monitored with in-situ sensors from May-October 2024. There were 141 days with continuous DO and pH data. Grab samples for TP (n=16), chlorophyll α (n=14) and other laboratory parameters were collected approximately every two weeks, and spot checks for DO and pH were also collected. Phosphorus grab sample results and continuous monitoring of DO saturation, DO concentration, pH and flow are illustrated in Figure 6. An instrument firmware issue caused a gap in data during September of the monitoring period. DO and pH grab samples collected during this gap are plotted for reference. In 141 days monitored with in-situ instruments in 2024, the stream never exceeded the DO >110% + pH >8.35 risk of eutrophication criteria (Table 4).

While there was no risk of eutrophication observed upstream of the outfall, continuous monitoring showed that the DO frequently fell below the instantaneous water quality standard of 5.0 mg/L from March through July on 58 of 92 days monitored, and below the enhanced standard of 4.0 mg/L from August through February on 13 of 48 days. The lowest concentration measured was less than 1.0 mg/L on July 08, 2024 during a period of low flow. A consistent pattern in DO concentrations occurred at this site related to reservoir outflow: after each rain or runoff event, DO increases, then over a period of days it declines, often falling below the water quality standard for multiple days until the next rain event. This pattern indicates that when water is flowing over the spillways, the flow allows for sufficient DO in the stream, but when flow is low, oxygen demanding processes in the stream dominate, reducing DO. Similarly, pH follows a pattern when water is overtopping the reservoir spillways: diel range and maxima of pH increases over baseline. The three days of pH above 9.0 all occurred during high flow conditions when water was being released from the lakes.

Table 4 – Upstream Middle Fork Shoal Creek Risk of Eutrophication Summary

Days with Continuous Monitoring	Median Daily Maximum	# of Days (%) Exceeding the Risk of Eutrophication Criteria (8.35 pH + 110% DO)	# Days (%) Exceeding the Minimum DO Water Quality Standard (5.0 Mar-July; 4.0 Aug-Feb)
141	82% (DO Saturation) 7.9 (pH)	0 (0%)	71 (51%)

The DO data collected during this assessment is consistent with Illinois EPA's designation of Middle Fork Shoal Creek as impaired with cause of non-pollutant DO.

Sestonic chlorophyll α levels are low relative to the median 26 µg/L threshold (Figure 5), with a median concentration of 15.6 µg/L (n=14) and a maximum of 36.3 µg/L. Periphyton was not observed at this site. These conditions are not indicative of a phosphorus impairment.

There is phosphorus available in the stream (Figure 6) from NPS runoff, and phosphorus is likely being released from stream sediments when low oxygen conditions occur. A maximum concentration of 1.4 mg/L (n=16) and median of 0.2 mg/L were observed.

Nitrogen data (n=14) was collected for potential future use and to better understand stream water quality dynamics. Median ammonia-nitrogen was 0.44 mg/L, median nitrate-nitrogen was 0.33 mg/L, and median TKN was 1.55 mg/L.

Site MSCU looking upstream during typical flow conditions.

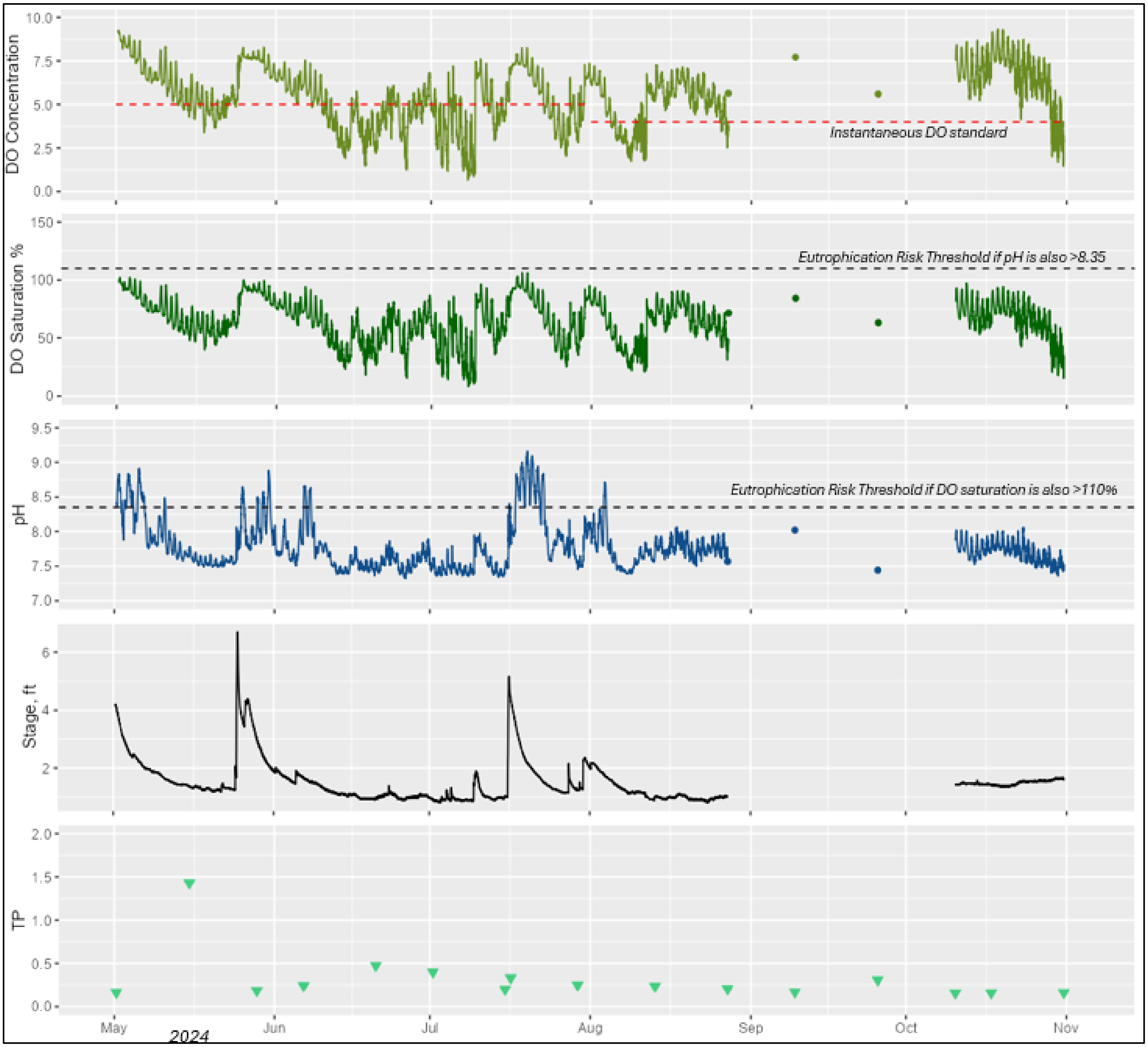

Figure 6 - MSCU Grab Samples and Continuous Monitoring Results

DO, pH, PHOSPHORUS – DOWNSTREAM MIDDLE FORK SHOAL CREEK (MSCD)

MSCD Key Takeaways:

- This station is 0.37 miles downstream of the outfall.
- Water quality at this site is very similar to the upstream site, and the reservoirs are the main drivers of water quality conditions.
- There were 155 days of continuous DO + pH monitoring in 2024.
- Eutrophication risk was not observed based on the DO + pH criteria.
- Eutrophication risk was observed based on the pH > 9 criteria on 2 of 155 monitoring days.
- Eutrophication risk was not observed based the sestonic chlorophyll α criteria of median >26 µg/L.
- Dissolved oxygen concentration was recorded below the March - July 5.0 mg/L instantaneous standard on 66 of 92 days monitored and below the August - February 4.0 mg/L enhanced standard on 15 of 62 days monitored (combined 53% of days).

Middle Fork Shoal Creek 0.37 miles downstream of the outfall was monitored with in-situ sensors from May - October 2024. There were 155 days with continuous DO and pH data. Grab samples for TP (n=16) and chlorophyll α (n=14) were collected approximately every two weeks. Phosphorus grab sample results and continuous monitoring of DO saturation, pH and flow are illustrated in Figure 7. In 155 days of monitoring in 2024, the stream experienced no days where the maximum DO and pH exceeded the DO >110% + pH >8.35 risk of eutrophication criteria. The instantaneous low DO standard was violated at this site on 81 days of monitoring, or 53% (Table 5).

Like upstream, monitoring data did not indicate a risk of eutrophication at this site. However, DO was frequently below the water quality standard. This site exhibited the same pattern, where DO rose during runoff events, when water was being discharged over the spillways from the upstream reservoirs, then decreased over a series of days as flows receded. High pH also occurred during a period when there was water flowing over the spillways following a rain event. Water quality at this site is primarily driven by the reservoirs water quality and altered flow, not WWTP effluent.

Table 5 – Downstream Middle Fork Shoal Creek Risk of Eutrophication Summary

Days with Continuous Monitoring	Median Daily Maximum	# of Days (%) Exceeding the Risk of Eutrophication Criteria (8.35 pH + 110% DO)	# Days (%) Exceeding the Minimum DO Water Quality Standard (5.0 Mar-July; 4.0 Aug-Feb)
155	78.4% (DO Saturation) 7.8 (pH)	0 (0%)	81 (53%)

Sestonic chlorophyll α levels are low relative to the median 26 µg/L threshold (Figure 5), with a median concentration (n=14) of 13.1 µg/L and a maximum of 34.8 µg/L. Minimal periphyton was observed at this site, at levels not symptomatic of a phosphorus impairment.

There is phosphorus available in the stream (Figure 7) from NPS and WWTP effluent, with a maximum concentration of 1.12 mg/L (n=14), and a median of 0.43 mg/L. Based on the small number of storm events captured by grab samples, a systematic relationship between TP concentrations and flow conditions is not discernable at this site, with some high flow events showing elevated TP and some showing depressed concentrations.

Nitrogen data was collected (n=16) to aid in understanding water quality dynamics and for future use. Median ammonia-nitrogen was 0.33 mg/L, median nitrate was1.61 mg/L, and median TKN was 1.5 mg/L.

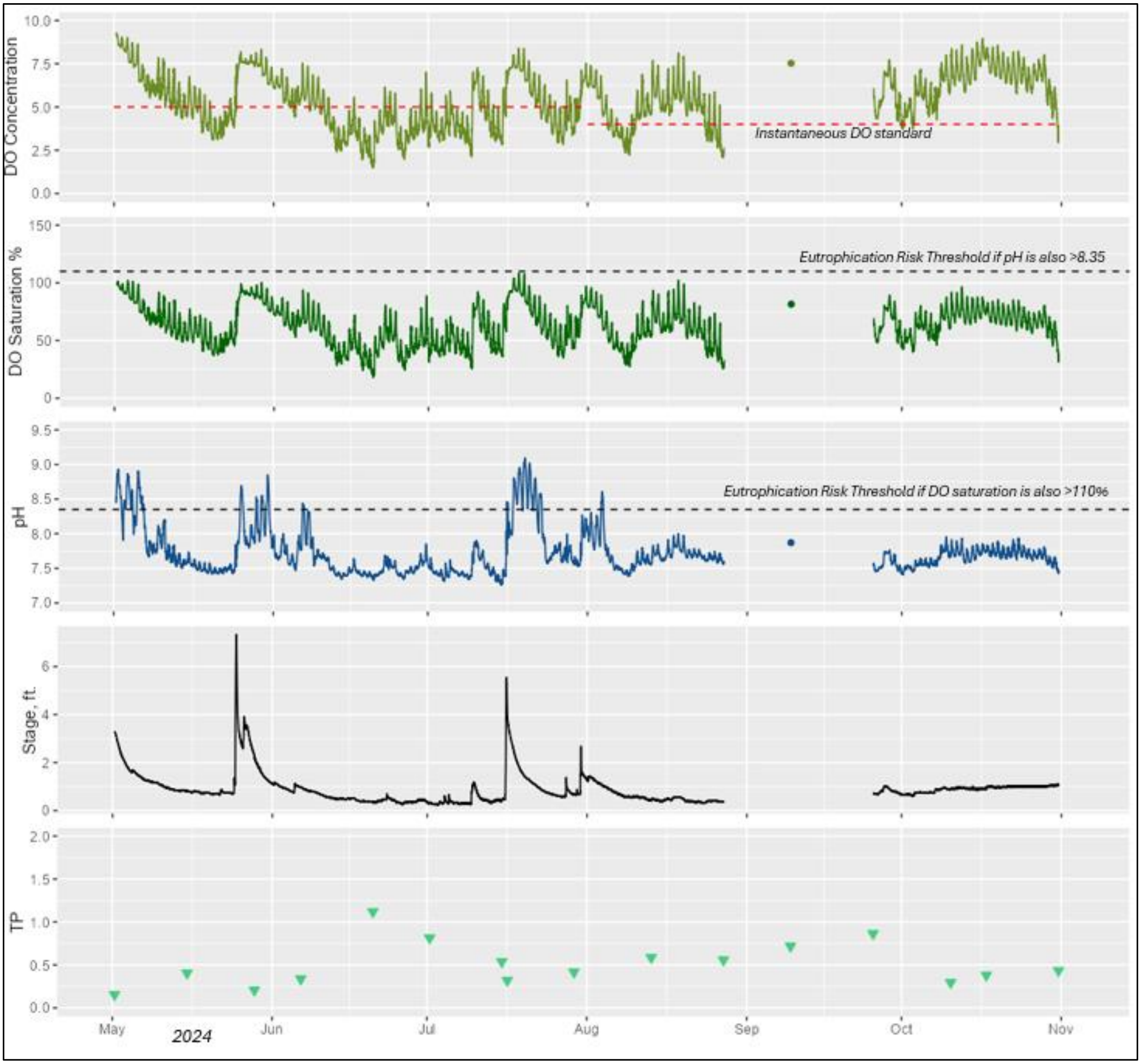

Figure 7 – MSCD Grab Samples and Continuous Monitoring Results

Site MSCD looking upstream during typical flow conditions

3.4 INTREPRETATION & ANALYSIS

The upstream lake environment is driving water quality issues in Middle Fork Shoal Creek, including low DO. A comparison of continuous data from the upstream of the outfall and the site downstream is in Figure 8, showing the DO concentrations and patterns in the time-series data at the downstream site closely tracks the DO of the upstream site. This similarity at the two sites is evidence that the lakes, not effluent from the WWTP, are driving water quality issues.

The monitoring results confirm that there is a non-pollutant caused DO impairment in the stream, as is indicated on Illinois EPA's 303(d) lists. Nutrients are not driving the impairment, as evidenced by typically low sestonic algae concentrations and observations of very limited periphyton in the creek. The low DO is a result of flow being held back by Glenn Shoals Lake and Lake Hillsboro during dry weather. This low flow does not allow for sufficient aeration of the stream. Patterns in DO data indicate that there is also a high oxygen demand in the stream environment that further lowers DO. As water flows over the spillways of the reservoirs, DO increases, followed by several days of decreasing flow and DO, until the next storm event increases flow to the stream. Both reservoirs are subject to TMDLs for phosphorus, as they were previously listed as impaired. Total phosphorus concentrations are still above the water quality standard in the lakes, and the effects of that impairment as well as the altered flow regime are being observed in the creek downstream and are unrelated to the WWTP.

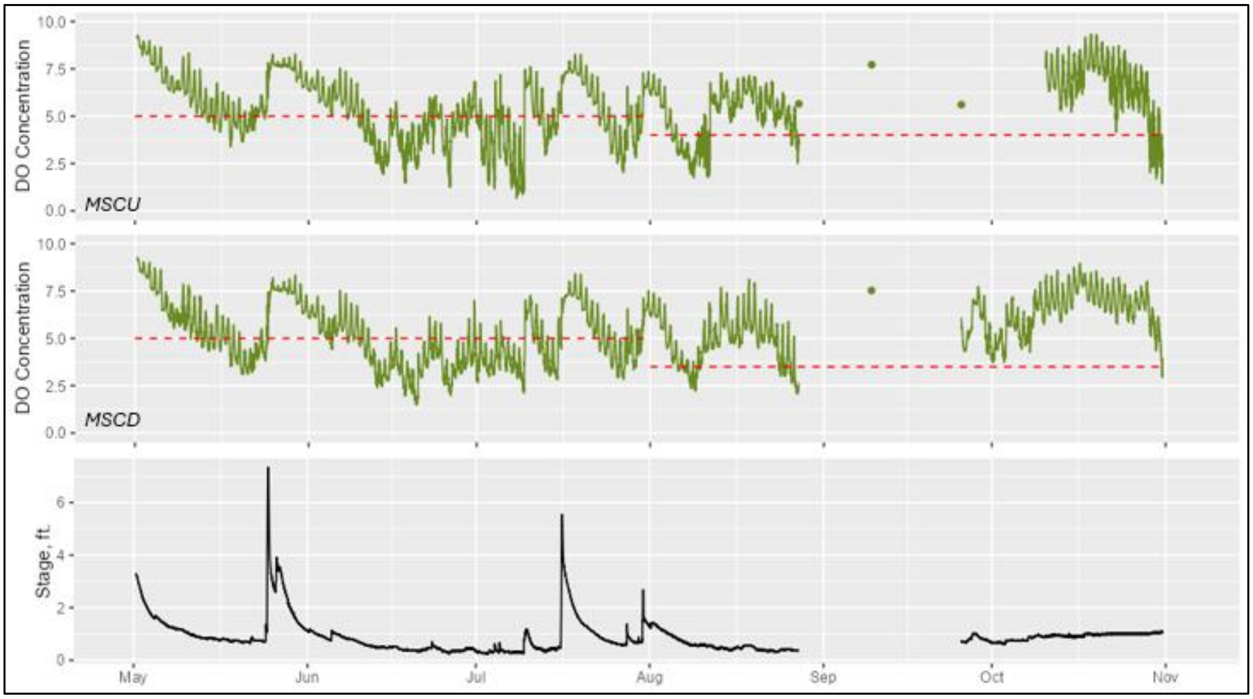

Figure 8 - Comparison of DO Concentration at the Upstream and Downstream Sites - Stream stage Plotted for Reference

The pH increases in the creek during periods of high flow over the spillway. This elevated pH is consistent with data collected by Hillsboro from the lakes as part of the 2024 watershed plan, and again is not indicative of a water quality issue caused by effluent phosphorus. One example of this phenomenon can be seen in the clear change in pattern can be seen in Figure 6 and Figure 7 beginning on July 15 and ending on July 23.

The Hillsboro WWTP does currently contribute a point source phosphorus load to Middle Fork Shoal Creek, with an average effluent concentration of 2.7 mg/L during the monitoring period. Effluent increases the creek TP concentration from a median of 0.22 mg/L upstream of the outfall, to a median of 0.42 mg/L downstream. However, based on the collected data and observations made during site visits, the point source phosphorus is having little effect on the stream environment, and there is no evidence of a phosphorus impairment downstream.

In summary, as illustrated in Table 6, water quality conditions are substantially similar at the upstream and downstream sites. The main driver of issues is the altered flow regime of Middle Fork Shoal Creek and the NPS nutrients causing eutrophication in the upstream impoundments, which influences DO and pH conditions downstream. The aquatic life impairment caused by DO would be present even without the addition of treated effluent from the WWTP. There was no evidence of a phosphorus-related impairment originating in Middle Fork Shoal Creek downstream of the reservoirs.

Table 6 - Risk of Eutrophication and DO Summary

Site	Days with Continuous Monitoring	Median Daily Maximum	# of Days (%) Exceeding the Risk of Eutrophication Criteria (8.35 pH + 110% DO)	# Days (%) Exceeding the Minimum DO Water Quality Standard (5.0 Mar-July; 3.5 Aug-Feb)
MSCU	141	82% (DO Saturation) 7.9 (pH)	0 (0%)	71 (51%)
MSCD	155	78.4% (DO Saturation) 7.8 (pH)	0 (0%)	81 (53%)

Potential point source phosphorus reductions beyond the 0.5 mg/L stipulated in Hillsboro's NPDES permit would have little or no effect on water quality of Middle Fork Shoal Creek. Instead, management activity should be focused on reducing NPS nutrients delivered to Glenn Shoals Lake and Lake Hillsboro, which will improve water quality downstream.

Glenn Shoals Lake

4. NARP & WORK PLAN

Based on an understanding of the Hillsboro NARP trigger, watershed dynamics and the results of the monitoring, the NARP and Work Plan focuses on reducing phosphorus inputs to the Middle Fork Shoal Creek, and the associated 74,937-acre watershed, including Glenn Shoals Lake and Lake Hillsboro. The focus area is comprised of the four HUC12 subwatersheds that make up the Middle Fork Shoal Creek HUC10 watershed (Figure 9). The watershed area is primarily agricultural with a portion developed/urban, and the remainder in grassland, forest, and pasture.

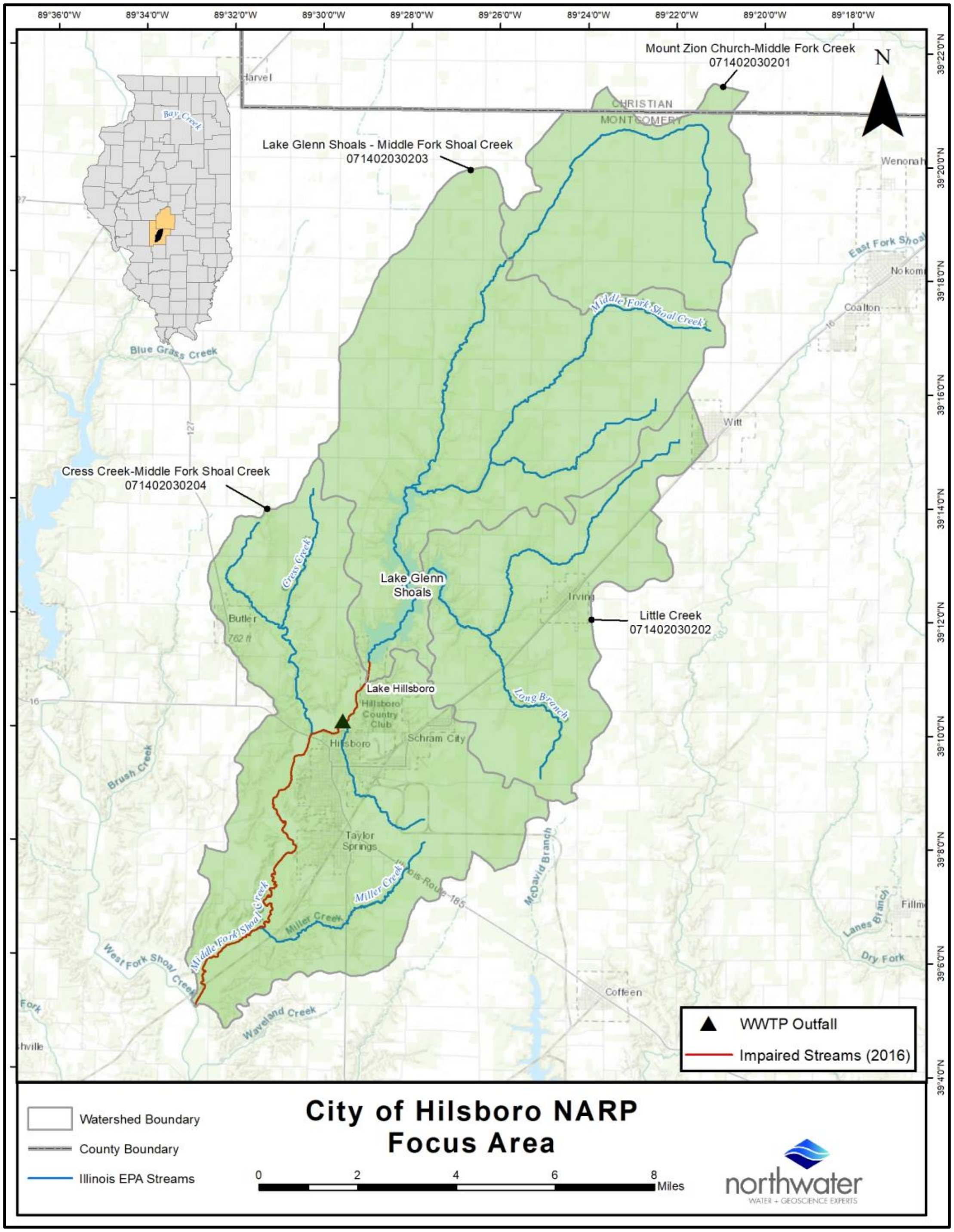

Figure 9 - NARP Focus Area

4.1 WATERSHED CHARACTERIZATION

A concise watershed characterization is presented and includes relevant information related to hydrology, landcover, climate, and demographics. Current and historical water quality impairments are summarized and estimates of phosphorus loading from NPS are presented from a detailed modeling effort conducted to support the recently completed Glenn Shoals Lake and Lake Hillsboro Watershed-Based plan and a map-based, planning-scale pollutant load model created for this NARP to capture the additional watershed area downstream of the lakes, using formulas and methods derived from the United States EPA Spreadsheet Tool for Estimating Pollutant Loads (STEPL). This section also details links to other relevant plans, efforts, and initiatives in the watershed.

HYDROLOGIC UNITS

The NARP focus area of the Middle Fork Shoal Creek HUC10 consists of four HUC12 subwatersheds (Table 7) totaling 74,937 acres. This watershed lies in the east-central part of Illinois almost entirely in Montgomery County with a small section in Christian County. It is within the Kaskaskia River Basin, which drains to the Mississippi River.

Table 7 – Hillsboro WWTP NARP HUC12 Subwatersheds

HUC Name	HUC12 ID	Area (acres)
Mount Zion Church	071402030201	10,761
Little Creek	071402030202	13,732
Lake Glenn Shoals	071402030203	24,965
Cress Creek	071402030204	25,480
	Total:	**74,937**

STREAMS & LAKES

According to the National Hydrography Dataset (NHD) there are 258 miles of streams and rivers in the planning area, including artificial drainageways (Table 8). The Middle Fork Shoal Creek is the longest named stream at 25 miles followed by Little Creek (6.5 miles). The NHD also identifies 1,208 acres of lakes, ponds and reservoirs. The largest lake is Glenn Shoals Lake at 1,092 acres.

Table 8 – Relevant Stream Segments and Illinois EPA Assessment ID

Stream Name	Illinois EPA Assessment ID	Length (Miles)
Unnamed Tributary/Drainage Way	N/A	210
Cress Creek	IL_OILB-01	6.4
Little Creek	IL_OILC	6.5
Long Branch	IL_OILCA	4.2
Middle Fork Shoal Creek	IL_OIL-01, IL_OIL-03, IL_OIL-HB-C1	25
Miller Creek	IL_OILA	5.4
Total:	-	**258**

CLIMATE NORMALS

Based on climate normals published by the National Oceanic and Atmospheric Administration for a weather station in Hillsboro, for the period of 1991 – 2020 (NOAA NCEI, 2024), the area experiences an average of 42.1 inches of precipitation per year (3.4 inches/month). May is typically the wettest month, with an average of 5.06 inches of rain.

LANDCOVER

Table 9 presents watershed landcover. The two predominant categories are (i) 65% agriculture comprising 48,732 acres of cultivated crops, and (ii) 16% forest areas or 11,888 acres according to the National Land Cover Database (NLCD) (Dewitz, J., 2021). The Cress Creek, Lake Glenn Shoals, Little Creek, and Mount Zion Church HUC basins have 48%, 70%, 65%, and 94% agriculture/cultivated crops respectively.

Table 9 – Hillsboro NARP Watershed Land cover

Land Cover	Area (acres)	% of Watershed Area
Cultivated Crops	48,732	65%
Forest	11,888	16%
Developed	6,826	9.1%
Grasslands/Hay/Pasture	5,729	7.6%
Open Water	1,535	2.0%
Wetlands	142	0.2%
Barren Land	84	0.1%
Total	**74,937**	**100%**

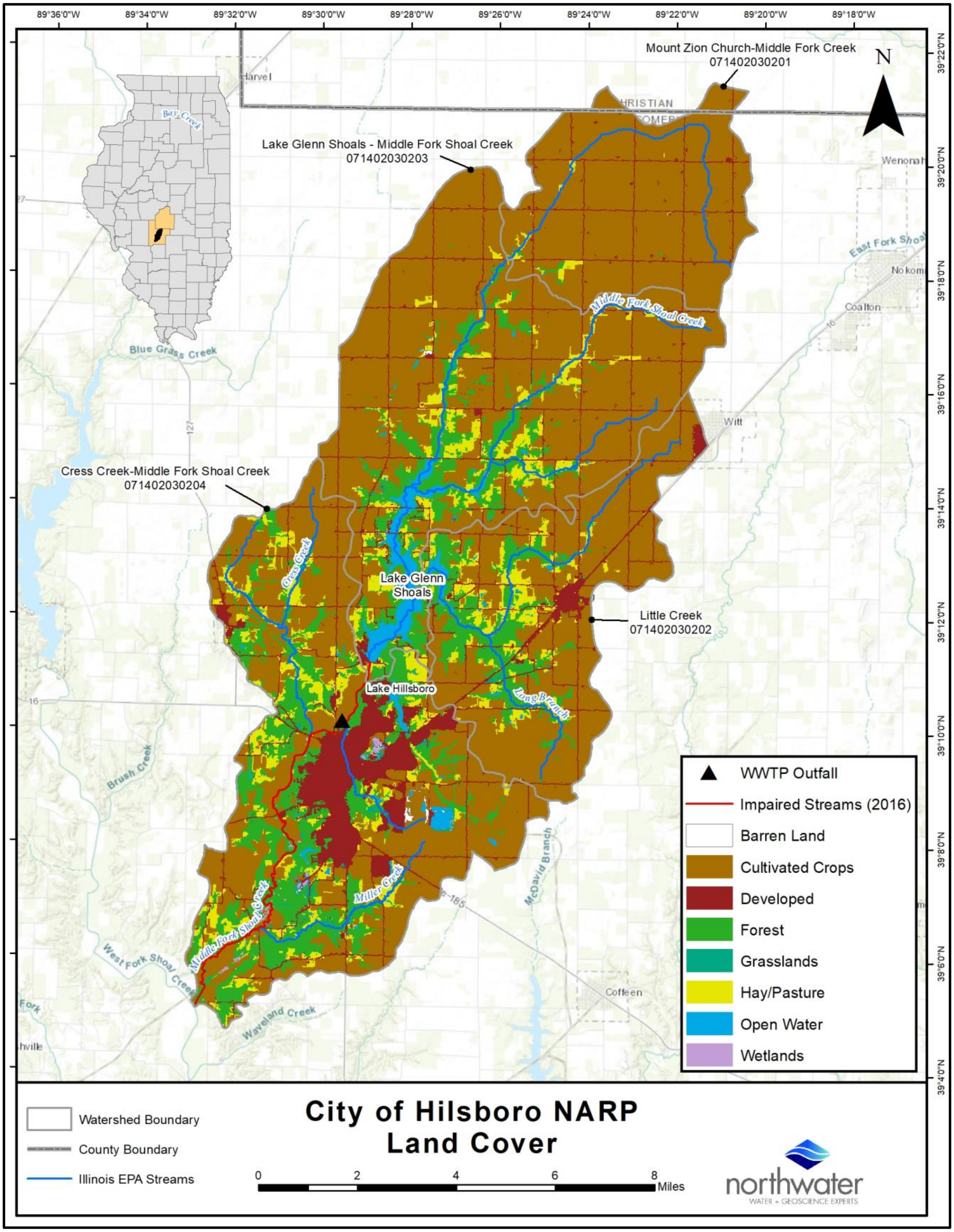

Figure 10 – NARP Landcover

DEMOGRAPHICS & ECONOMY

The City of Hillsboro is located entirely within the watershed and has a population of 5,773, a decrease of ~2% since 2010 according to the US Census Bureau. Median household income (2018 – 2022) was $48,302 in Hillsboro, compared to $78,433 for Illinois and the national average of $75,149.

WATER QUALITY IMPAIRMENTS

Middle Fork Shoal Creek segment IL_OIL-HB-C1, which receives effluent from the WWTP and is also the segment to which Glenn Shoals Lake and Lake Hillsboro discharge, has been on the Illinois 303(d) list as impaired for aquatic life since at least 2012, the oldest list examined. Causes are non-pollutant DO, TP and manganese. In addition, the next segment of Middle Fork Shoal Creek, IL_OIL-03, was listed as impaired for aquatic life use, caused by DO in 2016 and 2018 but was removed from the list in 2020/2022. Upstream, Glenn Shoals Lake and Lake Hillsboro have been subject to a 2006 TMDL for phosphorus that also addresses manganese. Phosphorus concentrations in the reservoirs continue to routinely be well above the 0.05 mg/L water quality standard for lakes.

RELATIONSHIP TO OTHER PLANS & WATERSHED EFFORTS

The 2006 Glenn Shoals-Hillsboro Watershed TMDL report indicated that phosphorus was causing impairment of the two reservoirs. Potential sources identified included agricultural sources, release from existing sediments under anoxic conditions (known as “legacy phosphorus”), recreational activities, and failing private sewage disposal systems. For Glenn Shoals Lake, an 85% reduction in phosphorus load to the reservoir was recommended, and in Lake Hillsboro, an 83% reduction was recommended to meet the water quality standard of 0.05 mg/L for lakes. The companion implementation plan for the watershed TMDL focused on general suggestions for implementation of NPS phosphorus reduction management practices in the watershed, including nutrient management plans, conservation tillage, buffers and others. The plan also suggested in-lake practices such as dredging, sediment control structures, and aeration/destratification.

A new watershed plan for Glenn Shoals Lake and Lake Hillsboro was finalized in December 2024. The plan, authored by Northwater Consulting with support from the City of Hillsboro and the Montgomery County Soil and Water Conservation District (MCSWCD), addresses phosphorus, nitrogen and sediment delivered to the reservoirs and builds upon the 2006 TMDL. Though it does not cover the watershed area downstream of the lakes, the plan is directly relevant to the NARP as it covers the reservoirs and their watersheds which are driving water quality in Middle Fork Shoal Creek. Row crop agriculture is identified as the biggest contributor of phosphorus to the reservoirs. Internal release of phosphorus from anoxic sediments, known as legacy phosphorus, is also a major contributor to water quality issues. Other sources include lake shoreline and streambank erosion, and to a lesser extent, septic systems, and a point source discharge. Load reductions resulting from management practices recommended in the plan will improve downstream water quality that is causing impairment in Middle Fork Shoal Creek. The plan identifies specific locations for management practices and estimates of costs and expected load reductions for each.

The Illinois Nutrient Loss Reduction Strategy (INLRS) is a state-wide strategy for nutrient reduction, with an interim goal of a 25% reduction in phosphorus loads and 15% reduction in nitrogen loads to Illinois waters by 2025 and a long-term goal of 45% reduction in both nutrients from the 2011 baseline. Nutrient reductions related to this NARP will contribute to meeting those goals.

HILLSBORO WATERSHED PROTECTION EFFORTS

The City of Hillsboro is committed to active watershed protection and restoration, as Glenn Shoals Lake and Lake Hillsboro are the water supply reservoirs for the city. Hillsboro has partnered with local groups and organizations such as the MCSWCD for many years on work in the Middle Fork Shoal Creek watershed. Over the last two years Hillsboro has taken a more active role in lake and watershed protection and improvement. Examples of work include:

- Late 1990s and mid-2000s – partnered with MCSWCD to implement streambank stabilization and several other sediment and nutrient reduction practices such as grass waterways and lake shoreline stabilization.
- Source Water Protection Plan (SWPP) – completed in December of 2024, Hillsboro submitted a SWPP to the Illinois EPA. Building off the recent watershed plan, it details raw and finished water quality and potential contamination risks to source water lakes, and treatment infrastructure. The SWPP also describes current and future source water protection efforts. An action plan quantifies priority best practices needed or planned to reduce watershed sediment and nutrient loading, education, outreach and monitoring strategies, an implementation schedule and milestones, resources (technical and financial) needed, and any barriers to source water protection efforts.
- Investment in a watershed-based plan to direct activities that will result in improvements to water quality. In addition, Hillsboro has undertaken a series of grant applications, and expanded partnerships with agencies, non-governmental organizations or NGOs, industry and individual landowners to amplify watershed work. Recent implementation efforts have focused on "in-lake" treatments with approximately 1,000 ft of eroding shoreline stabilized since 2023. With a dedicated lake and watershed fund now established, source water protection efforts are accelerating.
    - A renewed and expanded partnership with the MCSWCD and Natural Resources Conservation Service (NRCS) has resulted in broad support and interest from the farming community and the submittal of a $10.5 million RCPP grant application for agricultural practices recommended in the newly completed watershed plan.
    - Engagement with the American Farmland Trust (AFT) to develop and maintain a farmer-led peer-to-peer network. This has already resulted in a number of watershed-specific outreach events and cost-share for in-field practices such as cover crops.
    - Interest from the local coal mine in contributing both financially and technically to source water protection efforts. The mine is the largest raw water user, drawing millions of gallons per day from Glenn Shoals Lake.
    - An Illinois EPA Section 319 grant application submitted in early 2024 to implement critical projects identified in the watershed plan. If funded, the award will result in the construction of

three ponds and 1,000 ft of shoreline stabilization at locations delivering the greatest sediment and nutrient loads.

- Establishment of a committee to explore options to utilize State Revolving Loan funds for the construction of large-scale “green infrastructure” projects that benefit water quality and mitigate flooding.
- Deployment of a new stream and lake monitoring program to fill data gaps and establish a baseline for which to measure lake and watershed improvements. This includes five stream and six lake sites.
- The city is now considering updating a long-overdue water availability assessment to evaluate if Glenn Shoals Lake and Lake Hillsboro are sufficient to meet existing and future water needs over the next thirty years and ensure resiliency in the face of climate change. If approved by City Council, this will effort include lake bathymetry surveys, an analysis of current and future demand, modeling and simulation, and action recommendations.

POINT & NONPOINT SOURCE LOADING

Point source pollution is defined by the United States EPA as “any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack” (Hill, 1997). The NPDES, a provision of the Clean Water Act, prohibits point source discharge of pollutants into waters of the United States unless a permit is issued by the USEPA or a state or tribal government. Individual permits are specific to individual facilities (e.g., water or wastewater treatment facilities), and general permits are for a group of facilities in a geographical area. Permits describe the allowed discharge of pollutant concentrations (mg/L) and loads (lbs/day). The WWTP currently does not have an effluent phosphorus concentration limit. There is, however, a schedule for achieving an interim 1.0 mg/L limit and future limit of 0.5 mg/L annual geometric mean in its current permit.

Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. The term "nonpoint source" is defined to mean any source of water pollution that does not meet the legal definition of "point source." Unlike pollution from point sources like industrial and sewage treatment plants, NPS pollution comes from many diffuse sources and is caused by rainfall or snowmelt moving over and through the ground. The runoff picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters (USEPA, 2018).

Annual point source loading of phosphorus from the WWTP is provided in Table 10. Based on USEPA-required DMR data retrieved from USEPA ECHO (Enforcement and Compliance History Online), and from City of Hillsboro data, average annual loading from 2020 through 2023 was 10,161 lbs with an average discharge of 1.4 MGD. Average effluent TP concentration during the same period was 2.38 mg/L.

Table 10 - Annual Phosphorus Load – City of Hillsboro WWTP (Data Source: City of Hillsboro and USEPA ECHO)

WWTP	2020	2021	2022	2023	Annual Average
Hillsboro - Existing	10,363	9,272	10,415	10,5693	**10,161 lbs**

Nonpoint source loading was estimated using data obtained during field surveys and a customized and detailed map-based model created by Northwater Consulting for the Glenn Shoals Lake and Lake Hillsboro watershed plan. The model was expanded by developing a complimentary planning-scale map-based model based on STEPL to include the portions of the NARP focus area that were not included in the watershed plan. Results indicate an average annual phosphorus load of 113,292 lbs/yr for the 74,937-acre watershed. Total average annual phosphorus loading from all sources is estimated at 123,453 lbs/yr with the WWTP accounting for only 8% and NPS 92% (Figure 11). It is important to note that the phosphorus load estimated for this NARP is for NPS runoff only, and it does not account for phosphorus that becomes trapped in the reservoirs, nor does it account for internal lake loading (release of previously trapped phosphorus), streambank erosion and reservoir shoreline erosion. Because some phosphorus is trapped, the true load that leaves the NARP watershed via downstream Middle Fork Shoal Creek is likely less than the estimated load calculated for this NARP. The gross load estimate is presented in this report as it provides a picture of overall load delivered to the watershed, not just what is exiting the lakes.

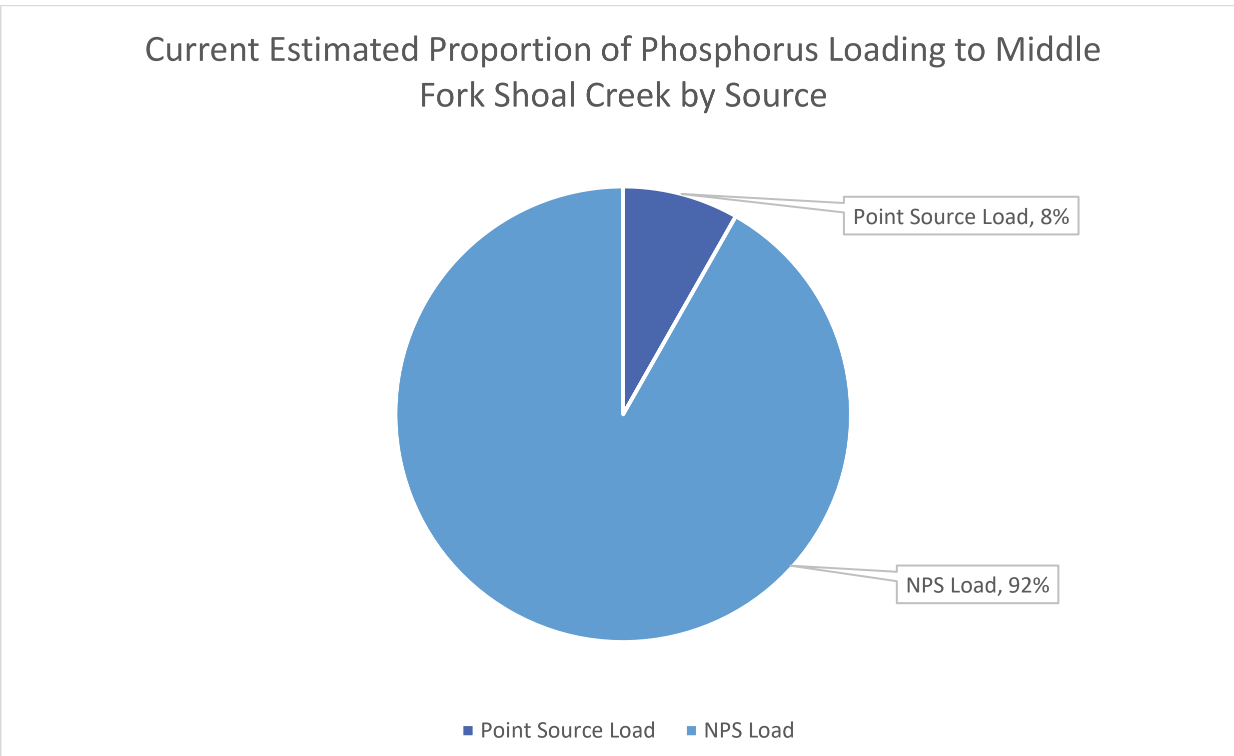

Figure 11 - Proportion of Annual Phosphorus Load to Middle Fork Shoal Creek by Source. Model does not account for loading from legacy phosphorus internal release in Glenn Shoals Lake and Lake Hillsboro.

4.2 NARP

The NARP focuses on 74,937-acre Middle Fork Shoal Creek watershed. Based on an analysis of landcover, watershed nutrient load estimates and monitoring data, Glenn Shoals Lake and Lake Hillsboro are the primary drivers of water quality issues downstream on Middle Fork Shoal Creek. Current and historic NPS nutrients delivered to the lakes cause eutrophication in that environment, and the water quality effects are propagated downstream. In addition, the highly altered flow regime downstream of the lakes, with long periods of low flow and high oxygen demand in the stream during critical periods is causing low DO. The limited instances of high pH occur during opposite conditions: when reservoir flows are high and water with high pH is being released from the spillways.

The City of Hillsboro recognizes the WWTP is a contributor of phosphorus to Middle Fork Shoal Creek, and this input is part of complex and dynamic processes that affect the conditions in the upstream reservoirs, the stream itself and the watershed. However, after examining data collected for this NARP, it is clear that low DO conditions would exist even without the relatively low point source contribution, and phosphorus from the WWTP is not driving water quality issues in the creek. There was little evidence of a phosphorus impairment in Middle Fork Shoal Creek.

Currently, the WWTP contributes approximately 8% of the average annual phosphorus loading to the receiving watershed, with NPS the remaining 92% (Figure 11). As stated in the prior section, this load estimate is for phosphorus delivered to streams in the watershed via NPS runoff, and does not account for the fact that some phosphorus is trapped in the upstream reservoirs, nor does it account for non-runoff sources like streambank erosion. The availability of phosphorus in the stream systems is systemic due to the agricultural and urban land that dominate the watershed. In addition, phosphorus is released from past deposits of sediment during anoxic stream conditions.

Except in limited instances, such as city-owned property surrounding the reservoirs and the reservoir shorelines, Hillsboro does not have relevant jurisdiction over land management practices in the watershed, nor jurisdiction over the physical condition of the streams, which are the most significant factors contributing water quality issues. Implementation of land management practices that reduce sediment and nutrients are voluntary and at the discretion of the landowner in the vast majority of cases.

In this context, the NARP is focused on improving water quality in the watershed in three ways:

1. **WWTP Plant Upgrades** – Hillsboro is in the process of substantial treatment plant upgrades. The current plant was built in the 1980s and current flows regularly exceed the original design capacity. With upgrades, plant reliability will be significantly improved, and the capacity will be expanded from 1.045 mgd to 3.7 mgd DAF, allowing for the plant to reduce the use of its excess flow treatment system and outfall, resulting in improvements to water quality. Upgrades will allow the plant to meet the interim 1.0 mg/L phosphorus effluent limit, followed by the proposed 0.5 mg/L limit. At the 1.0 mg/L limit and 3.7 mgd flow, phosphorus loadings to the creek will be similar to the current plant with some potential for a slight increase. However, accounting the fact that typical concentrations will allow for a margin of safety below the effluent limit, loadings will be similar or less than current. After the plant begins to meet the proposed 0.5 mg/L limit, loads will be substantially less than current loads. Though the WWTP is not the driver of the water quality issues such as low DO in Middle Fork Shoal Creek, plant upgrades are likely to improve overall water quality.
2. **Watershed Plan and Stakeholder Engagement** – Hillsboro will work to implement the 2024 Glenn Shoals Lake and Lake Hillsboro watershed plan and will seek funding for management practices proposed. While the goal of the plan is improving and protecting the public drinking water supply reservoirs upstream of the WWTP, the nutrient and sediment load reductions from watershed practices will improve water quality in the lakes, which will in turn improve downstream water quality. The plan recommends location-specific practices and prioritizes actions that will be most cost

effective at reducing nutrients. Public input on the plan was sought and both a stakeholder committee and farmer-led group was established to forward future watershed management efforts. These important stakeholder groups will be engaged to support implementation of the NARP.

3. **Partner to Amplify Watershed Management Activities** – Hillsboro is actively partnering with stakeholders and agencies such as the MCSWCD, NRCS and the AFT to form a sustainable coalition that can amplify investments in the watershed. One such example is the recent submission of a USDA-RCPP grant with over 10 partners. The grant request was for $10.5 million with over $3.4 million in matching funds pledged. Should this request be funded, the activities will benefit water quality in Middle Fork Shoal Creek.
4. **Continue Periodic Monitoring of Middle Fork Shoal Creek –** Hillsboro proposes to periodically monitor upstream and downstream of the outfall using continuous monitoring equipment and discrete sampling to track water quality indicators such as DO, pH and TP, similar to the program completed for this NARP assessment. Monitoring will not necessarily be completed annually, as it will coincide with plant operational changes. Data will assess whether these changes are having the desired impact on stream water quality.

Plant upgrades are currently in the bidding process as of December 2024. While the expanded capacity of the plant may slightly increase the point source phosphorus load in the interim, overall effluent quality, and thus creek water quality is expected to improve. As the proposed 0.5 mg/L effluent limit is achieved, phosphorus loads will substantially decrease (Figure 12). The current annual average point source phosphorus load, based on 2020-2023 data, is 10,161 lbs/yr. After plant upgrades, assuming the plant discharges at the design average flow and exactly meets the 1.0 mg/L interim limit, the point source phosphorus load may increase approximately 10% to 11,270 lbs/yr, though in reality, the load will be smaller as the average effluent concentration will be below 1.0 mg/L to allow for a margin of safety below the limit, and the plant is likely to operate well below DAF. When the plant begins to meet the proposed 0.5 mg/L limit, again assuming operation at DAF and exactly meeting the 0.5 mg/L limit, the load will decrease 44% over current levels to 5,635 lbs/yr. Assuming no change in NPS load, this decreases the point source proportion of the total watershed load from 8% to 5%.

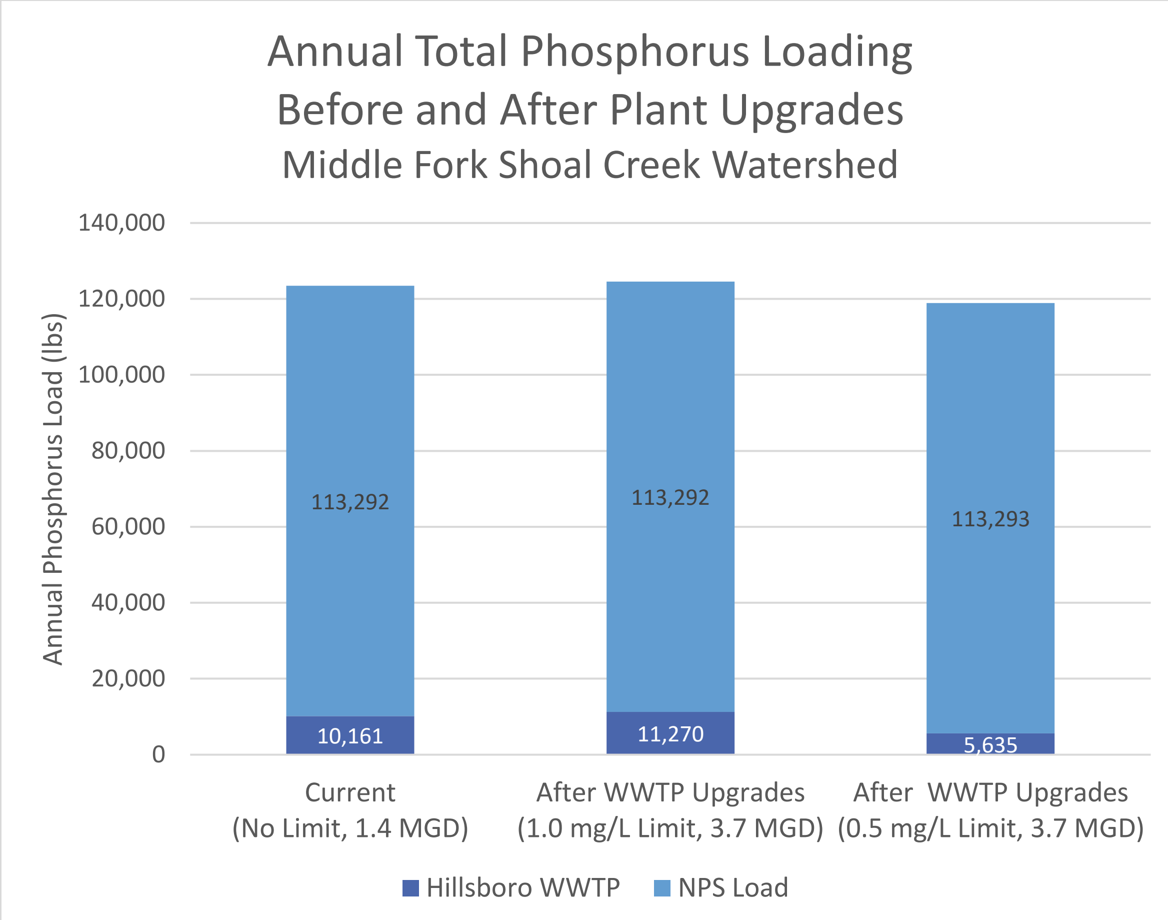

Figure 12 - Annual Total Phosphorus Load Before and After Plant Upgrades

4.3 NARP WORK PLAN

The Work Plan includes a schedule and cost estimate for NARP activities moving forward. Hillsboro is committed to a series of key activities that will allow for continued phosphorus discharge optimization, as well as contributing to source reductions needed to meet targets in the Illinois NLRS. Furthermore, Hillsboro will continue to work with area stakeholders to further limit NPS loading through collaborative efforts outside of its jurisdiction. Actions include plant upgrades, pursuing recommendations of the 2024 watershed plan, and partnering with other agencies and stakeholders. Input on the NARP will be sought from the existing stakeholder and farmer-led committees established for the 2024 watershed plan.

ACTIONS & SCHEDULE

An estimated schedule of activities is presented in Table 11. Plant upgrades are currently in the bid phase, with construction anticipated to begin in early 2025, and an estimated completion in 2027. Watershed activities and partnerships for NPS nutrient reductions are in progress and ongoing. The City of Hillsboro engages with stakeholders regularly on watershed issues. A public meeting will be held in early 2025 to provide stakeholders with information on the NARP and related activities.

Table 11 - NARP Actions and Estimated Schedule

NARP Action	Anticipated Start Date	Estimated End Date	Notes
WWTP Upgrades	Early 2025	2030	Plant upgrades will allow the Hillsboro WWTP to improve reliability and meet a future 0.5 mg/L TP effluent limit by 2030 as stipulated in the NPDES permit. The project will allow for significant reductions in the use of the excess flow treatment system and secondary outfall, improving overall water quality. This extensive capital project is estimated to cost over $38,900,000.
Stakeholder Engagement and Watershed Plan Implementation	In Progress	Ongoing	Hillsboro will continue implementation of the 2024 Glenn Shoals and Lake Hillsboro watershed plan, which will have downstream water quality benefits relevant to the NARP. Implementation will focus on the practices and locations that offer the most cost-effective sediment and nutrient reductions. Engagement with and input from the existing stakeholder and farmer-led group established to support the plan and its implementation will be expanded to cover the NARP.
Partnerships for Watershed Management	In Progress	Ongoing	Hillsboro will continue the formal and informal partnerships with organizations and individual stakeholders to amplify the City's source water protection work in the Middle Fork Shoal Creek watershed. These long-standing and recently developed partnerships will amplify the local resources available for on-the-ground watershed work. Hillsboro will work to pursue new and expanded partnerships as well. Through this, Hillsboro will continue to seek resources for implementation.
Ongoing Monitoring	2026	Ongoing	If necessary, periodically monitor Middle Fork Shoal Creek upstream and downstream of the outfall using continuous monitoring equipment, similar to the program completed for the NARP assessment. Monitoring will coincide with plant upgrades or significant watershed management activities and will provide before and after data to confirm that management activities are having the desired impact on stream water quality and reducing phosphorus impairment.

BUDGET & COST ESTIMATES

The WWTP capital improvements and plant upgrades are estimated at over $33,500,000. Direct city costs associated with watershed plan implementation to reduce NPS nutrients and sediment are estimated to average $200,000 per year. Additional funds, in an amount to be determined, may be committed as Hillsboro pursues partnerships and grant requests to amplify its work on the watershed plan. Potential continued monitoring of Middle Fork Shoal Creek is estimated at approximately $20,000 per season.

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APPENDIX A: DATA MINING AND MONITORING PLAN

HILLSBORO Illinois

CITY OF HILLSBORO, ILLINOIS

WASTEWATER TREATMENT PLANT

NUTRIENT ASSESSMENT REDUCTION PLAN

DATA MINING & MONITORING PLAN

March 2024

Prepared for: City of Hillsboro

Prepared by: Northwater Consulting

northwater

WATER + GEOSCIENCE EXPERTS

CONTENTS

INTRODUCTION

NARP PROCESS & REQUIREMENTS

In 2018 the Illinois EPA instituted nutrient reduction permit requirements applicable to Publicly Owned Treatment Works (POTW) with effluent discharges greater than 1-million gallons per day (MGD). The nutrient reduction approach for POTWs supports a pathway to establish site-specific permit limits for phosphorus at each facility in lieu of instituting a statewide limit. The Nutrient Assessment Reduction Plan (NARP) requirement resulted from negotiations with environmental organizations, Illinois EPA, and the Illinois Association of Wastewater Agencies.

A NARP Special Permit Condition is now included in a National Pollution Discharge Elimination System (NPDES) permit if a receiving stream segment or downstream segment is on the Illinois Clean Water Act (CWA) 303(d) list as impaired with phosphorus-related causes. A NARP is also required if there is a "risk of eutrophication" as defined by meeting any of the three conditions outlined in Table 1.

Table 1 - Illinois EPA Risk of Eutrophication Criteria

Risk of Eutrophication if Any of These Conditions Met:		
pH	**Median Sestonic Chlorophyll α**	**On Any Two Days During Illinois EPA Monitoring Week, Daily Max**
> 9	> 26 µg/L	pH > 8.35 and DO saturation > 110%

Whether the NARP special permit condition is triggered by a CWA 303(d) impairment listing, or eutrophication risk criteria, the designation is often based on limited data. For example, the risk of eutrophication justification for some sites is based on only two non-consecutive weeks of continuous Dissolved Oxygen (DO) and pH data collection performed by the Illinois EPA. In some cases, the data is over 10 years old.

The Illinois EPA allows the NPDES permittee to undertake additional data collection and assessment, which can confirm NARP triggering conditions, or determine that the watershed does not have a phosphorus-related impairment or risk of eutrophication. If sufficient evidence indicates no impairment or risk of eutrophication, it is possible that phosphorus regulation and mitigation measures may not be necessary. The following actions have been proposed to comply with the NARP permit condition:

- Examine if sufficient data exists to fully characterize impairment or risk of eutrophication in the receiving watershed.
    - If data is insufficient, create a water quality monitoring plan and collect data.
- If existing or new data indicates a full NARP is required:
    - Undertake watershed characterization.
    - Model watershed and instream processes.
    - Establish defensible site-specific water quality criteria.
    - Define scenarios and strategies to achieve water quality targets.
    - Implement NARP recommended actions and engage stakeholders.

The City of Hillsboro, Illinois owns and operates a Wastewater Treatment Plant (WWTP) with design average flow (DAF) of 1.045 million gallons per day (MGD) which is subject to a NARP special permit condition (NPDES No. IL0029203). This facility discharges to the Middle Fork Shoal Creek in the Cress Creek-Middle Fork Shoal Creek subwatershed (HUC 071402030204). The plant currently has a compliance schedule for an interim monthly average effluent concentration limit of 1.0 mg/L in its NPDES permit. In addition, the plant's permit requires creation of a phosphorus reduction feasibility study and a phosphorus discharge optimization plan. The permit also outlines a schedule and scenarios for the plant to meet a 0.5 mg/L phosphorus effluent limit.

Northwater Consulting was retained by Hillsboro to perform data mining and analysis to examine the appropriateness of the NARP requirement and guide a monitoring plan that will inform next steps to satisfy NARP requirements.

DATA FOR NARP DETERMINATION

To make a satisfactory case to the Illinois EPA contesting the applicability of a NARP Special Permit Condition, or to confirm the NARP-triggering conditions and define the extent activities necessary, there must be sufficient dissolved oxygen (DO), pH and sestonic chlorophyll α data available between May 1 and October 31. This data is needed to assess if eutrophication risk criteria are met, or if the receiving stream/downstream segment are appropriately categorized as impaired with phosphorus-related causes. As presented in the following section, there is limited data available for Hillsboro's receiving stream, thus a monitoring program is recommended. Data collection is necessary to establish baseline conditions in the waterway and inform subsequent NARP stages as necessary, including such activities as modeling, establishing site-level water quality standards, and estimating nutrient input reductions needed to achieve standards. Monitoring data will also be used to evaluate the initial Illinois EPA NARP requirement.

DATA MINING RESULTS

LOCATION & BACKGROUND

Hillsboro is in Montgomery County in Central Illinois. The city has a population of 5,902 according to the 2020 census. The city owns and operates one WWTP, which has a design average flow of 1.045 MGD and a design maximum flow of 3.067 MGD. The plant is currently undergoing a major upgrade and expansion to implement biological nutrient removal technology to meet the initial 1.0 mg/L phosphorus effluent limit with the ability to meet a 0.5 mg/L limit with additional phased upgrades as required in the NPDES permit. The capacity will increase to DAF of 3.7 MGD after project completion. The plant discharges to the Middle Fork of Shoal Creek, which joins the West Fork Shoal Creek to become Shoal Creek (Figure 1). Shoal Creek is tributary to the Kaskaskia River, a major tributary of the Mississippi River. Upstream of the outfall, are two reservoirs, Lake Glenn Shoals and Lake Hillsboro. The watershed area of Middle Fork Shoal Creek upstream of the outfall is 88.5 mi^2.

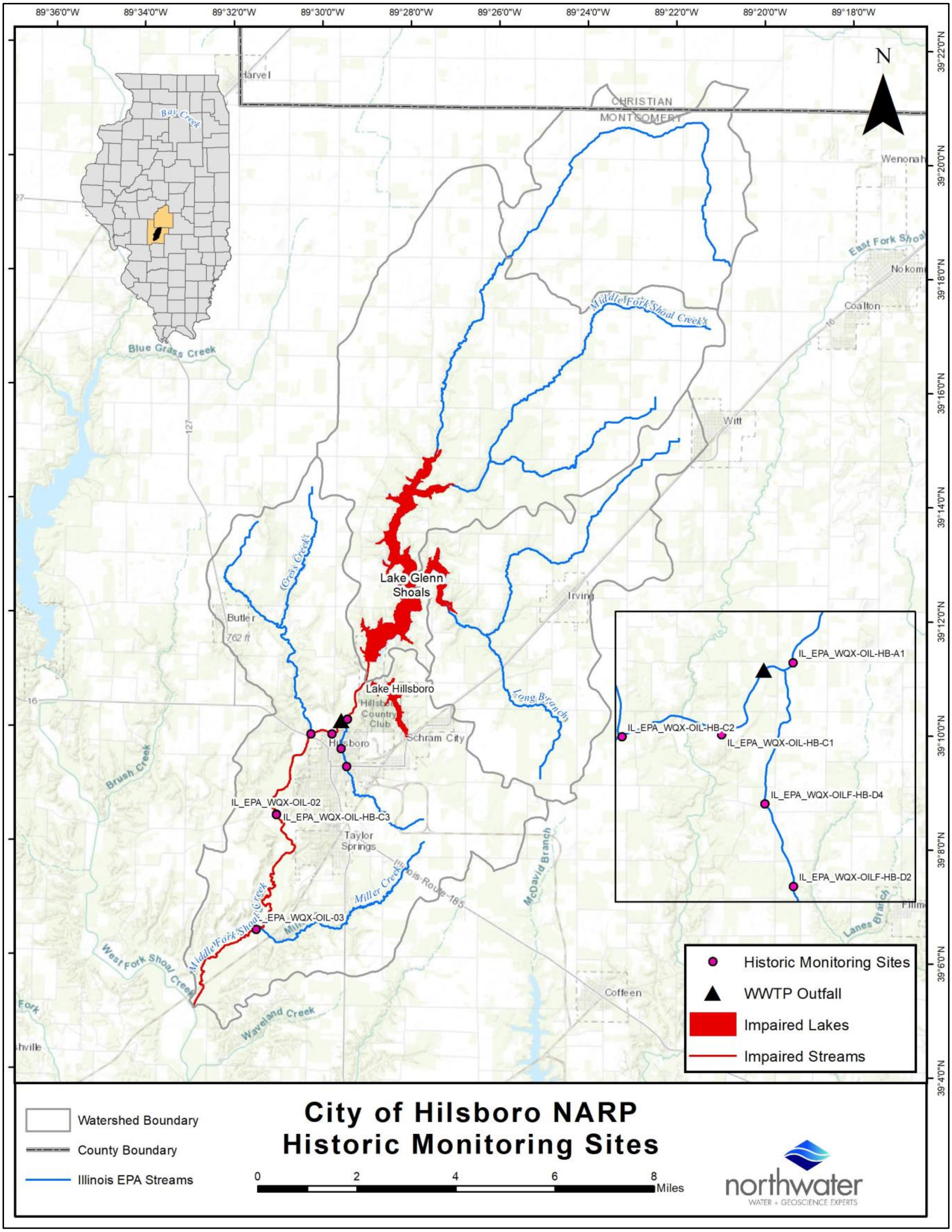

Figure 1 - City of Hillsboro NARP Map with Historic Monitoring Sites

NARP TRIGGER: PHOSPHORUS-RELATED IMPAIRMENT

The Hillsboro NPDES permit and an Illinois Freedom of Information Act request to Illinois EPA revealed that historic data on Middle Fork Shoal Creek indicated a violation of the narrative total phosphorus standard on segment IL_OIL-HB-C1. As the NARP was triggered by an impairment in the stream, Illinois EPA did not collect continuous monitoring data to evaluate the risk of eutrophication in this segment nor in downstream segments. Full details on relevant impairments in the watershed are in the following section.

RECEIVING STREAM AND DOWNSTREAM IMPAIRMENTS

Shoal Creek and upstream reservoirs Glenn Shoals and Lake Hillsboro were cross referenced with the 2012, 2014, 2016, 2018 and 2020/2022 Illinois EPA Clean Water Act Section 303(d) list[1] of impaired waters. Details of impairments are summarized for the treatment plant's watershed in Table 2. Middle Fork Shoal Creek has been on each list since at least 2012 as impaired for aquatic life use with causes of total phosphorus, DO (non-pollutant) and manganese. In this case, the non-pollutant designation indicates the cause of low DO is unknown. The two upstream reservoirs were on each list with several phosphorus-related causes and total suspended solids, indicating that nutrients have historically been an issue upstream of the WWTP.

Table 2 - Receiving Stream and Tributary Summary of Relevant Impairments since 2012. Excludes impairments for fish consumption and pesticide-related impairments.

Receiving Stream	HUC12 Watershed	Illinois Assessment Unit	Relevant 303(d) Impairments	Relevant Causes & Years on List	
Middle Fork Shoal Creek	071402030204	IL_OIL-HB-C1	Aquatic Life	2012 2014 2016 2018 2020/2022	Dissolved Oxygen (non-pollutant) Manganese Total Phosphorus
Downstream Segment	**HUC12 Watershed**	**Illinois Assessment Unit**	**Relevant 303(d) Impairments**	**Relevant Causes & Years on List**	
Middle Fork Shoal Creek	071402030204	IL_OIL-03	Aquatic Life	2016 2018	Dissolved Oxygen (non-pollutant)
Upstream Lake	**HUC12 Watershed**	**Illinois Assessment Unit**	**Relevant 303(d) Impairments**	**Relevant Causes & Years on List**	
Lake Glenn Shoals	071402030202 071402030203	IL_ROL	Aesthetic Quality	2012 2014 2016 2018 2020/2022	Algae TP TSS
Lake Hillsboro	071402030204	IL_ROT	Aesthetic Quality	2012 2014 2016 2018 2020/2022	Algae TP TSS Aquatic Plants

[1] https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/303d-list.aspx

HISTORIC WATER QUALITY DATA SUMMARY

A search of the Water Quality Portal[2] (STORET, NWIS, other databases) returned little water quality data collected during the period beginning in 2001. Illinois EPA completed a study near the Hillsboro WWTP in 2007 and 2015 with one sampling event at each of 8 sites on the Middle Fork Shoal Creek and on an unnamed tributary upstream of the outfall. The other historic monitoring sites on Middle Fork Shoal Creek are IL_OIL-02 and IL_OIL-03, part of the Illinois intensive basin survey, which is typically completed every five years (Figure 1). However, recent data is limited to a small number of samples. A summary of relevant grab sample data is provided in Table 3.

Table 3 - Historic Water Quality Data Summary

Site Name	Parameter	Avg Result	Units	Number of Samples	Begin Date	End Date
IL_EPA_WQX-OIL-02	Chlorophyll a	4.06	ug/L	3	6/27/2017	9/20/2017
IL_EPA_WQX-OIL-02	Dissolved oxygen (DO)	5.4	mg/L	3	6/27/2017	9/20/2017
IL_EPA_WQX-OIL-02	Dissolved oxygen saturation	60	%	3	6/27/2017	9/20/2017
IL_EPA_WQX-OIL-02	pH	7.43	None	3	6/27/2017	9/20/2017
IL_EPA_WQX-OIL-02	Phosphorus, Dissolved	0.71	mg/L	3	6/27/2017	9/20/2017
IL_EPA_WQX-OIL-02	Phosphorus, Total	0.67	mg/L	5	6/19/2017	9/20/2017
IL_EPA_WQX-OIL-02	Temperature, water	21.9	deg C	3	6/27/2017	9/20/2017
IL_EPA_WQX-OIL-03	Chlorophyll a	3.97	ug/L	14	6/18/2002	6/13/2022
IL_EPA_WQX-OIL-03	Dissolved oxygen (DO)	6.46	mg/L	13	6/18/2002	9/24/2012
IL_EPA_WQX-OIL-03	Dissolved oxygen saturation	83	%	3	5/30/2012	9/24/2012
IL_EPA_WQX-OIL-03	pH	7.66	None	13	6/18/2002	9/24/2012
IL_EPA_WQX-OIL-03	Phosphorus, Dissolved	0.52	mg/L	10	6/18/2002	6/13/2022
IL_EPA_WQX-OIL-03	Phosphorus, Total	0.7	mg/L	16	6/18/2002	6/13/2022
IL_EPA_WQX-OIL-03	Temperature, water	22.87	deg C	13	6/18/2002	9/24/2012
IL_EPA_WQX-OIL-HB-A1	Dissolved oxygen (DO)	3.9	mg/L	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-A1	pH	7.3	None	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-A1	Phosphorus, Total	0.58	mg/L	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-A1	Temperature, water	23.6	deg C	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C1	Dissolved oxygen (DO)	5.1	mg/L	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C1	pH	7.44	None	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C1	Phosphorus, Total	1.46	mg/L	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C1	Temperature, water	25.14	deg C	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C2	Dissolved oxygen (DO)	4.88	mg/L	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C2	pH	7.43	None	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C2	Phosphorus, Total	1.87	mg/L	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C2	Temperature, water	25.5	deg C	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C3	Dissolved oxygen (DO)	8.48	mg/L	1	8/29/2007	8/29/2007

[2] https://waterqualitydata.us

Site Name	Parameter	Avg Result	Units	Number of Samples	Begin Date	End Date
IL_EPA_WQX-OIL-HB-C3	pH	7.77	None	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C3	Phosphorus, Total	1.36	mg/L	1	8/29/2007	8/29/2007
IL_EPA_WQX-OIL-HB-C3	Temperature, water	25.78	deg C	1	8/29/2007	8/29/2007
IL_EPA_WQX-OILF-HB-D2	Dissolved oxygen (DO)	8.95	mg/L	1	10/13/2015	10/13/2015
IL_EPA_WQX-OILF-HB-D2	Dissolved oxygen saturation	92.2	%	1	10/13/2015	10/13/2015
IL_EPA_WQX-OILF-HB-D2	pH	7.6	None	1	10/13/2015	10/13/2015
IL_EPA_WQX-OILF-HB-D2	Phosphorus, Total	0.14	mg/L	1	10/13/2015	10/13/2015
IL_EPA_WQX-OILF-HB-D2	Temperature, water	15.7	deg C	1	10/13/2015	10/13/2015
IL_EPA_WQX-OILF-HB-D4	Dissolved oxygen (DO)	6.52	mg/L	1	10/13/2015	10/13/2015
IL_EPA_WQX-OILF-HB-D4	Dissolved oxygen saturation	64.5	%	1	10/13/2015	10/13/2015
IL_EPA_WQX-OILF-HB-D4	pH	7.4	None	1	10/13/2015	10/13/2015
IL_EPA_WQX-OILF-HB-D4	Phosphorus	0.13	mg/L	1	10/13/2015	10/13/2015
IL_EPA_WQX-OILF-HB-D4	Temperature, water	14.1	deg C	1	10/13/2015	10/13/2015

MONITORING PLAN OVERVIEW

Considering the effort and investment necessary for NARP development and implementation, and the lack of data available to make informed and supported stream impairment and "risk of eutrophication" determinations, stream monitoring is recommended. Data collection will guide additional NARP components, if required.

To maintain cost effectiveness, a combination of grab sampling and continuous monitoring is proposed. The goal is to collect adequate data during the critical period of May 1 through October 31 when NARP-triggering conditions are most likely to occur, and to strengthen understanding of the role of the plant's effluent the phosphorus impairment and eutrophication risk in the receiving watershed. Monitoring will support evaluation of water quality impacts in the receiving stream. Establishment of an upstream station will assess conditions before the addition of effluent, and a downstream site will assess the initial impacts after the addition of treated effluent. The sites are located to maximize the amount of upstream watershed area and minimize the amount of downstream watershed influence while still allowing for adequate mixing.

Monitoring Frequency and Location:

- Two continuous monitoring sites with biweekly grab samples:
    - Upstream: Middle Fork Shoal Creek above the WWTP outfall on plant grounds.
    - Downstream: Middle Fork Shoal Creek at North Main Street bridge. IL_EPA_OIL-HB-C1, 0.37 miles downstream of the outfall.

Monitoring Parameters:

1. Continuous sensor site parameters:
    a. Hydrological: stream stage.
    b. Water quality: pH, DO, chlorophyll α optical fluorescence, water temp, conductivity.
2. Grab samples and storm monitoring parameters:

i. Stream discharge/flow.
ii. Handheld meter spot checks of pH, conductivity, oxidation/reduction potential, temperature, DO saturation, and turbidity.
iii. Grab samples for laboratory analysis of orthophosphate, total phosphorus, total nitrogen, nitrate, ammonia, and chlorophyll α.

The parameters recommended are key for NARP determination and will assist with future stages such as instream modeling of nutrients and management scenarios. While there are myriad sampling methodologies and parameters that are eutrophication indicators, such as periphyton (attached algae chlorophyll), this sampling scheme is designed to adhere closely to Illinois EPA guidance and be cost-effective.

STREAM MONITORING

GENERAL SCHEDULE

Data collection shall occur from May 1 through October 31, 2024. This captures the critical period when water quality issues are most likely to occur. Supplementary sampling during storm events will help to capture conditions believed to contribute a majority of the annual nonpoint source (NPS) sediment and nutrient loading.

STATIONS

Two primary monitoring stations are suggested to assess receiving stream water quality: one upstream and one downstream of the WWTP outfall (Figure 2, Table 4).

Stations:

- **Middle Fork Shoal Creek at Hillsboro WWTP Plant (MSCU)**
  - Upstream of influence of WWTP effluent
  - Site accessed from plant grounds
  - Continuous monitoring and bi-weekly grab sampling, storm sampling
- **Middle Fork Shoal Creek at North Main Street Bridge (MSCD)**
  - Downstream of WWTP outfall
  - Continuous monitoring and bi-weekly grab sampling, storm sampling
  - Site is on IL EPA stream segment IL_EPA_OIL-HB-C1, the impaired stream segment that triggered the NARP special permit condition
  - Site is the location of Illinois EPA historic monitoring site IL_EPA_OIL-HB-C1

Table 4 – Proposed Water Quality Monitoring Stations

Station ID	Name	Lat/Long (Decimal Degrees)	Approximate Distance from Outfall	Watershed Area at Sampling Location (mi^2)	Type of Sampling
MSCU	Middle Fork Shoal Creek Upstream	39.169406, -89.488709	*NA - Upstream*	88.5	Continuous, Biweekly Grab and Storm
MSCD	Middle Fork Shoal Creek Downstream	39.165343, -89.493118	0.37 mi	88.8	Continuous, Biweekly Grab and Storm

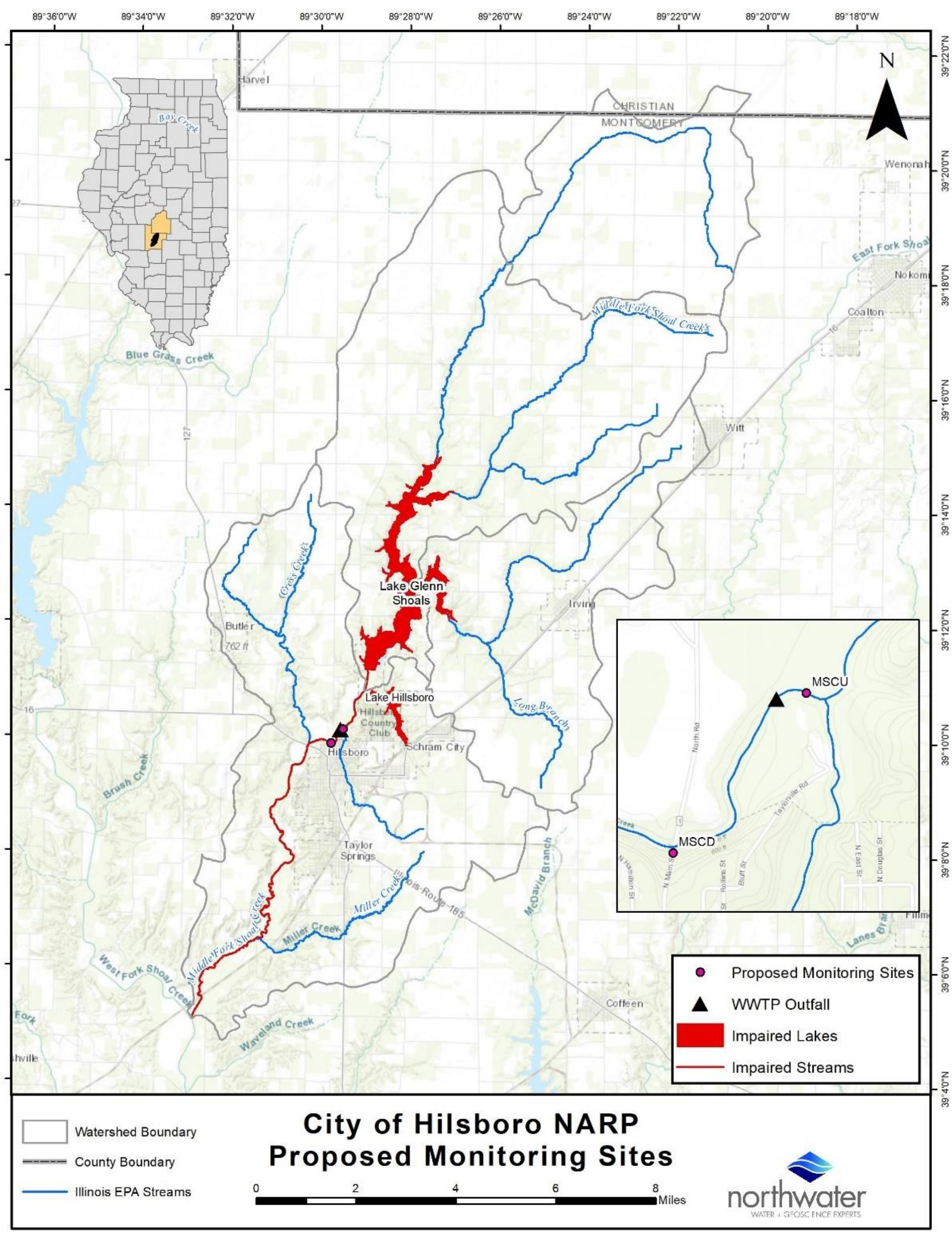

Figure 2 - City of Hillsboro NARP Proposed Monitoring Sites

SAMPLING & ANALYSES

Sampling will use industry standards and manufacturer protocols for calibration, maintenance, and data collection, and will be documented.

HYDROLOGY

Stream stage and discharge data will be collected at each site (Table 5). If a sufficient range of flows is captured, a rating curve can support estimates of stream loading which will inform watershed characterization and further NARP development, if necessary.

Table 5 - Hydrology Parameters

Parameter	Collection Type	Frequency	Instrument/Method
Stream Stage	Continuous Probe Staff Gauge	Continuous Discreet	Vented Pressure Transducer, Graduated Staff Gauge
Discharge	Manual	Bi-weekly, with Additional Storm Samples	Digital Electromagnetic Flow Meter + Wading Staff or ADCP

WATER QUALITY

Multiparameter sondes with integrated sensor wipers to reduce biofouling will be installed at each continuous monitoring site and will collect data on a 15-minute interval (Table 6). Sondes will be left in place for multi-week deployments and serviced and/or calibrated approximately bi-weekly using manufacturer protocols. Grab samples and in-situ water quality measurements will be collected to augment sonde data, support quality assurance and provide additional parameters useful for the NARP assessment. Data collection will coincide with instrument calibration.

Grab samples will be collected on a bi-weekly frequency at continuous monitoring sites. Analysis procedures from 40 CFR Part 136 will be followed and will include using laboratory-provided bottles, adherence to recommended sample preservation, holding times, and conditions for samples. Field data sheets and chains of custody will be used to document data collection. Grab sample analysis will be outsourced to an accredited environmental laboratory.

A typical stream sampling event will include:

- Calibration and cleaning of all sensors.
- Data download.
- Measure of streamflow.
- Collection of grab samples.
- Recording of spot check data from handheld meter.

Table 6 - Water Quality Parameters

Parameter	Collection Type	Frequency	Method	Method Identifier
Dissolved Oxygen, Concentration and % Saturation	Continuous Probe	Continuous	Optical	ASTM D888-09
	Handheld Meter	Bi-weekly, Storm	Optical	ASTM D888-09
pH	Continuous Probe	Continuous	Potentiometric	EPA 150.2
	Handheld Meter	Bi-weekly, Storm	Potentiometric	EPA 150.2
Water Temperature	Continuous Probe	Continuous	Thermistor	EPA 170.1
	Handheld Meter	Bi-weekly, Storm	Thermistor	EPA 170.1
Chlorophyll-a	Continuous Probe	Continuous	In-situ Optical Fluorescence	Instrument Manufacturer Optical Method
	Grab	Bi-weekly, Storm	Lab Spectrophotometric	EPA 445.0
Total Phosphorus	Grab	Bi-weekly, Storm	Colorimetry	EPA 365.1 / EPA 365.3
Orthophosphate	Grab	Bi-weekly, Storm	Colorimetry	EPA 365.1 / EPA 365.3
Total Nitrogen	Grab	Bi-weekly, Storm	Colorimetry	USGS-NWQL: I-4650-03
Nitrate	Grab	Bi-weekly, Storm	Colorimetry	EPA 352.1
Ammonia	Grab	Bi-weekly, Storm	Colorimetry	EPA 350.2
Conductivity	Continuous Probe	Continuous	Resistor Network	EPA 120.1
	Handheld Probe	Bi-weekly, Storm	Resistor Network	EPA 120.1

DATA MANAGEMENT & QUALITY CONTROL

Data will be downloaded at each site visit and will be maintained in a relational database or spreadsheet with appropriate permissions, backups, and controls. Continuous data will be corrected for drift as necessary using a statistical software package designed for that purpose, such as the R package driftR[3]. This drift correction is a standard procedure based on instrument calibration and if necessary, stream grab sample data. Illinois EPA has indicated that a Quality Assurance Project Plan (QAPP) is not necessary for NARP monitoring, however a full quality assurance and quality control procedure document will be created and implemented in lieu of a QAPP and will include detailed sampling and analysis protocols and procedures.

[3] https://rdocumentation.org/packages/driftR/versions/1.1.0

APPENDIX B: WATER QUALITY DATA

Date	Time	Site	Parameter	Result	Unit	Censor
5/1/2024	10:40	MSCD	Temp	17.4	C	
5/1/2024	10:40	MSCD	DOsat	96.5	%	
5/1/2024	10:40	MSCD	DO	9.06	mg/L	
5/1/2024	10:40	MSCD	SpCond	368.4	uS/cm	
5/1/2024	10:40	MSCD	pH	8.21		
5/1/2024	10:40	MSCD	ORP	163.7	mV	
5/1/2024	10:40	MSCD	Turb	29.5	RFU	
5/1/2024	10:40	MSCD	Flow		cfs	
5/1/2024	10:40	MSCD	NH3-N	0.19	mg/L	
5/1/2024	10:40	MSCD	TKN	1.1	mg/L	
5/1/2024	10:40	MSCD	TN	1.6	mg/L	
5/1/2024	10:40	MSCD	NO3-NO2-N	0.482	mg/L	
5/1/2024	10:40	MSCD	TP	0.154	mg/L	
5/1/2024	10:40	MSCD	OrthoP	0.063	mg/L	
5/1/2024	10:40	MSCD	ChlA	18.8	ug/L	
5/1/2024	9:40	MSCU	Temp	17.4	C	
5/1/2024	9:40	MSCU	DOsat	96.5	%	
5/1/2024	9:40	MSCU	DO	9.06	mg/L	
5/1/2024	9:40	MSCU	SpCond	470.2	uS/cm	
5/1/2024	9:40	MSCU	pH	8.16		
5/1/2024	9:40	MSCU	ORP	167.8	mV	
5/1/2024	9:40	MSCU	Turb	9.3	RFU	
5/1/2024	9:40	MSCU	Flow		cfs	
5/1/2024	9:40	MSCU	NH3-N	0.24	mg/L	
5/1/2024	9:40	MSCU	TKN	1.1	mg/L	
5/1/2024	9:40	MSCU	TN	1.5	mg/L	
5/1/2024	9:40	MSCU	NO3-NO2-N	0.444	mg/L	
5/1/2024	9:40	MSCU	TP	0.163	mg/L	
5/1/2024	9:40	MSCU	OrthoP	0.082	mg/L	
5/1/2024	9:40	MSCU	ChlA	17.3	ug/L	
5/15/2024	12:30	MSCD	Temp	19.8	C	
5/15/2024	12:30	MSCD	DOsat	74.1	%	
5/15/2024	12:30	MSCD	DO	6.6	mg/L	
5/15/2024	12:30	MSCD	SpCond	597	uS/cm	
5/15/2024	12:30	MSCD	pH	7.47		
5/15/2024	12:30	MSCD	ORP	210.4	mV	
5/15/2024	12:30	MSCD	Turb	7.02	RFU	
5/15/2024	12:30	MSCD	Flow	17.39	cfs	
5/15/2024	12:30	MSCD	NH3-N	0.3	mg/L	
5/15/2024	12:30	MSCD	TKN	1.5	mg/L	
5/15/2024	12:30	MSCD	TN	3.2	mg/L	
5/15/2024	12:30	MSCD	NO3-NO2-N	1.66	mg/L	
5/15/2024	12:30	MSCD	TP	0.405	mg/L	
5/15/2024	12:30	MSCD	OrthoP	0.31	mg/L	
5/15/2024	12:30	MSCD	ChlA	24.9	ug/L	
5/15/2024	13:15	MSCU	Temp	20.3	C	
5/15/2024	13:15	MSCU	DOsat	78	%	
5/15/2024	13:15	MSCU	DO	6.86	mg/L	
5/15/2024	13:15	MSCU	SpCond	627	uS/cm	
5/15/2024	13:15	MSCU	pH	7.57		
5/15/2024	13:15	MSCU	ORP	218.8	mV	
5/15/2024	13:15	MSCU	Turb	8.71	RFU	
5/15/2024	13:15	MSCU	Flow	17.72	cfs	
5/15/2024	13:15	MSCU	NH3-N	0.35	mg/L	
5/15/2024	13:15	MSCU	TKN	1.6	mg/L	
5/15/2024	13:15	MSCU	TN	2.2	mg/L	
5/15/2024	13:15	MSCU	NO3-NO2-N	0.629	mg/L	
5/15/2024	13:15	MSCU	TP	1.43	mg/L	
5/15/2024	13:15	MSCU	OrthoP	0.104	mg/L	
5/15/2024	13:15	MSCU	ChlA	33.8	ug/L	

Date	Time	Site	Parameter	Result	Unit	Censor
5/28/2024	13:10	MSCD	Temp	23.5	C	
5/28/2024	13:10	MSCD	DOsat		%	
5/28/2024	13:10	MSCD	DO	8.1	mg/L	
5/28/2024	13:10	MSCD	SpCond	350.5	uS/cm	
5/28/2024	13:10	MSCD	pH	7.9		
5/28/2024	13:10	MSCD	ORP	165.6	mV	
5/28/2024	13:10	MSCD	Turb	12.89	RFU	
5/28/2024	13:10	MSCD	Flow		cfs	
5/28/2024	13:10	MSCD	NH3-N	0.1	mg/L	
5/28/2024	13:10	MSCD	TKN	1.1	mg/L	
5/28/2024	13:10	MSCD	TN	1.9	mg/L	
5/28/2024	13:10	MSCD	NO3-NO2-N	0.797	mg/L	
5/28/2024	13:10	MSCD	TP	0.208	mg/L	
5/28/2024	13:10	MSCD	OrthoP	0.103	mg/L	
5/28/2024	13:10	MSCD	ChlA	27.2	ug/L	
5/28/2024	13:40	MSCU	Temp	23.5	C	
5/28/2024	13:40	MSCU	DOsat	97.2	%	
5/28/2024	13:40	MSCU	DO	8.13	mg/L	
5/28/2024	13:40	MSCU	SpCond	507	uS/cm	
5/28/2024	13:40	MSCU	pH	7.9		
5/28/2024	13:40	MSCU	ORP	164	mV	
5/28/2024	13:40	MSCU	Turb	11.28	RFU	
5/28/2024	13:40	MSCU	Flow		cfs	
5/28/2024	13:40	MSCU	NH3-N	0.14	mg/L	
5/28/2024	13:40	MSCU	TKN	1.2	mg/L	
5/28/2024	13:40	MSCU	TN	1.9	mg/L	
5/28/2024	13:40	MSCU	NO3-NO2-N	0.678	mg/L	
5/28/2024	13:40	MSCU	TP	0.185	mg/L	
5/28/2024	13:40	MSCU	OrthoP	0.105	mg/L	
5/28/2024	13:40	MSCU	ChlA	25.2	ug/L	
6/6/2024	13:40	MSCD	Temp	24.7	C	
6/6/2024	13:40	MSCD	DOsat	96.8	%	
6/6/2024	13:40	MSCD	DO	7.84	mg/L	
6/6/2024	13:40	MSCD	SpCond	498.2	uS/cm	
6/6/2024	13:40	MSCD	pH	7.9		
6/6/2024	13:40	MSCD	ORP	146.4	mV	
6/6/2024	13:40	MSCD	Turb	10.15	RFU	
6/6/2024	13:40	MSCD	Flow	41.22	cfs	
6/6/2024	13:40	MSCD	NH3-N	0.21	mg/L	
6/6/2024	13:40	MSCD	TKN	1.6	mg/L	
6/6/2024	13:40	MSCD	TN	2.8	mg/L	
6/6/2024	13:40	MSCD	NO3-NO2-N	1.22	mg/L	
6/6/2024	13:40	MSCD	TP	0.337	mg/L	
6/6/2024	13:40	MSCD	OrthoP	0.201	mg/L	
6/6/2024	13:40	MSCD	ChlA	34.8	ug/L	
6/6/2024	14:20	MSCU	Temp	25.2	C	
6/6/2024	14:20	MSCU	DOsat	99.2	%	
6/6/2024	14:20	MSCU	DO	7.96	mg/L	
6/6/2024	14:20	MSCU	SpCond	588	uS/cm	
6/6/2024	14:20	MSCU	pH	8.27		
6/6/2024	14:20	MSCU	ORP	111.9	mV	
6/6/2024	14:20	MSCU	Turb	10.3	RFU	
6/6/2024	14:20	MSCU	Flow	45.01	cfs	
6/6/2024	14:20	MSCU	NH3-N	0.21	mg/L	
6/6/2024	14:20	MSCU	TKN	1.5	mg/L	
6/6/2024	14:20	MSCU	TN	2.1	mg/L	
6/6/2024	14:20	MSCU	NO3-NO2-N	0.575	mg/L	
6/6/2024	14:20	MSCU	TP	0.241	mg/L	
6/6/2024	14:20	MSCU	OrthoP	0.102	mg/L	
6/6/2024	14:20	MSCU	ChlA	36.3	ug/L	

6/20/2024	12:50	MSCD	NH3-N	1.28	mg/L
6/20/2024	12:50	MSCD	TKN	2.3	mg/L
6/20/2024	12:50	MSCD	TN	6.8	mg/L
6/20/2024	12:50	MSCD	NO3-NO2-N	4.46	mg/L
6/20/2024	12:50	MSCD	TP	1.12	mg/L
6/20/2024	12:50	MSCD	OrthoP	0.8	mg/L
6/20/2024	12:50	MSCD	ChlA	3	ug/L
6/20/2024	12:50	MSCD	Temp	25.5	C
6/20/2024	12:50	MSCD	DOsat	48.9	%
6/20/2024	12:50	MSCD	DO	3.96	mg/L
6/20/2024	12:50	MSCD	SpCond	1187	uS/cm
6/20/2024	12:50	MSCD	pH	7.25	
6/20/2024	12:50	MSCD	ORP	150.8	mV
6/20/2024	12:50	MSCD	Turb	5.55	RFU
6/20/2024	12:50	MSCD	Flow	3.13	cfs
6/20/2024	13:30	MSCU	NH3-N	1.54	mg/L
6/20/2024	13:30	MSCU	TKN	2.4	mg/L
6/20/2024	13:30	MSCU	TN	2.7	mg/L
6/20/2024	13:30	MSCU	NO3-NO2-N	0.382	mg/L
6/20/2024	13:30	MSCU	TP	0.474	mg/L
6/20/2024	13:30	MSCU	OrthoP	0.305	mg/L
6/20/2024	13:30	MSCU	ChlA	6.9	ug/L
6/20/2024	13:30	MSCU	Temp	26.1	C
6/20/2024	13:30	MSCU	DOsat	52.3	%
6/20/2024	13:30	MSCU	DO	4.19	mg/L
6/20/2024	13:30	MSCU	SpCond	1228	uS/cm
6/20/2024	13:30	MSCU	pH	7.37	
6/20/2024	13:30	MSCU	ORP	103.6	mV
6/20/2024	13:30	MSCU	Turb	7.04	RFU
6/20/2024	13:30	MSCU	Flow	1.24	cfs
7/1/2024	13:15	MSCD	NH3-N	0.65	mg/L
7/1/2024	13:15	MSCD	TKN	1.7	mg/L
7/1/2024	13:15	MSCD	TN	4.6	mg/L
7/1/2024	13:15	MSCD	NO3-NO2-N	2.93	mg/L
7/1/2024	13:15	MSCD	TP	0.815	mg/L
7/1/2024	13:15	MSCD	OrthoP	0.63	mg/L
7/1/2024	13:15	MSCD	ChlA	10.4	ug/L
7/1/2024	13:15	MSCD	Temp	23.2	C
7/1/2024	13:15	MSCD	DOsat	59.1	%
7/1/2024	13:15	MSCD	DO	5.04	mg/L
7/1/2024	13:15	MSCD	SpCond	1588	uS/cm
7/1/2024	13:15	MSCD	pH	7.74	
7/1/2024	13:15	MSCD	ORP	168.3	mV
7/1/2024	13:15	MSCD	Turb		RFU
7/1/2024	13:15	MSCD	Flow		cfs
7/1/2024	13:55	MSCU	NH3-N	1.18	mg/L
7/1/2024	13:55	MSCU	TKN	2.2	mg/L
7/1/2024	13:55	MSCU	TN	2.5	mg/L
7/1/2024	13:55	MSCU	NO3-NO2-N	0.312	mg/L
7/1/2024	13:55	MSCU	TP	0.399	mg/L
7/1/2024	13:55	MSCU	OrthoP	0.27	mg/L
7/1/2024	13:55	MSCU	ChlA	14.4	ug/L
7/1/2024	13:55	MSCU	Temp	23	C
7/1/2024	13:55	MSCU	DOsat	54.3	%
7/1/2024	13:55	MSCU	DO	4.34	mg/L
7/1/2024	13:55	MSCU	SpCond	1486	uS/cm
7/1/2024	13:55	MSCU	pH	7.56	
7/1/2024	13:55	MSCU	ORP	125.1	mV
7/1/2024	13:55	MSCU	Turb		RFU
7/1/2024	13:55	MSCU	Flow		cfs
7/15/2024	13:00	MSCD	NH3-N	0.45	mg/L
7/15/2024	13:00	MSCD	TKN	1.4	mg/L
7/15/2024	13:00	MSCD	TN	3.7	mg/L
7/15/2024	13:00	MSCD	NO3-NO2-N	2.44	mg/L
7/15/2024	13:00	MSCD	TP	0.538	mg/L
7/15/2024	13:00	MSCD	OrthoP	0.425	mg/L
7/15/2024	13:00	MSCD	ChlA	5.6	mg/L
7/15/2024	13:00	MSCD	Temp	28.1	C
7/15/2024	13:00	MSCD	DOsat	71.8	%
7/15/2024	13:00	MSCD	DO	5.49	mg/L
7/15/2024	13:00	MSCD	SpCond	1635	uS/cm
7/15/2024	13:00	MSCD	pH	7.35	
7/15/2024	13:00	MSCD	ORP	77.9	mV
7/15/2024	13:00	MSCD	Turb	8	RFU
7/15/2024	13:00	MSCD	Flow	5.5	cfs
7/15/2024	13:30	MSCU	NH3-N	0.49	mg/L
7/15/2024	13:30	MSCU	TKN	1.3	mg/L
7/15/2024	13:30	MSCU	TN	1.6	mg/L
7/15/2024	13:30	MSCU	NO3-NO2-N	0.343	mg/L
7/15/2024	13:30	MSCU	TP	0.2	mg/L
7/15/2024	13:30	MSCU	OrthoP	0.11	mg/L
7/15/2024	13:30	MSCU	ChlA	5.6	mg/L
7/15/2024	13:30	MSCU	Temp	29.4	C
7/15/2024	13:30	MSCU	DOsat	85.1	%
7/15/2024	13:30	MSCU	DO	6.33	mg/L
7/15/2024	13:30	MSCU	SpCond	2098	uS/cm
7/15/2024	13:30	MSCU	pH	7.61	
7/15/2024	13:30	MSCU	ORP	121.4	mV
7/15/2024	13:30	MSCU	Turb	5.9	RFU
7/15/2024	13:30	MSCU	Flow	1.14	cfs
7/16/2024	14:15	MSCD	NH3-N	0.32	mg/L
7/16/2024	14:15	MSCD	TKN	1.7	mg/L
7/16/2024	14:15	MSCD	TN	1.9	mg/L
7/16/2024	14:15	MSCD	NO3-NO2-N	0.197	mg/L
7/16/2024	14:15	MSCD	TP	0.32	mg/L
7/16/2024	14:15	MSCD	OrthoP	0.115	mg/L
7/16/2024	15:00	MSCU	NH3-N	0.25	mg/L
7/16/2024	15:00	MSCU	TKN	1.7	mg/L
7/16/2024	15:00	MSCU	TN	0.19	mg/L
7/16/2024	15:00	MSCU	NO3-NO2-N	0.17	mg/L
7/16/2024	15:00	MSCU	TP	0.332	mg/L
7/16/2024	15:00	MSCU	OrthoP	0.145	mg/L
7/29/2024	12:30	MSCD	NH3-N	0.56	mg/L
7/29/2024	12:30	MSCD	TKN	1.3	mg/L
7/29/2024	12:30	MSCD	TN	2.4	mg/L
7/29/2024	12:30	MSCD	NO3-NO2-N	1.04	mg/L
7/29/2024	12:30	MSCD	TP	0.417	mg/L
7/29/2024	12:30	MSCD	OrthoP	0.3	mg/L
7/29/2024	12:30	MSCD	ChlA	13.6	ug/L
7/29/2024	12:30	MSCD	Temp	25.9	C
7/29/2024	12:30	MSCD	DOsat	62	%
7/29/2024	12:30	MSCD	DO	4.92	mg/L
7/29/2024	12:30	MSCD	SpCond	828	uS/cm
7/29/2024	12:30	MSCD	pH	7.39	
7/29/2024	12:30	MSCD	ORP	162.5	mV
7/29/2024	12:30	MSCD	Turb	5.52	RFU
7/29/2024	12:30	MSCD	Flow	13.46	cfs

7/29/2024	13:00	MSCU	NH3-N	0.49	mg/L
7/29/2024	13:00	MSCU	TKN	1.4	mg/L
7/29/2024	13:00	MSCU	TN	1.8	mg/L
7/29/2024	13:00	MSCU	NO3-NO2-N	0.374	mg/L
7/29/2024	13:00	MSCU	TP	0.249	mg/L
7/29/2024	13:00	MSCU	OrthoP	0.145	mg/L
7/29/2024	13:00	MSCU	ChlA	15.4	ug/L
7/29/2024	13:00	MSCU	Temp	26.6	C
7/29/2024	13:00	MSCU	DOsat	65.5	%
7/29/2024	13:00	MSCU	DO	5.12	mg/L
7/29/2024	13:00	MSCU	SpCond	879	uS/cm
7/29/2024	13:00	MSCU	pH	7.5	
7/29/2024	13:00	MSCU	ORP	222.3	mV
7/29/2024	13:00	MSCU	Turb	7.81	RFU
7/29/2024	13:00	MSCU	Flow	16.82	cfs
8/13/2024	12:00	MSCD	NH3-N	0.5	mg/L
8/13/2024	12:00	MSCD	TKN	1.3	mg/L
8/13/2024	12:00	MSCD	TN	3.5	mg/L
8/13/2024	12:00	MSCD	NO3-NO2-N	2.26	mg/L
8/13/2024	12:00	MSCD	TP	0.586	mg/L
8/13/2024	12:00	MSCD	OrthoP	0.48	mg/L
8/13/2024	12:00	MSCD	ChlA	9.4	ug/L
8/13/2024	12:00	MSCD	Temp	22.6	C
8/13/2024	12:00	MSCD	DOsat	70.7	%
8/13/2024	12:00	MSCD	DO	5.98	mg/L
8/13/2024	12:00	MSCD	SpCond	2575	uS/cm
8/13/2024	12:00	MSCD	pH	7.6	
8/13/2024	12:00	MSCD	ORP	163.5	mV
8/13/2024	12:00	MSCD	Turb	1.78	RFU
8/13/2024	12:00	MSCD	Flow	6.31	cfs
8/13/2024	12:30	MSCU	NH3-N	0.58	mg/L
8/13/2024	12:30	MSCU	TKN	1.2	mg/L
8/13/2024	12:30	MSCU	TN	1.5	mg/L
8/13/2024	12:30	MSCU	NO3-NO2-N	0.234	mg/L
8/13/2024	12:30	MSCU	TP	0.235	mg/L
8/13/2024	12:30	MSCU	OrthoP	1.6	mg/L
8/13/2024	12:30	MSCU	ChlA	15.8	ug/L
8/13/2024	12:30	MSCU	Temp	22.8	C
8/13/2024	12:30	MSCU	DOsat	76.5	%
8/13/2024	12:30	MSCU	DO	6.44	mg/L
8/13/2024	12:30	MSCU	SpCond	2900	uS/cm
8/13/2024	12:30	MSCU	pH	7.73	
8/13/2024	12:30	MSCU	ORP	188.3	mV
8/13/2024	12:30	MSCU	Turb	2.27	RFU
8/13/2024	12:30	MSCU	Flow	4.63	cfs
8/27/2024	12:00	MSCD	Temp	25.7	C
8/27/2024	12:00	MSCD	DOsat	61.6	%
8/27/2024	12:00	MSCD	DO	4.91	mg/L
8/27/2024	12:00	MSCD	SpCond	1116	uS/cm
8/27/2024	12:00	MSCD	pH	7.43	
8/27/2024	12:00	MSCD	ORP	143	mV
8/27/2024	12:00	MSCD	Turb	1.5	RFU
8/27/2024	12:00	MSCD	Flow	2.94	cfs
8/27/2024	12:00	MSCD	NH3-N	0.54	mg/L
8/27/2024	12:00	MSCD	TKN	1.5	mg/L
8/27/2024	12:00	MSCD	TN	3.8	mg/L
8/27/2024	12:00	MSCD	NO3-NO2-N	2.28	mg/L
8/27/2024	12:00	MSCD	TP	0.558	mg/L
8/27/2024	12:00	MSCD	OrthoP	0.455	mg/L
8/27/2024	12:00	MSCD	ChlA	7.7	mg/L
8/27/2024	12:30	MSCU	Temp	26.2	C
8/27/2024	12:30	MSCU	DOsat	71.5	%
8/27/2024	12:30	MSCU	DO	5.65	mg/L
8/27/2024	12:30	MSCU	SpCond	1446	uS/cm
8/27/2024	12:30	MSCU	pH	7.57	
8/27/2024	12:30	MSCU	ORP	212	mV
8/27/2024	12:30	MSCU	Turb	3.25	RFU
8/27/2024	12:30	MSCU	Flow	0.38	cfs
8/27/2024	12:30	MSCU	NH3-N	0.51	mg/L
8/27/2024	12:30	MSCU	TKN	1.6	mg/L
8/27/2024	12:30	MSCU	TN	1.9	mg/L
8/27/2024	12:30	MSCU	NO3-NO2-N	0.259	mg/L
8/27/2024	12:30	MSCU	TP	0.205	mg/L
8/27/2024	12:30	MSCU	OrthoP	0.11	mg/L
8/27/2024	12:30	MSCU	ChlA	14.3	mg/L
9/9/2024	12:15	MSCD	Temp	18.5	C
9/9/2024	12:15	MSCD	DOsat	81.5	%
9/9/2024	12:15	MSCD	DO	7.53	mg/L
9/9/2024	12:15	MSCD	SpCond	1875	uS/cm
9/9/2024	12:15	MSCD	pH	7.87	
9/9/2024	12:15	MSCD	ORP	218.6	mV
9/9/2024	12:15	MSCD	Turb	4.2	RFU
9/9/2024	12:15	MSCD	Flow	6.87	cfs
9/9/2024	12:15	MSCD	NH3-N	0.28	mg/L
9/9/2024	12:15	MSCD	TKN	1.5	mg/L
9/9/2024	12:15	MSCD	TN	4.2	mg/L
9/9/2024	12:15	MSCD	NO3-NO2-N	2.7	mg/L
9/9/2024	12:15	MSCD	TP	0.719	mg/L
9/9/2024	12:15	MSCD	OrthoP	0.6	mg/L
9/9/2024	12:15	MSCD	ChlA	14.1	mg/L
9/9/2024	13:00	MSCU	Temp	18.7	C
9/9/2024	13:00	MSCU	DOsat	84.2	%
9/9/2024	13:00	MSCU	DO	7.72	mg/L
9/9/2024	13:00	MSCU	SpCond	1979	uS/cm
9/9/2024	13:00	MSCU	pH	8.02	
9/9/2024	13:00	MSCU	ORP	220.4	mV
9/9/2024	13:00	MSCU	Turb	6.34	RFU
9/9/2024	13:00	MSCU	Flow		cfs
9/9/2024	13:00	MSCU	NH3-N	0.32	mg/L
9/9/2024	13:00	MSCU	TKN	1.4	mg/L
9/9/2024	13:00	MSCU	TN	1.5	mg/L
9/9/2024	13:00	MSCU	NO3-NO2-N	0.154	mg/L
9/9/2024	13:00	MSCU	TP	0.166	mg/L
9/9/2024	13:00	MSCU	OrthoP	0.075	mg/L
9/9/2024	13:00	MSCU	ChlA	22.1	mg/L
9/25/2024	12:30	MSCD	Temp	20.4	C
9/25/2024	12:30	MSCD	DOsat	64.6	%
9/25/2024	12:30	MSCD	DO	5.7	mg/L
9/25/2024	12:30	MSCD	SpCond	793	uS/cm
9/25/2024	12:30	MSCD	pH	7.43	
9/25/2024	12:30	MSCD	ORP	174.2	mV
9/25/2024	12:30	MSCD	Turb	5.58	RFU
9/25/2024	12:30	MSCD	Flow	4.89	cfs
9/25/2024	12:30	MSCD	NH3-N	0.44	mg/L
9/25/2024	12:30	MSCD	TKN	2.1	mg/L
9/25/2024	12:30	MSCD	TN	6.5	mg/L
9/25/2024	12:30	MSCD	NO3-NO2-N	4.4	mg/L
9/25/2024	12:30	MSCD	TP	0.864	mg/L
9/25/2024	12:30	MSCD	OrthoP	0.76	mg/L
9/25/2024	12:30	MSCD	ChlA	1	mg/L

9/25/2024	13:00	MSCU	Temp	20.2	C
9/25/2024	13:00	MSCU	DOsat	63.2	%
9/25/2024	13:00	MSCU	DO	5.61	mg/L
9/25/2024	13:00	MSCU	SpCond	912	uS/cm
9/25/2024	13:00	MSCU	pH	7.44	
9/25/2024	13:00	MSCU	ORP	195.8	mV
9/25/2024	13:00	MSCU	Turb	10	RFU
9/25/2024	13:00	MSCU	Flow	1.79	cfs
9/25/2024	13:00	MSCU	NH3-N	1.05	mg/L
9/25/2024	13:00	MSCU	TKN	2.3	mg/L
9/25/2024	13:00	MSCU	TN	2.7	mg/L
9/25/2024	13:00	MSCU	NO3-NO2-N	0.463	mg/L
9/25/2024	13:00	MSCU	TP	0.307	mg/L
9/25/2024	13:00	MSCU	OrthoP	0.215	mg/L
9/25/2024	13:00	MSCU	ChlA	1	mg/L
10/10/2024	13:25	MSCD	Temp	18.2	C
10/10/2024	13:25	MSCD	DOsat	80.9	%
10/10/2024	13:25	MSCD	DO	7.51	mg/L
10/10/2024	13:25	MSCD	SpCond	867	uS/cm
10/10/2024	13:25	MSCD	pH	7.68	
10/10/2024	13:25	MSCD	ORP	208.3	mV
10/10/2024	13:25	MSCD	Turb	3.05	RFU
10/10/2024	13:25	MSCD	Flow	11.47	cfs
10/10/2024	13:25	MSCD	NH3-N	0.25	mg/L
10/10/2024	13:25	MSCD	TKN	1.9	mg/L
10/10/2024	13:25	MSCD	TN	2.9	mg/L
10/10/2024	13:25	MSCD	NO3-NO2-N	0.983	mg/L
10/10/2024	13:25	MSCD	TP	0.295	mg/L
10/10/2024	13:25	MSCD	OrthoP	0.21	mg/L
10/10/2024	13:25	MSCD	ChlA	23.2	mg/L
10/10/2024	12:45	MSCU	Temp	18	C
10/10/2024	12:45	MSCU	DOsat	79.1	%
10/10/2024	12:45	MSCU	DO	7.38	mg/L
10/10/2024	12:45	MSCU	SpCond	927	uS/cm
10/10/2024	12:45	MSCU	pH	7.73	
10/10/2024	12:45	MSCU	ORP	203.8	mV
10/10/2024	12:45	MSCU	Turb	3.87	RFU
10/10/2024	12:45	MSCU	Flow	8.69	cfs
10/10/2024	12:45	MSCU	NH3-N	0.3	mg/L
10/10/2024	12:45	MSCU	TKN	1.6	mg/L
10/10/2024	12:45	MSCU	TN	1.8	mg/L
10/10/2024	12:45	MSCU	NO3-NO2-N	0.227	mg/L
10/10/2024	12:45	MSCU	TP	0.157	mg/L
10/10/2024	12:45	MSCU	OrthoP	0.065	mg/L
10/10/2024	12:45	MSCU	ChlA	29.9	mg/L
10/17/2024	11:20	MSCD	Temp	12.1	C
10/17/2024	11:20	MSCD	DOsat	73.3	%
10/17/2024	11:20	MSCD	DO	7.83	mg/L
10/17/2024	11:20	MSCD	SpCond	498.5	uS/cm
10/17/2024	11:20	MSCD	pH	7.64	
10/17/2024	11:20	MSCD	ORP	121.6	mV
10/17/2024	11:20	MSCD	Turb	3.75	RFU
10/17/2024	11:20	MSCD	Flow	10.43	cfs
10/17/2024	11:20	MSCD	NH3-N	0.34	mg/L
10/17/2024	11:20	MSCD	TKN	1.5	mg/L
10/17/2024	11:20	MSCD	TN	3	mg/L
10/17/2024	11:20	MSCD	NO3-NO2-N	1.56	mg/L
10/17/2024	11:20	MSCD	TP	0.381	mg/L
10/17/2024	11:20	MSCD	OrthoP	0.298	mg/L
10/17/2024	11:20	MSCD	ChlA	12.5	mg/L
10/17/2024	11:45	MSCU	Temp	12.4	C
10/17/2024	11:45	MSCU	DOsat	78.5	%
10/17/2024	11:45	MSCU	DO	8.32	mg/L
10/17/2024	11:45	MSCU	SpCond	515	uS/cm
10/17/2024	11:45	MSCU	pH	7.74	
10/17/2024	11:45	MSCU	ORP	165.2	mV
10/17/2024	11:45	MSCU	Turb	5.38	RFU
10/17/2024	11:45	MSCU	Flow	6.94	cfs
10/17/2024	11:45	MSCU	NH3-N	0.39	mg/L
10/17/2024	11:45	MSCU	TKN	1.3	mg/L
10/17/2024	11:45	MSCU	TN	1.6	mg/L
10/17/2024	11:45	MSCU	NO3-NO2-N	0.264	mg/L
10/17/2024	11:45	MSCU	TP	0.158	mg/L
10/17/2024	11:45	MSCU	OrthoP	0.078	mg/L
10/17/2024	11:45	MSCU	ChlA	15.4	mg/L
10/31/2024	11:25	MSCD	NH3-N	0.22	mg/L
10/31/2024	11:25	MSCD	TKN	1.7	mg/L
10/31/2024	11:25	MSCD	TN	3.2	mg/L
10/31/2024	11:25	MSCD	NO3-NO2-N	1.51	mg/L
10/31/2024	11:25	MSCD	TP	0.434	mg/L
10/31/2024	11:25	MSCD	OrthoP	0.292	mg/L
10/31/2024	11:25	MSCD	ChlA		mg/L
10/31/2024	11:50	MSCU	NH3-N	0.52	mg/L
10/31/2024	11:50	MSCU	TKN	1.6	mg/L
10/31/2024	11:50	MSCU	TN	1.7	mg/L
10/31/2024	11:50	MSCU	NO3-NO2-N	0.125	mg/L
10/31/2024	11:50	MSCU	TP	0.161	mg/L
10/31/2024	11:50	MSCU	OrthoP	0.054	mg/L
10/31/2024	11:50	MSCU	ChlA		mg/L

APPENDIX C: NARP SPECIAL PERMIT CONDITION

SPECIAL CONDITION 21. The Agency has determined that the Permittee's treatment plant effluent is located upstream of a waterbody or stream segment that has been determined to have a phosphorus related impairment. This determination was made upon reviewing available information concerning the characteristics of the relevant waterbody/segment and the relevant facility (such as quantity of discharge flow and nutrient load relative to the stream flow).

A phosphorus related impairment means that the downstream waterbody or segment is listed by the Agency as impaired due to dissolved oxygen and/or offensive condition (algae and/or aquatic plant growth) impairments that is related to excessive phosphorus levels.

The Permittee shall develop, or be a part of a watershed group that develops, a Nutrient Assessment Reduction Plan (NARP) that will meet the following requirements:

A. The NARP shall be developed and submitted to the Agency by December 31, 2024. This requirement can be accomplished by the Permittee, by participation in an existing watershed group or by creating a new group. The NARP shall be supported by data and sound scientific rationale.
B. The Permittee shall cooperate with and work with other stakeholders in the watershed to determine the most cost-effective means to address the phosphorus related impairment. If other stakeholders in the watershed will not cooperate in developing the NARP,

the Permittee shall develop its own NARP for submittal to the Agency to comply with this condition.
C. In determining the target levels of various parameters necessary to address the phosphorus related impairment, the NARP shall either utilize the recommendations by the Nutrient Science Advisory Committee or develop its own watershed-specific target levels.
D. The NARP shall identify phosphorus input reductions by point source discharges and non-point source discharges in addition to other measures necessary to remove phosphorus related impairments in the watershed. The NARP may determine, based on an assessment of relevant data, that the watershed does not have an impairment related to phosphorus, in which case phosphorus input reductions or other measures would not be necessary. Alternatively, the NARP could determine that phosphorus input reductions from point sources are not necessary, or that phosphorus input reductions from both point and nonpoint sources are necessary, or that phosphorus input reductions are not necessary and that other measures, besides phosphorus input reductions, are necessary.
E. The NARP shall include a schedule for the implementation of the phosphorus input reductions by point sources, non-point sources and other measures necessary to remove phosphorus related impairments. The NARP schedule shall be implemented as soon as possible, and shall identify specific timelines applicable to the Permittee.
F. The NARP can include provisions for water quality trading to address the phosphorus related impairments in the watershed. Phosphorus/Nutrient trading cannot result in violations of water quality standards or applicable antidegradation requirements.
G. The Permittee shall request modification of the permit within 90 days after the NARP has been completed to include necessary phosphorus input reductions identified within the NARP. The Agency will modify the NPDES permit, if necessary.
H. If the Permittee does not develop or assist in developing the NARP, and such a NARP is developed for the watershed, the Permittee will become subject to effluent limitations necessary to address the phosphorus related impairments. The Agency shall calculate these effluent limits by using the NARP and any applicable data. If no NARP has been developed, the effluent limits shall be determined for the Permittee on a case-by-case basis, so as to ensure that the Permittee's discharge will not cause or contribute to violations of the dissolved oxygen or narrative water quality standards.

SPECIAL CONDITION 21 – DETAILS OF COMPLIANCE WITH PERMIT REQUIREMENTS

Below is a summary of responsiveness to each subpart of NARP special condition.

A. This NARP was developed and submitted by the permittee, fulfilling this requirement. Participation in an existing stakeholder and farmer-led committee formed to support a 2024 watershed plan for Glenn Shoals Lake and Lake Hillsboro will continue.
B. This NARP was developed and submitted by the permittee, fulfilling this requirement. The permittee is also cooperating with other stakeholders to implement a 2024 watershed plan for Glenn Shoals Lake and Lake Hillsboro with a primary goal of addressing phosphorus above the water quality standard in the reservoirs. This is directly relevant to the NARP.
C. Nonpoint source input reductions will provide impactful results, reducing risk of eutrophication. Monitoring does not indicate a phosphorus-related impairment. The DO-related impairment is not related to the WWTP. A target level of 0.05 mg/L in the upstream reservoirs will improve water quality downstream.
D. Hillsboro will reduce phosphorus inputs from the WWTP with plant upgrades, and implementation of NPS phosphorus reductions are being pursued via the 2024 watershed plan.
E. A timeline is provided in Section 4.3 of this report.
F. Trading is not proposed.
G. Permit modification is not necessary, as provisions for the 1.0 mg/L interim limit and proposed 0.5 mg/L TP effluent limit are already in place.
H. Submitted NARP satisfies this condition, and the 1.0 mg/L interim TP limit and proposed 0.5 mg/L TP limit are sufficient, as point-source phosphorus is not causing an impairment.